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FOOD HABITS OF YOUNG LARGEMOUTH BASS *(Micropterus salmoides)* IN HATCHERY PONDS [1]

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ABSTRACT

The stomachs of 525 largemouth bass fry and fingerlings were examined and the food organisms identified to genus when possible. Length and width measurements were made on the food organisms to determine area and then the area was used as an index to volume. The most important food organisms were copepods, cladocerans, and midges. There was a size relationship between fish and food item with the larger fish taking a larger food item. Fish smaller than 15 millimeters in length ate copepods and cladocerans primarily while larger fish ate mostly midges. No cannibalism was detected in the fish examined.

[1] This work was done while the author was employed as a fishery biologist at the Marion, Alabama, National Fish Hatchery.

INTRODUCTION

There is an abundance of literature on food habits of fishes, however, few studies have been made on the food habits of young largemouth bass. Most of the previous largemouth bass food studies have been made on fish collected from the natural environment (Turner and Kraatz, 1920; Murphy 1949). Cooper (1936) conducted a study of the food habits of young largemouth bass from rearing ponds in Michigan, however, the ponds had been accidentally stocked with golden shiners which would not represent a normal hatchery situation. The present study is the first that has been made on young largemouth bass collected in the southeastern United States from hatchery rearing ponds.

METHODS

Five-hundred and twenty-five bass were collected from four rearing ponds during a 3-week period in April, 1962. The ponds had been stocked at a rate of 75,000 fish per acre. Collections were made at twice-a-week intervals from the time the fish were stocked until they were harvested for distribution. Immediately after collection, the fish were killed in a 5-10 percent formalin solution and brought to the laboratory for examination. In the laboratory, the stomachs were dissected and the contents placed on a slide and covered with a cover-slip. Measurements of length and width of the food organisms were made with an ocular micrometer to determine the area; then the area was used as an index to volume. This procedure is described by Welch (1948, pp. 290-292). The food organisms were identified using Pennak's (1953) keys to fresh water invertebrates.

RESULTS AND DISCUSSION

A. *Average Number and Volume of Individual Species per Fish Size Group.*

Thirty-eight different food items of young bass were found during the study. The average number and average volume of the food item per each 5-millimeter fish group plus the number of fish in each 5-millimeter fish group is presented in Table 1.

Cladocerans, copepods, and midges were the most abundant food species eaten by young largemouth bass. The different species were combined to major groups to present the data graphically in Figure 1.

In the 25, 30 and 35 millimeter groups of bass, *Chaoborus* formed 2.5, 7.5, and 3.2 percent of total volume, respectively. Since these size groups were the only ones where *Chaoborus* constituted more than 1.0 percent of volume, this species was included with the tendipedid midges.

One species of mayfly was taken, but only a few fish had eaten them. The resulting average number and volume were not significant.

Two species of beetle larvae occurred in the 25 to 40 millimeter fish groups. In the 40 millimeter fish group, beetle larvae made up 3.4 percent of the total volume and only on one other occasion made up more than 1.0 percent.

Several miscellaneous species and objects were found but none comprised a significant volume. Backswimmers were found in 20 to 40 millimeter fish groups, nematodes in 15-45 millimeter fish groups, and one fish in the 35 millimeter size group had ingested a colony of *Plumatella*. Ceratopogonids were found several times but were an insignificant food item. One cell of **Closterium** was found in a fish of the 15 millimeter group which represented the only plant life found in the stomachs examined.

Fragments of an oligochaete worm tentatively identified as *Nais sp.* were found in the 15 to 40 millimeter fish groups. This form comprised 8.4 percent of total volume in the 15 millimeter fish group and was one percent or less in the other groups. Welch (op. cit. p. 305) suggested that in bottom samples, the number of worm fragments found should be doubled for an approximate number of complete worms. This tech-

Table 1. Average number and volume by percent of food organisms of young largemouth bass

Fish Examined			Food Items													FOOD ITEM																		FOOD ITEM						
MM Group	Number In Group	Number and Volume of Food Organisms	Mayflies	Caddisflies	Damselflies (larvae)	Damselflies (pupae)	Dragonflies	Crayfish	Fingerlings	Leeches	Snails	Waterpillars	Flies	Midge Adults	Chydoridae	Macrothrix	Simocephalus	Chydorus	Polyphemus	Pseudosida bairdi	Bythotrephes	Bosmina	Midge Pupae	Ceriodaphnia	Polyphemus pediculus	Daphnia	Leptodora	Epischura	Misc.	Mayflies	Caddisflies	Damselflies	Crayfish	Fingerlings	Leeches	Snails	Waterpillars	Flies
5	3	No.	8.3				0.3	1					11.0																										2.3
		Vol.	28.8				0.4	10.7					57.2																										1.7
10	3	No.	11.0	4.0	0.7								0.3																										
		Vol.	41.8	44.0	11.0								3.2																										
15	96	No.	11.4	4.7	1.0	0.3	0.04	0.2			0.1	0.1	0.6			0101	0.02		0.07					C.1		0.04			8.5			0.01		0.2	27
		Vol.	38.7	31.3	16.7	10.5	1.2	4.4			0.4	0.9	1.1			0.6	0.4		0.9					2.0		1.0			6.4			Tr.		0.3	0.3
20	103	No.	19.9	4.8	2.4	0.5	0.3	0.2	0.01		7.0	0.01	72.4			0.02	0.1	0.01	0.04	0.1	0.1	0.1		9.1		0.04			8.1	0.04	0.03			0.1	0.02
		Vol.	17.8	16.8	12.6	15.2	1.3	1.3	0.1		5.9	Tr.	3.8			0.3	0.3		0.3	0.1	0.7	0.9		1.1		0.6			1.0	0.3	0.1			0.1	0.3
25	91	No.	7.7	5.9	4.2	0.8	0.9	0.2	0.1	0.1	0.2	0.1	2.3		0.01					0.1	0.02	0.01	0.1		0.3	0.1		0.01		8.3	0.04	0.02	0.01			
		Vol.	1.2	11.2	48.9	10.4	4.8	1.3	2.0	1.3	0.2	0.2	1.7		Tr.					1.5	0.1	Tr.	0.4		2.7	Tr.		1.2		6.8	0.3	Tr.	0.2			
30	72	No.	8.2	4.7	2.3	0.8	0.4	0.4	0.01	0.06	0.2	0.01	0.7		0.04	0.01	0.01		0.4	0.01			0.03		0.8		0.01			8.2		0.04			57	57
		Vol.	2.6	8.2	40.6	24.9	1.9	1.8	0.1	0.7	0.3	Tr.	0.3		0.2	Tr.	0.1		7.5	Tr.			0.1		8.8		0.7			0.9		Tr.			Tr.	0.5
35	84	No.	4.1	4.7	2.4	0.8	0.3	0.1	0.2	0.1	0.3	0.01	0.4	0.04	0.05				0.2	0.05			0.01		1.8	0.05	0.02		0.01			0.03			57	57
		Vol.	1.6	11.1	38.1	11.4	1.0	0.4	1.0	0.8	0.6	Tr.	0.2	0.3	0.3				1.0	0.2			0.1		15.4	0.7	0.3		Tr.			Tr.		1.7	Tr.	Tr/3
40	66	No.	0.9	0.2	4.4	0.2	0.4	0.4	0.2	0.03	0.03		0.03	0.6	0.1		0.01	0.1	0.1				0.1	0.01	2.1	0.1	0.05	0.01		0.05	0.01	0.4	0.01		57	0.05
		Vol.	0.4	0.6	42.3	32.5	1.4	1.0	2.5	0.1	0.1		Tr.	3.1	0.6		Tr.	0.7	0.3			0.4	0.1	14.3	0.6		3.4	0.7			9.1	0.9	0.4	0.1		Tr.	1.3
45	5	No.	0.4		1.8	0.4	0.4		0.2					3.0											7.0			0.2				7.3	0.4				
		Vol.	0.1		17.3	7.0	3.4		0.6					50.7											16.3			1.5				7.3	1.5				
50	1	No.																																			57
		Vol.																																			
55	1	No.			1				1.0					1.0											1.0							4.0					
									35.3					40.1											17.8							6.8					

1. Misc. includes caddis case, midge case, fly-fly spine, and smears.
2. Volume indicated is smears but was all of Cladophora was present which was the only plant life found.
3. Tr. - Trace - less than 0.05%.
4. Mucus
5. Only mucus were found.
6. Apparently only one colony was ingested but torn into 14 parts.
7. Adult Chydorus.

8. Only mucus found in this stomach

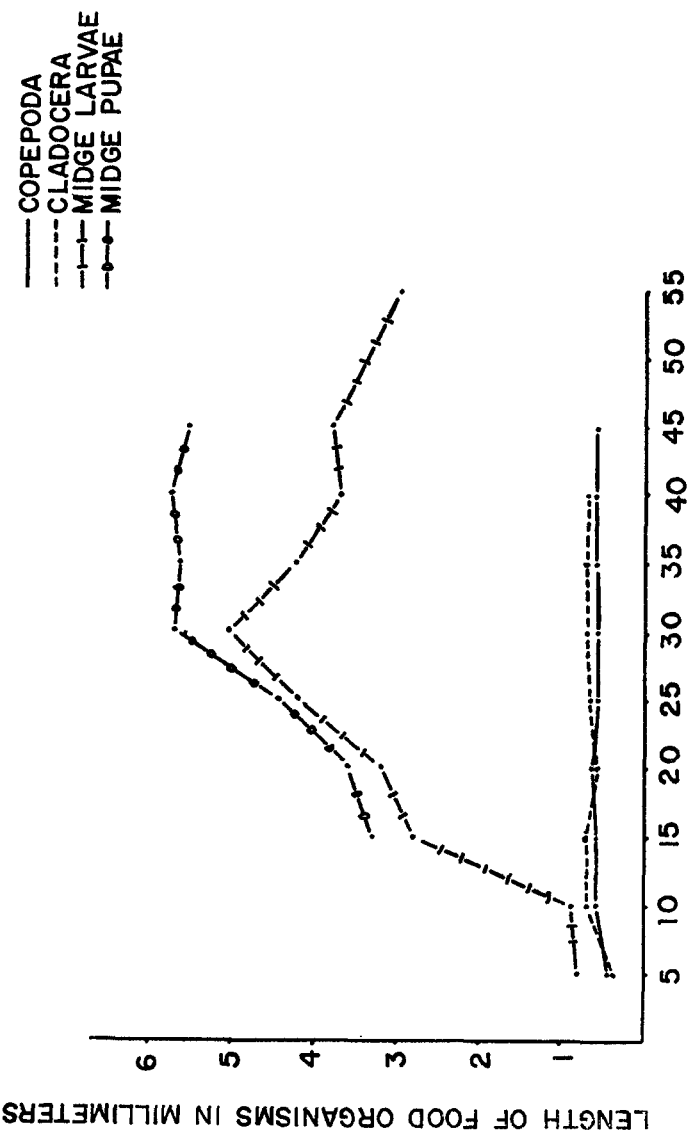

Figure 1. The relationship of the average length of the major food items to the length of young largemouth bass.

nique could possibly be used in food studies; however, it appeared that in this case, the number of fragments should be four per worm. At any rate, since they constitute only a small part of the food study, the number of fragments was reported as found without any piecework or adjustment.

Ostracods appeared in the diet of fish of the 20 millimeter group and occurred in all the larger groups. However, they only started to become a significant food item in the 45 to 55 millimeter groups.

Rotifer remains were found in all but two of the fish size groups from 5 to 40 millimeters. In the smaller fish, there were identifiable remains of *Keratella sp.* and *Brachnionus sp.*; and in the larger fish, only mastax and eggs were found. Plankton samples taken during the

fish collection period showed a heavy bloom of rotifers with the above mentioned species being dominant. The mastax and eggs were included in the mucus volume since it was not practical to measure such small items. The rotifers were quite abundant, however, which might indicate that they are eaten by small bass more than was previously thought.

Other miscellaneous items included a caddis case, midge case, water mite, fin spine, pebble, and mucus.

B. Length of Food Organisms.

Turner and Kraatz (op. cit.) stated that it seemed that the size of the food organisms as compared to the size of the bass was the most important factor in the selection of the food. However, in a hatchery environment, the fish would not have a great variety of foods of different size and must, therefore, take what is available.

Since the most important food items found in the study were copepods, cladocerans, and midge larvae and pupae, the average lengths of the food organisms were plotted for each size group of fish to determine the relation of length of food organism to length of fish (Figure 1).

The 5 millimeter group of fish had eaten only the smallest midge larvae and even the cladocerans and copepods were the smallest species found, or either were immature forms. The cladocerans averaged 0.36 millimeter in length, the copepods 0.45 millimeter in length and the midges 0.84 millimeters in length. The 10 millimeter fish-group showed a very slight increase in size of food organism. At this point the fish were taking mostly mature cladocera and copepods; and since some fish had ingested well over one hundred specimens, it was decided that to save time, an average figure of length and width could be used and the specimens in the fish stomach only counted. The average length of copepods and cladocerans ranged from 0.6 to 0.7 millimeters in the remainder of the length groups. The average midge larvae length was 0.9 millimeter in the 10 millimeter fish group.

There was a general increase in length of midge larvae with the increase in fish length from the 10 millimeter group up to the 30 millimeter group of fish where the larvae were averaging 5.1 millimeters in length. Beyond this point, the average length of the larvae decreased for all of the remaining groups. It appeared that the larger larvae were no longer available and the fish were forced to either utilize the smaller forms or go hungry. Further studies are planned to attempt to determine whether the mature larvae were emerging, had been depleted by heavy predation, or were not consumed for other reasons. There apparently was a heavy emergence of midges during the latter period of fish collections as shown by the fact that nearly half of the volume of food of the 45 to 55 millimeters groups was made up of adult midges (Figure 2).

The midge pupae followed the same pattern as the larvae except they averaged slightly longer than the larvae for each fish group, and they did not show up in the 5 and 10 millimeter groups of fish. The pupae length also reached a peak in the 30 millimeter group of fish; however, the pupae length remained fairly constant in the remaining groups of fish, while the larvae length decreased. The average length of adult midges was 5.25 millimeters in the 45 millimeter fish group and 3.3 millimeters in the 55 millimeter fish group. It should be pointed out that the number of fish for these groups was limited and may have given a biased picture of the food habits of these sizes of fish.

C. Volumes of Food Organisms.

The method of using the area of the food organisms as an index to volume proved to be very satisfactory. Volumes for the individual species are presented in Table 1. The species were combined to major groups to graphically show the volume of each group (Figure 2).

In the 5 and 10 millimeter groups of fish, the greatest percentage of food volume was made up of cladocerans and copepods with very

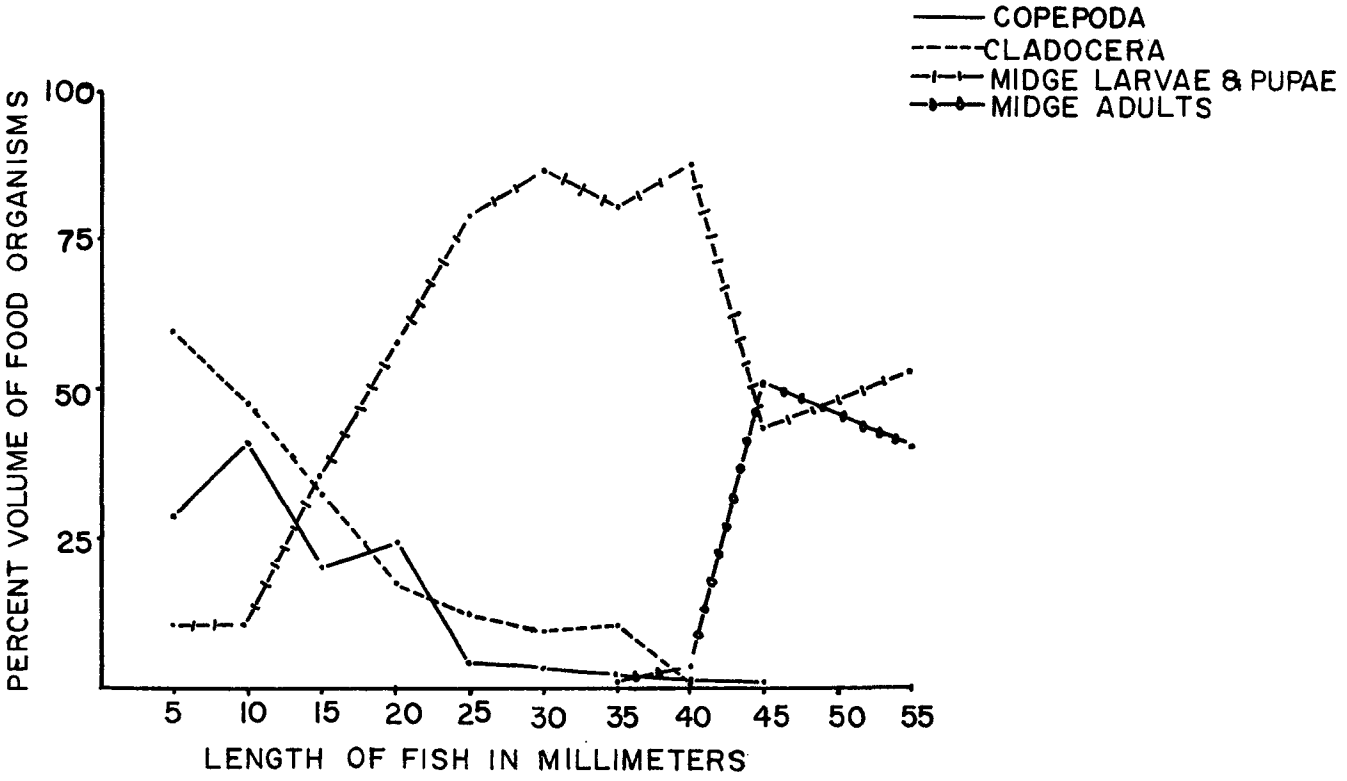

Figure 2 The percent volumes of the major food organisms of the various length groups of young largemouth bass.

small midge larvae comprising about 11 percent in each group. Since all other organisms combined formed such a small percentage of the food volume, only the cladocera, copepoda, and midges (larvae, pupae, and adults) will be discussed.

Midge larvae and pupae became an important food item in the 15 millimeter group and increased in volume as the cladocerans and copepods decreased until midge larvae and pupae were comprising 80 to 90 percent of volume in the 25 to 40 millimeter fish groups.

Cladocera were not found in fish larger than the 40 millimeter group and copepods were not found beyond the 45 millimeter group. Adult midges appeared in the 35 millimeter fish group but comprised only a small percentage of total volume in both 35 and 40 millimeter groups. Midges made up practically the total volume of food for the 45 and 55 millimeter fish groups with adult midges comprising 50 and 40%, respectively, but again the small number of fish examined should be considered.

The study of Turner and Kraatz (1920) showed that the intermediate sizes of young bass (30 to 50 millimeters) became unselective in food habits, with a great variety of food organisms being included into the diet. This study revealed the same results, except that none of the other organisms mentioned in their study (mayflies, beetle larva, etc.) comprised a significant amount of volume. The Turner-Kraatz study also showed that the young bass larger than 35 to 40 millimeters turned to a significant fish diet. No cannibalism was found during this study although a 40 percent difference in length was noted between fish taken from the same pond on one sample date and a size difference of 25 to 35 percent was noted for most of the samples.

A comparison was made of the food habits of 100 bass fingerlings collected from four ponds (25 from each pond) on one sampling date (Table 2). Length of the fish ranged from 25 to 35 millimeters with fairly equal distribution among the length groups except for pond S-13 which had 14 fish in the 35 millimeter group and 11 in the 30 millimeter group.

In general, the major food item was midge larvae with midge pupae being the next most abundant food item except in pond S-11 which had cladocera as the most abundant item and midge larvae next. Cladocera and copepoda comprised only a small percentage of total volume in the other three ponds.

D. Frequency of Occurrence of Food Organisms.

Although the cladocera made up a greater volume of total food than the copepoda, the copepods had a greater percent frequency of occurrence than the cladocerans in fish larger than 15 millimeter group (Figure 3). Both groups occurred in 100, 66.7, and 76 percent of the 5, 10 and 15 millimeter groups of fish, respectively. Both cladocerans and copepods gradually declined in frequency of occurrence until their disappearance in the 40 and 45 millimeter groups of fish, respectively.

The midge larvae occurred in a high number of fish throughout all lengths of the fish examined. Approximately two-thirds of the fish of the 5, 10, and 15 millimeter fish groups had eaten midge larvae and roughly 80 to 95 percent of the remaining fish groups had eaten them. The pupae were first taken in the 15 millimeter fish group, and were not found in fish longer than 45 millimeters. Between 35 and 50 percent of the fish had taken pupae in the size groups of fish utilizing pupae.

E. Average Number of Organisms Consumed.

The average number of organisms consumed does not give a true picture of the significance of various food organisms when used alone, however, it will serve to supplement the other information obtained. In this study, the greatest number of organisms per fish occurred in the 20 millimeter fish group which had an average of 21.8 copepods, 6.3 cladocerans, 3.3 midge larvae, and all other averaged less than one per individual fish (Figure 4). The greatest average number of midges,

Table 2. A comparison of the percent volume of major food organisms from the stomachs of largemouth bass fingerlings collected from four different ponds on one sampling date

Pond No.	Length groups and No. of fish per group				Percent volume of major food organisms				
					Cladocera	Copepoda	Midge Larvae	Midge Pupae	Miscellaneous
S-7	Length	25	30	35	2.2	3.1	64.0	29.1	1.5
	No.	7	8	9					
S-9	Length	25	30	35	2.4	1.5	52.0	35.2	8.7
	No.	5	15	5					
S-11	Length	25	30	35	62.0	0.2	27.6	5.3	4.7
	No.	8	7	9					
S-13	Length	25	30	35	0.1	0.2	66.9	31.8	0.9
	No.	0	11	14					

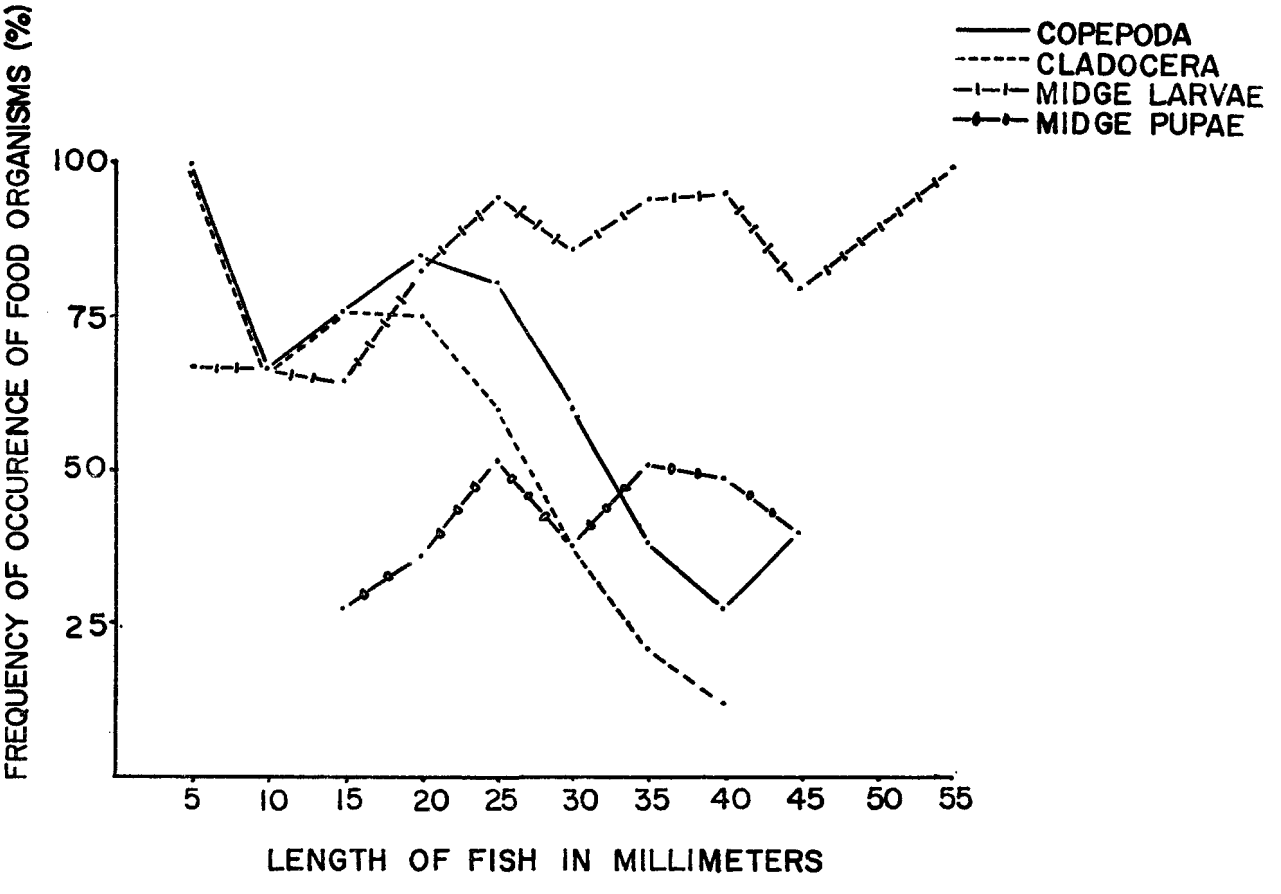

Figure 3. Percent frequency of occurence of the major food groups of the various sizes of young largemouth bass.

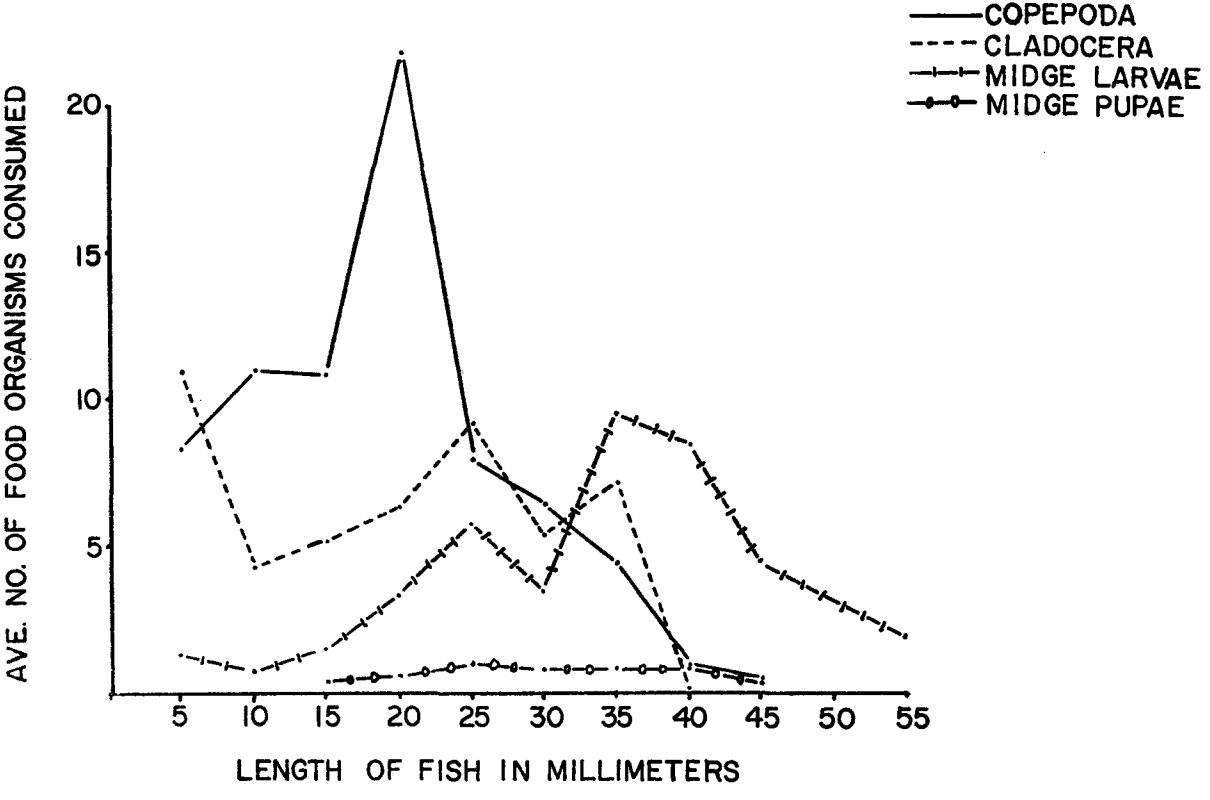

Figure 4. The average number of major food organisms consumed per size group of young largemouth bass.

9.6 per fish, was observed in the 35 millimeter fish group, and the greatest average number of cladocera, 11 per fish, was found in the 5 millimeter fish group.

SUMMARY

1. The most important food items were copepods, cladocerans, and midges.
2. Using primarily midge larvae as an index to food organism length, it was found that the larvae increased in length as fish increased in length up to a size of 30 millimeters, after which the larger food organisms apparently were no longer available resulting in the larger fish having to revert back to smaller forms.
3. The greatest volume of food was copepods and cladocerans in the 5 and 10 millimeter fish groups with midge larvae and pupae becoming most important in fish examined larger than the 15 millimeter group.
4. Adult midges comprised 50 and 40 percent of the food volume in the 45 and 55 millimeter fish groups, respectively.
5. Ostracods were found regularly in all fish size groups larger than 15 millimeters, but only started to become a significant item in the larger fish. Various insects were taken occasionally, but were insignificant as food items.
6. The average number of major food items consumed was erratic with the highest number of copepods (21.8) being reached in the 20 millimeter fish group. Cladocerans averaged 11 per fish in the 5 millimeter fish group. Midges reached the highest average number of 9.6 in the 35 millimeter group.
7. Both copepods and cladocerans occurred in 100 percent of the 5 millimeter fish group and generally declined in percent frequency of occurrence until the cladocerans disappeared in the 40 millimeter fish group and the copepods from the 45 millimeter group.
8. Midge larvae occurred in approximately two-thirds of the fish of 15 millimeters or smaller and consistently occurred in 80-95 percent of the larger size groups.
9. Midge pupae occurred in 30 to 50 percent of the fish groups from 15 to 45 millimeters.
10. The method of using the area of the food organisms as an index to relative volume proved to be very satisfactory.

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SUMMARY REPORT
SOUTHERN DIVISION
AMERICAN FISHERIES SOCIETY

The sixteenth annual meeting of the Southern Division of the American Fisheries Society was held in New Orleans, Louisiana, on September 24-27, 1967, in conjunction with the Southeastern Association of Game and Fish Commissioners.

Technical meetings, which included separate sessions on fish, game, law enforcement, and information and education were attended by more than 1,200 persons. The fisheries sessions were highlighted by several outstanding papers on striped bass, population dynamics, life history, management, physiology and farm ponds. An average of over 200 persons attended the fisheries sessions.

Business meetings were held on Monday and Tuesday afternoons. The Reservoir Committee announced that the Proceedings of the Reservoir Fisheries Resources Symposium will be available in early 1968. A resolution was passed supporting the stand taken by the American Fisheries Society and the Western Division on calling for the title and ownership of fish and wildlife to remain in the several states.

New officers elected for 1967-1968 were as follows:

PRESIDENT — Robert G. Martin, Washington, D. C.

PRESIDENT-ELECT — Buford L. Tatum, Oklahoma

SECRETARY-TREASURER — James Harry Barkley, Mississippi

AFS NOMINATING COMMITTEE — Felix (Jerry) Banks, Florida

The 1968 meeting of the Southern Division will be held in Baltimore, Maryland.

THE AMERICAN ALLIGATOR — PAST, PRESENT AND FUTURE

By ROBERT H. CHABRECK
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Grand Chenier, Louisiana

Of the many species of reptiles found in the United States, only two native representatives of the order Crocodilia exist today. These are the American alligator, *Alligator mississipiensis*, and the American crocodile, *Crocodylus acutus*. Both species are found only in the Southeastern States and both occur in very low numbers when compared with past populations.

Of the Crocodilia there are four forms including the alligator, crocodile, caiman and gavial. From these 21 species are recognized throughout the world (Ditmar, 1964). In addition to the American alligator the only other member of this group is *Alligator sinensis* of the Yangtee-Kiang River in China, which reaches about six feet long when fully grown.

The American alligator occurs throughout all of Louisiana and Florida and inhabits parts of Texas, Arkansas, Mississippi, Alabama, Georgia, South Carolina and North Carolina. Kellogg (1929) reported that the original range extended as far north as New Jersey. Today, however, the range extends from the North Carolina coast (Louder, 1966) southward along the South Atlantic and Gulf Coasts, inland to the mouth of the Arkansas River and westward to the 100th meridian in Texas. Many alligators have been reported far distant from their natural range, but they were probably purchased for pets and later released when they became a nuisance.