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Food Habits of Largemouth Bass *(Micropterus salmoides)* at Big Creek Lake[1]

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Food habits of largemouth bass *(Micropterus salmoides)* were studied at Big Creek Lake, from 1974-76, to determine the utilization of various prey species, temporal food habits, size at which bass became piscivorous, and size of fish-food items in relation to size of bass. Stomach contents from 259 bass were examined and 75 were empty. Entomostraca and insects were important food items of young bass but a transition stage was noted at about 125 mm TL when fish became the prominent food item. Crayfish were important food items early in the spring. Bass fed mostly on 0-age Centrarchids, and particularly bluegill and *Notropis sp.* Fish provided 29 to 86% of the biomass consumed and 2 to 70% by number. Larger bass (300+ mm) tended to utilize larger but fewer fish-food items while smaller bass (200-299 mm) consumed smaller fish more frequently.
INDEX DESCRIPTORS: largemouth bass, food habits, Big Creek Lake.

Largemouth bass *(Micropterus salmoides)* food habits were studied for three years at Big Creek Lake, a 351 ha (867 ac) sub-impoundment of Saylorville Reservoir. The objective was to determine the utilization of various prey species for food, temporal food habits, size at which bass became piscivorous and fish-food item size in relation to bass size. The study was part of an intensive largemouth bass population dynamics investigation at Big Creek Lake.

METHODS AND PROCEDURES

Largemouth bass food habits were studied by examination of the stomach content of fish captured by electro-fishing for three years. Bass samples were taken on an irregular schedule from April through mid-November each year. Fifteen bass, of which five measured less than 200 mm in total length (TL) and 10 were 200 mm+ TL, were collected each sampling period in 1974. From 1975-76 collections included 10 bass 200-299 mm TL and 3-5 bass 300 mm+ TL. Each fish was measured, weighed, and the whole alimentary tract removed, then preserved in 10% formalin for analysis. Stomach contents were removed and viewed with a 1-6X dissecting microscope, identified, enumerated, and weighed.

STOMACH CONTENT ANALYSIS OF LARGEMOUTH BASS

Stomach samples from 60 largemouth bass ranging from 100-199 mm TL were examined (Table 1). Cladocera and Ostracoda were the most numerous food item found, 3,465 items weighing 2.8 g and were found in 9 stomachs. Insects, primarily Corixids and Dipterans, ranked second, 257 weighing 4.2 g from 30 stomachs. 0-age Centrarchids, primarily bluegill, were utilized more frequently than any other group of fish, 78 items weighing 2.8 g from 6 stomachs. Unidentified fish accounted for 34 items weighing 2.9 g and were found in 15 stomachs. Although only three shiners were found, their combined weight of 4.5 g accounted for nearly one-half of the total fish weight consumed. Seventeen bass stomachs were empty.

Cladocera provided 85% of the food items by number, but contributed only 14% by weight (Table 2). Insects ranked second in numerical importance (6%) and contributed 21% by weight. Fish provided 3% by number and contributed 52% by weight. Fish were initially consumed by bass of about 125 mm TL. Crayfish contributed less than 1% by number and 13% by weight.

Stomach contents of 119 largemouth bass ranging from 200-299 mm TL were examined (Table 3). Twenty-nine were void. Aquatic insects, primarily Corixids and Dipterans, contributed 768 items weighing 11.6 g in the diet of 43 bass. Fish contributed 208 items weighing 118.4 g and were found in 62 stomachs. Bluegill and crappie young made up a substantial portion of the diet with 79 items weighing 28 g in 21 stomachs. Ten shiners weighing 56.4 g were found in 8 stomachs. Eighteen crayfish weighing 48.9 g were in 17 stomachs.

Invertebrates were numerically most important, contributing 72% of the food items but providing only 6% of the weight (Table 4). Fish ranked second in number (26%) but comprised 63% of the biomass. Crayfish comprised less than 2% by number but the 27% by weight ranked second.

Table 1. *Food items found in the stomach content of 43 largemouth bass 200 mm or less in Big Creek Lake, 1974-75.*

	Number of stomachs containing items	Number of items	Total weight (grams)
Centrarchids [a]	6	78	2.844
Carp	1	3	.011
Notropis sp.	3	3	4.465
Unidentifiable fish	15	34	2.897
Total fish	19	118	10.217
Decapoda	2	2	2.635
Cladocera and Ostracoda	9	3,465	2.774
Aquatic insects [b]	23	231	3.355
Terrestrial insects [c]	6	8	.355
Unidentifiable insects	10	18	.454
Total insects	30	257	4.164
Hydra	1	1	.001
Vegetation	1	1	.001

[a] About 86% identified as crappie and 2% identified as bluegill; the remainder were unidentified Centrarchids.

[b] Included Zygoptera, Tricoptera, Corixidae, Chironomidae, Ephemeroptera and unidentifiable Diptera.

[c] Included Hemiptera, Lepidoptera and Coleoptera.

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Table 2. *Food item composition by percent found in the stomach contents of 43 largemouth bass 200 mm or less in Big Creek Lake, April through October, 1974-75.*

	Number	Weight	Stomachs containing items
Centrarchids [a]	1.9	14.4	14.0
Carp	.1	.1	2.3
Notropis sp.	.1	22.6	7.0
Unidentifiable fish	.8	14.6	34.9
Total fish	2.9	51.6	44.2
Decapoda	<.1	13.3	4.7
Cladocera and Ostracoda	84.5	14.0	20.9
Aquatic insects [b]	5.6	17.0	53.5
Terrestrial insects [c]	.2	1.8	14.0
Unidentifiable insects	.4	2.3	23.3
Total insects	6.3	21.0	69.8
Hydra	<.1	.1	2.3
Vegetation	<.1	.1	2.3

[a] Primarily crappie

[b] Included Zygoptera, Tricoptera, Corixidae, Chironomidae, Ephemeroptera and unidentifiable Diptera.

[c] Included Hemiptera, Lepidoptera and Coleoptera.

Table 3. *Food items found in the stomach content of 90 largemouth bass from 200-299 mm TL in Big Creek Lake, April to mid-November, 1974-76.*

	Number of stomachs containing items	Number of items	Total weight (grams)
Centrarchids [a]	21	79	27.986
Largemouth bass	1	1	9.563
Notropis sp.	8	10	24.437
Unidentifiable fish	51	208	56.401
Total fish	62	298	118.387
Decapoda	17	18	48.690
Aquatic insects [b]	43	768	10.180
Terrestrial invertebrates [c]	6	40	.812
Unidentifiable invertebrates	4	4	.561
Total invertebrates [d]	46	812	11.553
Vegetation	3	6	.516
Unknown matter	1	1	.028

[a] About 61% identified as bluegill and 8% crappie; the remainder were unidentifiable Centrarchids other than bass.

[b] Included Corixidae, unidentifiable Diptera, Zygoptera, Anisoptera and Ephemeroptera.

[c] Included Annelida, Orthoptera, Lepidoptera, Anisoperta, Formicidae.

[d] Does not include Decapoda.

Table 4. *Food item composition by percent of food items found in the stomach contents of 90 largemouth bass from 200-299 mm TL in Big Creek Lake, April to mid-November, 1974-76.*

	Number	Weight	Stomachs containing items
Centrarchids [a]	7.0	15.6	21.2
Largemouth bass	.1	5.3	1.0
Notropis sp.	.9	13.6	8.1
Unidentifiable fish	18.3	31.5	51.5
Total fish	26.3	66.1	62.6
Decapoda	1.6	27.2	17.2
Aquatic invertebrates [b]	67.7	5.7	43.4
Terrestrial invertebrates [c]	3.5	.5	6.1
Unidentifiable invertebrates	.4	.3	4.0
Total invertebrates [d]	71.5	6.4	46.5
Vegetation	.5	.3	3.0
Unknown matter	.1	<.1	1.0

[a] Primarily bluegill.

[b] Included Corixidae, unidentifiable Diptera, Zygoptera, Anisoptera and Ephemeroptera.

[c] Included Annelida, Orthoptera, Lepidoptera, Anisoptera, Formicidae, Coleoptera and Lampyridae.

[d] Does not include Decapoda.

Stomachs of 80 largemouth bass ranging from 300-420 mm TL were examined and 29 were empty (Table 5). Bass over 300 mm were uncommon in catch samples during 1976, thus the sample size was smaller than previous years. Ninety-five fish weighing 581 g were found in 28 stomachs of bass 300+ mm. 0-age bluegill were seen most frequently and young crappie ranked second, but unidentifiable fish accounted for 33 items weighing 56 g in 33 stomachs. Crayfish contributed 18 items weighing 157 g in 14 stomachs. Insects were also utilized by larger bass, 41 items weighing 3 g were found in 9 stomachs.

Fish were the most important food item to the larger bass comprising 29% by number and 70% by weight (Table 6). 0-age bluegill were predominant in this category contributing 17% by number and 37% by weight. Cladocera and Ostracoda ranked higher numerically than fish, but they comprised .1% by weight and were found in only one stomach. Crayfish were second in importance contributing 6% of the number and 19% of the biomass. Invertebrates, other than Crustaceans, provided 22% by number and 6% by weight.

Seasonal food habits of largemouth bass 200 mm or greater were determined (Paragamian, unpublished) by dividing the stomach samples into two periods, April through June (spring) and July through mid-November (autumn). The spring sample comprised 37 stomachs, 23 containing food items of which 61% contained crayfish and 22% contained fish. Fish contributed 63% to the diet by weight and crayfish 35%. The autumn sample consisted of 20 stomachs containing food items while 15 others were empty. Fish continued to be the most

Table 5. *Food items found in the stomach contents of 51 largemouth bass 300-420 mm TL in Big Creek Lake, April through mid-November, 1974-76.*

	Number of stomachs containing items	Number of items	Total weight (grams)
Centrarchids [a]	11	56	306.920
Largemouth bass	1	1	47.000
Walleye	1	1	41.920
Notropis sp.	2	2	11.240
White sucker	1	1	112.000
Carp	1	1	4.449
Unidentifiable fish	18	33	56.986
Total fish	28	95	580.516
Decapoda	14	18	156.803
Cladocera and Ostracoda	1	134	.190
Aquatic invertebrates [b]	9	41	2.969
Terrestrial invertebrates [c]	5	28	44.701
Unidentifiable invertebrates	2	2	.266
Total invertebrates [d]	14	71	47.936
Frog	1	1	40.000
Vegetation	3	3	.080
Unknown matter	4	4	1.008

[a] About 88% identified as bluegill, 4% crappie, 4% green sunfish, and the remainder were unidentifiable Centrarchids other than bass.

[b] Included Ephemeroptera, Corixidae, unidentified Ciptera, Anisoptera and Zygoptera.

[c] Included Annelida, Orthoptera, Coleoptera and Formicidae.

[d] Does not include Decapoda or Ostracoda.

Table 6. *Food item composition by percent of food items found in the stomach contents of 51 largemouth bass from 300-420 mm TL in Big Creek Lake, April through mid-November, 1974-76.*

	Number	Weight	Stomachs containing items
Centrarchids [a]	17.2	37.1	21.6
Largemouth bass	.3	5.7	2.0
Walleye	.3	5.1	2.0
Notropis sp.	.6	1.4	3.9
White sucker	.3	13.6	2.0
Carp	.3	.5	2.0
Unidentifiable fish	10.1	6.9	35.3
Total fish	29.1	70.2	54.9
Decapoda	5.5	19.0	27.5
Cladocera and Ostracoda	41.1	<.1	2.0
Aquatic invertebrates [b]	12.6	.4	17.6
Terrestrial invertebrates [c]	8.6	5.4	9.8
Unidentifiable invertebrates	.6	<.1	3.9
Total invertebrates [d]	21.8	5.8	27.5
Frog	.3	4.8	2.0
Vegetation	.9	<.1	5.9
Unknown matter	1.2	.1	7.8

[a] Primarily bluegill

[b] Included Ephermeroptera, Corixidae, unidentified Diptera, Anisoptera and Zygoptera.

[c] Included Annelida, Orthoptera, Coleoptera and Formicidae.

[d] Does not include Decapoda, Cladocera or Ostracoda.

important food by weight (88%) and crayfish declined (9%). Fish also increased to 55% occurrence in stomachs as compared to 20% for crayfish.

DISCUSSION OF FINDINGS

A transition stage in food habits was noted for smaller bass within the 100-199 mm TL size ranges, similar to findings of other investigators (Murphy, 1949; Mraz et al., 1961; Applegate and Mullan, 1967; Hodson and Strawn, 1968). Young bass utilized a variety of food items. In order of decreasing numerical importance they were Entomostraca, aquatic insects, fish and terrestrial insects. Although Entomostraca were most important numerically they were found in only 21% of the stomachs containing food. By weight, in the same order fish, aquatic insects, Entomostraca, and Decapoda were consumed. Aquatic insects were the most important food item since they comprised 17% of the weight and were found in 54% of the stomachs containing food.

Opportunistic behavior of bass 200 mm or greater was apparent in the seasonal food habit variation when crayfish played an important role early in the year but were surpassed later in the season. Early in 1974 (April and May) few young or small fish were seen during electrofishing indicating many species spawned later. Stomach analysis of bass captured during these periods revealed the bass utilized crayfish more than fish.

Snow (1962) reported crayfish were the most important food items of largemouth bass in Murphy Flowage, Wisconsin. Centrarchids were second in importance followed by bullhead. Bluegill were utilized more frequently only after a drawdown reduced crayfish abundance. Lewis and Helms (1964) found crayfish were more vulnerable to bass predation than bluegill and green sunfish. At Big Creek Lake crayfish decreased in diet importance later in the summer and autumn while fish were utilized more frequently. This trend was associated with two factors; by July most fish spawned which made young fish more abundant and crayfish abundance was probably reduced by predation. In addition, since Big Creek Lake was a new impoundment the crayfish population was relatively free of predation by larger bass in 1972 and 1973, but in 1974 many bass were large enough to consume crayfish.

Zweiacker and Summerfelt (1973) suggested that a 56% empty stomach occurrence could be used as a guide to assess availability of prey for largemouth bass age 1+. Percent occurrences of empty stomachs of largemouth bass age 1+ at Big Creek Lake from 1974-76 was 40%, 19%, and 20%. Relative abundance of forage was monitored systematically by seine hauls during these same years. Total seine catches were 1,997; 20,620; and 4,949 fish. High occurrence of empty stomachs was positively associated with forage abundance. *Annual* largemouth bass growth was also related to prey abundance. Mean total length of age I bass captured in the autumn of 1973, 1975, and 1976 was greater than the length of bass of the same age captured during the same

period in 1974. Growth of the 1973 year class was greater in the third year of life (1975) than it was for their second (1974).

Examination of bass food habits showed fish was the most important food item to bass over 200 mm. O-age Centrarchids, primarily bluegill and crappie, contributed the largest segment of the fish food items. Up to 22% of the bass from 200 mm and larger consumed young Centrarchids. The differences in the use of young Centrarchids in the diet can be clarified by the fact smaller bass (200-299 mm) utilized more insects, thus reducing the representation of other items. Many fish were digested beyond identification and it is likely many of these items were young bluegill and crappie.

Food habits of bass 200-299 mm and larger bass did not differ, but forage size was quite different. Larger bass consumed about 1.9 fish per stomach averaging 6.1 g while bass 200-299 mm contained 3.3 fish with a mean weight of .4 g. Lewis, et al., (1975) found that the size of food items increased with bass size, but the biomass consumed compared to body weight decreased. Snow (1971) noted that an increase in size of bluegill and crayfish eaten was positively correlated to an increase in bass size. Bullhead consumed did not increase in size.

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