FOOD HABITS OF BIGMOUTH AND SMALLMOUTH BUFFALO FROM FOUR OKLAHOMA RESERVOIRS

by

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INTRODUCTION

Bigmouth buffalo *(Ictiobus cyprinellus)* and smallmouth buffalo *(Ictiobus bubalus)* often comprise a large percentage of the commercial fish harvest in inland lakes. These comprise the majority of the catch of Oklahoma commercial fishermen and have contributed over two million pounds to the fishery during the last five years. Limited research has been conducted on the life histories of bigmouth and smallmouth buffalo considering their importance as a commercial species, and their potential influence on game fish. Only one study has been concerned with food habits of buffalo in the southern plains (Dalquest and Peters, 1966). More information is needed in order to understand the food habits of the species as well as their relationship to other species.

This paper, part of a larger food habits study (Summerfelt, Mauck and Mensinger, 1971), will describe the feeding habits, quantitatively and qualitatively, of 1132 smallmouth buffalo and 623 bigmouth buffalo, commercially harvested from four Oklahoma reservoirs. Inter-reservoir, interspecific and seasonal variations will also be discussed.

The project was undertaken jointly be personnel from the Oklahoma Cooperative Fishery Unit and the Oklahoma Department of Wildlife Conservation and was financed, in part, by PL 88-309 funds. Data are representative of collections made from September 1967 through August 1968.

DESCRIPTION OF RESERVOIRS

Study reservoirs were selected which had commercial fisheries. Grand and Fort Gibson Reservoirs are located in northeastern Oklahoma on the Grand (Neosho) River. Grand Reservoir contains approximately 59,000 surface acres at the power pool and was constructed in 1941. Fort Gibson Reservoir, downstream from Grand Reservoir, was impounded in 1963 and contains 19,000 surface acres at the top of the power pool.

Eufaula Reservoir, in central Oklahoma, is the largest Oklahoma reservoir and impounds the North Canadian, South Canadian, and Deep Fork Rivers. Construction was completed by 1965, and the 102,500 surface acre lake filled shortly thereafter. The 93,000 surface acre Lake Texoma, located in south central Oklahoma, was constructed in 1944 and is fed by the Red and Washita Rivers.

MATERIALS AND METHODS

Smallmouth buffalo were collected from Grand, Fort Gibson and Texoma Reservoirs, and bigmouth buffalo were collected from Grand, Eufaula and Texoma Reservoirs. Entire alimentary tracts from adult buffalo were purchased from commercial fishermen at a cost of $0.20 each. Individual tracts were placed in cotton soil-sample bags with draw strings and were preserved in 10% formalin solution in summer and in a 5% formalin solution in winter. Fishermen were encouraged to save only tracts from fish which had been in nets a short time and were precautioned to dress fish so as not to lose any tract contents.

For analysis of food habits the following procedure was used: 1) that portion of the tract from the esophagus to the first major loop of the intestine was removed; 2) the tract section was cut open lengthwise; 3) the contents of all fish/species/month were washed into a container; 4) after settling, the supernatant was poured off; 5) the remaining contents were stored in 70% ethanol; 6) the contents were filtered; 7) the volume was determined by water displacement; 8) appropriate aqueous dilutions were made to reduce the number of organisms to less than 100 per cc; 9) the contents were thoroughly mixed and 10 random samples of one cc each were drawn and placed on a Sedgwich-Rafter slide; and 10) counts of each taxon or organism were recorded. From this information, average number of organisms per stomach and percent total volume of food material per stomach for each toxon was calculated. The term trace is used to denote values of less than 0.05%.

RESULTS

Tract Contents

Smallmouth buffalo

Volumetrically, the major constituent (>65%) found in smallmouth buffalo stomachs from the four reservoirs investigated was organic detritus (Table 1). Copepoda and Cladocera were the most abundant identifiable organisms except during warmer months when they were exceeded by chironomids and animal fragments composed of pieces of Crustacea.

Of the identifiable organisms, Copepoda and Cladocera made up 74% and 6% respectively in Grand Reservoir, 29% and 54% respectively in Fort Gibson Reservoir and 82% and 16% respectively in Texoma Reservoir.

Food items of lesser importance included Chironomidae, Ostracoda, Pelecypoda, Chaoborinae, algae and plant and animal fragments. Chironomidae composed 4% of the identifiable organisms in Grand Reservoir, 3% in Fort Gibson Reservoir and 2% in Texoma Reservoir. Ostracoda constituted only a trace of the identifiable organisms in Grand Reservoir, 14% in Fort Gibson Reservoir and 1% in Texoma Reservoir. Pelecypoda and Chaoborinae were found at trace levels in Grand Reservoir and Texoma stomachs contained trace amounts of algae. Stomachs from Fort Gibson Reservoir contained none of these items. Animal fragments composed of pieces of Crustaceans were found in all three reservoirs and constituted up to 14% of the total volume in Fort Gibson Reservoir. Plant fragments made up 10% of the total food volume in Grand Reservoir for the month of November. Smallmouth buffalo stomachs were not taken in Grand Reservoir in April or in Fort Gibson Reservoir in February and April due to a closed season.

In contrast to this study, smallmouth buffalo in Wheeler Reservoir, Alabama fed mostly on mollusks with Copepoda and Cladocera found in lesser amounts (Wrenn, 1968). Conversely, Dalquest and Peters (1966) found no mollusca but instead Copepoda, Cladocera and Ostracoda in all stomachs from Lake Diverson, Texas. Thus, it appears that the smallmouth buffalo diet is opportunistic in nature.

Table 1. Percentage composition of total volume of smallmouth buffalo *(Ictibus babalus)* stomachs from Grand, Ft. Gibson and Texoma Reservoirs and bigmouth buffalo *(Ictiobus cyprinellus)* stomachs from Grand, Eufaula and Texoma Reservoirs from October 1967 through August 1968.

Food items	Smallmouth buffalo			Bigmouth buffalo		
	Grand	Ft. Gibson	Texoma	Grand	Eufaula	Texoma
Plant						
Algae	-	T	-	-	-	-
Fragments	1.0	T	T	-	-	-
Animal						
Copepoda	4.0	7.4	9.1	2.0	16.1	3.2
Cladocera	8.0	1.0	4.7	3.3	11.6	12.9
Ostracoda	0.5	0.6	T	1.0	T	T
Chironomidae	0.5	3.5	0.9	0.1	0.1	0.2
Chaoborinae	T	-	-	-	-	-
Pelecypoda	T	-	-	-	-	-
Trichoptera	-	-	T	-	-	-
Odonata	-	-	T	-	-	-
Fragments	1.7	4.4	3.7	1.4	11.2	3.8
Detritus						
Organic	91.5	83.1	81.2	92.3	60.6	79.3
Inorganic	-	0.3	0.2	-	-	0.1
Total no. stomachs/lake	396	268	468	89	233	301
Avg. vol. food/ stomach (cc)	0.60	1.00	0.89	0.53	0.69	0.81

Bigmouth buffalo

Volumetrically, the major constituent found in bigmouth buffalo stomachs from the four reservoirs investigated was organic detritus (usually 60%) except during December through April in Eufaula Reservoir and during April and May in Texoma Reservoir when values were as low as 12% of the total volume.

Copepoda and Cladocera were the most abundant identifiable organisms found in bigmouth buffalo. The identifiable organisms Copepoda and Cladocera composed 37% and 58% respectively in Grand Reservoir, 41% and 57% respectively in Eufaula Reservoir and 23% and 77% respectively in Texoma Reservoir. Food items of lesser importance were Chironomidae which composed 1% of the identifiable organisms in Grand Reservoir and only a trace for Eufaula and Texoma Reservoirs. Ostracoda were utilized at levels of 5% of the identifiable organisms in Grand Reservoir, 2% in Eufaula Reservoir and only a trace in Texoma Reservoir.

Bigmouth buffalo did not feed on any other organisms but animal fragments were also found in tracts from all three reservoirs and constituted up to 33% of the total volume in Eufaula Reservoir. Items such as plant fragments and inorganic detritus were found in only trace amounts for both fish species. Bigmouth buffalo occurred seasonally and were not taken in Grand Reservoir in December, January, March and April, in Eufaula Reservoir in June, or in Texoma Reservoir in November and December.

SEASONAL VARIATION

Smallmouth buffalo

Copepoda and Cladocera were fed upon more intensely in greater numbers in the fall (October) and spring (March and April) (Figures 1 and 2). In Grand Reservoir the largest numbers of Cladocera in smallmouth buffalo stomachs occurred in May and November. Fort Gibson and Texoma Reservoirs showed similar results with minor variations. A fall peak was noted in December in Grand Reservoir, in October and December in Fort Gibson Reservoir, and October through December in Texoma Reservoir. However, maximum intake sometimes occurred at other times of the year. For example, in Texoma Reservoir highest consumption was in July.

Ostracoda were utilized to a minor extent except in March in Grand Reservoir and October in Fort Gibson Reservoir when their numbers in the diet increased. Ostracoda numbers in the diet remained low in Texoma Reservoir throughout the year (Figure 3). Chironomid numbers in the diet were high in Grand Reservoir in October, February, March, June and August while Texoma Reservoir numbers reached peaks in October and March, but also in June and August (Figure 4). Only in Fort Gibson Reservoir did a typical fall (October) and spring (May, June and July) pattern occur.

Bigmouth buffalo

Peak numbers of Cladocera in the diet were noted only in spring in all three reservoirs, May in Grand Reservoir, March and April in Eufaula Reservoir, and March in Texoma Reservoir. In this case, the peaks appeared first in the southern most reservoir and last in the northern most. Copepoda in bigmouth buffalo showed seasonal variations similar to smallmouth buffalo. Peak months in Grand Reservoir were October, November and May. Numbers of Copepoda consumed in Eufaula Reservoir peaked in December and May but also peaked in July and January. The peak recorded in Texoma Reservoir for this species occurred in March. The usual spring and fall peaks were sometimes accompained by winter and summer peaks.

Ostracods were more abundant in tracts of bigmouth buffalo in October in Grand Reservoir and December in Eufaula Reservoir while numbers in Texoma Reservoir remained low throughout the year. Chironomids in the diet also peaked in October in Grand Reservoir but remained low throughout the remainder of the year. In Texoma Reservoir Chironomid numbers showed a small peak in July and Eufaula Reservoir stomachs contained low numbers sporadically throughout the year.

Inter-reservoir Variation

Smallmouth buffalo:

A comparison of diets between reservoirs reveals that Copepoda and Cladocera were utilized to a greater extent in Fort Gibson and Texoma Reservoirs than in Grand Reservoir. Copepoda was the dominant organism in stomachs from Grand and Texoma Reservoirs and Cladocera dominated in Fort Gibson Reservoir (Figures 1 and 2). Ostracoda were utilized to a much greater extent (10X) in Fort Gibson Reservoir than in Grand and Texoma Reservoirs (Figure 3). Chironomidae were fed upon in all the reservoirs throughout the year but midges were utilized more extensively in Fort Gibson Reservoir than Texoma Reservoir with utilization in Grand Reservoir especially low. Other food items, such as, Pelecypoda, Chaoborinae, Trichoptera, Odonata, algae and plant fragments made up 1% or less of the volume. Animal fragments appeared in the diet in quantities as high as 14% of the total volume during May through August in Grand Reservoir and throughout the year in Fort Gibson and Texoma Reservoirs. Inorganic detritus (sand) made an insignificant contribution to total tract volume from Fort Gibson and Texoma Reservoirs and was not found in tracts from Grand Reservoir.

Bigmouth buffalo:

A comparison of diets between reservoirs reveals that Copepoda and Cladocera were utilized most extensively in Eufaula and Texoma Reservoirs respectively (Table 1). Ostracoda numbers in the diet were somewhat higher in Grand Reservoir but this was due to a large number found in October, the only month they appeared. They were fed upon sporadically in the other two reservoirs (Figure 3). Utilization of chironomids was higher in Grand Reservoir than Eufaula and Texoma Reservoirs, however, this was again due to a large number found in October, the only month they were present (Figure 4). Animal fragments were found in the stomachs intermittently from Grand Reservoir and throughout the year in Eufaula and Texoma Reservoirs in quantities as high as 33% of the total volume. Inorganic detritus (sand) was ingested to a very minor extent only in Texoma Reservoir.

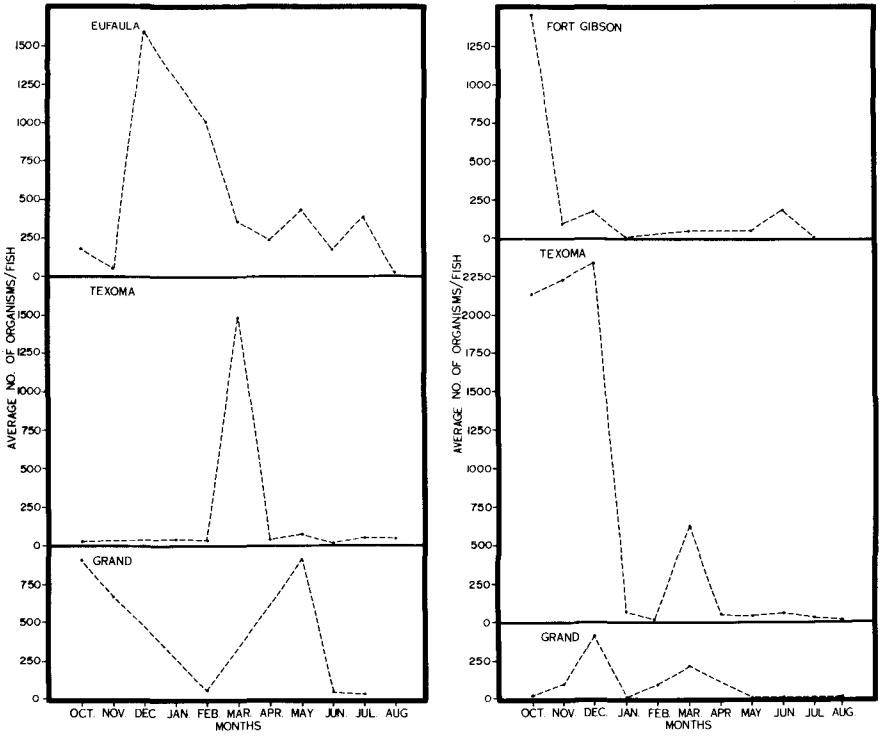

Figure 1. Monthly averages of numbers of Copepoda in the alimentary tracts of bigmouth buffalo (left) and smallmouth buffalo (right).

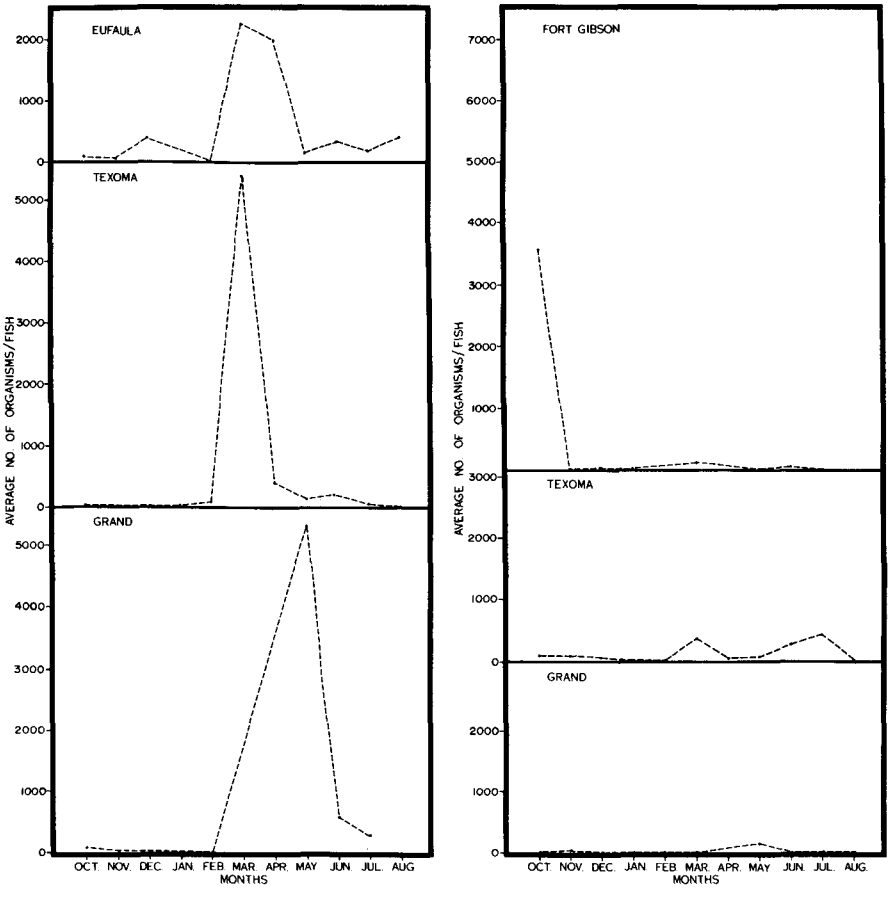

Figure 2. Monthly averages of numbers of Cladocera in the alimentary tracts of bigmouth buffalo (left) and smallmouth buffalo (right).

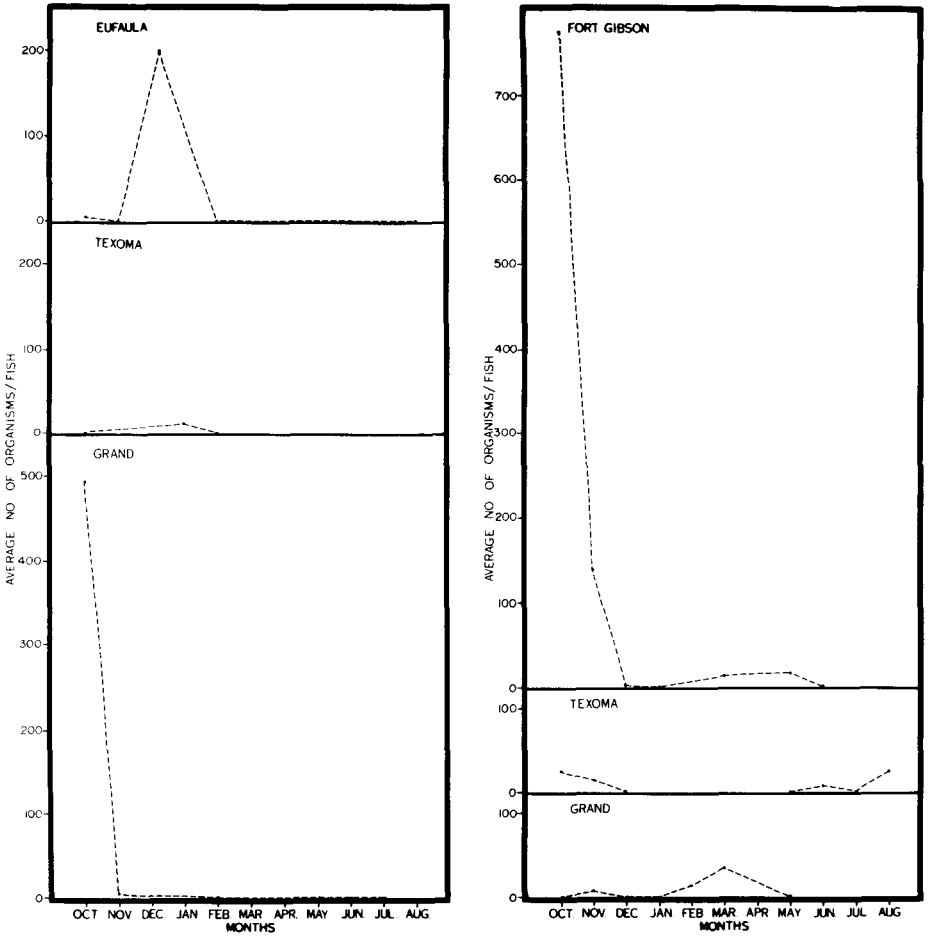

Figure 3. Monthly averages of numbers of Ostracoda in the alimentary tracts of bigmouth buffalo (left) and smallmouth buffalo (right).

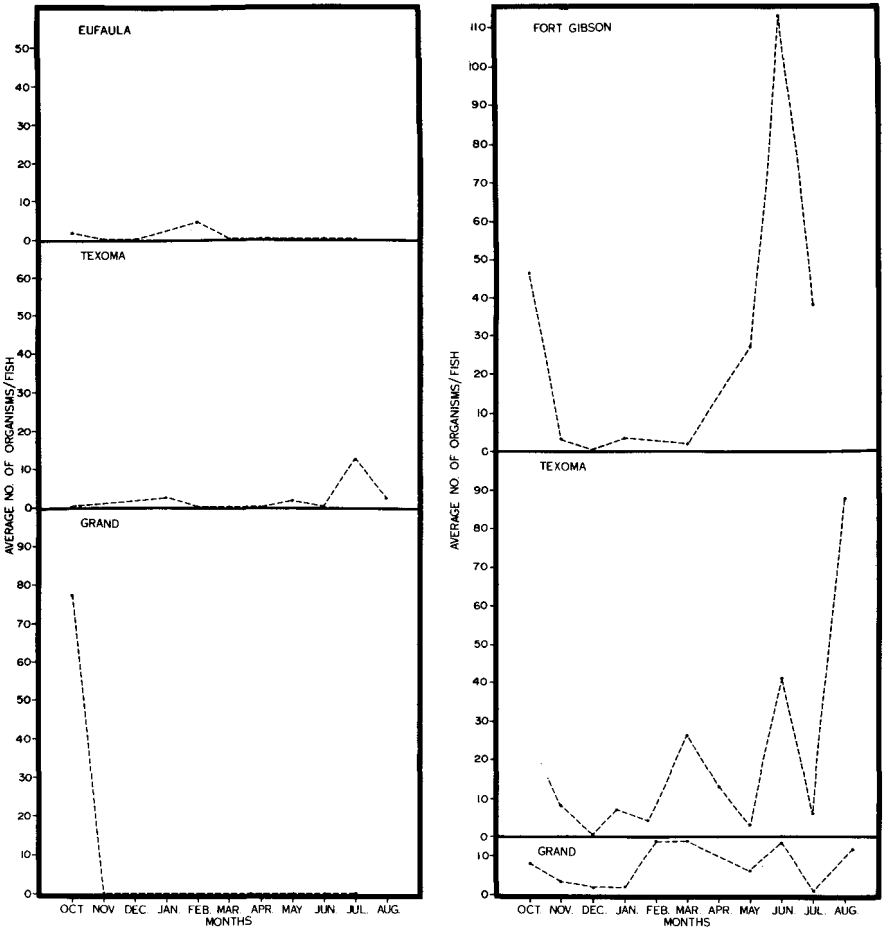

Figure 4. Monthly averages of numbers of Chironomidae in the alimentary tracts of bigmouth buffalo (left) and smallmouth buffalo (right).

Interspecific Variation

Comparison of feeding habits of smallmouth and bigmouth buffalo indicates that their feeding habits overlap concerning certain organisms, but the smallmouth buffalo feeds upon a greater variety of organisms than the bigmouth buffalo. In Grand and Texoma Reservoirs, Copepoda were utilized more extensively than Cladocera by smallmouth buffalo while the inverse was true for bigmouth buffalo for both reservoirs (Figures 1 and 2). Smallmouth buffalo utilized Ostracoda and Chironomidae to a small extent but bigmouth buffalo utilized them only in trace amounts (Figures 3 and 4). Pelecypoda, Chaoborinae, Trichoptera, Odonata and plant material including algae were reported only from smallmouth buffalo.

A comparison of the average number of food items or average volume per stomach versus water surface temperature did not produce any obvious relationship. However, larger food volumes were more often noted during the cooler months of the year for both fish species. This may be due to a slower rate of digestion at the cooler temperature.

DISCUSSION

A comparison of the total food volume and the volume of organic detritus consumed by smallmouth buffalo showed that the two values varied directly, indicating that it is a bottom or substrate feeder. Percent by volume of Copepoda and Cladocera is reported to be somewhat lower in the diet of smallmouth buffalo than bigmouth buffalo (Walburg and Nelson, 1966). Values in this study were also lower for smallmouth buffalo but were not as low as those of other authors (Moen, 1954; Walburg and Nelson, 1966; McComish, 1967). This evidence supports the premise offered by McComish (1967) that smallmouth buffalo are opportunists and feed on whatever is available.

The same comparison for bigmouth buffalo showed that as the volume of stomach contents increased, the volume of organic detritus tended to decrease indicating that the bigmouth buffalo has more pelagic feeding habits. Johnson (1963) states that bigmouth buffalo is both a bottom and planktonic feeder with Copepoda and Cladocera being the most important food of young bigmouth buffalo and constituting 75% of total stomach volume in adults. Other authors have found that bigmouth buffalo are not predominantly bottom feeders, evidenced by low volumes of insect larvae, detritus and sand (Walburg and Nelson, 1966; Moen, 1954); however, they further state that young bigmouth buffalo may be more benthic than adults. In addition to the above observations, Starostka and Applegate (1970) suggest that bigmouth buffalo are planktivorous, exhibiting little or no food selectivity and occuping all strata of Lake Poinsett, South Dakota.

However, Trautman (1957) suggests that bigmouth buffalo and carp are direct competitors. Summerfelt, Mauck and Mensinger (1971) have pointed out that the largest single food item category in carp is organic detritus and carp apparently feed on the unconsolidated bottom. Therefore, it appears from this study that of the two buffalo species, the smallmouth buffalo would be a more direct competitor of the carp than the bigmouth buffalo.

Results may be somewhat unreliable during months when sample sizes were small. This was especially true in Grand Reservoir where monthly means for four of seven months were derived from five bigmouth buffalo. In Eufaula Reservoir three out of ten months produced less than ten stomachs and in Texoma Reservoir two out of nine months had a sample size of less than ten. Fort Gibson Reservoir had a sample size of less than ten smallmouth buffalo stomachs for two out of eight months, while the other two reservoirs produced a larger sample size throughout the study period.

CONCLUSIONS

The results of this study seem to corroborate the findings of other authors even though there is considerable variation in the details. The general conclusions reached are:

1. Smallmouth buffalo in the reservoirs studied are bottom feeders while bigmouth buffalo are more pelagic feeders.
2. The major food category of smallmouth buffalo was organic detritus.
3. The major food category of bigmouth buffalo was organic detritus, except for occasional winter and spring months.
4. The major identifiable food items in the diet of both species were Copepoda and Cladocera. This was more evident in bigmouth buffalo while smallmouth buffalo also utilized relatively greater amounts of Chironomidae and Ostracoda.
5. A slight seasonal variation in diet occurred for both species which showed more plankton in spring and fall and a greater volume of stomach contents during cooler months.
6. Average stomach volume for both species was lowest in Grand Reservoir.
7. Smallmouth buffalo stomachs had lower numbers of food items in most catagories.
8. Cladocerans appeared in the diet of bigmouth buffalo earliest in the southernmost reservoir and last in the northernmost reservoir.

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