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*Iowa State Conservation Commission*

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## Food of the Bigmouth Buffalo, *Ictiobus cyprinellus* (Valenciennes), in Northwest Iowa Lakes

By TOM MOEN

Three species of the genus *Ictiobus* occur in Iowa waters; the bigmouth buffalo, *Ictiobus cyprinellus*, the black buffalo, *Ictiobus niger*, and the smallmouth buffalo, *Ictiobus bubalus*. Of these three species the bigmouth buffalo is the most common in the Northwest Iowa lakes, the remaining two species are comparatively rare.

Bigmouth buffalo (hereafter referred to as buffalo) have been removed from Iowa lakes as undesirable and obnoxious fish since the early nineteen hundreds. Harlan and Speaker (1951) state that nearly a half million pounds are removed from the inland waters of the state each year by the State Conservation Commission. In spite of the apparent abundance and commercial importance of this largest member of the sucker family, there is relatively little specific information concerning the food of this species. In fact, all statements in regard to the food of buffalo have been general in nature and apparently founded on casual observations of a few fish. Forbes and Richardson (1920) examined 17 buffalo with results recorded as follows: "About a third of the food of seventeen specimens consisted of algae, seeds of aquatic plants and distillery slops . . . Of the remaining two-thirds, nearly half consisted of *Entomostraca*, and more than half of aquatic insects, very largely *Chironomus* larvae and the larvae of day-flies." Everman and Clark (1920) examined one buffalo from Lake Maxinkuckee, finding: "Its stomach filled to distension with chironomus larvae and the remains of algae, the latter so digested as to be incapable of identification." Eddy and Surber (1947) state that buffalo feed largely on molluscs, insect larvae and vegetation. These and similar statements have led to the assumption that buffalo are primarily bottom feeders and thus not too far removed from carp in their food and feeding habits. Data from the present study do not bear out this assumption.

Buffalo used in this study were collected from seven lakes located in Northwest Iowa: East Okoboji, Spirit, Little Spirit and Silver Lakes in Dickinson County; Tuttle and Iowa Lakes in Emmet County; and Storm Lake in Buena Vista County. They are all shallow (maximum depth 25 feet), glacial, eutrophic lakes

ranging from 1,000 to slightly less than 6,000 acres in surface area.

#### METHODS AND PROCEDURE

Methods and procedure used in this study are similar to those employed in the author's study of the food of carp, (Moen, 1953). Fish to be examined were collected by several methods, including seines, gillnets, and traps. Drag seines operated by the rough fish removal crews contributed the majority of the fish. All fish were taken to the laboratory where routine data were recorded. All intestinal tracts were either examined while fresh or preserved in formalin.

The digestive tract of buffalo consists of one continuous tube, thus the entire tract was considered as the stomach. The contents of each stomach were measured while the material was moist or slightly wet. No volumes were recorded for young fish. Most of the food items were comparatively small, consequently separation prior to making volumetric measurement was not satisfactory.

After volumetric measurement was completed the contents were put into a beaker and thoroughly mixed. Water was then added to obtain a good separation of the food items. This mixture was placed in several Petri dishes and examined under a binocular microscope. If the volume was greater than ten cubic centimeters, a ten per cent sample was removed for detailed study, the remaining portion was examined less critically.

An initial examination of the material was made at which time the various food items were identified. A second examination was then made in order to estimate the percentage of total volume represented by each item. These percentages were then converted to volumes. Anything less than one-tenth of one cubic centimeter was recorded as a trace. Identifications were carried as far as could be readily accomplished but in the following discussion and in the tables, the material has been grouped by orders and larger units.

The data from the analyses of 259 stomachs (184 containing food) taken from seven lakes during the period of 1946-53 were separated by season (where possible) and expressed as percentages of total volume and as frequencies of occurrence of food organisms (appendix tables 1, 2, 3).

#### DISCUSSION OF FOOD CONSUMED

Although buffalo have been commonly thought of as bottom feeders, data from this study indicate that they are predominately

plankton feeders, taking principally small crustaceans (Entomostraca). Insect larvae were taken frequently but seldom made up more than one per cent of the total volume of food in any one collection. Midge larvae (Tendipedidae) were the most common insects found in buffalo stomachs. Insect volumes greater than one per cent were usually the result of heavy feeding on these organisms by one or two individuals of any one collection. Among the animal organisms taken as food were rotifers and hydrachnids, but neither group was considered important.

Plant material in the food of buffalo was predominately blue-green algae. Blue-green algae reached a maximum of 51 per cent of the total volume of food taken by two buffalo collected from Spirit Lake in June, but seldom exceeded ten per cent. Of the blue green algae found in buffalo stomachs *Michocystis* appeared to be the most common. *Aphanizomenon* may have been equally important in some lakes, but because flakes of this algae are easily reduced to extremely small filaments it may have escaped notice in some cases. Diatoms occurred occasionally but always contributed less than one per cent of the volume. Plant debris occurred frequently during the summer months but did not exceed one per cent by volume in any one collection except in lakes having high populations of bottom feeding fish and high turbidity.

A total of 56 stomachs were examined from buffalo collected from three lakes during the winter period of ice cover. Forty-three per cent of these stomachs contained food as compared to 80 per cent containing food at the time of collection from open water. Entomostracans made up 100 per cent of the total volume of food taken by these fish. A trace of blue-green algae was noted in one stomach.

#### SUPPLEMENTARY STOMACH ANALYSES

During the summer of 1940 the author examined the stomachs of 48 buffalo from East Okoboji Lake. Thirty-five (73 per cent) of these contained food. This was not a detailed analysis and these fish were not included in the 259 stomachs reported upon in this study. They are mentioned here only to point out that in each stomach entomostracans were estimated to amount to 90 to 95 per cent of the total volume. Blue-green algae and debris of vegetation made up the remainder. A few fragments of molluscs were noted in one stomach.

## NUMBER OF ORGANISMS PER STOMACH

It would be difficult to show competition among fish for such numerous items as zooplankters, but the number of these organisms per stomach is at least interesting. During the course of the study 16 stomachs were checked for total number of organisms. Counts were made on 11 stomachs taken in open water periods and five on stomachs taken during the winter. These determinations were made with a modified counting cell. Two of the 11 stomachs taken during open water were from young fish, one weighing 7.8 grams and the other 6.7 grams. These two fish had taken 1,330 and 2,000 entomostracans respectively. The volume of entomostracans in the remaining nine summer adults ranged from 4 to 24 cubic centimeters. The number of entomostracans in these stomachs ranged from 4,000 to 1,250,000 individuals, averaging 200,000. The volume of entomostracans in winter stomachs ranged from three to six cubic centimeters per stomach, the number of individuals averaged 8,600 (range 5,000 to 18,000).

An attempt was made to correlate plankton counts with the food found in the stomachs of buffalo from Storm Lake. Plankton counts were made on July 27, 1951 and on February 4, 1952. Buffalo were collected on the same dates and from the same general area that the samples were taken. Each plankton sample was based on ten liters of water at one station.

Based on two samples taken July 27 there were 7.0 cladocerans and 12.2 copepods per liter. Four buffalo stomachs from a collection of 12 fish taken on the same date (appendix table 2) contained an average of 7,131 cladocerans and 6,492 copepods. Although no counts were made, blue-green algae units were estimated to be 10 to 20 times as numerous as the entomostracans in the plankton samples. No algae were found in the four stomachs mentioned above and only one stomach in the collection of 12 contained algae. It appears that buffalo are either able to select entomostracans or that they seek out areas or swarms of entomostracans that are free of algae.

Based on an average of five samples taken on February fourth there were 1.4 cladocerans and 3.2 copepods per liter. Three buffalo selected from a collection of 17 fish taken on this date contained an average of 1,373 cladocerans and 4,966 copepods. Although one fish had taken ostracods none were noted in the plankton samples. *Microcystis* was noted in each of the plankton samples but not in the stomachs.

These counts are subject to considerable error and are discussed here only to indicate that buffalo are apparently selective in their food habits and consume vast numbers of entomostracans.

#### SUMMARY

Bigmouth buffalo, *Ictiobus cyprinellus*, have been commonly thought of as bottom feeders but data from the analysis of 259 buffalo stomachs taken from seven lakes during the period of 1946-53 indicate that they are predominately plankton feeders, taking principally small crustaceans (Entomostraca). Insect larvae, largely midge larvae, were taken frequently but seldom made up more than one per cent of the total volume of food in any one collection. Plant material in the food of buffalo was predominately blue-green algae of the genus *Microcystis*. Plant material seldom contributed more than 10 per cent of the volume of food organisms.

The winter food of buffalo consisted of 100 per cent entomostracans. Forty-three per cent of these stomachs contained food as compared with 80 per cent of the stomachs collected during the summer. The volume of food in each stomach was also less than that for summer collections.

Forty-eight stomachs from East Okoboji Lake buffalo (not included in the 259 reported here) collected in 1940 contained 90 to 95 per cent entomostracans with the remainder consisting of blue-green algae.

During the course of the study 16 stomachs were checked for the total number of entomostracans. These figures ranged from 1,330 for young fish to 1,250,000 for adults and averaged 200,000 for fish taken during the summer and 8,600 for fish taken during the winter.

In trying to correlate plankton counts with the food found in the stomachs of buffalo taken at the same time it appeared that buffalo were able to select nearly pure entomostracans in spite of the fact that blue-green algae was estimated to be 10 to 20 times more numerous.

#### ACKNOWLEDGEMENT

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Appendix Table 1

Food of bigmouth buffalo from East Okoboji Lake, expressed as percentages of total volume of food organisms (where volumes were taken) and percentages of occurrence.

Season and Maturity	Summer Adults				Summer		Young		Winter Adult	
	April-May 1946	July 1947	August 1947	April 1953	June 1951	July 1951	March 1948			
Number of stomachs taken	18	7	3	10	25	5	1			
Number of stomachs containing food	14	6	3	9	25	5	1			
Per cent of stomachs containing food	77	86	100	90	100	100	100			
Total volume of food in c.c.	Not taken	123.5	70.0	49.5	Not taken	Not taken	30.0			
Weight in lbs. or grams.	mean 3.0 range 1.9-4.6	4.6 1.3-8.2	4.7 3.8-5.2	1.5 1.3-1.7	(one inch)	1.0 gr. 0.5-1.5	6.5			
	Per cent		Per cent		Per cent		Per cent		Per cent	
	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.
ANIMAL		100	92	100	99	100	100	100	100	100
Insects			T	16	1	67		48		
Diptera			T	16	1	67		48		
Crustaceans		100	91	100	98	100	100	100	94	100
Entomostraca		100	91	100	98	100	100	100	94	100
Cladocera		100	78	100	84	100	82	100	84	100
Copepoda		57	13	50	14	100	18	100	60	80
Ostracoda									8	40
Rotifera			T	16						
Hydracarina									4	
PLANT		7	8	83	1	100			10	80
Algae (blue-green)		7	7	83	T	100			10	40
Diatoms			T	16					4	
Debris			1	83	1	33				60

Appendix Table 2

Food of bigmouth buffalo from Storm Lake, expressed as percentages of total volume of food organisms (where volumes were taken) and as percentages of occurrence.

Season and Maturity	Summer-Adults		Summer-Young		Winter-Adults		
	June 1948	July 1951	July 1951	March 1953	February 1948	February 1952	
Date of collection							
Number of stomachs taken	3	12	11	28	34	17	
Number of stomachs containing food	3	11	11	0	20	3	
Per cent of stomachs containing food	100	92	100	0	58	18	
Total volume of food in c.c.	22.0	145.5	Not taken	0	69.8	14.5	
Weight in lbs. or grams	mean range	5.2 lb. 2.7-6.7	5.6 lb. 1.0-10.0	10.5 gr. 1.5-61.0	0.8 lb. 0.5-1.0	1.1 lb. 0.9-2.0	5.5 lb. 1.7-8.0
	Per cent		Per cent		Per cent		
	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	
ANIMAL	100	100	100	100	100	100	
Insects			34	36	45		
Hemiptera			T	36			
Trichoptera			2	27			
Diptera			32	27	45		
Crustaceans	100	100	66	100	91	100	
Entomostraca	100	100	66	100	91	100	
Cladocera	89	100	41	100	82	33	
Copepoda	11	100	25	100	45	100	
Ostracoda			T	9	9	33	
Malacostraca					9		
<i>Hyaella</i>					9		
Rotifera					9		
Hydracarina			T	9			
PLANT			T	9	18		
Algae (blue-green)			T	9	18		

Appendix Table 3

Food of bigmouth buffalo from several Iowa lakes, expressed as percentages of total volume of food organisms (where volumes were taken) and as percentages of occurrence.

Lake	Silver Lake (Dick Co.)				Spirit Lake		Little Spirit Lake		Tuttle Lake		Iowa Lake		
	July 1946	Sept. 1948	June 1948	February 1949	July 1947	Sept. 1947	July 1951						
Number of stomachs taken	23	16	3	4	8	16	15						
Number of stomachs containing food	20	16	2	0	8	15	15						
Per cent of stomachs containing food	87	100	66	0	100	94	100						
Total volume of food in c.c.	171.5	229.5	75.0	0	139.5	158.0	Not taken						
Weight in lbs. or grams	mean 3.3 lb. range 1.4-6.1	3.8 lb. 1.0-6.4	9.3 lb. 4.7-14.0	2.8 lb. 2.5-3.2	1.3 lb. 0.7-1.6	1.5 lb. 1.2-2.8	6.0 gr. 5.0-7.0						
	Per cent		Per cent		Per cent		Per cent		Per cent		Per cent		
	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	
ANIMAL	100	100	77	100	49	100			89	100	38	93	94
Insects	1	5	T	12									27
Hemiptera	T	5	T	6									
Trichoptera			T	6									
Diptera	1	5											27
Crustaceans	99	100	77	100	49	100			89	100	38	93	94
Entomostraca	99	100	77	100	49	100			89	100	38	93	94
Cladocera	89	80	75	100	25	100			88	100	33	93	94
Copepoda	10	40	2	50	24	100			1	87	5	80	94
Ostracoda	T	5											
PLANT			23	100	51	100			11	100	62	93	60
Algae (blue-green)			23	100	51	100			6	75	11	93	60
Diatoms			T	31					T	12			
Debris									5	100	51	86	

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