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Mathur,Dilip

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Seasonal Food Habits of Adult White Crappie, Pomoxis annularis Rafinesque, in Conowingo Reservoir

ABSTRACT: *Stomach contents of 903 adult white crappie (160 to 310 mm fork length) collected from June 1966 to December 1967 in Conowingo Reservoir were analyzed. By volume, zooplankton and small fishes were dominant food items in most of the spring, summer and autumn months, whereas amphipods predominated in the winter months. Insects and plant material were least important in the diet.*

Based on percentage frequency of occurrence, amphipods were found most frequently in the stomachs throughout the year. Dipterans (midge larvae and pupae) ranked next in importance. Zooplankters (Cyclops *and* Daphnia), *sunfishes* (Lepomis *spp.*) *and johnny darter* (Etheostoma olmstedi) *appeared most frequently in the spring, summer and autumn months. The wide variety of organisms in the diet suggested opportunistic feeding habits. Feeding activity was heaviest in June through October, moderate in April, May and November, and lowest in the winter months.*

INTRODUCTION

Food habits of the white crappie, *Pomoxis annularis* Rafinesque, have been reported by Burris (1956), Hoopes (1960), Marcy (1954), Mitchell (1945), Morgan (1954), Neal (1961) and Scidmore and Woods (1959). However, none of these studies discussed in detail seasonal trends in feeding. Food habits of the young white crappie in Conowingo Reservoir have been described earlier (Mathur and Robbins, 1971). This paper discusses aspects of seasonal food habits of the white crappie in Conowingo Reservoir, which is located on the lower Susquehanna River in Pennsylvania and Maryland. Its physical, chemical and biological characteristics have been discussed by Moyer and Raney (1969), Whaley (1960) and Whitney (1961). The white crappie is the major sport fish in the reservoir.

This study is one of a series completed as part of an ecological study by Ichthyological Associates for the Philadelphia Electric Company with reference to the Muddy Run Pumped Storage and Peach Bottom Atomic Stations.

METHODS

Adult crappies were collected from all sections of the reservoir during June 1966 through December 1967. Gear used included a 16-ft semiballoon trawl with ¼-inch bar mesh liner in the cod end and a 3 x 6-ft trap net with ½-inch bar mesh. The trawl hauls of 10-min duration were made in open waters 6 to 20 ft deep. Trap nets were set for 12 to 24 hr close to the shore in waters up to 12 ft deep. Collections were made biweekly except in February 1967 when the reservoir was frozen. Fish were preserved immediately on capture in 10% formalin and later transferred to 40% isopropyl alcohol. A total of 368 crappies were collected in the trawl and 535 in the trap nets during the study period. These specimens ranged from 160 to 310 mm fork length.

The stomach was removed from each fish and the total volume of its contents measured by water displacement. The contents were removed and identified under the dissecting microscope. Zooplankters were identified to genus, fishes to species whenever possible, and insects to order. Because of the difficulty in identification of the semidigested bluegill (*Lepomis macrochirus*) and pumpkinseed (*L. gibbosus*), they were lumped together and are shown in the accompanying table as *Lepomis* spp. Frequency of occurrence of each food

item was recorded. Later the contents were sorted into major taxonomic groups and the volume of each determined by water displacement.

RESULTS

Feeding intensity.—Of 903 stomachs examined, 193 (21%) were empty. Percentage of empty stomachs was considerably higher in January, March and December (Table 1). This suggests a low level of feeding activity in these winter months, a suggestion also supported by the data on the mean volume of stomach contents per fish (Table 1). The amount of food present in the stomachs was highest during June through October, which are considered to be the peak feeding months of the white crappie. In April, May and November the amount of food present in the stomachs was moderate. Least amount of food was observed in the winter months. These differences in the seasonal food uptake of white crappie correspond fairly well with the data on the food consumption of several species, including the black crappie (*P. nigromaculatus*) at low temperatures in Fish Lake, Little Cataraqui Creek and Jones Creek, Ontario (Keast, 1968a, b).

An important feature of the stomach contents was the great individual variation in volume. The variation was observed mostly during the months of active and moderate feeding. One series of fish samples collected in these months had stomach-content volumes of 0.05 to 4.0 cc. Another series, collected in the same months, varied from 1.0 to 9.1 cc. Similar results were noted by Keast (1968a) in black crappie in Lake Opinicon, Ontario. These findings emphasize the need for examining large series of fish for detailed food studies.

TABLE 1.—Seasonal feeding intensity of adult white crappie in Conowingo Reservoir expressed as mean volume of stomach contents and percentage of empty stomachs

Month	No. of stomachs examined	Stomachs empty (%)	Volume (cc) of stomach contents	
			Range	Mean
Jan.	6	50	0.05-0.4	0.20
Mar.	34	32	0.05-0.5	0.28
Apr.	56	9	0.1 -3.0	0.71
May	220	27	0.1 -2.6	0.50
June	100	16	<0.05-3.5	1.50
July	52	17	0.1 -3.7	1.81
Aug.	53	22	0.1 -6.5	1.19
Sept.	43	14	0.1 -4.4	1.73
Oct.	165	16	<0.05-9.0	1.10
Nov.	120	21	<0.05-2.5	0.41
Dec.	54	33	0.1 -0.5	0.17

TABLE 2.—Seasonal food of the white crappie in Conowingo Reservoir expressed as percentage volume

Month	Zooplankton	Insects	Amphipods	Fishes	Detritus[1]
Jan.	....	....	100	....	....
Mar.	48	7	28	9	8
Apr.	8	1	6	83	2
May	24	24	9	33	10
June	72	6	4	16	2
July	50	8	3	39	Tr
Aug.	19	12	6	63	Tr
Sep.	20	1	5	74	Tr
Oct.	9	Tr	7	82	2
Nov.	52	Tr	6	42	Tr
Dec.	6	4	69	19	2

[1] Includes plant and inorganic materials. Tr = Less than 0.5 per cent

Food composition.—On the basis of volumetric determination, the diet of white crappie was made up largely of zooplankton and fishes, although amphipods were important in some months (Table 2). Fishes contributed 33 to 83% to the total food by volume in April, May and July through November. Zooplankton was important food in March, June, July and November when it comprised 48 to 72% of the total stomach contents. Amphipods were the dominant food in January and December and comprised very little of the total food in other months. Insects were relatively important only in May.

Based on the percentage frequency of occurrence (Table 3), amphipods were present in the diet throughout the study period. In contrast, other items were absent in the diet during at least part of the year. A variety of insects were observed in the stomachs, but dipterans (midge larvae and pupae) ranked second in importance to amphipods in the diet, being absent only in January. Zooplankters (*Cyclops* and *Daphnia*) were important in the diet during most of the spring, summer and autumn months. Several other zooplankters were also found occasionally in the stomachs. The sunfishes, *Lepomis* spp., and johnny darter, *Etheostoma olmstedi*, occurred in the stomachs in low frequencies in most of the months. The sunfishes appeared in a high number of stomachs in April and July while johnny darters were important in August

TABLE 3.—Food of the adult white crappie in Conowingo Reservoir expressed as percentage frequency of occurrence

Food items	Jan.	Mar.	Apr.	May	June
Zooplankton					
Daphnia	....	....	....	20	83
Bosmina	....	....	....	....	3
Diaphanosoma	....	....	....	....	25
Leptodora	....	....	....	....	....
Ceriodaphnia	....	....	....	....	....
Alona	....	....	....	....	....
Chydorus	....	....	....	....	....
Camptocercus	....	....	....	1	1
Cyclops	....	78	57	7	41
Diaptomus	....	....	....	....	1
Cypris	....	....	....	....	....
Amphipoda	100	50	50	48	13
Isopoda	....	....	2	1	....
Acari	....	....	....	1	....
Aquatic insects					
Diptera	....	100	27	70	74
Ephemeroptera	....	....	11	18	....
Odonata	....	....	2	4	12
Neuroptera	....	....	....	1	....
Plecoptera	....	....	....	1	....
Terrestrial insects					
Coleoptera	....	....	....	....	3
Hemiptera	....	....	....	....	3
Hymenoptera	....	....	....	4	3
Unidentified	....	....	....	....	....
Fishes					
Notropis hudsonius	....	....	....	....	....
N. spilopterus	....	....	5	1	....
Notemigonus crysoleucas	....	....	....	....	....
Ictalurus punctatus	....	....	....	....	....
Lepomis spp.	....	....	100	3	....
Pomoxis annularis	....	....	....	....	....
Etheostoma olmstedi	....	....	2	2	1
Percina caprodes	....	....	....	....	....
Unidentified	....	8	18	11	4
Detritus[1]	....	56	48	3	15

and September. Unidentifiable fish remains appeared quite frequently and were believed to be sunfishes because of high abundance of these species in the reservoir and because most fish remains contained ctenoid scales resembling those of the sunfishes. If the data on the frequency of occurrence of the fish remains are combined with those of the sunfishes, then the sunfishes would rank third on the basis of percentage of frequency of occurrence after amphipods and dipterans.

DISCUSSION

The kinds of organisms found in the stomachs of adult crappie in this study in general were similar to those reported by other investigators from different bodies of water (Burris, 1956; Hoopes, 1960; Marcy, 1954; Mitchell, 1945; Morgan, 1954; Neal, 1961, and Scidmore and Woods, 1959). Presence of a wide variety of organisms in the stomachs suggests that the white crappies are opportunistic feeders. The degree of importance of each taxonomic group in the diet of the crappie, however, varied considerably in the various investigations, including the present one. Insects were important in the diet of crappie studied by Hoopes (1960). Zooplankton and insects contributed significantly to the diet of crappie examined by Neal (1961) and Scidmore and Woods

TABLE 3.—(continued)

Food items	July	Aug.	Sept.	Oct.	Nov.	Dec.
Zooplankton						
Daphnia	85	72	58	28	35	3
Bosmina	2	....	....	5	4	....
Diaphanosoma	....	2	....	....	....	....
Leptodora	27	47	6	....	....	....
Ceriodaphnia	2	2	....	....	....	....
Alona	....	....	3	1	....	....
Chydorus	....	....	....	3	1	....
Camptocercus	....	2	....	1	....	....
Cyclops	47	2	58	41	52	....
Diaptomus	2	2	....	....	....	....
Cypris	2	3	....	....	....	....
Amphipoda	18	15	14	44	43	90
Isopoda	....	....	....	....	....	....
Acari	....	....	....	....	....	....
Aquatic insects						
Diptera	40	55	40	36	17	29
Ephemeroptera	4	2	....	1	7	....
Odonata	2	....	....	....	....	....
Neuroptera	....	....	....	....	....	....
Plecoptera	....	....	....	....	....	....
Terrestrial insects						
Coleoptera	2	....	3	....	....	....
Hemiptera	....	2	....	....	....	....
Hymenoptera	....	....	....	....	....	....
Unidentified	4	4	2	3	1	....
Fishes						
Notropis hudsonius	....	....	....	2	....	....
N. spilopterus	....	....	....	....	....	....
Notemigonus crysoleucas	....	2	....	....	....	....
Ictalurus punctatus	2	....	....	....	....	....
Lepomis spp.	11	6	8	7	7	....
Pomoxis annularis	....	2	....	....	....	....
Etheostoma olmstedi	4	19	22	4	3	....
Percina caprodes	....	....	....	2	....	....
Unidentified	29	53	28	13	17	8
Detritus[1]	6	12	33	25	18	3

[1] Includes plant and inorganic materials

(1959). Burris (1956), Marcy (1954), Mitchell (1945) and Morgan (1954) found fishes to be dominant in the diet. In Conowingo Reservoir, however, small fishes, zooplankton and amphipods were seasonally prominent in the diet. Benthic insects were little used by the crappie. These reported differences are perhaps related to the differences in the abundance and availability of the local food supplies of the bodies of water studied, or to bias due to single-season sampling by many workers.

Feeding activity as measured by the total volume of the stomach contents showed definite seasonal trends. Although the volume of stomach contents varied greatly throughout the months of heavy feeding, it was consistently low in late autumn, winter and early spring months. Stomachs of crappies collected during June through October usually contained two to eight times the quantity of food as in November through May. Thus, it may be concluded that white crappie feed more intensively in summer and early autumn months than at other times of the year. Low feeding during months when water temperatures were usually below 50 F was also apparent in young white crappie and channel catfish (*Ictalurus punctatus*) in this reservoir (Mathur, 1970; and Mathur and Robbins, 1971).

The crappies did not appear to show any definite preference with regard to the size of the prey. This inference is based on the observation that the prey of the crappie varied in size from tiny plankters to fishes as large as 104 mm total length. Whenever zooplankters were observed in the stomachs, they were always present in prodigious numbers. The sunfishes found in the stomachs ranged from 18 to 55 mm total length, johnny darters 16 to 44 mm, and one spottail shiner (*Notropis hudsonius*) measured 104 mm.

Keast (1968a) noted a protracted transition from plankton to fish feeding in black crappie. He suggested the prolonged nature of the plankton feeding phase was associated with the long gill rakers. The results of the food studies of the young white crappie in Conowingo Reservoir (Mathur and Robbins, 1971) indicated that they feed primarily on zooplankton. Plankton feeding phase is obviously continued in adult white crappie of all sizes and is perhaps also related to the long gill rakers of white crappie.

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DILIP MATHUR[1] Ichthyological Associates, Box 12, Drumore, Pennsylvania 17518. *Submitted 13 November 1970; accepted 1 April 1971.*

[1] Present address: Alabama Cooperative Fishery Unit, Auburn University, Auburn, Alabama 36830.

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