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FOOD OF THE BLACK CRAPPIE *POMOXIS NIGRO-MACULATUS* (LeSueur), IN ORANGE LAKE, FLORIDA

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ABSTRACT

Orange Lake in north central Florida has an area of approximately 14,000 acres and is surrounded by extensive marshes. During a 12-month period, stomach contents of 902 black crappie *(Pomoxis nigro-maculatus)* ranging in size from 31 to 291 millimeters, standard length, were analyzed. The frequency of occurrence of various food organisms, seasonal trends in the consumption of food items, and the average volume of food per stomach are presented.

Gizzard shad are the most important food item of the adult crappie except during the spring months of February, March, and April when their frequency is exceeded or equalled by Malacostraca. In summer and fall crappies feed largely upon fishes and, to a lesser extent, upon Malacostraca, dipterous larvae, pupae and adults, and Entomostraca. During the winter months fishes constitute the main food of the crappie, all other food items occurring in less than 50 percent of the stomachs. The chief food of young crappies is Entomostraca. The consumption of larger organisms increases as they attain larger size. During breeding season male crappies eat approximately 33 percent more malacostracans and 33 percent less fish than females.

INTRODUCTION

Widespread interest in the black crappie, *Pomoxis nigro-maculatus,* and the scarcity of published ecological information concerning this species in Florida waters, suggested the study of the seasonal food habits which was carried on at Orange Lake from June, 1947 through May, 1948. Most of this lake is in Alachua County, Florida, and it is the largest of several bodies of water lying in a drainage basin of approximately 600 square miles. The surrounding terrain is gently rolling and pitted, particularly to the south, by numerous sinkholes in limestone formations which underlie the sandy topsoils.

The overall length is approximately 16 miles, the maximum width is nearly 4 miles, and the open water area covers approximately 14,000 acres. Maximum depth is approximately 35 feet. The bottom is composed of thick layers of silt and plant detritus over sandy clay and limestone. During 1948, the pH range was 6.8-7.2 except in June when the water level was lowest and the pH was then 8.2. During the same year the surface temperature varied from 33.0° C. in June, to 13.5° C. in January. Orange Lake water is usually turbid and colored brownish or greenish by large amounts of suspended detritus and its extractives and the presence of considerable quantities of plankton.

The lake is surrounded by extensive marshy areas which are dominated by *Nymphaea macrophylla, Sagittaria lancifolia, Pontederia lanceolata,* and several species of shrubs. The shallow waters of the littoral zone are dominated by *Ceratophyllum demersum* and *Naias guadalupensis.* A conspicuous part of the vegetation is formed by the large floating mats of *Piaropus crassipes.* Floating islands, varying in size from a few square feet to several acres, are found in Orange Lake. They are characterized by one or more of such emergent plants as *Sagittaria lancifolia, Mariscus jamaicensis, Persicaria* sp., and *Sambucus simpsonii.*

This lake produces and supports a rich fish population composed of approximately 30 identified species. Small species and forage fishes are quite abundant and thousands of sunfishes are taken annually by sport fishermen.

Seven collecting stations were established in areas which appeared to be typical or important environments in order to ascertain the relative abundance of crappies and other fishes in various situations. Collections were made at four of the stations by trapping and by pole fishing with live fishes for bait. The three remaining stations were shallow areas where a seine could be employed. One 10-foot common sense seine and one 20-foot bag seine with one-quarter-inch mesh were used. Dipnets were used under floating islands and in the marshy areas of the lake. Small specimens were also taken with a 6-foot cast net. Frequently catches of sport fishermen were examined and crappie stomachs taken.

Food of the Black Crappie

Considerable information concerning food and feeding habits of the crappie has been gathered in previous studies. Crappie from the region of Illinois and Wisconsin were found by Forbes (1878), Forbes and Richardson (1920), and Pearse (1919) to have eaten mostly larvae and pupae of dipterous insects, cladocerans, amphipods, and ephemerid nymphs. Bailey and Harrison (1945) found the food of crappie in Iowa to consist of *Hyalella,* insects, and organic debris and fragments. Dendy (1946) found the food of adult crappie in Norris Reservoir, Tennessee, throughout the year to be mainly chaoborines and chironomids, plankton, and fishes.

In presenting the data concerning food and feeding habits of the crappie in Orange Lake the fish have been divided into two groups based on a natural break in the types of food organisms ingested as the crappie grew in size. A conspicuous decrease in the consumption of Entomostraca and an increase in utilization of larger food items were noted as the crappie reached approximately 100 millimeters in length. Consequently those individuals of less than 100 millimeters, standard length, are here classed as young while those of more than 100 millimeters are

TABLE 1.—*Crappie stomachs examined during period of June, 1947 through May, 1948.*

Month	Number examined	Number containing food	Number empty
June	45	36	9
July	65	43	22
August	103	72	31
September	74	52	22
October	82	65	17
November	74	67	7
December	49	40	9
January	93	79	14
February	76	75	1
March	77	68	9
April	91	72	19
May	73	71	2
Totals	902	740	162

termed adults. Further justification for this designation is also to be found in the conditions of gonads during breeding season.

A total of 902 stomachs which were collected over a 12-month period was examined during the investigation (Table 1). Of this group 740 stomachs contained food and 162 were empty. Only those stomachs which contained food were considered in the tabulations of food items.

Fishes.—Fishes were found in 66 percent of the stomachs examined and proved to be the most frequently taken food item of the adult crappie. Seventy-four percent of the adult stomachs and approximately 9.4 percent of young stomachs contained fishes (Fig. 1). Seventy-one percent of the fishes taken as food were identified as shad. Two species of clupeids are known to occur in Orange Lake; the gizzard shad *(Dorosoma cepedianum)* and the Florida lesser shad *(Signalosa petenensis vanhyningi)*.

As Hubbs (1934) suggests, the ecological role of the shad appears to be that of a connecting link between plankton and the larger piscivorous fishes. Insofar as the crappie is concerned, the plankton-shad-piscivorous fish chain is doubtless the most important food chain in the lake. Apparently the large population of crappies and Florida largemouth bass that characterizes the lake depends in a large measure upon the presence of these forage fishes.

Other identifiable fishes constituted only 1 percent of the total fishes taken as food by crappie. Represented by one or only a few individuals were: *Labidesthes sicculus vanhyningi,* an immature centrarchid, *Elassoma* sp., *Fundulus chrysotus, Gambusia affinis holbrooki,* and *Ameiurus nebulosus marmoratus.*

Young crappie apparently did not take fish for food until they reached a size of approximately 61 millimeters in length. From that size on, however, fishes were eaten with increasing frequency.

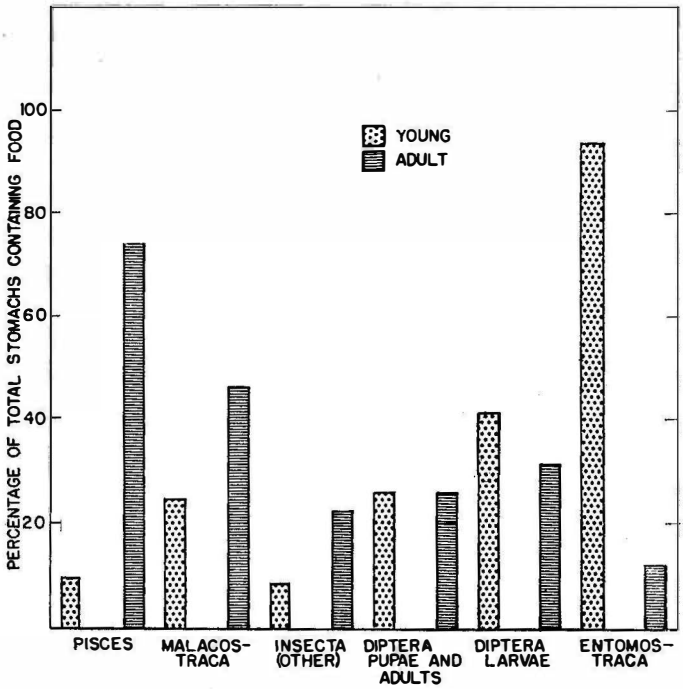

FIGURE 1.—*Diet in young and adult crappie based on frequency of occurrence of food groups.*

The consumption of fishes by crappie appeared to vary seasonally. In the months of May and June and those from October through January, nearly 90 percent of the adult crappies examined had eaten fishes. During the remaining months approximately 65 percent of the stomachs contained fishes. During the summer months (July-September) 17 percent of the stomachs of young crappie contained fishes, but only 8 percent of the young crappies examined had eaten fishes during May and June.

Amphibia.—Amphibians as a group formed an insignificant item in the food of crappie. One frog, *Hyla* sp., was found in a stomach in February, 1948. Several larval salamanders *(Pseudobranchus striatus axanthus)* were taken by one crappie in April, 1947.

Insecta.—Insects comprised the most frequently taken food item although the kinds varied seasonally. One or more kinds of insects occurred in over 80 percent of the stomachs examined.

Dipterous pupae and adults occurred in 27 percent of the stomachs examined. The most common forms were *Chaoborus* sp. and chironomids. Pupae and adults of these Diptera were taken by both young and

adult crappies throughout the year and constituted 52 percent of the total number of Diptera consumed.

Dipterous larvae of the kinds previously mentioned occurred in 33.6 percent of all the crappie stomachs, having been found in 41 percent of young individuals and 32.6 percent of the adults.

Insects other than Diptera were found in 21.3 percent of the stomachs examined. Of the total number of non-dipterous insects which occurred in these stomachs, 78.5 percent consisted of the nymphs of several species of Odonata. *Perithemis seminole, Pachydiplax longipennis* and *Enallagma* sp. were the most common of these odonate species. Other species taken in lesser quantities were *Anomalagrion hastatum, Aphylla williamsoni, Anax junius, Coryphaeschna ingens, Epicordulia regina, Tetragoneuria* sp., and *Cannacria gravida.*

Pearse (1919) observed that Odonata nymphs formed 2.3 percent of the food of 140 black crappie in Lake Wingra, Wisconsin. He states that the dragon-fly, may-fly, and damsel-fly nymphs eaten were those which were found among aquatic plants and my observations tend to support this generalization. Most of the species listed above typically inhabit the vegetated areas of ponds and lakes (Byers, 1930).

Hemiptera such as notonectids and corixids were taken by crappies occasionally but did not appear to be an important part of the diet.

The category "other insects" includes ephemerid nymphs *(Caenis diminuta* and *Callibaetis floridanus),* trichopterans of the family Hydropsychidae, formicinid ants, and Coleoptera *(Hydroporus* sp., *Hydrovatus compressus, Hydrocanthus oblongus,* and forms of the families Lathridiidae and Chrysomelidae). Altogether, their importance was insignificant from the standpoint of quantity and frequency of occurrence.

The relative importance of insects, other than Diptera, to the young and adult crappie in Orange Lake is demonstrated by the differences in the numbers of stomachs in which the insects occurred. Only 8.2 percent of the young crappie had eaten non-dipterous insects, while 23 percent of the adult crappie stomachs contained these food items. It was noted that the period of greatest consumption of Odonata nymphs was February through April, or just prior to the time of emergence of these insects which usually occurs during April, May, and June in Florida.

Crustacea.—Entomostracans are of greater importance to young crappie than to the adults. Of the stomachs of crappie less than 100 millimeters in length, 94 percent contained one or more Entomostraca while only 12 percent of adult crappie took them for food.

Copepoda comprised 84.3 percent of the total number of entomostracans consumed. The forms most frequently taken were *Cyclops* sp. and *Diaptomus* sp. Cladocerans such as *Bosmina* sp., *Daphnia* sp., and *Simocephalus* sp., constituted 14.6 percent of the entomostracan diet of young and adult crappie. Only 1.1 percent of the Entomostraca taken as food were Ostracods.

In a study of the food of 140 adult black crappie in Lake Wingra, Pearse (1919) found that cladocerans constituted 33 percent while copepods and ostracods were insignificant.

From the records of Pearse and others it appears that Entomostraca form a staple though variable item in the diet of crappie. Consumption of entomostracans by crappie appears to be greater in northern waters than in Orange Lake.

The larger Crustacea were eaten throughout the year by 44.4 percent of crappie of all sizes. These Malacostraca form the second most frequently taken food item. Malacostracans occurred in 46.8 percent of the adult stomachs and in 25.8 percent of the young which were examined. They were not observed in crappie less than 61 millimeters, standard length.

An amphipod, *Hyalella azteca,* formed 99 percent of the total numbers of Malacostraca ingested by crappie. *Hyalella* were quite common in the roots of water hyacinths *(Piaropus crassipes)* and were found frequently in the bushy submerged portions of marsh plants.

The fresh-water shrimp *(Palaemonetes paludosa)* comprised only 0.8 percent of the Malacostraca taken by crappie. These crustaceans were common among the roots of floating plants and in such submerged vegetation as *Anacharis* and *Ceratophyllum.* Two stomachs which were examined contained crayfishes.

Occasional food items.—Spiders, represented by two individuals of the families Argiopidae and Erigonidae and one *Ulaborus* sp., were found in the stomach of one adult crappie. Unidentified mites were found in five, and leeches in two crappie stomachs. A few of the fish examined contained traces of eggs of fishes and other undetermined forms.

Bits of *Lemna, Nymphaea,* and some undermined leaves, roots, and stems occurred in a few crappie stomachs. These items are believed to have been taken accidentally.

TABLE 2.—*Frequency of occurrence of six groups of organisms in crappie stomachs during each month—expressed as percentage of total stomachs examined.*

Month	Fish	Diptera Pupae and adults	Diptera larvae	Other insects	Entomostraca	Malacostraca
January	76	14	28	12	15	52
February	61	40	53	29	5	85
March	52	45	34	58	22	67
April	62	30	17	39	4	56
May	90	20	10	40	10	30
June	90	31	31	31	47	44
July	61	29	53	14	35	32
August	71	15	57	12	6	30
September	74	40	40	10	8	36
October	91	29	20	15	4	28
November	97	13	13	6	3	25
December	82	15	20	15	12	40

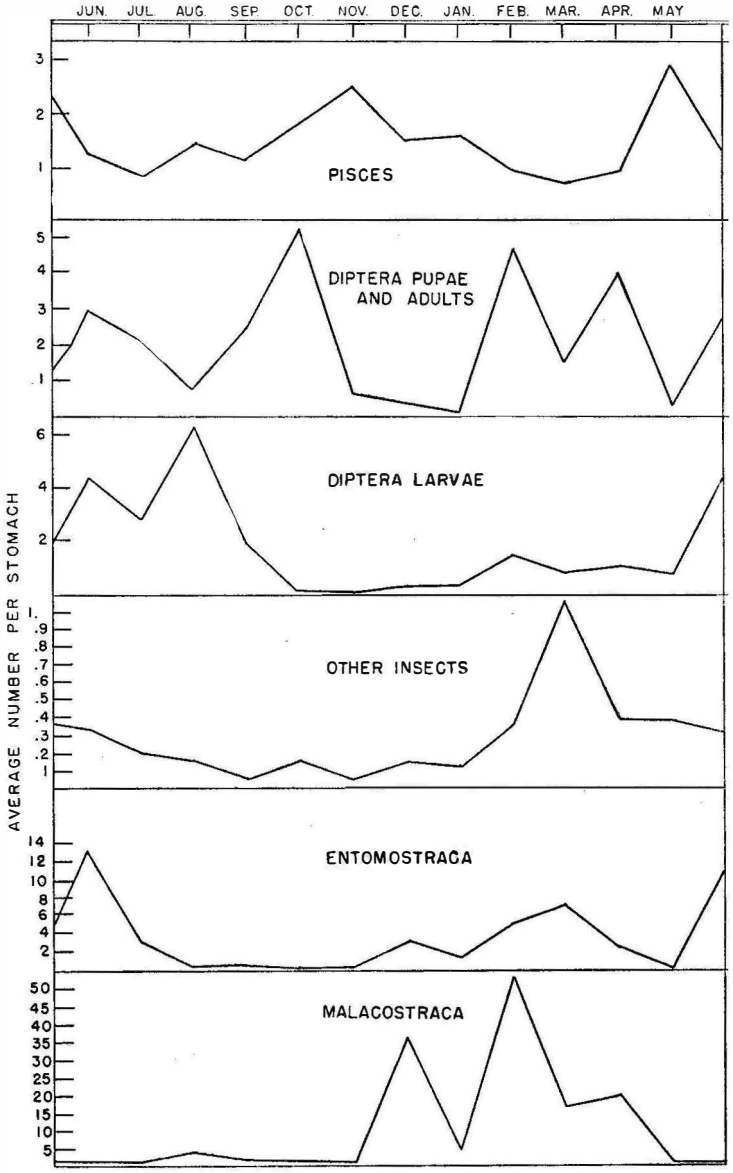

FIGURE 2.—*Average number of organisms of each food group per stomach by months.*

Seasonal Trends in Food Consumption

Variations in the types and quantities of food organisms consumed by crappie were quite pronounced in some instances as seasons progressed (Table 2, Fig. 2).

An interesting phase of the seasonal trends in feeding activity is the behavior and habits of crappies during the spawning season. Spawning occurred in 1948 during the period from January to April. It was noted that for many days the male crappies were preparing and guarding the nests which were usually situated under the edge of the floating part of the marsh or at the border of the emergent vegetation. Feeding habits of males and females during the breeding season are shown in Table 3.

It appeared that the chief component in the diet of the male crappie during the months shown consisted of vegetation inhabiting forms such as Malacostraca. On an annual basis the food item most frequently taken by both male and female adult crappie was shad. Yet during the breeding season the males ate approximately one-third more malacostracans and one-third less shad than did the female crappie. These differences might be explained on the basis of availability of the forage fishes. Shad were usually found in the open water; hence the male crappie, nesting in the vegetation, fed on Malacostraca. These data tend to confirm Pearse's (1919) conclusion that male crappie do not neglect feeding during the active breeding season.

Volume of Various Food Items Used

The food of the crappie has been interpreted volumetrically to show the relative importance of fish and invertebrate forms. The data shown in Figure 3 were obtained by determining the volume in cubic centimeters of specimens of average-sized *Dorosoma* and *Hyalella* taken by crappie and using these values to translate the numerical data to volumetric units.

Table 3.—*Comparison of two food groups taken by male and female crappie during breeding season—January through April.*

Item	January		February		March		April	
	Male	Female	Male	Female	Male	Female	Male	Female
Total stomachs[1]	32	42	31	40	6	38	11	43
Number containing fish	14	42	8	32	4	21	5	29
Percentage containing fish	44	100	26	80	67	55	45	67
Number containing malacostraca	25	12	30	30	5	21	9	22
Percentage containing malacostraca	78	29	97	75	83	55	82	51

[1]Stomachs containing food from fish which could be sexed.

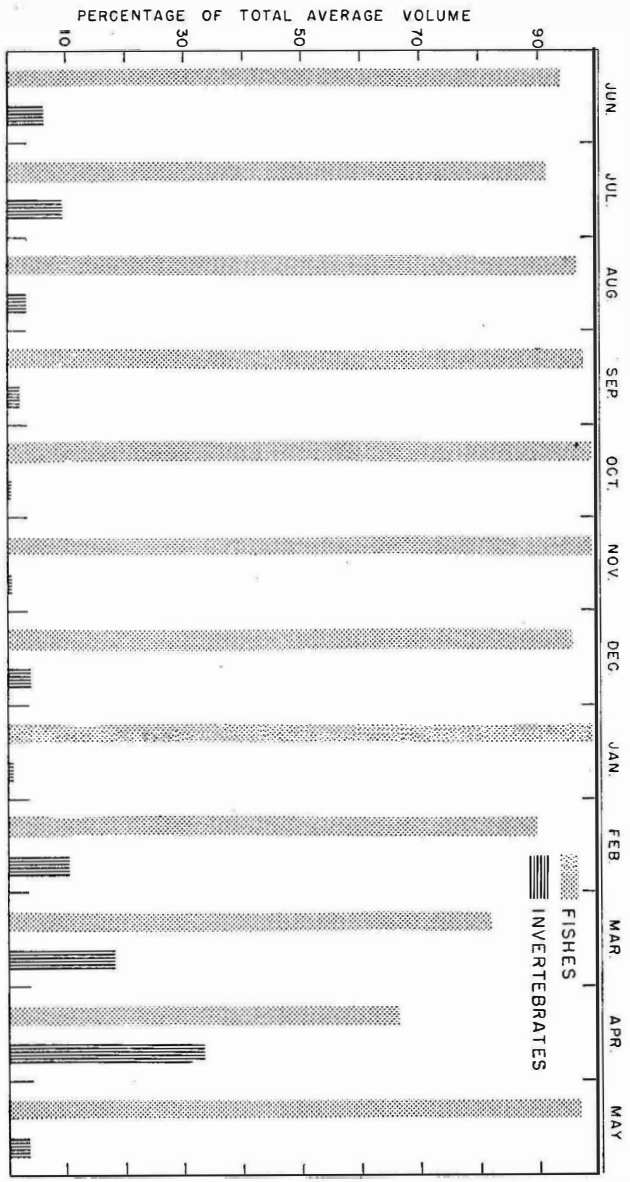

FIGURE 3.—*Average volume per adult crappie stomach of two food groups expressed as percentage for each month.*

From Figure 3 it can be seen that during only 3 months did the average volume of invertebrates amount to over 10 percent of the total average volume of food contained in the stomachs of crappie. The volume of invertebrate food items during February was greatly increased by the large amount of Malacostraca taken. These crustaceans, mostly *Hyalella,* occurred in 85 percent of the adult stomachs, with an average of 53.3 animals per crappie stomach. As shown in Table 2 and Figure 1 these February values represent the greatest frequency of occurrence and the largest average number of organisms per stomach for any one month.

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