Journal of the Arkansas Academy of Science

Volume 34 Article 10

1980

Food of Bluegill and Longear Sunfish in DeGray Reservoir, Arkansas, 1976

Horace E. Bryant
U.S. Fish and Wildlife Service

Thomas E. Moen
U.S. Fish and Wildlife Service

FOOD OF BLUEGILL AND LONGEAR SUNFISH IN DEGRAY RESERVOIR, ARKANSAS, 1976

HORACE E. BRYANT and THOMAS E. MOEN
U.S. Fish and Wildlife Service
Arkadelphia, Arkansas 71923

ABSTRACT

Stomach contents were examined from 544 bluegill *(Lepomis macrochirus)* and 709 longear sunfish *(L. megalotis)* collected from nearshore areas of DeGray Reservoir April - November 1976. Major foods of bluegill (percentage of total weight of food in parentheses) were insects (33), bryozoa (7.3), planktonic crustaceans (6.5), and plant materials (15.4). The major food items contributing to the diet of longear sunfish were insects (52.6%), crayfish (12.5%), fish (7.4%), and plant material (6.7%). Although bluegill and longear sunfish are closely related species, their diets were not as similar as expected: bluegill consumed zooplankton, adult dipterans, and adult ephemeropterans associated with limnetic areas; while longear sunfish consumed terrestrial insects, immature stages of aquatic insects, and macro-invertebrates associated with littoral areas.

INTRODUCTION

The U.S. Fish and Wildlife Service and the U.S. Corps of Engineers, in cooperation with state and private universities, are investigating the effects of multi-outlet water release on DeGray Reservoir and its tailwater. Study of the food of fishes is vital to the scientific understanding of reservoirs, and a knowledge of food habits and feeding relationships of closely related sympatric species is a prerequisite to understanding complex ecological associations.

Samples collected after the application of rotenone to coves ("cove-rotenone" samples) in August during the five-year period 1974-78 showed that the combined biomass of bluegill *(Lepomis macrochirus)* and longear sunfish *(L. megalotis)* accounted for 18 to 37% of the total fish biomass present. In 1976, longear sunfish was the dominant sunfish and the second most abundant fish in the reservoir; bluegill ranked second among sunfishes and third in number among all species (Multi-Outlet Reservoir Studies, unpublished data). To evaluate the impact of the bluegill and the longear sunfish on the ecosystem, feeding trends, selective feeding, and competition for food items between the two species and among different sizes within each species were examined.

Applegate et al. (1967) has cited many studies of bluegill food habits, but reported a lack of investigations for longear sunfish. Mullan and Applegate (1967; 1970), studying the food of longear sunfish and several other centrarchids in Bull Shoals and Beaver Reservoirs, contributed what is apparently the only published record of the food of longear sunfish.

METHODS AND MATERIALS

Study Site: DeGray Reservoir, created when the Caddo River was dammed in 1969, has an area of 5,427 ha and maximum and mean depths of 57 and 15 m at normal pool elevation, which is 124.4 m above mean sea level. The multi-outlet intake is constructed so that water can be selectively withdrawn from one of three 6.4-m^2 openings, the midpoints of which are located at elevations of 120.4, 115.8, and 108.2 m (Middleton, 1967). Water was discharged exclusively from the epilimnial outlet (120.4 m) throughout our investigation (Moen and Dewey, 1978).

Food Habits: To assess many of the biological and physical properties, the reservoir was divided into three compartments corresponding to upper, middle, and lower portions. Each compartment was further divided into five equal lengths of shoreline, and one compartment and one length of shoreline were randomly selected without replacement so that from April through November, bluegill and longear sunfish were sampled in each of the 15 areas. We attempted to collect 50 fish of each species (ten fish in each of five length classes of 0-50, 51-75, 76-100, 101-125, and 125 mm in total length) by electrofishing near shore after sundown for two hours. Upon capture, fish were placed in an ice slurry to prevent regurgitation, then preserved in 10% formalin, and grouped by species, date, reservoir compartment, and length class.

Stomach contents were pooled by species and size class, and food items were identified to the lowest taxon distinguishable by us. Food items from fish of each length class (pooled) were drained, blotted, and weighed to the nearest 0.1 mg.

RESULTS AND DISCUSSION

Bluegill Food: Of the 544 bluegill stomachs examined, 91% contained food. Major animal foods were insects, bryozoans, and planktonic crustaceans, which made up 33, 7.3 and 6.5% of the total diet, respectively. Plant material, mostly filamentous algae and organic debris, contributed 15.4% of their total diet (Table 1). Of the animal material (84.5% of the total), nearly one-third could not be identified. Generally, the amount of identifiable animal material increased as seasons progressed from spring to fall and as fish size increased. Food items for 497 bluegills are tabulated by season and fish size in Tables 2, 3, and 4. Feeding patterns generally were related to season availability of food items and fish size.

Aquatic insects made up most of the diet of bluegill in each size class and season, except in fish larger than 75 mm, which fed almost exclusively on plant material (mostly filamentous algae) during late fall. Consumption of immature aquatic insects decreased as bluegill size increased, ingesting more emerging aquatic insects. Terrestrial insects contributed less than 25% of all insects consumed; mayflies and aquatic dipterans accounted for the remainder. The quantity of terrestrial insects eaten was correlated with fish size. Terrestrial insects included beetles (e.g., June bugs, Phyllophaga), leaf hoppers, grasshoppers, and spiders. Although bryozoa made up only 7.3% of the total diet, large (greater than 125 mm) bluegill ingested greater quantities of these animals during late fall. During October and November, bryozoa made up 34.9% of the diet of 23 large bluegill. Planktonic crustaceans were important only in the diet of bluegill less than 50 mm. Weight of microcrustaceans consumed decreased seasonally (spring to fall).

Fish eggs were found in bluegill of all length groups collected during April and June and comprised up to 24.8% of the food of bluegill 51-75 mm (Table 2). By season, fish eggs made up less than 5% of the diet of the remaining four size groups. Fish remains were noted in several of the pooled samples, but made up less than 1% of the diet by season and length groups except one (fish composed 18.7% of the total for bluegill over 125 mm during July-September).

Bluegill over 50 mm consumed more plant material than did smaller specimens, especially during the fall. The percentage of plant material, mostly filamentous algae, consumed during October and November ranged from 1.6% for specimens less than 50 mm to 66.7% in fish 76-100 mm.

Food of Longear Sunfish: Of 709 longear sunfish stomachs examined, 644 (91%) contained food. Animal material made up 93.3% of the total weight, but approximately one-fourth of this material could not be identified. Insects, crayfish, and fish made up 52.6, 12.5 and 7.4% of the total diet, respectively; plant material made up 6.7% (Table 1). Food for longear by season and length groups is presented in Tables 2, 3, and 4.

Aquatic insects were only slightly more important than terrestrial insects in the diet of all longear sunfish. There was little correlation between size of longear sunfish and the consumption of immature or adult aquatic insects. By contrast, the consumption of terrestrial insects was positively correlated ($r = 0.81$) with fish length. Crayfish were eaten in significant amounts only by fish over 76 mm and made up a maximum of 15.1% of the diet of fish 101-125 mm (Table 1). Crayfish were taken primarily in the late summer and fall, accounting for 22.9% of the October and November food of fish over 125 mm (Table 4). Fish prey in the diet increased with predator size and reached a maximum of 9.3% in the diet of fish over 125 mm. Fish eggs were among the more important seasonal foods, appearing mostly in April through June and in the stomachs of fish less than 100 mm. Fish eggs composed 38% of the diet of longear sunfish less than 50 mm during April through June.

There was no relationship between the amount of plant material ingested and fish size. Most of the plant material was organic debris (3.3%); filamentous algae and fragments of macrophytes contributing equally to the remaining 3.4%. Of the plant material in longear stomachs, filamentous algae was the most important. The largest amounts were found in larger fish during October and November.

Comparison of Food for the Two Species: Although bluegill and longear sunfish are closely related species, their diets were not as similar as expected. Insects were the most important and the most consistently major food item for both species. However, there were differences between species as to source and types of insects consumed. Terrestrial insects and aquatic insects each made up nearly 50% of the insects in the diet of longear sunfish (22.5 and 30.1%, respectively), whereas terrestrial insects made up only 25% of the insect diet of bluegill. Immature aquatic insects were more prominent in the diet of longear sunfish than in that of bluegill. They were equally represented in all sizes of longear sunfish, whereas they were more strongly represented in small rather than large bluegill.

The consumption of terrestrial insects was greatest in spring and early summer (April-June) for both fishes. Terrestrial insects made up a greater proportion of the diet as the size of the fish increased. Adult aquatic insects were the major food items taken by bluegill, comprising nearly 50% of their total insect intake — about the same ratio that terrestrial insects were to the insect consumption by longear (Table 1).

Crayfish were missing in the diet of bluegill, but were taken by all sizes except the smallest longear. Crayfish made up about 20% of the food of longear sunfish over 100 mm during late summer and fall (July-November). Applegate et al. (1967) reported that crayfish were eaten by all species of sunfishes collected from Bull Shoals Reservoir, but were important only in the diet of large green sunfish *(L. cyanellus)*.

Differences in the food intake of these two species appear to support the hypothesis of a spatial segregation, at least during a portion of the diel cycle. Bauman and Kitchell (1974) reported that the bluegill of Lake Wingra, Wisconsin, migrated onshore after sunset and offshore after sunrise, and that they consumed mostly zooplankton in limnetic areas and macrofoods in the littoral zone. Werner et al. (1977) observed that during midday, longear sunfish were more abundant than bluegill in the littoral areas and that bluegill moved toward shore in the evening. They also noted that longear sunfish methodically search the bottom for food organisms. In the present study, bluegill consumed more zooplankton (mostly cladocerans) than did longear sunfish for each comparable size class and for each season (Tables 2, 3, and 4). Bluegill also consumed more adult dipterans and ephemeropterans associated with the surface of limnetic waters than with the limited areas of the littoral zone. Longear sunfish consumed more terrestrial insects, immature aquatic insects, and macroinvertebrates associated with littoral areas than did bluegill. It appears that longear sunfish are more ecologically oriented to the littoral zone than bluegill, except during the onshore migrations by the latter species. If this hypothesis is correct, differences in food consumption should be greater if fish are sampled from these respective areas during midday.

Table 1. Percent by weight of the major foods eaten by five length classes of bluegills and longear sunfish from DeGray Lake, 15 April - 1 November, 1976 (t = trace, or <0.05%).

Food	LENGTH GROUP, SPECIES, NUMBER OF STOMACHS EXAMINED, AND (IN PARENTHESES) PERCENT CONTAINING FOOD											
	≤50 mm		51-75 mm		76-100 mm		101-125 mm		>125 mm		All Lengths Combined	
	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear
	98	118	144	138	130	136	74	144	98	121	544	709
	(92.9)	(96.6)	(92.4)	(96.4)	(98.5)	(86.1)	(91.9)	(85.4)	(88.8)	(87.2)	(91.4)	(90.8)
FOOD CATEGORY												
Animal	96.4	94.0	88.5	96.3	82.4	91.0	87.2	94.2	83.9	92.7	84.5	93.3
Unidentified	46.2	42.5	28.3	35.3	15.9	24.0	34.2	19.9	29.5	12.6	31.3	17.4
Identified	50.2	51.5	60.2	59.0	66.6	67.0	53.0	74.3	53.8	80.1	53.2	75.9
Insects	29.8	25.8	33.7	31.9	58.9	51.0	40.4	49.9	29.2	36.4	33.0	52.6
Aquatic	25.8	24.8	33.1	25.3	32.0	44.4	36.2	34.8	18.7	23.8	23.0	35.1
Adult	1.9	1	4.8	1	19.8	12.4	16.4	2.9	14.3	3.6	15.0	4.0
Immature	27.9	24.8	28.9	27.3	12.2	32.0	19.8	31.9	4.4	22.2	10.0	31.1
Terrestrial	-	1.0	2.0	6.6	8.1	6.8	4.3	15.1	10.6	10.6	8.0	22.5
Crayfish	-	-	-	1.7	-	1.2	-	15.1	-	11.8	-	12.5
Fish	-	-	1	0.3	0.3	1.8	0.5	0.6	4.6	9.3	0.1	7.4
Fish eggs	1	22.8	15.2	16.1	2.0	4.6	1.8	0.2	0.1	0.3	1.8	1.9
Bryozoa	-	-	0.4	-	2.0	0.4	4.2	1	10.2	1	7.3	1
Planktonic crustaceans	20.4	8.9	5.7	4.0	3.2	1.0	4.4	1.2	1.4	0.2	4.1	1.4
Other	1	1.0	1.2	1.0	1	0.8	1.1	1.0	0.3	0.2	0.7	0.4
Plant	1.6	1.0	11.4	3.7	17.7	9.0	12.8	5.8	16.0	7.3	15.4	6.7
Algae	1.0	1	8.1	0.3	13.7	2.6	7.2	2.1	9.4	1.1	9.2	1.8
Green fragments	-	-	0.8	1	2.0	0.8	2.3	1.8	2.3	1.8	2.1	1.6
Debris	-	1.0	4.1	3.4	2.0	5.8	3.3	1.5	4.3	3.9	4.1	3.1

Table 2. Percent by weight of the major foods eaten by five length classes of bluegills and longear sunfish from DeGray Lake, 15 April - 15 June, 1976 (t = trace, or <0.05%).

Food	LENGTH GROUP, SPECIES, NUMBER OF STOMACHS EXAMINED, AND (IN PARENTHESES) PERCENT CONTAINING FOOD									
	0-50 mm		51-75 mm		76-100 mm		101-125 mm		>125 mm	
	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear
	42	34	55	70	53	66	29	73	34	54
	(45.2)	(100)	(87.3)	(42.4)	(86.8)	(86.4)	(86.2)	(81.6)	(84.8)	(88.1)
FOOD CATEGORY										
Animal	100	99.6	96.8	86.4	85.7	88.7	95.1	92.0	95.4	98.8
Unidentified	39.4	29.3	22.7	25.0	45.4	23.8	55.1	18.3	41.7	12.1
Identified	61.4	84.9	74.1	57.4	53.3	67.1	40.0	78.7	54.4	86.5
Insects	32.5	23.2	40.5	24.2	94.5	55.4	25.5	55.8	37.0	66.4
Aquatic	32.3	23.2	37.8	17.4	31.3	48.1	17.7	46.9	14.1	24.9
Adult	3.4	0.4	1.2	-	14.4	14.9	7.8	-	4.3	3.5
Immature	28.9	22.9	32.4	17.4	11.9	11.8	10.7	46.9	4.8	21.4
Terrestrial	-	1.7	2.9	6.8	6.2	6.2	5.8	16.9	22.9	39.5
Crayfish	-	-	0.3	0.2	-	-	-	1.8	-	0.1
Fish	-	-	-	-	2.7	0.6	0.3	15.5	0.1	10.7
Fish eggs	1.2	38.1	24.9	28.7	4.1	8.5	4.2	0.3	0.3	0.4
Bryozoa	-	-	-	-	1.3	0.1	0.3	-	1	1
Planktonic crustaceans	28.3	7.4	7.4	5.9	5.3	1.4	10.6	-	11.8	0.6
Other	1.2	1.2	0.9	0.6	0.2	0.2	1.1	0.1	0.2	0.3
Plant	1	0.4	1.2	3.6	4.2	6.3	4.1	1.0	4.6	1.2
Algae	-	-	1.0	0.2	1.1	0.1	2.7	0.3	0.8	0.1
Green fragments	-	-	-	-	1.2	+	+	0.1	+	0.4
Debris	1	0.4	2.2	3.1	2.7	6.0	1.4	2.6	1.8	0.7

Table 3. Percent by weight of the major foods eaten by five length classes of bluegills and longear sunfish from DeGray Lake, July - September, 1976 (t = trace, or <0.05%).

Food	0-30 mm		31-75 mm		76-120 mm		121-175 mm		176-225 mm	
	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear
	42	49	80	80	48	80	80	80	58	66
	(95.2)	(98.0)	(93.0)	(98.7)	(93.8)	(98.7)	(98.7)	(95.0)	(86.1)	(95.1)
FOOD CATEGORY										
Animal	100.0	96.7	76.4	95.1	80.3	95.3	86.0	95.6	77.1	95.7
Unidentified	38.8	34.1	45.2	33.7	33.9	25.1	15.7	18.4	25.2	11.7
Identified	61.4	62.6	31.2	61.4	46.8	70.2	70.3	77.0	51.9	74.0
Insects	33.5	34.4	27.9	48.4	46.3	58.0	61.0	52.3	24.1	46.4
Aquatic	33.5	34.4	27.0	47.9	40.6	45.3	36.8	23.6	23.6	28.4
Adult	2.4	-	4.0	0.4	25.5	12.3	29.1	5.4	20.2	5.0
Immature	30.1	34.4	18.0	47.2	15.1	33.0	28.7	29.2	3.2	21.4
Terrestrial	-	-	-	0.8	5.7	4.7	4.2	18.7	0.7	23.0
Crayfish	-	-	-	11.0	-	5.4	-	19.9	-	20.9
Fish	-	-	-	0.4	-	12.0	0.8	3.0	18.7	0.2
Fish eggs	1.2	-	-	-	-	-	-	0.2	-	0.1
Bryozoa	-	-	0.8	-	-	-	8.7	-	8.3	-
Planktonic crustaceans	26.3	6.8	3.0	0.4	0.3	-	0.2	-	0	-
Other	1.2	1.8	0.8	0.4	-	2.0	1.8	1.8	0.8	0.7
Plant	-	3.3	23.6	4.9	19.7	4.7	14.0	4.4	22.9	4.3
Algae	-	-	10.8	-	13.9	-	7.2	-	15.0	1.8
Green fragments	-	-	1.8	0.4	4.1	2.2	4.0	3.5	5.8	0.7
Debris	-	3.3	11.0	4.5	1.7	2.5	2.8	1.1	2.1	7.0

Table 4. Percent by weight of the major foods eaten by five length classes of bluegills and longear sunfish from DeGray Lake, October - November, 1976 (t = trace, or <0.05%).

Food	0-30 mm		31-75 mm		76-120 mm		121-175 mm		176-225 mm	
	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear	Bluegill	Longear
	20	30	20	20	29	30	15	19	23	29
	(100)	(96.9)	(96.6)	(100)	(93.1)	(86.7)	(93.3)	(84.7)	(100)	(82.1)
FOOD CATEGORY										
Animal	100.0	100.0	74.9	96.1	53.4	86.5	56.6	85.1	68.0	73.4
Unidentified	89.3	96.0	17.9	73.1	16.7	25.0	32.1	33.9	15.6	18.4
Identified	10.8	4.0	56.9	23.0	36.7	61.5	23.9	49.2	48.6	55.0
Insects	7.2	-	55.8	15.3	15.5	58.2	13.3	26.0	13.7	25.0
Aquatic	7.2	-	53.8	13.6	13.5	26.9	12.2	16.9	9.6	19.4
Adult	3.6	-	47.2	-	4.4	-	0.8	16.7	7.3	-
Immature	3.6	-	6.6	13.6	9.1	26.9	11.4	0.2	2.3	19.4
Terrestrial	-	-	-	1.9	-	4.3	-	7.1	4.1	5.8
Crayfish	-	-	-	-	-	20.0	-	21.7	-	23.9
Fish	-	-	0.9	-	-	0.6	-	0.2	-	1.1
Fish eggs	-	-	-	-	-	-	-	-	-	-
Bryozoa	-	-	-	-	2.0	2.1	11.4	-	16.9	-
Planktonic crustaceans	3.6	4.0	1.9	4.8	-	-	0.3	0.4	-	-
Other	-	-	-	2.5	-	0.6	-	2.9	-	-
Plant	-	-	25.5	3.7	84.6	13.5	43.8	14.9	32.0	26.6
Algae	-	-	24.9	3.7	65.8	12.3	23.4	14.2	18.2	11.4
Green fragments	-	-	-	-	-	-	4.3	-	1.2	1.7
Debris	-	-	0.6	1.0	0.8	1.2	13.7	0.70	12.6	13.5

LITERATURE CITED

APPLEGATE, R. L., J. W. MULLAN and D. I. MORAIS. 1967. Food and growth of six centrarchids from shoreline areas of Bull Shoals Reservoir. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 20:469-482.

BAUMAN, P. C. and J. F. KITCHELL. 1974. Diel patterns of distribution and feeding of bluegill *(Lepomis macrochirus)* in Lake Wingra, Wisconsin. Trans. Am. Fish. Soc., 103(2):255-260.

MIDDLETON, J. B. 1967. Control of temperatures of water discharged from a multi-purpose reservoir. *In:* Reservoir fishery resources symposium. Southern Division, American Fisheries. 37-46 pp.

MOEN, T. E. and M. R. DEWEY. 1978. Loss of larval fish by epilimnial discharge from DeGray Lake, Arkansas. Proc. Ark. Acad. Sic., 32:65-67.

MULLAN, J. W. and R. L. APPLEGATE. 1967. Centrarchid food habits in a new and old reservoir during and following bass spawning. Proc. Annu. Conf. Southeast Assoc. Game and Fish Comm. 21:332-342.

MULLAN, J. W. and R. L. APPLEGATE. 1970. Food habits of five centrarchids during filling of Beaver Reservoir, 1965-66. U. S. Fish Wild. Serv. Tech. Pap. 50. 16 pp.

WERNER, E. E., D. J. HALL, D. R. LAUGHLIN, D. J. WAGNER, L. A. WILSMANN and F. C. FUNK. 1977. Habitat partioning in a freshwater fish community. J. Fish. Res. Board Can., 34:360-370.