Proceedings of the Iowa Academy of Science

Volume 62 | Annual Issue Article 72

1955

Food and Feeding Habits of Some Fishes in a Dredged Iowa Lake

Joseph H. Kutkuhn
Iowa State College

Food and Feeding Habits of Some Fishes in a Dredged Iowa Lake[1]

By Joseph H. Kutkuhn

Introduction

In the last twenty years, the Iowa State Conservation Commission has dredged a number of shallow prairie lakes to enhance their recreational value. North Twin Lake, Calhoun County, was partially deepened by dredging in 1939. This lake, approximately 569 acres in area, now supports considerable boating, swimming, and fishing. In 1951 the Iowa Cooperative Fisheries Research Unit started a comparative study of the bottom fauna in the dredged and undredged portions of the lake. To determine the degree to which the various bottom organisms were being utilized as fish foods, the food habits of the more important fish species inhabiting North Twin Lake were investigated during the summers of 1953 and 1954.

Materials and Methods

A total of 2,729 game and pan fish comprising six species was collected for food habit analyses during the two summers of investigation. The species and numbers of each that were examined included: yellow bass, *Morone interrupta* Gill—1,224; yellow perch, *Perca flavescens* (Mitchell)—698; walleye, *Stizostedion v. vitreum* (Mitchell)—424; northern black bullheads, *Ameiurus m. melas* (Rafinesque)—307; black crappie, *Pomoxis nigromaculatus* (Le Sueur)—35; and orange-spotted sunfish, *Lepomis humilis* (Girard)—41.

The principal problem encountered during the present study was one of sampling, i.e., the acquisition of a number of fish whose stomach contents represented most nearly the food habits of the particular species under consideration both from a qualitative and quantitative standpoint. Throughout the study, special effort was made to obtain adequate and representative samples of fish for stomach content analysis, particularly with respect to fish size and time of day.

Gill nets were employed to collect the fish during the 1953 summer while seining alternated biweekly with gill netting as a means of capture in 1954. Nylon experimental gill nets proved to be

[1]From Project No. 42 of the Iowa Cooperative Fisheries Research Unit sponsored by the Iowa State Conservation Commission and the Industrial Science Research Institute of Iowa State College, with the cooperation of the U. S. Fish and Wildlife Service.

very satisfactory for capturing the larger fish specimens[1] while a 30 foot ¼ inch mesh bag seine sampled the smaller young-of-the-year and yearling fishes quite effectively. Both types of gear were employed in a similar manner as follows: The gill nets were first set at one of several specific locations in the lake at a convenient starting hour and then lifted and the entrapped fish removed every two hours. Each time the net was lifted and the fish removed, it was reset in the original position. This process was continued until a complete 24-hour cycle had been made. For obvious reasons, such a cycle of operations could not be completed on a continuous basis. It was therefore necessary to break up this period into two parts, usually 16 hours one day and 8 hours the following, thus completing the 24 hour cycle. Seining was done on a similar time basis with seine hauls of 15-20 minutes duration being made every two hours starting on the hour. Since fish were removed from the gill nets within two hours after capture, errors in final stomach content analyses due to continued digestion of food in trapped fish were held to a minimum. Furthermore, it was possible to obtain some idea of bihourly variation in the feeding pattern of some fish species by following these collection procedures.

A uniform fishing effort was exercised each week of both summer's investigations. If collections were being made by gill nets, one net, 125 feet long, was employed for a 24-hour sampling period each week. If seining was the sampling method being used, an accumulated seining time of 4 hours per 24-hour sampling period was maintained per week.

Each fish collected for stomach content analysis was dissected in a fresh condition within a very short time after capture. Its stomach was removed, and the stomach contents identified and measured volumetrically. Volumetric determinations were not feasible for fish less than 65 mm. total length. Stomach contents were analyzed using a method employed by Tester (1932), McHugh (1940), and, in part, by Ricker (1941). The total stomach content volume was determined by displacement in a graduated centrifuge tube and the individual components were ocularly estimated on a percentage of total volume basis. The volumes of the individual food components were then calculated and summed over all stomachs containing those particular items. The final volume percentages of the various food items in the stomachs were, in turn, calculated from these sums.

For purposes of comparison, the food habits of the various fish under consideration were broken down, where possible, into three general categories, namely, those of young-of-the-year, yearling, and adult fish.

[1]Gill nets with equal footage of the following mesh sizes: 1½, 2, 2½, 3, and 4 inch stretch measure.

Food of Young-of-the-year Fish

The food habits of the young yellow bass and perch were found to be quite similar (Table 1). From a frequency of occurrence standpoint, the copepod, *Cyclops*, and dipterous larvae of the family Tendipedidae (=Chironomidae) were by far the most important foods of each. A good percentage of the young-of-the-year yellow bass also ate ceratopogonid and *Chaoborus* larvae (Diptera) and mayfly (Ephemeroptera) nymphs of the genus *Caenis*. The latter organism also constituted the second most important food of the young-of-the-year perch from the standpoint of occurrence. Generally speaking, young-of-the-year of both the bass and perch seemed to be inclined to utilize for food those organisms usually associated with the shallow or littoral zone rather than those occurring in deeper water. The minute forms of tendipedid and ceratopogonid larvae and the tiny *Caenis* nymphs most commonly eaten by these fish during the latter part of their first summer, are primarily shallow water forms.

The transition from dependence upon planktonic crustaceans to dependence upon these very small immature insects during the first summer of life was quite apparent in the case of the yellow bass (Figure 1). It is thought that this change is a function of the increasing size and activity of the small fish, and, hence, a need for proportionally larger food items, rather than decreased availability of the smaller plankton organisms. The smaller insect forms of the littoral zone seem to fill the requirement for larger food items during this transition stage and possibly account for the presence of the small fish in the shallow shore zone. Similar transition processes also were suggested in the case of the yellow perch and black bullheads but the lack of sufficient numbers of some sizes of these species precluded inclusion of these data here.

In contrast to the feeding habits of young-of-the-year yellow bass and yellow perch, a fairly good sample (90) of young-of-the-year walleyes obtained in 1954, indicated that these small fish make the change from small to large food items at an early age and over a much shorter period of time. The smallest walleyes captured (2.8 inches total lentgh), were found to have been feeding entirely upon small forage fish as early as mid-June.

Food of Yearling Fish

Since the largest samples of yearling fish consisted of yellow bass and yellow perch (up to 5.9 inches total length), discussion will be limited chiefly to these species. A distinct change in feeding habits can be noted in each during the 5.0 to 5.9 inch stage (Figures 2, A and B). In each case there was a pronounced switch from insects to forage fish when the fish attained this length. It

Table 1.

Food of young-of-the-year yellow bass and yellow perch taken from North Twin Lake, Iowa: June-August, 1954

Species	Yellow Bass		Yellow Perch	
Total Length (m.m.)	25-65		30-70	
Number Examined	237		62	
Number Empty	52		17	
Food Item	Frequency of Occurrence *Number*	*Percent*	Frequency of Occurrence *Number*	*Percent*
FISH	1	Tr	—	—
INSECTS	160	86	32	71
Diptera	149	81	32	71
Tendipedidae	142	77	29	64
Chaoborus	33	18	—	—
Ceratopogonidae	37	20	6	13
Other Diptera	6	3	—	—
Ephemeroptera	28	15	19	42
Hexagenia	1	Tr	—	—
Caenis	27	15	19	42
Trichoptera	5	3	1	2
Homo.-Hemiptera	19	10	—	—
Other Insecta	4	2	3	7
CRUSTACEANS	147	80	33	73
Cladocera	33	18	16	36
Daphnia	23	12	13	29
Other Cladocera	13	7	3	7
Eucopepoda	145	78	27	60
Cyclops	140	76	23	51
Diaptomus	22	12	5	11
Other Crustacea	7	4	—	—
HYDRACARINA	8	4	2	4
OTHER MISC.	5	3	6	13
DEBRIS	2	1	4	9

is interesting to note, however, that below this limit and above the upper limit of the young-of-the-year category (2.9 inches total length), insects were the principal foods of the yearling bass and perch both from the standpoint of occurrence and volume. Crustacea constituted only a small fraction of the total food ingested by these fish. Apparently the change from insect to forage fish food habits occurs sometime during the latter part of the second summer of their lives.

The principal foods of the yearling yellow bass prior to the transition to forage fish apeared to be dipterous larvae and pupae, specifically Tendipedidae, *Chaoborus,* and Ceratopogonidae. These forms were followed closely in importance by mayfly nymphs of the genera *Hexagenia* and *Caenis* (Table 2). Yearling yellow

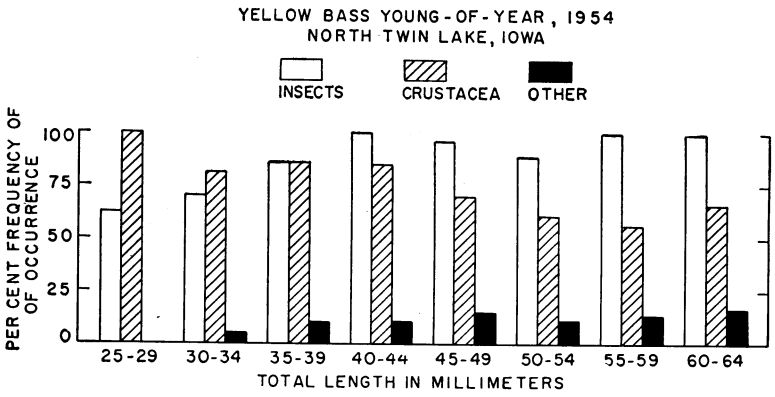


Figure 1. Food composition of young-of-the-year yellow bass taken from North Twin Lake, Iowa: June-August, 1954.

perch on the other hand differed as to the specific types of insects eaten. The principal forms eaten appeared to be caddis worms (Trichoptera larvae and pupae) and mayfly nymphs.

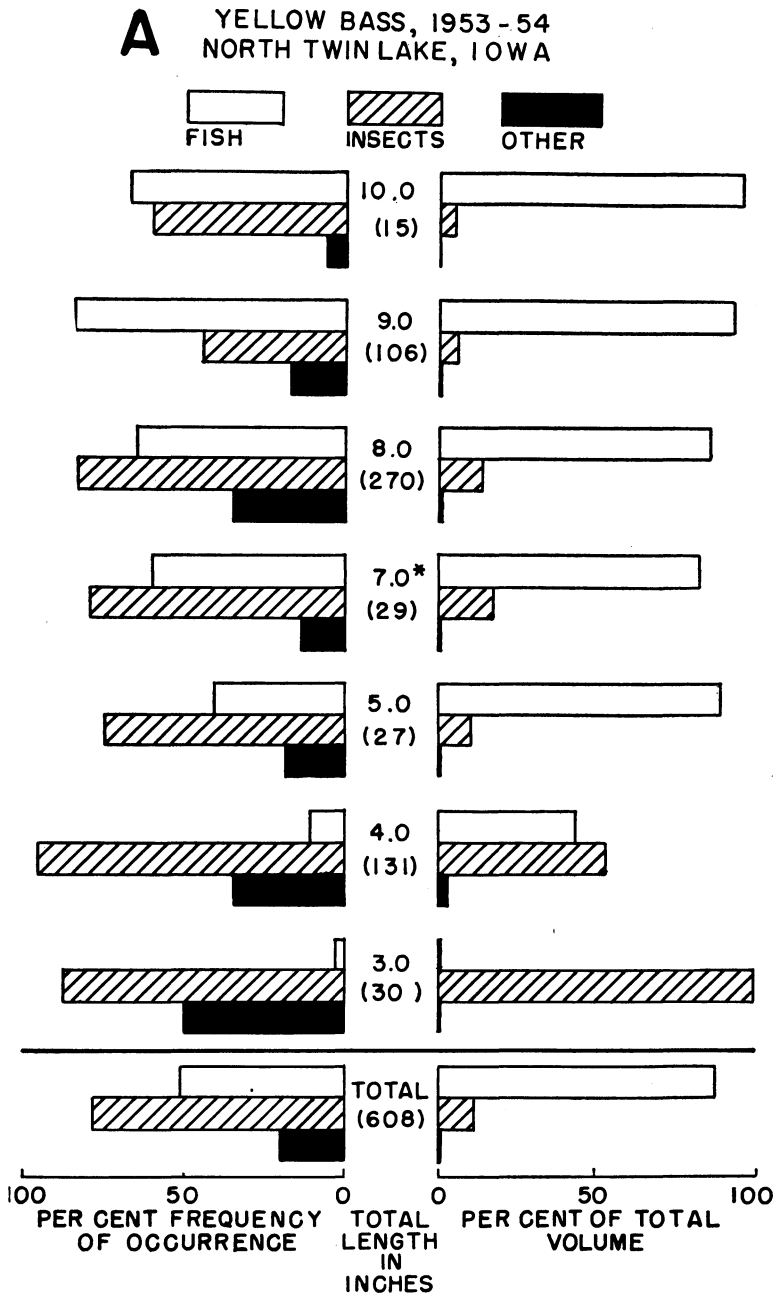
The few yearling bullheads captured exhibited food habits similar in nature to the foregoing species in that insects, mainly dipterous larvae and pupae and mayfly nymphs, were the important food items (Figure 2C, 5.0 to 5.9 inch class). Yearling walleye captured in 1954, as in the case of the young of this species, displayed a pronounced preference for forage fish, primarily the gizzard shad, *Dorosoma cepedianum* Le Sueur. Yearling black crappie (4.0-8.9 inches total length) also were found to be utilizing gizzard shad for their chief food in 1954 (Figure 2D, Table 2). In general, all species exhibited a tendency toward consuming increasingly larger food items as they progressed through the yearling stage.

Food of Adult Fish

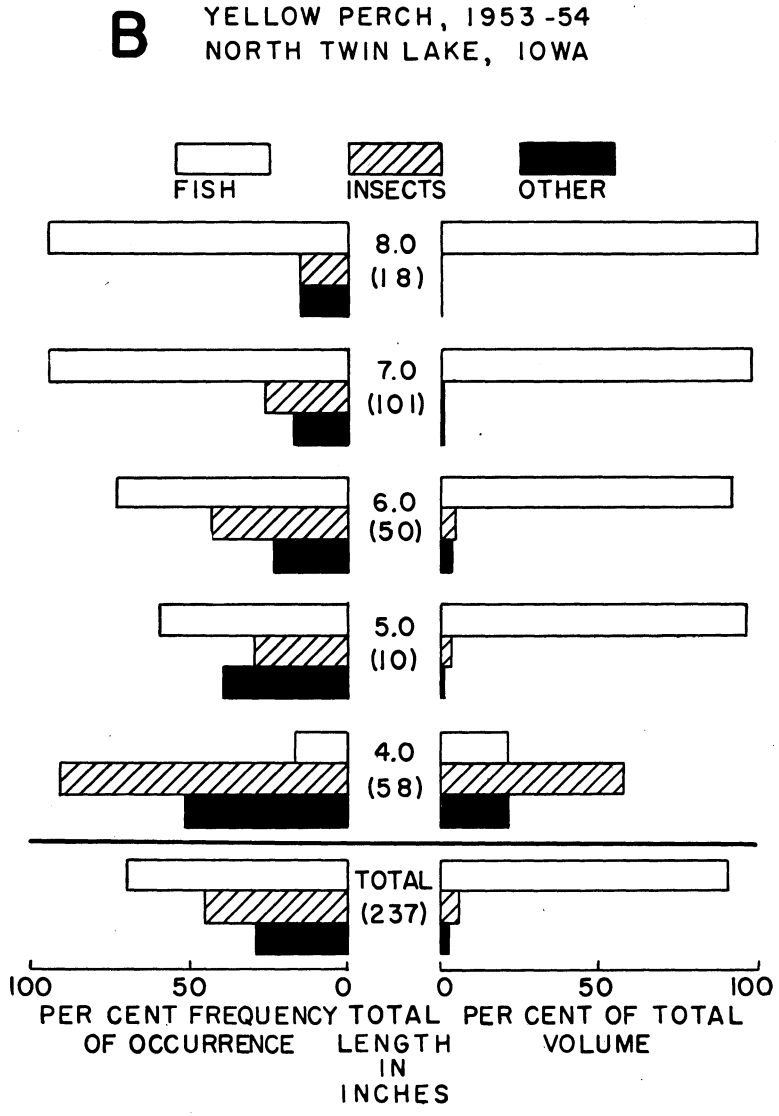
Upon assuming adult status, the majority of yellow bass and yellow perch appeared to depend on forage fish as their main food source (Figure 2, A and B; Table 2). Adult yellow perch utilized forage fish at practically all times while a good portion of the adult bass continued to utilize insects upon occasion. Points of transition to a practically exclusive forage fish diet are fairly obvious in the 9.0 inch class of the yellow bass and the 8.0 inch class of the yellow perch. A similar change is also noticeable in the case of the black bullhead in the 9.0 inch class (Figure 2, A, B, and C).

Legend for figures on pp. 581, 582, 583 and 584

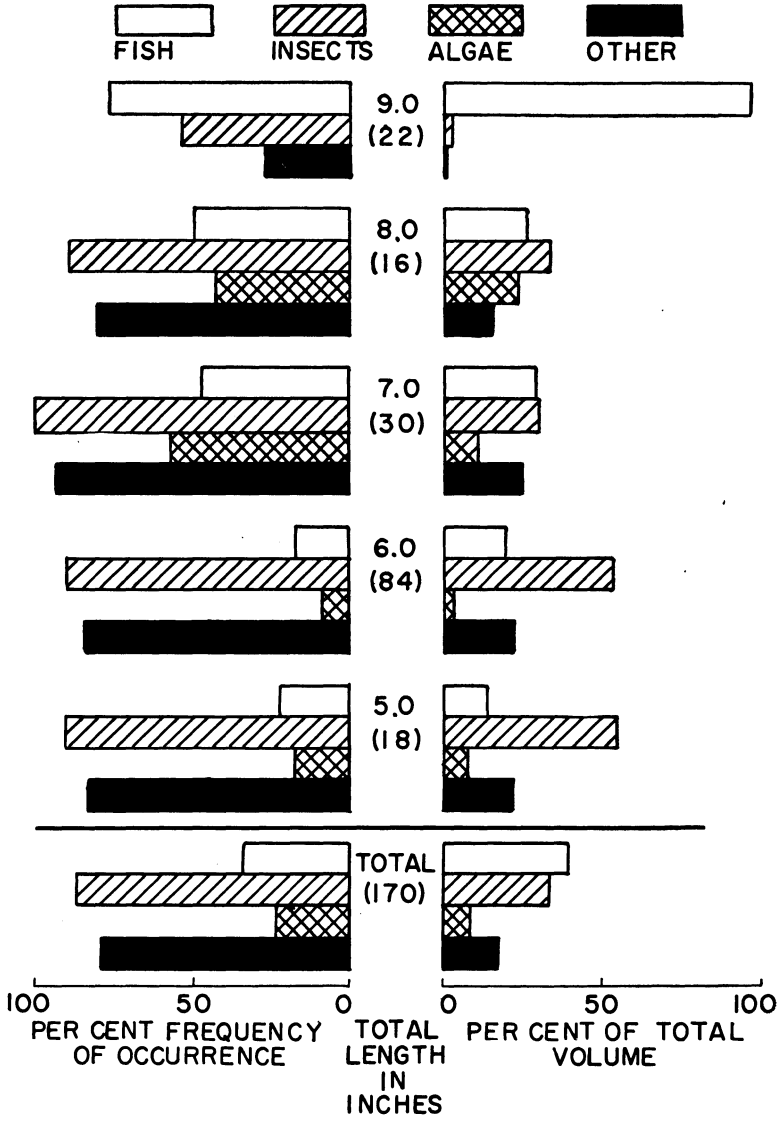
Figure 2. Food composition of six fish species taken from North Twin Lake, Iowa: 1953-54. Figures denoting fish size represent the lower limits of size classes. Figures in parentheses denote sample size.

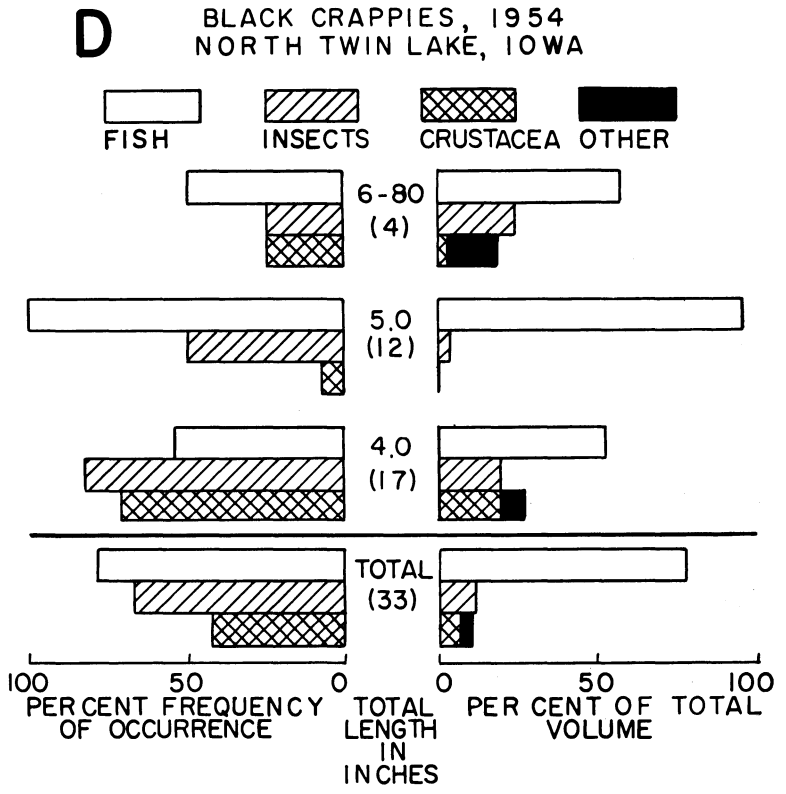


*Includes eight specimens in the 6.0-6.9 inch size class.


B
YELLOW PERCH, 1953-54
NORTH TWIN LAKE, IOWA
FISH
INSECTS
OTHER
8.0
(18)
7.0
(101)
6.0
(50)
5.0
(10)
4.0
(58)
TOTAL
(237)
100
50
0
0
50
100
PER CENT FREQUENCY OF OCCURRENCE
TOTAL LENGTH IN INCHES
PER CENT OF TOTAL VOLUME

C BLACK BULLHEADS, 1953-54
NORTH TWIN LAKE, IOWA




D
BLACK CRAPPIES, 1954
NORTH TWIN LAKE, IOWA
FISH
INSECTS
CRUSTACEA
OTHER
6-8
(4)
5.0
(12)
4.0
(17)
TOTAL
(33)
100
50
0
0
50
100
PER CENT FREQUENCY OF OCCURRENCE
TOTAL LENGTH IN INCHES
PER CENT OF TOTAL VOLUME

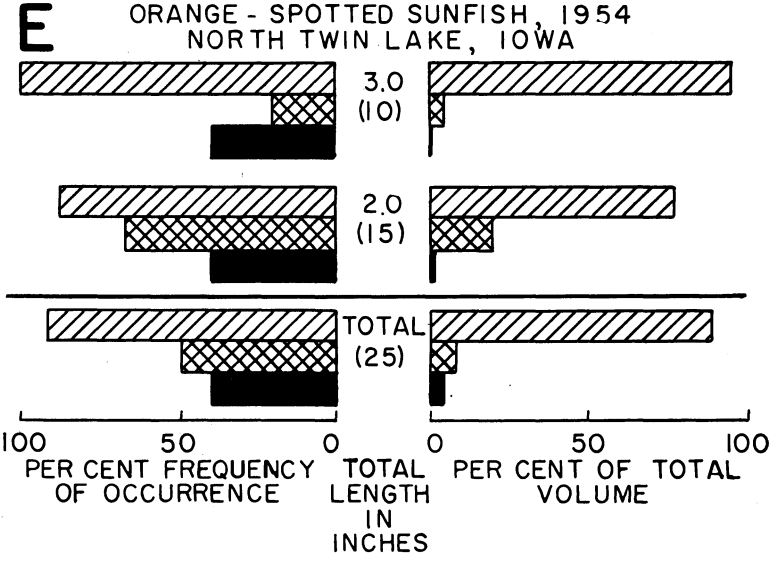

E
ORANGE-SPOTTED SUNFISH, 1954
NORTH TWIN LAKE, IOWA
3.0
(10)
2.0
(15)
TOTAL
(25)
100
50
0
0
50
100
PER CENT FREQUENCY OF OCCURRENCE
TOTAL LENGTH IN INCHES
PER CENT OF TOTAL VOLUME

Table 2.

Food of the principal game and pan fish species taken from North Twin Lake, Iowa: June-August, 1953-54.

Species	Yellow Bass				Yellow Perch			
Total Length (Inches)	3.0-5.9 (Yearlings)		6.0-10.9 (Adults)		3.0-5.9 (Yearlings)		6.0-8.9 (Adults)	
Number Examined	232		755		113		523	
Number Empty	44		335		44		354	
Tot. vol. stom. contents (cc)	26.21		588.18		13.00		111.76	
	Percent		Percent		Percent		Percent	
Food Item	*Occ.*	*Vol.*	*Occ.*	*Vol.*	*Occ.*	*Vol.*	*Occ.*	*Vol.*
FISH	14	53.24	70	88.75	23	45.26	89	96.23
INSECTS	88	45.03	73	10.42	84	39.95	31	2.26
Diptera	86	24.19	69	8.88	54	2.54	27	0.83
Tendipedidae	78	14.69	52	6.50	51	1.75	20	0.67
Chaoborus	31	4.97	46	2.34	4	0.31	7	0.15
Ceratopogonidae	35	3.41	4	0.04	6	0.15	2	0.01
Other Diptera	8	1.12	Tr.	Tr.	4	0.33	—	—
Ephermeroptera	60	10.89	16	1.18	52	14.04	4	0.42
Hexagenia	12	5.56	10	1.01	1	0.96	1	0.16
Caenis	46	5.33	6	0.17	52	13.08	4	0.26
Trichoptera	27	4.03	6	0.20	64	18.39	9	1.01
Homo.-Hemiptera	22	4.75	4	0.14	4	0.06	—	—
Other Insecta	8	1.18	1	0.02	1	4.92	—	—
CRUSTACEANS	18	0.13	17	0.53	7	0.08	17	0.21
Cladocera	6	0.05	11	0.06	5	0.08	15	0.19
Eucopepoda	14	0.05	4	0.01	4	Tr.	5	0.02
Other Crustacea	Tr.	0.03	Tr.	0.46	—	—	—	—
HYDRACARINA	3	0.03	2	Tr.	36	4.50	4	0.17
OTHER MISC.	12	0.67	1	0.01	7	8.23	3	0.87
DEBRIS	13	0.93	13	0.29	4	2.08	4	0.26

Tr. = less than 1%.

Table 2. (Continued)
Food of the principal game and pan fish species taken from North Twin Lake, Iowa: June-August, 1953-54.

Species	Black Bullheads		Walleye		Black Crappie		Orange-spotted Sunfish	
Total Length (Inches)	5.0–10.9		3.0–20.9		2.0–8.0		–3.9	
Number Examined	307		424		35		41	
Number Empty	132		155		2		4	
Tot. vol. stom. contents (cc)	128.24		865.49		12.11		1.54	
	Percent		Percent		Percent		Percent	
Food Item	*Occ.*	*Vol.*	*Occ.*	*Vol.*	*Occ.*	*Vol.*	*Occ.*	*Vol.*
FISH	33	39.82	99	99.58	73	77.56	—	—
INSECTS	84	34.05	6	0.38	67	11.30	92	87.30
Diptera	82	23.58	3	0.04	58	7.29	81	14.37
Tendipedidae	77	14.00	3	0.04	49	5.04	73	11.10
Chaoborus	29	2.09	Tr.	Tr.	30	2.00	5	1.13
Ceratopogonidae	18	7.23	—	—	9	0.25	16	2.14
Other Diptera	5	0.26	—	—	—	—	—	—
Ephermeroptera	24	5.58	3	0.34	6	0.08	51	32.42
Hexagenia	10	4.82	3	0.32	—	—	3	7.12
Caenis	23	0.76	Tr.	0.02	6	0.08	49	25.30
Trichoptera	9	0.25	—	—	—	—	49	37.70
Homo.-Hemiptera	11	1.06	—	—	12	2.00	5	2.50
Other Insecta	23	3.58	—	—	12	1.93	5	0.31
CRUSTACEANS	28	2.92	2	Tr.	42	7.02	65	8.36
Cladocera	25	2.73	1	Tr.	37	6.31	41	—**
Eucopepoda	8	0.07	1	Tr.	18	0.71	65	8.3
Other Crustacea	Tr.	0.12	—	—	—	—	3	0.06
HYDRACARINA	14	1.37	—	—	3	Tr.	16	4.05
OTHER MISC.	50	11.52*	—	—	—	—	8	0.23
DEBRIS	64	10.31	Tr.	0.04	15	4.12	5	0.06

*Includes: 8.35% Algae
2.27% Higher Plants.
Tr. = less than 1%.
**Vol. not measured.

Regardless of size, however, the adults of all species examined, with the exception of the small orange-spotted sunfish (Figure 2E), seemed to rely on forage fish for the bulk of their food. This dependence upon forage fish may exist only during the summer, which is the period of the year when most growth is made and the need for large amounts of food is at a maximum.

A pronounced difference in the types of forage fish utilized by the adult game and panfish of North Twin Lake was noted in the two summers of investigation. Young-of-the-year yellow bass were the primary forage fish eaten in 1953, occurring in 82 percent of all fish stomachs that contained forage fish. Other forage fish utilized during this period and their percentage occurrence included: unidentified forms (probably yellow bass), 13 percent; yellow perch young-of-the-year, 3.5 percent; and small gizzard shad, 0.5 percent. In contrast, young-of-the-year gizzard shad prevailed as the chief forage fish food in 1954. This form occurred in 86 percent of the stomachs of all fish-eaters examined while young-of-the-year yellow bass were found in only 8 percent. Other forage fish types utilized upon occasion were: unidentified forms (probably small gizzard shad), 6 percent; black bullhead young-of-the-year, less than 1 percent; and yellow perch young-of-the-year, approximately 2 percent. The reasons for this pronounced change from utilization of yellow bass one year to gizzard shad the next lie in the relative abundance of these two species in 1953 and 1954. Systematic seining indicated that the small yellow bass and gizzard shad were by far the most abundant forage species during 1953 and 1954 respectively. Such evidence strongly suggests that fish are not necessarily selective as to the species comprising a general food class but readily utilize that which is most available at any given time.

Dipterous larvae and pupae were the predominant insect forms utilized by all adult species studied except the orange-spotted sunfish. Tendipedidae were the chief insects consumed as in the case of the smaller fishes (Table 2). Adults of all species seemed to have a slight preference for the *Chaoborus* larvae and pupae which appeared to be the most abundant insect inhabitant of the lake even though they were found in large numbers only in the deepened or dredged area (Owen, 1954). Adult yellow perch and walleyes ate little but forage fish at any time during the study. Adult black bullheads were primarily insect-feeders but seemingly ate anything they could find, including measurable amounts of such items as the filamentous green algae, *Stigeoclonium*. The bullheads also exhibited a definite preference for the ceratopogonid or biting midge larvae which live in shallow water. Caddis worms, mayfly nymphs, and other shallow water organisms seemed to be preferred as foods by the diminutive orange-spotted sunfish (Table 2).

Summary

Stomach contents of yellow bass, yellow perch, walleye, black bullheads, black crappies, and orange-spotted sunfish from North Twin Lake, Iowa were analyzed during the summers of 1953 and 1954. All sizes of each species were collected employing a systematic sampling scheme which permitted collection of these fish with respect to time of day. Stomach contents were analyzed immediately following capture using both numerical and volumetric methods.

In general, the food of the young-of-the-year of each species studied consisted mainly of planktonic crustaceans and minute immature insects. Yearlings fed primarily on the larger immature insect fauna but gradually utilized increasing amounts of forage fish as they progressed toward the end of their second summer. Forage fish were the chief food of adults of all species excepting the orange-spotted sunfish which cannot utilize the proportionally larger forage fish. Young yellow bass were the principal forage fish in 1953; young gizzard shad, in 1954.

Acknowledgments

The author wishes to express sincere gratitude to Dr. Kenneth D. Carlander for his suggestions in the preparation of the manuscript and for guidance throughout the study. Special thanks are due John B. Owen for valuable help in the field.

Literature Cited

McHugh, J. L., 1940. Food of the Rocky Mounty whitefish *Prosopium williamsoni* (Girard). Jour. Fish. Res. Bd. Canada 5:131-137.

Owen, J. B., 1954. Project No. 42. Dredged lakes. Qtrly Rept. Iowa Coop. Fish and Wildl. Res. Units 19(4):34-35.

Ricker, W. E. 1941. The consumption of young sockeye salmon by predaceous fish. Jour. Fish. Res. Bd. Canada 5:293-313.

Tester, A. L., 1932. Food of the small-mouthed bass (*Micropterus dolomieui*) in some Ontario waters. Univ. Toronto Stud., Pub. Ontario Fish Res. Lab. No. 46: 171-203.

Department of Zoology and Entomology
Iowa State College
Ames, Iowa