Proceedings of the Iowa Academy of Science

Volume 70 | Annual Issue Article 44

1963

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Food and Growth of Spottail Shiners and Other Forage Fishes of Clear Lake, Iowa[1]

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Abstract. Collections of spottail shiners, *Notropsis hudsonius*, and other forage fishes were made by systematic seining in Clear Lake in 1961. Spottails made up 71.6 per cent of all forage species and were collected most frequently in areas of vegetation. Although most spawning occurred in late May and early June, a few spottails apparently spawned in August. Young spottails grew an average of 0.05 millimeters per day which is slower than in warmer years. No parasites of spottails were observed.

Tadpole madtoms, *Noturus gyrinus*, made up 18.4 per cent of all forage species collected, higher than any previous year. All species studied fed primarily on Cladocera and vegetable material until mid-summer when insect material became abundant. After this, insects made up the major part of the diet.

INTRODUCTION

Clear Lake, Cerro Gordo County, in north-central Iowa is a shallow eutrophie lake providing much sport fishing and other recreation. The Iowa Cooperative Fisheries Research Unit has been studying the fish populations of this lake since 1941. Bailey and Harrison (1945) pointed out that minnows and other forage species are relatively scarce and are less significant as food for game fish in the lake than are young game and panfishes. The present study deals with minnows and other forage fishes collected at Clear Lake in the summer of 1961.

[1] Journal Paper No. J-4337 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1374. Iowa Cooperative Fisheries Research Unit, sponsored by the Iowa State Conservation Commission and Iowa State University of Science and Technology, with the cooperation of the U. S. Fish and Wildlife Service. Sport Fishing Institute, Inc., Washington, D. C., also contributed to the support of this research. This particular study was supported in part by a grant, G15689, from the National Science Foundation for an Undergraduate Research Participation Program with Dr. D. E. Hudson as local director.

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Collection of Data

Minnows for this study were collected in a 30-foot bag seine with one-quarter-inch mesh. Eight predetermined stations along the shore were sampled once a week for eight weeks starting July 21. The first week, a station was picked at random as a starting point. In the subsequent weeks, the next station in order around the lake was sampled first until each station had served as a starting point and the time element had been averaged. Sampling started precisely at sundown and continued into the night until each station had been sampled. Late evening and night were shown to be the most efficient times to seine (Ridenhour, 1960).

Two 50-foot hauls were made at each station for each sampling period and all species were measured and counted unless numbers of a species were excessively large, in which case 30 fish were selected without preference to size, and measured. The remaining specimens of that species in that individual haul were counted.

Occasional minnow specimens, mostly spottails, were collected in the trawl or by shocking. Also, seine hauls were made during the daylight hours in the early part of the summer, but these proved relatively unproductive and were discontinued after the weekly nighttime seining schedule began. Data from these last three techniques were also included in the study.

Scales were collected from many of the fish for laboratory examination to determine age and growth. A number of scales from each individual were placed between two clear plastic slides. Impressions of surface features of the scale were made on the slide by passing the two slides between a roller, such as the one described by Smith (1954). These impressions were then examined in a microprojector and read at 42 diameters. All scales were read twice. No reference was made to the previous aging and when conflicts existed, the scales were read a third time. Age was determined by counting the number of annuli. The annulus was recognized on the basis of the crowding of the circuli and the anastomosis of circuli on the lateral fields. Yearling spottails did not develop an annulus until mid-July.

In a study of food habits, stomachs were split lengthwise, the contents were removed to a petri dish and then were flushed with water from a pipette to remove any remaining food material. The contents were then studied under a dissecting microscope. If microscopic organisms were detected under high power, a drop of the liquid was examined under a compound microscope. All stomachs were examined except when a large percentage of a sample from a particular location showed similar contents, in which case a sample was taken.

Species Composition

McCann (1959) reports that the spottail shiner made up only 4.7 and 8.5 per cent of the Clear Lake minnow seine catches in 1956 and 1957 respectively. In 1961, all forage fish species studied made up only 5.6 per cent of the total minnow seine catches. Young pan and game fish comprised the other 94.4 per cent. Of the forage species, 71.6 per cent were spottail shiners and 18.4 per cent were madtoms. The remaining 10 per cent included various shiners, johnny darters, and a stoneroller (Table 1).

Table 1. Species and numbers of forage fish collected at Clear Lake, Iowa, from July 21 to September 13, 1961

Species	Number	Percentage
Spottail shiner, *Notropis hudsonius*	534	71.6
Madtom, *Noturus gyrinus*	137	18.4
Bigmouth shiner, *Notropis dorsalis*	34	4.6
Common shiner, *Notropis cornutus*	15	2.0
Golden shiner, *Notemigonus crysoleucas*	11	1.5
Johnny darter, *Ethiostoma nigrum*	9	1.2
Bluntnose minnow, *Pimephales notatus*	2	.28
Central stoneroller, *Campostoma anomalum*	1	.14
Rosy face shiner, *Notropis rubellus*	1	.14

Larger numbers of spottails were taken at stations with large amounts of submergent vegetation. The four most productive stations had abundant vegetation extending out to depths of 5 feet or more. The two least productive, the Outlet and Island Stations, were free of all types of vegetation. The bottom near the Outlet consisted entirely of large rocks up to 2 feet in diameter. The Island Station has a very sandy bottom. The two stations, where just an average number of spottails were collected, Garner Beach and the Hatchery, have fine, sand bottoms but both have some vegetation nearby. Surber (1940) found an abundance of spottails in beds of water willow in the Shenandoah River. Many other fishery workers including Adams and Hankinson (1928), Forbes and Richardson (1920), and Hubbs and Lagler (1949) reported spottails more abundant in areas with large amounts of vegetation.

Spottail Shiners

On June 15, 1961, several female spottails were taken at the McIntosh Woods and Garner Beach Stations. The ovaries of these fish were enlarged with eggs which were hard and crystalline, apparently in the act of being resorbed. Some fry were collected at the same time. Apparently, spawning occurred in late May or early June. McCann (1959) reported that spawning occurred early in May in 1958. Fish (1932) reported spottails spawning in Lake Erie in late June and early July.

As the season progressed, the size of the ovaries was reduced to a thin ribbon-like structure. On August 3, two gravid females were collected on the north shore of the Island Station. Then, on the weeks of August 22 and September 6, a number of very

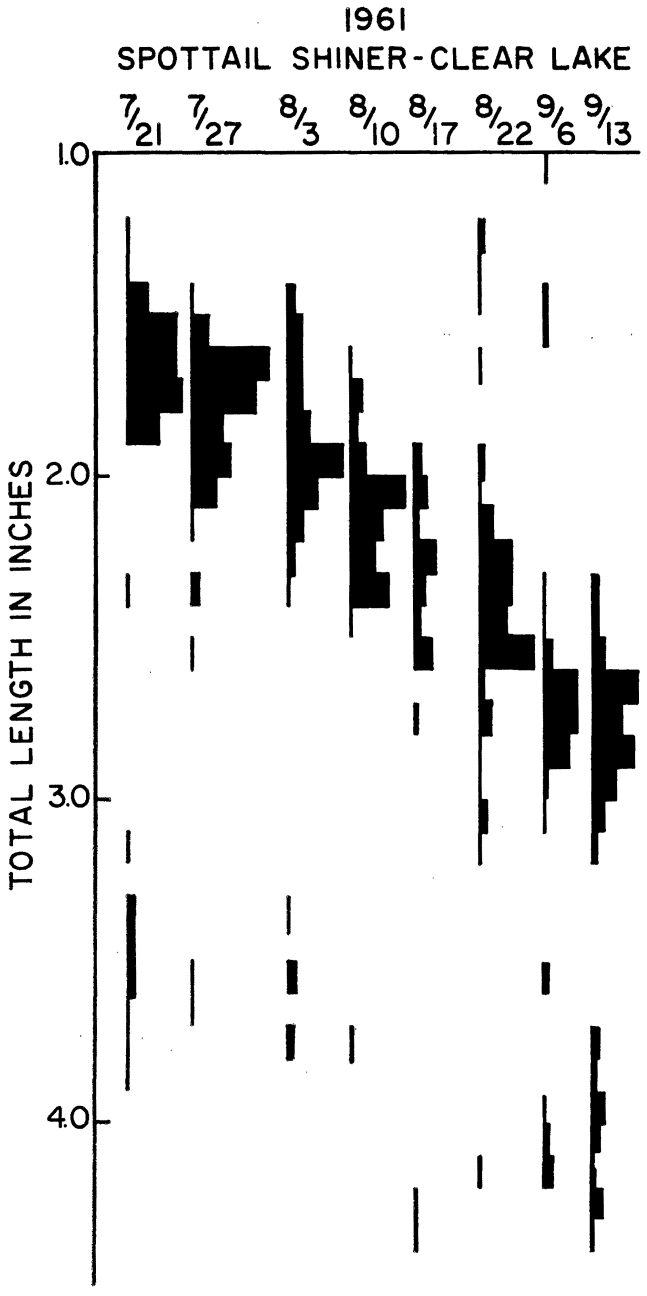

Figure 1. Numbers of spottail shiners by 0.1-inch size groups collected at Clear Lake, 1961, showing growth through the season.

small young-of-the-year spottails were collected at Farmer's Beach (Figure 1). This indicates a smaller, later hatch occurring sometime in early August. A second spawning period has not been previously noted.

Young-of-the-year spottails were easily recognized by their size distribution (Figure 1), and, to avoid reading an excessive number of scales, fish in this distribution were placed into weekly classes and a sample of five envelopes was selected at random from each class without reference to length. Scales from all larger spottails were studied. Young-of-the-year spottails made up 90 per cent of all spottails collected as compared to 80 per cent in 1956 and only 47 per cent in 1957.

McCann (1959) showed that the small size of spottails in July 21-27, 1958, was related to low May 1 to July 24 temperatures and that the larger size in 1956 was related to higher temperatures (Table 2). In 1961, young spottail shiners averaged between the sizes reported for 1956 and 1957 and the mean temperature for that period was also intermediate. Average daily increment from July 24 to August 28 was 0.55 mm in 1961, lower than in 1956, 1957 or 1958. The mean August temperature in 1961 was also low, though not quite as low as in 1956. In general, the 1961 data further demonstrate the correlation between temperature and growth rate of spottail shiners reported by McCann (1959). Hubbs (1921) found the daily increment of young-of-the-year spottails in Portage Lake, Michigan, to be 0.5 mm for the first month.

Table 2. Mean air temperatures and mean total lengths of spottail shiners at Clear Lake, Iowa[1]

	1956	1957	1958	1961
Mean air temperature May 1-July 24	66.1°F	65.1°F	63.0°F	65.3°F
Mean total length of spottails July 21-27	43.9 mm	41.1 mm	36.6 mm	43.0 mm
Mean air temperature August	70.0°F	80.3°F	73.1°F	71.0°F
Daily increment of spottails July 24-August 28	0.63 mm	0.68 mm	0.65 mm	0.55 mm

[1] The 1956-58 data are from McCann, 1959.

Scale examination indicated that a few of the spottails were 3 years old (Table 3). The sizes at various ages were similar to those reported for 1956 and 1957 (McCann, 1959).

In contrast to 1956 studies, spottails tended to be selective as to food preference with all of the food in a stomach and intestine being similar. This was true of full stomachs as well as those with little food. Spottail shiners collected in the early part of the daily seining period tended to have full stomachs, indicating a distinct feeding period just before sundown. Although individuals tended to be selective, the population as a whole seemed much less selective (Figure 2). Spottails seemed to feed on dif-

Table 3. Age group composition by lengths of 448 spottails collected from Clear Lake, Iowa, July 21 to September 13, 1961

Total lengths	Total number fish taken	Number in each age group			
		O	I	II	III
1.0-3.0	403	403*			
3.1-3.3	7	3	4		
3.4-3.6	11		11		
3.7-4.0	16		12	4	
4.1-4.2	9			7	2
4.3	2				2
Totals	448	406	27	11	4
Percentage totals		90	6	3	1

* Scales examined from only 45 fish in this size range.

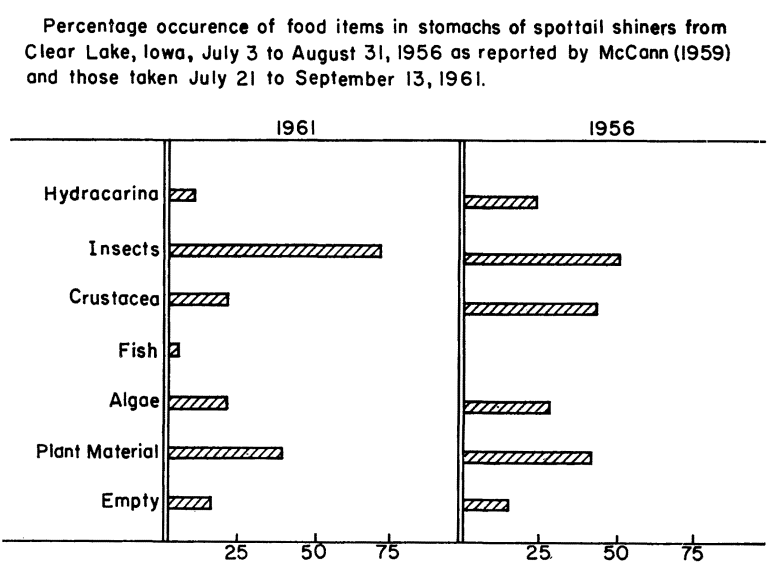

Figure 2. Food habits of spottail shiners in Clear Lake, Iowa, during the summers of 1956 and 1961.

ferent organisms in different environments. Boesel (1935) reported this tendency existed among spottails on the western end of Lake Erie.

No parasites were observed while the specimens were examined for food habits. One spottail bore a large hard growth posterior to the dorsal fin, believed to be the result of an injury. Haley and Winn (1959) reported that 20.8 per cent of the spottail shiners in a Maryland pond had copepod parasites, *Lernea cyprinacea.*

Madtoms

Madtoms were the second most abundant of the small fishes, comprising 18.4 per cent of the seine catch (not counting the young game and panfishes). This catch is higher than reported for other years and indicates a good 1961 year class. The growth of the young madtoms through the summer is indicated in Figure 3. The ages of the larger madtoms were not determined. Gravid female madtoms were collected on July 15 and 17.

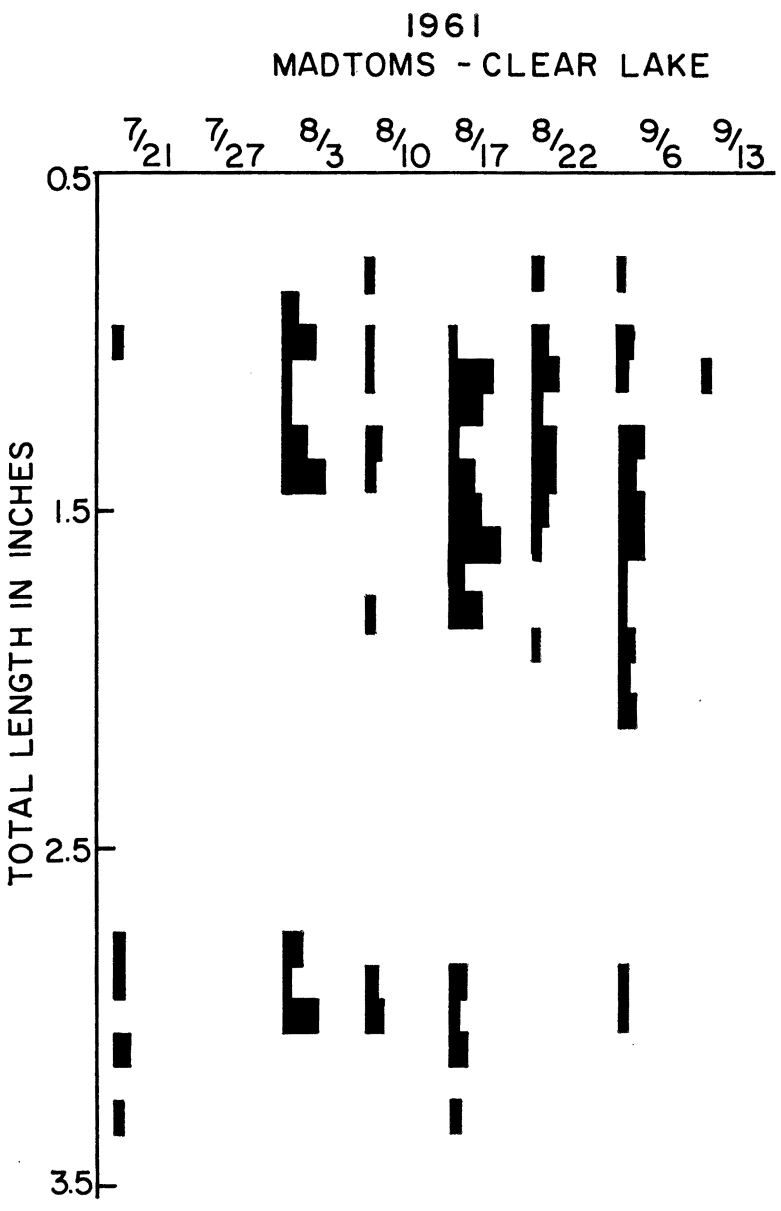

Figure 3. Numbers of madtoms by 0.1-inch size groups collected at Clear Lake, 1961, showing growth through the season.

Other Species

Few other minnows and johnny darters were taken. Data for these are too few to be significant. Their food does not differ much from that of the spottail shiner (Table 4).

The bigmouth shiner showed little selectivity, even when well fed. Full stomachs showed just as great a variation in contents as nearly empty individuals. The johnny darter showed a great deal of selectivity, feeding almost entirely on Diptera larvae. The main food organisms was Cladocera in the areas with little submergent vegetation and various vegetable matter where it was available. Later in the summer, when insect material became more prevalent, this animal material composed almost 100 per cent of the diet.

Table 4. Numbers of stomachs in which various food fish items occurred in other species of forage fish from Clear Lake, Iowa, July 21 to September 13, 1961

Item	Bigmouth shiner	Golden shiner	Common shiner	Johnny darter	Bluntnose minnow	Rosyface shiner
Arachnoides	1	3	1	..	..	..
Hydracarina	1	3	1	..	..	..
Insecta	21	7	13	9	2	..
Diptera larvae	9	2	9	8	1	..
Chironomidae	3	2	1	1	1	..
Diptera adult	7	1	6	..	1	..
Hemiptera	2	1	..	..	..	..
Corixidae	2	1	..	..	..	..
Homoptera	..	1	2	..	..	..
Aphidoidea	..	1	2	..	..	..
Ephemeroptera	3	..	3	..	..	..
Trichoptera	1	4	..	..	..	..
Unidentified	3	..	..	1	..	..
Crustacea	4	1	6	..	..	1
Cladocera	1	1	6	..	..	1
Plant	11	1	3	..	..	..
Fiber	1	..	..	..	..	..
Algae	9	1	3	..	..	..
Chlorophyta	6	..	3	..	..	..
Cyanophyta	7	..	..	..	..	..
Empty stomachs	3	..	..	..	..	..
Total fish	34	11	15	9	2	1
Size range (inches)	2.5-1.1	4.4-1.5	3.0-1.7	2.3-1.6	2.0-1.8	2.1

Young-of-the-year comprised 79 per cent of the bigmouth shiners collected and 90 per cent of the johnny darters collected. Neither species was represented by any specimens of the II-year class or older (Table 5).

Table 5. Numbers and lengths of other forage fishes in each age group

Species	Age group 0 No.	0 Total length (inches)	I No.	I Total length (inches)	II No.	II Total length (inches)
Bigmouth shiner	27	1.1-2.3	8	2.1-2.6		
Common shiner	11	1.4-3.1	3	3.0-3.6	1	4.1
Golden shiner	6	1.4-2.6	4	2.8-3.7	1	4.8
Johnny darter	8	1.1-2.0	1	2.2		
Bluntnose minnow			1	3.3		
Common stoneroller					1	4.8
Rosyface shiner			1	2.2		

Use as a Forage Fish

Surber (1939 and 1940) found spottails an important food fish of smallmouth bass in West Virginia streams. Maloney and Johnson (1957) report that spottails and johnny darters make up 3 and 4 per cent respectively of the diet of walleyes in Mille Lacs Lake, Minnesota. Van Oosten and Deason (1937) found johnny darters make up a considerable amount of the lake trout diet in

Lake Michigan and Bailey and Harrison (1948) report common shiners are a prime food of the southern channel catfish in the Des Moines River. Hunt and Carbine (1951) state that spottail shiners, common shiners, and bluntnose minnows made up a major portion of the diet of young northern pike in Peterson's Ditches, Houghton Lake, Michigan. Examination of stomachs of 150 walleyes from Clear Lake in the summer of 1961 indicated that 57 contained fish, most of which were unidentified. There was, however, no evidence of their having eaten spottail shiners or the other forage fishes reported here.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to Dr. Kenneth D. Carlander, Professor, Department of Zoology and Entomology, for his guidance and assistance in preparing this manuscript. The author also is indebted to John Hervey and Richard Neal for their help in collecting and processing of data.

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