Proceedings of the Iowa Academy of Science

Volume 62 | Annual Issue Article 70

1955

Fishes of Little Wall Lake, Iowa Prior to Dredging

Kenneth D. Carlander
Iowa State College

George Sprugel Jr.
Iowa State College

Fishes of Little Wall Lake, Iowa Prior to Dredging[1]

By KENNETH D. CARLANDER AND GEORGE SPRUGEL, JR.

Little Wall Lake, in Hamilton County (R 24W, T 86N, Sec. 9, 10, 15 and 16), is a shallow prairie lake of approximately 273 acres (Iowa State Conservation Commission, 1952, p. 158). The lake has been dry a number of times since the white man came. It is reported to have been dry in 1892, 1904-05, and 1936-41. In 1953 the Iowa State Conservation Commission dredged about 65 acres thereby providing an area of deeper water for recreational purposes. The present paper summarizes the observations which have been made on the fish populations of the lake from the time it filled up after the drought of the late 1930's until the dredging.

When the water was at lake-full stage, in the spring of 1948, the maximum depth was found to be 6.5 feet. The lake bed was rather flat with approximately 75 percent of the lake between 5 and 6 feet deep. Most of the lake bottom was silt or silt and peat mixture, but some sand and gravel areas were found near the southern and eastern shores. Aquatic plants were abundant and every year, by late summer, their growth was so thick as to almost prevent boating and fishing. In 1948, local sportsmen kept open two parallel channels approximately 50 feet wide in a north-south direction across the west end. River and softstem bullrushes, *Scirpus fluviatilis* (Torr.) Gray and *S. validus* Vahl., covered most of the lake. Spatterdock, *Nuphar advena* Oit., and water lilies, *Nymphaea tuberosa* Paine, were present in two dense colonies as well as being scattered in lesser abundance in most parts of the lake. The submerged plants, *Ceratophyllum demersum* L., *Potomogeton* spp., *Anacharis* spp. and *Myriophyllum exalbescens;* extended almost to the surface even in the deepest portions of the lake. Most limnologists would have classified Little Wall Lake at that time as a marsh.

GENERAL HISTORY OF THE FISH POPULATION

Dr. Paul Errington, who has studied the muskrat populations of the lake since 1935, tells us that the lake was completely dry in

[1]From Project 42 of the Iowa State 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. Much of the data is in a doctoral thesis submitted by George Sprugel, Jr. and on file in the Iowa State College library.

1940, started filling in 1941 but dried up again that fall. The water levels then gradually increased until the lake was full in 1944. Most of the cattails which had been present at lower water levels died out in 1944. In 1943 and 1944 tadpoles and frogs were reportedly very abundant in the lake. The Iowa State Conservation Commission felt that the lake was ready for fish in 1945 and stocked largemouth bass and bluegills (Table 1). Additional stockings of these species were made in 1947 and 1948.

Table 1.

Number and Sizes of Fish Stocked in Little Wall Lake by the Iowa Conservation Commission[1]

Year	Species	Size			
		Fry	Fingerlings	Yearings	Adults
1945	Largemouth black bass	–	500	–	–
	Bluegills	–	–	1,400	100
1947	Largemouth black bass	–	2,500	508	30
	Bluegills	–	10,400	1,000	–
1948	Bluegills	8,000	–	–	–
1949	Northern pike	50,000	–	–	–

[1]Iowa State Conservation Commission.

A number of other species of fish also got into the lake in one fashion or another. Two of these have contributed significantly to the anglers' catch: the green sunfish and the black bullhead. In the spring of 1948 the lake became quite famous locally for its sunfish and anglers took many fine strings. Although some bluegills were caught most of the larger fish were green sunfish. These fish were 7 to 8.5 inches long. In most Iowa waters the green sunfish does not exceed 5 inches in length and is considered an undesirable species. The expanding lake, with few fish in it apparently provided exceptional growing conditions for these green sunfish. By early July, however, the aquatic vegetation became so thick that most fishermen became discouraged and there was little fishing at the lake until late in the fall.

Black bullheads provided most of the angling in Little Wall Lake during the years covered in this report. The fishing pressure was seldom very heavy but many fishermen did get some reasonably good bullhed fishing, largely in the spring and late fall.

The water level dropped more than a foot in 1948 and was over two feet below the oulet in 1949 (Table 2). The water remained at about this level until the lake was dredged in 1953.

Table 2.

Fluctuations in Water Level at Little Wall Lake during the Period January, 1948 through June, 1950 (Measured in inches from lake full level as zero)

Date	Water level	Date	Water level
1-16-48	0.00	5- 2-49	-11.00
6-16-48	- 5.00	5-27-49	-11.50
8- 4-48	- 8.00	6-17-49	-16.50
9-24-48	-14.00	7-20-49	-18.25
10- 6-48	-15.00	7-29-49	-20.00
11-13-48	-15.25	8- 4-49	-25.50
11-25-48	-14.00	9- 4-49	-27.50
3-27-49	-11.50	11-29-49	-29.00
		6-23-50	-18.00

The reduced water level and the masses of decaying vegetation resulted in oxygen depletion and the suffocation of many of the fish in the winter of 1948-49. From February 1 through 26, no dissolved oxygen concentrations of over 0.8 p.p.m. could be found and most readings were less than 0.5 p.p.m. Apparently all the fish, except some black bullheads, some fathead minnows, and a few green sunfish were killed during this period. The species which were found dead when the ice went out in the spring are discussed later. Conditions were even more severe in the winter of 1949-50 when no dissolved oxygen could be found from February 9th through March 2nd. Only a few bullheads and fathead minnows survived this winter. No detailed observations were made in the succeeding winters but the water levels were low and dead bullheads and fathead minnows were found when the ice went out in 1951, 1952, and 1953. The winter kill of 1951-52 was probably less severe than in the two earlier years.

Dr. Errington called our attention to a phenomenon which probably explains the survival of some bullheads and fathead minnows even when the disolved oxygen is entirely depleted for several weeks. He has noted, and we have since observed, that these two species congregate in muskrat burrows when conditions become unfavorable in the marsh. In the burrows they are able to get sufficient oxygen to survive. When the ice broke up in 1953, several of the burrows, partially exposed by the dropping water levels, caved in, sealing hundreds of small bullheads and minnows in small isloated pools. Many of these fish, having escaped the winter kill in the muskrat burrows, were unable to return to the lake and died as the pools dried up.

With this general background, let us now review the history of the various species of fish in the lake from about 1945 until the dredging in 1953.

Northern Pike

In the spring of 1949, the State Conservation Commission stocked 50,000 northern pike, *Esox lucius* Linnaeus, fry in the hopes that these rapid-growing fish might provide some good sport fishing before the next winterkill. The winter of 1949-50 was a severe one from the standpoint of the fish, however, and the young northern pike were apparently all killed. Only a few dead pike were found in the spring of 1950 which may mean that the survival of the stocked fry was low or merely mean that few of the pike carcasses came to shore as the ice went out. The seven dead pike which were found averaged 14.7 inches, total length, indicating they made good growth in their first summer.

Minnows

Bluntnose minnows, *Pimephales notatus* (Rafinesque), and fathead minnows, *Pimephales promelas* Rafinesque, were collected from Little Wall Lake in 1948 but apparently only the latter species was able to survive the frequent winterkills. Young fatheads were collected in 1948, 1949, and 1950 and the winter kills indicated that the fathead minnows reproduced successively in 1951 and 1952 also. Fatheads usually mature at one year of age and die shortly after the spawning season (Dobie, Meehan and Washburn, 1948). The males average a little larger than the females (Table 3). The minnows collected from a hole in the ice where they were congregated in January 1953 were much smaller than similar fish collected in 1949 and 1950. This suggests a late spawning season or slow growth in 1952 compared to 1948 and 1949. Reasons for slow growth or late spawning in 1952 are not apparent at this time. The mean temperatures in June, July, and August were about average and not much different than in 1948 and 1949.

Table 3.

Total lengths of fathead minnows collected from Little Wall Lake, Iowa

			Total Length in Inches	
Date	Sex	Number	Mean	Range
June, 1949	Males	6	3.06	2.9-3.2
	Females	8	2.78	2.6-2.8
July, 1949	Males	6	2.16	2.1-2.3
	Females	2	2.40	2.0-2.8
February 16, 1949	Males	80	2.88	2.6-3.3
	Females	69	2.60	2.4-2.9
July 31, 1950	Males	17	2.33	2.1-2.6
	Females	21	2.02	1.7-2.4
	Young	45	1.24	0.9-1.6
February, 1950	Males	13	2.54	1.8-2.9
	Females	8	2.42	2.2-3.0
January 29, 1953	Undetermined	83	1.39	0.9-2.2

White Sucker

One 12.7 inch white sucker, *Catostomus commersoni* (Lacépède), was caught in a gill net in October 1948 and another, 13.7 inches long, was found among the winter killed fish in April, 1949.

Northern black bullhead

The northern black bullhead, *Ameiurus melas melas* (Rafinesque) has been the principal fish caught by anglers except for the spring of 1948. Some individuals survived each of the winterkills.

Study of the rings on the vertebrae of the bullheads (as described by Lewis, 1949) shows that most of the bullheads were of the 1945 to 1947 year classes (Table 4). Young of the year bullheads were not found in 1948 or 1949. The growth of the bullheads was fairly slow, with average total lengths of 3.4, 5.5, 6.0 and 6.7 for age groups I, II, III and IV respectively. The 1942 to 1944 year classes apparently grew somewhat faster, because of the small numbers of bullheads in the lake at the time it was filling. Some of these bullheads may have been put into Little Wall Lake when a year or two old. The winterkilled age group II and III fish in 1949 averaged less than the age group I and II fish in the summer of 1948. This situation is probably the result of the selective effect of the hoop nets used in catching bullheads in 1948. Probably only the larger I and II year old bullheads were caught in the nets resulting in an overestimate of the average sizes of the bullheads of these age groups.

No difference could be found in the growth rates of the male and the female bullheads. The sexes are probably about equally abundant, but an interesting difference in the sex ratios in various samples was noted (Table 5). In the spring and early summer males predominated in the catch and in the late summer and fall, females predominated. Probably there is a difference in the activity of the two sexes at these seasons.

Although the winterkills of 1948-49 and 1949-50, probably eliminated most if not all of the large bullheads, moderate numbers of 6 and 7 inches bullheads have been taken by anglers each year despite recurring winterkills.

The length-weight relationship of the bullheads of Little Wall Lake (Table 6) can be described quite accurately by the formula (fitted to the mean lengths and weights):

$$\text{Log } W = -4.439 + 2.935 \text{ Log } L$$

where W = weight in grams

and L = standard length in millimeters.

Table 4.
Sizes of bullheads from Little Wall Lake by year classes and age groups

Year Class	Date	Age group	Total length in inches Number	Mean	Range	Weight in grams Number	Mean	Range
1942	1948	VI	3	9.4	8.9-10.0	3	202	175-234
	Winterkill 1950	VIII	1	8.4	.....	....	.....	.....
1943	July 1947	IV	1	7.7	.....	....	.....	.....
	October 1948	V	1	7.7	.....	1	98	.....
	April 1949	VI	2	10.4	10.2-10.6	2	219	200-237
1944	1948	IV	13	7.5	6.6-8.5	12	90	55-118
	1949	V	10	7.8	6.9-9.0	10	94	52-187
	Winterkill 1950	VI	4	9.6	8.1-11.3	....	.....	.....
1945	1948	III	47	6.6	5.9-7.4	47	63	35-82
	Winterkill 1949	IV	3	6.9	5.9-7.6	3	74	43-98
	1949	IV	28	6.8	5.8-8.2	28	71	33-120
	Winterkill 1950	V	22	7.2	6.0-8.2	7	63	41-101
1946	1948	II	89	6.0	4.4-6.9	89	47	15-73
	Winterkill 1949	III	21	5.1	4.7-6.5	21	30	21-61
	1949	III	70	6.0	4.9-7.4	70	44	21-80
	Winterkill 1950	IV	36	6.4	5.5-7.6	20	44	35-66
1947	1948	I	27	4.8	4.6-5.8	24	26	8-42
	Winterkill 1949	II	51	4.5	4.0-4.9	51	20	11-27
	1949	II	29	5.7	4.7-6.4	29	35	20-46
	Winterkill 1950	III	19	5.9	5.4-6.4	19	41	31-61
1950	July 1950	0	158	1.7	0.8-3.6	....	.....	.....
1951	Winterkill 1953	II	5	4.4	3.9-4.8	....	.....	.....
1952	Winterkill 1953	I	34	2.2	1.5-3.6	....	.....	.....

Table 5.
Sex ratios of black bullheads collected at Little Wall Lake in different seasons

Collection dates	Method of collection	Number of Males	Females	Percentage male
June-July, 1948	Trapnets	11	3	78.5
August, 1948	Hoopnets	52	66	44.1
October-December, 1948	Hoopnets	16	32	33.3
February, 1949	Winterkill	44	31	58.7
April, 1949	Hoopnets	39	19	67.3
June, 1949	Hoopnets	16	8	66.7
July, 1949	Hoopnets	22	23	48.9
October-December, 1949	Hoopnets	4	8	33.3
February-March, 1950	Winterkill	26	20	56.5

Since weight increases nearly as the cube of the length, the coefficient of condition, k^1, gives a fairly good comparison of the relative plumpness of the bullheads in various collections. The coeffi-

[1] $k = \frac{W}{L^3} : 100{,}000$

Table 6.

Length-Weight Relationship of Black Bullheads from Little Wall Lake, Iowa, 1948-50

Standard length** in millimeters	Number	Mean weight in grams	Computed* weight	Mean length
71-80	6	10.5	10.7	76.8
81-90	18	15.8	15.3	86.7
91-100	48	21.4	20.2	95.2
101-110	30	28.6	27.9	106.5
111-120	62	34.5	35.6	115.7
121-130	105	42.5	44.8	125.1
131-140	82	54.6	56.2	135.1
141-150	48	63.3	68.4	144.5
151-160	19	79.6	83.4	154.4
161-170	16	97.5	102.1	165.4
171-180	1	120.0	118.3	174.0
181-190	2	181.0	151.0	189.0
205-215	2	216.0	203.2	209.5
225-230	2	228.5	250.6	225.0

*Log $W = -4.439 + 2.935$ Log L.

**Standard lengths in millimeters	Number measured	Average factor for converting standard to total length
under 100	72	1.227
101-130	197	1.212
131-160	149	1.208
over 161	22	1.192

cients of condition indicate that the bullheads were heavier for their length in 1948 than in 1949 or 1950 (Table 7). It was expected that the bullheads might be heavier in 1949 and 1950 after their population density was decreased by the winterkills. Apparently the population density was not sufficient to depress the "condition" of the bullheads in 1948, or the habitat deterioration with the reduced water levels more than balanced the decreased bullhead abundance. Since there was some indication of decrease in mean k factor with increase in length (associated with the fact that the weight increased as the 2.935 power of the length rather than 3.0), a comparison of *k* factors of bullheads within a narrow size range might be more valid than that of all sizes. When only those bullheads from 121-140 millimeters in standard length were compared (Table 7), the 1948 bullheads still appeared to be in better condition than those collected in 1949 and 1950. Since no constant differences in the *k* factors of male and female bullheads could be demonstrated in any of the collections, the data for the two sexes are combined in these analyses.

The mean *k* values indicate that the Little Wall Lake bullheads were lighter for their lengths than bullheads from Clear Lake,

Iowa (mean k of 2.9) (Forney, 1955) and from Lost Island Lake, Iowa (mean k values of 2.4 to 3.07 (Rose and Moen, 1951). They were heavier than a sample of 58 from various Iowa farm ponds (mean k, 1.77) (Carlander and Fredin, 1948).

Bullheads apparently do not feed during the winter. Stomachs and intestinal tracts were all found to be empty when the following bullheads were examined: 9 on December 1, 1949, 4 on December 5, 1948, 73, February 16, 1949, and 4 February 5, 1950. On April 5, 1949 ,two bullheads were found to be empty but 12 had plant material in their digestive tracts. On April 28th, 13 were empty, 20 had plant material, 4 had snails or snail shells, and 4 had both plant and snail material. One 7.5 inch bullhead collected on June 18, 1949 had a 65 mm. fathead minnow. A 9-inch bullhead collected on July 22, 1949 had 14 fathead minnows and one dragonfly numph, a meal of 27 grams for a 187 gram fish.

Table 7.
Coefficients of Condition, k, for Black Bullheads Collected from Little Wall Lake, Iowa, 1948-50

Year	Standard length in millimeters	Number	Mean k	Standard length in millimeters	Number	Mean k
1948	71-215	180	2.30	121-140	94	2.30
1949	76-230	215	2.19	121-140	61	2.04
1950	111-165	46	2.16	121-140	32	2.11

Largemouth bass

Largemouth bass, *Micropterus salmoides* (Lacépède), were stocked in 1945 and 1947 (Table 2). One young bass, 47 millimeters standard length, was collected by the limnology class on October 20, 1947. Young bass were seen in the summer of 1948 and in October four, ranging from 46 to 49 millimeters standard length, were collected. Apparently there was a complete kill of bass in the winter of 1948-49 for none were seen in subsequent years. A total of 32 dead bass were observed after the winterkill but these probably represented only a small proportion of those which were killed. The winterkilled bass ranged in total lengths from 5.5 to 17.3 inches.

Bluegill

Bluegills, *Lepomis macrochirus* Rafinesque, were also stocked in 1945, 1947, and 1948 (Table 2). Seining in 1948 failed to reveal the presence of young-of-the-year bluegills from natural reproduction or from the 8,000 stocked fry. In 1948 Sprugel collected 3 bluegills by angling, 24 from gillnets, 3 from traps, 2 from seines, and 98 from fyke nets. Scales were collected from an additional 38 bluegills after the winterkill of 1948-49 which apparently

eliminated the population. After the winterkill 791 bluegills were measured compared to 196 green sunfish although during the previous summer bluegills were harder to catch than the green sunfish. These bluegills were almost all one year old fish, 71 to 120 mm. standard length, whereas the green sunfish were mostly larger and older.

Age and growth of the bluegills were determined by scale analysis (Table 8). Calculated lengths at previous years were computed from scale measurements to the various annuli assuming a straight line relationship between scale and body length with an intercept at 8.4 millimeters standard length. The latter relationship was demonstrated to be sufficiently accurate for a neighboring population of bluegills (Sprugel, 1954) and appeared to be very close to the true relationship for the Little Wall Lake bluegills as well.

Increments of growth for the first year of life appeared to be similar for the 1944, 1945, and 1946 year classes, but the 1947 year class showed much more rapid growth. Growth was rapid for all year classes in 1947. The 1944 year class bluegill nearly doubled its length during its fourth year of life, 1947. The 1945 year class made much of its growth during the 3rd year and the 1946 year class during the 2nd year. The reason for the rapid growth in 1947 is not evident at this time.

Annulus formation had been completed by the time collections were begun in 1948, June 3rd. Over 75 percent of the season's growth was completed by bluegills of the 1947 year class by late June, although the growing season seemed to extend on into late October (Table 9).

False annuli were studied in the same manner as at McFarland's Lake (Sprugel, 1954.). All except 2 of the 147 bluegills from the 1947 year class had an early mark on the scale corresponding to an average calculated length of 21.4 millimeters. One specimen had an additional false mark prior to the first annulus. Four females and three specimens, sex unknown, each had an accessory mark in the second year of life. Only 1 of 9 members of the 1946 year class produced a false annulus in 1947, a season of good growth, but 4 produced false annuli in 1948 when growth was slow. Three of the 1945 year class developed false marks on their scales in 1947 and only one did in 1948. The 1944 year class bluegill showed false checks in 1947 and 1948. There seemed to be no consistent relationship between environmental conditions, sexual development, or rate of growth, and the formation of false annuli on the scales.

The Little Wall Lake bluegills appear to have been above average in weight for their length (Table 10). (For comparisons see Carlander, 1953.)

Table 8.

Calculated Standard Langths in Millimeters of Bluegills Collected at Little Wall Lake, Iowa, 1948 and 1949

Year Class	Calculated lengths at each annulus* (Number of specimens in parentheses)				
	1	2	3	4	5
1947	65.6(147)	96.1(22)			
1946	40.6(12)	114.4(12)	135.0(9)		
1945	38.7(7)	67.8(7)	150.0(7)	179.3(7)	
1944	40.1(1)	62.0(1)	76.0(1)	143.0(1)	180.0(1)
Average	62.5	95.8	137.7	174.7	180.0
Annual increment	62.5	38.2	45.2	34.0	37.0
Corresponding total length in inches**	3.2	4.7	6.8	8.5	8.9

*The last lengths in each year class represent the lengths at death in the winterkill of February 1949.

**Using the following conversion factors:

Standard length in millimeters	Number measured	Average factor for converting standard to total length
70-89	93	1.291
90-119	61	1.267
160-199	12	1.238

Table 9.

Length at First Annulus and Percentage of Average Seasonal Growth Completed at Capture for the 1947 Year Class of Little Wall Lake Bluegills (Measurements of growth in millimeters)

Date of collection	Number of specimens	Average standard length at capture	Average calculated length at formation of annulus	Growth since annulus formed	Percent of 1948 growth[1] completed
1948					
6/3	1	88.0	71.0	17.0	75.6
6/26	7	84.1	66.6	17.5	77.8
7/7-12	9	80.7	62.7	18.0	80.0
7/17-28	4	91.2	72.0	19.2	85.3
8/3-7	54	85.5	65.3	20.2	89.8
8/17-18	18	85.5	65.5	20.0	88.9
10/6	13	90.4	68.6	21.8	96.9
12/5	19	77.6	54.3	23.3	103.6
3/28/49	22	96.5	73.6	22.5[1]	100.0

[1]Average calculated growth beyond the annulus in specimens collected February 28 was considered the average total 1948 growth for the population.

Each of the 42 individuals that were examined superficially for parasites contained metacercaria of the white grub, *Posthodiplostomum minimum,* in the liver. Metacercaria, probably of *Neascus* sp., were also observed to be present in irregular concentrations on the fins and under the body skin. Those specimens heavily infested with white grubs did not appear to be characterized by emaciation, lack of growth or modification of the state of sexual development.

Stomach contents were examined in only the collection made December 5, 1948. Two of the 19 specimens had empty stomachs at the time of capture. Five had stomachs filled with plant material, and nine stomachs contained snail shells and plant material. One specimen had eaten a dragon fly larva plus plant material and two other individuals contained only snail shells (*Physa* sp. and *Fossaria* sp.). The digestive tract of one of the latter fish contained the shells of 37 snails.

Table 10.
Length-Weight Relationship and Coefficients of Condition of Bluegill Collected at Little Wall Lake, 1948

Standard lengths in millimeters		Corresponding total length	Average weight		Mean	Number
Range	Mean	in inches	grams	ounces	*k*	of fish
70-79	76.7	3.9	17.8	0.63	3.86	50
80-89	85.9	4.3	25.5	0.90	3.96	39
90-99	92.4	4.6	34.8	1.23	3.95	31
100-109	102.7	5.1	46.6	1.65	4.29	4
110-119	115.0	5.6	54.0	1.91	3.54	4
	165.0	8.2	220.0	7.77	4.89	1

Green sunfish

Green sunfish, *Lepomis cyanellus* Rafinesque, were the principal panfish taken in 1948. Since the population included unusually large specimens, the growth and life histories of the green sunfish have been reported in a separate paper (Sprugel, 1955) and only a brief summary is included here. Most of the green sunfish collected in 1948 were 2.5 to 7.2 inches, total length. The largest was 8.5 inches long. Most of them belonged to the 1946 year class with a few 1944 and 1945 year class specimens being taken. Only one 1947 and one 1948 year class green sunfish were collected. It appears that the bluegills were replacing the green sunfish in abundance prior to the 1948-49 winterkill. Some of the green sunfish survived the first winterkill and there is evidence that the slower growing individuals survived to a greater extent than the more rapid growing specimens. The 1949-50 winterkill eliminated the green sunfish population.

Black crappie

Two black crappie, *Pomoxis nigro-maculatus* (Le Sueur), 9

and 12 inches long, were found among the winterkilled fish in March, 1949.

Yellow perch

One male yellow perch, *Perca flavescens* (Mitchill), 6.2 inches total length, was taken in a gill net in August 1948, and a 6.5 inch perch was found among the winterkilled fish in April, 1949.

Summary and Discussion

As little Wall Lake began to fill up after being completely dry in 1940 and 1941, a fish population developed. Apparently green sunfish and black bullheads got into the lake by 1944. Bluegills and largemouth bass were stocked in 1945. Bluegills reproduced successfully in 1947 and appeared to be replacing the green sunfish. All species except some bullheads, green sunfish, and fathead minnows were eliminated during the winter of 1948-49 after the water level dropped. The green sunfish were eliminated the next winter by more severe conditions. The bullheads and fathead minnows probably survive in muskrat burrows and other areas where oxygen may be available. Deepening of the lake by dredging in 1953 has changed conditions so that a new population of fish may survive.

The green sunfish showed rapid growth, reached a large size for this species, and provided good fishing in 1948. Bullheads showed rather slow growth, which may be the result of an overabundance of this species despite winterkilling each year from 1949 through 1953.

Literature Cited

Carlander, K. D. 1953 Handbook of freshwater fishery biology with the first supplement. W. C. Brown, Dubuque, Iowa. 429 pp.

Carlander, K. D. and R. A. Fredin 1948 Management of small ponds for fish production. Progress Report, Iowa Coop. Wildl. Res. Unit, Oct.-Dec.: 101-105.

Dobie, J. R., O. L. Meehean and G. N. Washburn 1948 Propagation of minnows and other bait species. U.S. Fish and Wildl. Serv. Circ. 12: 113 pp.

Forney, John L. 1955 Life history of the black bullhead, *Ameiurus melas* (Rafinesque), of Clear Lake, Iowa. Iowa St. Coll. J. Sci 30(1):145-162.

Iowa State Conservation Commission 1952 Report for biennium ending June 30, 1952. Des Moines, Iowa. 206 pp.

Lewis, William M. 1949 The use of vertebrae as indicators of the age of northern black bullhead, *Ameiurus m. melas* (Rafinesque). Iowa St. Coll. J. Sci. 22(2):209-218.

Rose, Earl and Tom Moen 1951 Results of increased fish harvest in Lost Island Lake. Trans. Amer. Fish. Soc. 80: 50-55.

Sprugel, George, Jr. 1954 Growth of bluegills in a new lake, with particular reference to false annuli. Trans. Amer. Fish. Soc. 83: 58-75

1955 The growth of green sunfish (*Lepomis cyanellus*) in Little Wall Lake, Iowa, Iowa St. Coll. J. Sci. 29(4):707-719.

Department of Zoology and Entomology
Iowa State College
Ames, Iowa

