2 copies to Dr. Pirnie

INSTITUTE FOR FISHERIES RESEARCH
UNIVERSITY MUSEUMS
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ANN ARBOR, MICHIGAN

Report 289

June 5, 1935

# THE FISH FAUNA OF WINTERGREEN LAKE ON THE KELLOGG BIRD SANCTUARY, KALAMAZOO COUNTY, MICHIGAN

On May 3, 4, and 5, 1935 a party (R. W. Eschmeyer, D. Shetter, and G. Cooper) from the Institute for Fisheries Research cooperated with members of the staff at the Kellogg B ird Sanctuary (Dr. Pirnie, Lyman, and Allen) in a study of the fish fauna of Wintergreen Lake. The participation by the Institute in this study was at the request of Dr. Pirnie, and was intended to aid the Sanctuary staff in their present limnological study of the lake. During this three-day period an intensive sampling of the fish fauna was made; scale samples for further study were taken from a large series of each of the game species; and tagging experiments were initiated.

The collecting of fishes from the lake was done by means of several types of gear. Records were taken of all specimens collected by each type of gear in order to obtain a quantitative and qualitative estimate of the fish fauna. Most of the larger game fishes were examined, while fresh, in the field and scale samples were taken; the minnows and young game fish were preserved.

Since this study is to be considered of a preliminary nature and supplementary to the limnological study, the data are given in detail for each of the collections in order to retain their value for future reference. At this time we are able to describe the methods used for each collection, and to give, for each species collected, the number of specimens and certain remarks concerning their size and age. The several hundred game fishes which were collected offer excellent material for growth rate studies, but as yet, time has not been sufficient to allow for this phase of the study; it is hoped that the growth rate report will be forthcoming soon.

## Fish Fauna of the Lake

A list of the species of fish taken from Wintergreen Lake during this three-day study is here presented, giving both the scientific and common names. Further investigations will, no doubt, increase this list considerably. Throughout the remainder of the report only the common names are used.

| Family | Scientific Name | Common name |
|---|---|---|
| Amiidae | Amia calva | Dogfish |
| Catostomidae | Erimyzon sucetta kennerlii | Chub sucker |
| Cyprinidae | Notropis heterodon heterodon | Black-chinned Shiner |
| " | Notropis heterolepis heterolepis | Black-nosed Shiner |
| " | Notropis cornutus frontalis | Common Shiner |
| " | Notemigonus crysoleucas auratus | Golden Shiner |
| " | Hyborhynchus notatus | Bluntnosed Minnow |
| Ameiuridae | Ameiurus natalis | Yellow Bullhead |
| Percidae | Perca flavescens | Yellow Perch |
| " | Poecilichthys exilis | Iowa Darter |
| Centrarchidae | Aplites salmoides | Largemouthed Black Bass |
| " | Helioperca macrochira | Bluegill |
| " | Eupomotis gibbosus | Pumpkinseed Sunfish |
| " | Helioperca × Eupomotis | Bluegill × Sunfish hybrid |

## Weather during period of study

During the entire day of May 3, there was a moderate, cold rain turning to snow in the early part of the evening; the air temperature remained near freezing; and a strong NNE wind produced waves on the lake averaging about 8 inches high. On May 4 the air was warmer, the day generally fair (sky part cloudy, no rain, and very little breeze), and the lake was quiet. On May 5, the air was again colder, the sky was completely cloudy, and there was a light rain during the middle of the day. If it is desired, a more detailed account of the prevailing weather conditions can be obtained from the records of the Sanctuary.

## Gill net - 800 feet, 3 1/2 inch stretched mesh

Eight hundred feet of 3 1/2" mesh gill net was set in a straight line between points A and B (see map sketch of lake) at 11 A.M., May 3, 1935.

At 1 P.M. (May 3) the net was examined and found to contain: 1 adult Yellow

Perch, 1 adult Bluegill and 4 adult Pumpkinseed Sunfish; these fish were not removed from the net.

At 4 P.M. (May 3) this net was examined and found to contain: 2 adult Yellow Perch, 1 adult Largemouthed Black Bass, 2 adult Bluegills, and 8 adult Pumpkinseed Sunfish; these fish were not removed from the net.

At 8 P.M. (May 3) this net was examined and found to contain 15 fish, the specific identity of which was not determined due to darkness; these fish were not removed from the net.

At 7:30 P.M. (May 4) the net was examined and found to contain:

| | |
|---|---|
| Yellow Perch | 4 adults |
| Largemouthed Black Bass | 3 adults |
| Pumpkinseed Sunfish | 4 adults |
| Yellow Bullhead | 1 adult |

These fish were removed from the net, the bullhead was preserved, and scale samples were taken from the perch, bass and sunfish. In addition to the specimens removed, the net contained the remains of 3 Yellow Perch and 3 Pumpkinseed Sunfish; these fish had evidently been partially eaten during the night by predators—possibly turtles, dogfish or bullheads.

At 10 A.M. (May 4) the net was examined and the following fishes were obtained:

| | |
|---|---|
| Yellow Perch | 1 adult |
| Bluegill | 2 adults |
| Pumpkinseed Sunfish | 3 adults |
| Yellow Bullhead | 1 adult |
| Dogfish | 1 adult |

All of these specimens were preserved. The bullhead and dogfish had apparently been attracted to the net by the remains of two perch noted and left in the net on the previous examination—each of these two fish was ensnared in the net within 6 inches from the remains of a perch.

At 1:30 P.M. (May 4) the net contained:

| | |
|---|---|
| Yellow Perch | 2 adults |
| Bluegill | 4 adults |

These fish were removed and scale samples were taken.

During this continual set from 11 A.M., May 3 to 1:30 P.M., May 4 between stations A and B, the catch of perch was confined chiefly to the 1/3 of the net length lying to the northeast (next to A), while the catch of each of the remaining species was distributed quite equally throughout the length of the net.

At 2 P.M. (May 4) this 800-foot unit of 3 1/2 inch mesh gill net was set in the position A to C to D (see map). Between positions C and D, the net was located 100 to 200 feet from the shore. The operations in placing the net in this position were begun at position A and the set was completed at D at 2 P.M. Immediately the net was examined, starting at position A. From 2 to 3 P.M. the section of the net from A to C took only 1 Bluegill, while the section from C to D took several each of Pumpkinseed Sunfish, Bluegills, and Largemouthed Black Bass. At 3 P.M. the section of the net from A to C was shifted to $E^1C$ so that the entire net thus lay in the position $E^1CD$, at which position it was left until 4 P.M. During this period from 2 to 4 P.M., the net was examined 3 times, during which were taken from the net:

| | |
|---|---|
| Largemouthed Black Bass | 29 adults |
| Bluegills | 17 adults |
| Pumpkinseed Sunfish | 24 adults |

Scale samples were taken from the entire lot. Our observations during the setting of this net were that the water depth over the area from A to C was considerably more than 10 feet; and the depth along the set from $E^1$ to C to D was less than 10 feet.

At 4 P.M. (May 4) the position of the net was shifted slightly to $E^2D$, approximately 10 to 30 feet nearer shore than in the previous position. The water depth along this position was estimated as less than 10 feet and as low as 4 feet along the end of the net to the northwest. The net was examined twice between 4 and 8 P.M., during which were removed from the net:

| | |
|---|---|
| Yellow Perch | 1 adult |
| Largemouthed Black Bass | 14 adults |
| Bluegills | 15 adults |
| Pumpkinseed Sunfish | 11 adults |
| Yellow Bullhead | 1 adult |

The bullhead was preserved, and scale samples were taken from the remaining specimens.

At 8 P.M. (May 4) this net was again pulled somewhat (10 to 30 feet) closer to the shore, especially along the northeast end of the lake, to the position $E^3D$ (see map). At $E^3$ the water depth was approximately 3 feet, at D approximately 6 feet, while the maximum depth along the net was not more than 8 feet.

At 9:30 A.M. (May 5) the net was lifted from its $E^3D$ position and the following fish were obtained:

| | |
|---|---|
| Largemouthed Black Bass | 13 adults |
| Bluegills | 16 adults |
| Pumpkinseed Sunfish | 25 adults |
| Bluegill × Pumpkinseed Sunfish hybrid | 1 adult |
| Yellow Bullhead | 3 adults |

The entire lot was preserved. The hybrid, together with 1 sunfish and 1 bluegill, was left at the Kellogg Bird Sanctuary for future reference as to hybrid identity; scale samples of these three specimens were taken.

Gill net—300 feet, 1 1/4 inches stretched mesh

At 10:30 A.M. (May 4) a 300-foot unit of 1 1/4 inch mesh gill net was set across the NE bay at the position F to G (see map). The water depth along this set was 4 to 6 feet. The net was left in this position during its employ.

At 2 P.M. (May 4) the net was examined and 1 bass and 16 adult Golden Shiners were obtained—many shiners escaped from the net as it was being raised.

The net was again examined at 8 P.M. (May 4) and only 8 adult Golden Shiners were obtained—about half of the total catch of the net escaped while the net was being raised.

At 9:30 A.M. (May 5) the net was lifted and the following fish were obtained: 1 Golden Shiner, 1 Bluegill and 2 Yellow Bullheads (all preserved). The remains of more than a dozen adult Golden Shiners indicated that these fish had been des-

troyed by predators (probably bullheads). The two bullheads had obviously been attracted to the net by entailed shiners.

## Bag seine — 100 feet

The seine was, for each haul, set with a boat. The net was set at a distance of 100 to 150 feet from the shore and dragged in toward the shore by means of ropes. The net covered an along-shore distance of approximately 75 feet; thus in each haul it covered an area varying from 75 × 100 feet to 75 × 150 feet. A soft bottom and numberous snags impaired the efficiency of this seine—it was estimated that, of the fish trapped by the seine, there was an escape of approximately 25% of the larger fish (adult bass, sunfish, bluegills, etc.) and at least 50% of the smaller fish (minnows, and young game fish) because of frequent holes in the bag of the seine and the difficulty in operating the seine due to the large amount of bottom debris which accumulated within the bag.

Between 2:30 and 4:30 P.M. (May 3) two hauls were made with the 100-foot bag seine at the "point" on the east shore of the lake (stations $X^1$ and $X^2$—see map). The submerged shore bottom at this point was sand (covering a width of several feet immediate to the shore line) and a marly muck (beyond the sand zone). Examinations were made in the field upon, and scale samples were taken from, most of the larger specimens collected, namely:

| | |
|---|---|
| Yellow Perch | 7 adults |
| Largemouthed black bass | 8 adults |
| Bluegills | 8 adults |
| Pumpkinseed sunfish | 19 adults |

The remainder (preserved) of the total catch included:

| | |
|---|---|
| Yellow Perch | 12 young |
| Bluegill | 1 adult |
| Pumpkinseed Sunfish | 3 juvenile and 1 young |
| Blacknosed Shiner | 15 adults |
| Golden Shiner | 20 young to adult |

From 9 to 12 A.M. (May 4) four hauls were made with the 100-foot bag seine along the east shore of the lake at stations $X^3$, $X^4$, $X^5$ and $X^6$ (see map). Three

of these hauls were made in relatively open water; one haul was made through a bed of yellow water-lilies (Nymphaea). The entire catch by these four hauls included many adult game fish which were tagged (employing the metal jaw tag), and a large series of smaller fishes (minnows and young game fish) which were preserved. The specimens which were tagged and released included:

| | |
|---|---|
| Yellow Perch | 4 adults |
| Largemouthed Black Bass | 18 adults |
| Bluegills | 18 adults |
| Pumpkinseed Sunfish | 8 adults |

The preserved collection of these four hauls (about 95% of which were taken by the one seine haul through the bed of aquatic vegetation) included:

| | |
|---|---|
| Pumpkinseed Sunfish | 1 adult & 3 young |
| Golden Shiner | 1 adult & 16 young to juvenile |
| Black-chinned Shiner | 69 juvenile to adult |
| Black-nosed Shiner | 410 juvenile to adult |
| Blunt-nosed Minnow | 200 juvenile to adult (males near breeding condition) |

The weed bed habitat was clearly being used more than the open water by the minnows, but there was no apparent difference in the concentration of the adult game fishes in the two types of habitat.

Common sense seine—30 feet

Between 2 and 2:30 P.M. (May 3) 6 hauls with a 30-foot common sense seine were made at the "point" on the east shore between stations $X^1$ and $X^3$. These hauls covered about 150 feet of shore, out 50 feet to a water depth of 3'. The submerged shore bottom in this area was sand and marly muck. The following fishes were taken:

| | |
|---|---|
| Yellow Perch | 6 young |
| Pumpkinseed Sunfish | 3 young |

Between 1:30 and 2 P.M. (May 4) 4 hauls were made with the 30-foot seine along the NE shore between stations $X^7$ and $X^8$. The water temperature was 10°C. ; the air 12 1/2°C. The bottom was sand. Seining was done from shore to 20 feet out, to a water depth of 4 feet. The following fishes were collected:

| | |
|---|---|
| Yellow Perch | 12 young |
| Bluegill | 1 juvenile |
| Pumpkinseed Sunfish | 1 adult |
| Blacknosed Shiner | 1 adult |
| Bluntnosed Minnow | 3 adults |

Between 2:30 and 2:45 P.M. (May 4) 9 hauls were made along the NW shore between stations $X^9$ and $X^{10}$. The water temperature was 10°C., the air 12 1/2°C. The bottom was debris and marly peat, with very little sand and gravel at the shore margin. The shoreline was marshy. The seining covered the immediate shore waters to 15 feet out to a water depth of 4 feet. The following fishes were collected:

| | |
|---|---|
| Yellow Perch | 5 young |
| Largemouthed Black Bass | 1 young |
| Bluegill | 2 young |
| Pumpkinseed Sunfish | 1 young |
| Iowa Darter | 2 adults |
| Blackchinned Shiner | 44 young to adults |
| Blacknosed Shiner | 33 juveniles to adults |
| Bluntnosed Minnows | 62 " " |

Between 3 and 3:15 P.M. (May 4) one continuous haul was made in the outlet between stations $X^{11}$ and $X^{12}$. The bottom was chiefly debris and fibrous peat. In places the water depth was as great as 5 feet. The water temperature was 11 degrees C., the air 11 1/2°C. The following fishes were collected:

| | |
|---|---|
| Large-mouthed Black Bass | 5 adults (tagged & liberated) |
| Pumpkinseed Sunfish | 1 adult (tagged & liberated) |
| Blackchinned Shiner | 13 young to adults |
| Blacknosed Shiner | 10 young to adults |
| Golden Shiner | 325 young to adults |

Between 4:15 and 4:45 P.M. (May 4) 5 hauls were made along the SE shore between stations $X^{13}$ and $X^{14}$. The bottom was chiefly marly peat and debris with a small amount of sand at the shore margin. The seined area was from shore out 20 to 50 feet to a water depth of 3 feet. The water temperature was 9°C., the air 12°C. The seining was difficult due to snags. The following fishes were collected:

| | |
|---|---|
| Yellow Perch | 1 young |
| Pumpkinseed Sunfish | 3 young |
| Blackchinned Shiner | 58 young to adults |
| Bluntnosed Minnow | 13 young to adults. |

Between 11:30 A.M. and 12:30 P.M. (May 5) 3 hauls were made in the "exhibit

pond" at the south end of the lake at stations $X^{15}$, $X^{16}$, and $X^{17}$. Two of the hauls were made at the east end of the pond, and the third haul was made within the bay-network at the south edge of the pond. The maximum water depth within the area seined was approximately 4 feet. The bottom was chiefly muck and debris. The following fishes were collected:

| | |
|---|---|
| Yellow perch | 6 young |
| Largemouthed Black Bass | 1 juvenile & 18 young |
| Bluegill | 5 young |
| Pumpkinseed Sunfish | 2 juveniles and 37 young |
| Bluegill × Sunfish hybrid | 2 young |
| Iowa Darter | 2 adults |
| Chub Sucker | 3 young |
| Blackchinned Shiner | 164 young to adults |
| Blacknosed Shiner | 130 juveniles to adults |
| Bluntnosed Minnow | 44 juveniles to adults |
| Golden Shiner | 56 young |
| Common Shiner | 2 young |

Other methods of obtaining specimens

In addition to the fishes collected by the gill nets and seines other specimens were obtained as follows:

At 9 A.M. (May 5) one Common Shiner (nearly dead) was found floating at the surface at the NE corner of the lake.

The following specimens were obtained from Mr. Durward Allen who had collected them (from May 2 to 5) by means of a wire trap set near the mouth of the outlet:

| | |
|---|---|
| Chub Suckers | 3 adults |
| Large-mouthed Black Bass | 2 adults |
| Yellow Bullhead | 1 adult |

The number of fish of each species as taken by each type of gear (gill nets and seines) at each locality is given in the following table. The totals given in this table also indicate the total number of specimens of each species taken throughout the study, and the total number of specimens taken by each type of gear at each location.

Table 1. The number of specimens of each species of fish taken at each station by each type of gear, during the study of Wintergreen Lake, May 3-5, 1935

| Species | Gill net—800-ft. unit 3 1/2" stretched mesh[1] | | | | Gill net 300-ft. | Bag seine 100-ft. | | Seine—30-ft. common sense | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Net positions[2] | | | | Net position | At stations | | Between stations | | | | | | |
| | A-B[3] | $E^1$-D[4] | $E^2$-D | $E^3$-D | F-G[5] | $X^1$&$X^2$ | $X^3$-$X^6$ | $X^1$&$X^3$ | $X^7$&$X^8$ | $X^9$&$X^{10}$ | $X^{11}$&$X^{12}$ | $X^{13}$&$X^{14}$ | $X^{15}$&$X^{17}$ | |
| Dogfish | 1 | ... | ... | ... | ... | ... | .... | ... | ... | ... | ... | ... | ... | 1 |
| Chub Sucker | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 3 |
| Blackchinned Shiner | ... | ... | ... | ... | ... | ... | 69 | ... | ... | 44 | 13 | 58 | 164 | 348 |
| Blacknosed Shiner | ... | ... | ... | ... | ... | 15 | 410 | ... | 1 | 33 | 10 | ... | 130 | 599 |
| Common Shiner | ... | ... | ... | ... | ... | ... | ... | .... | ... | ... | ... | ... | 2 | 2 |
| Golden Shiner | ... | ... | ... | ... | 25 | 20 | 17 | ... | ... | ... | 325 | ... | 56 | 443 |
| Bluntnosed Minnow | ... | ... | ... | ... | ... | ... | 200 | ... | 3 | 62 | ... | 13 | 44 | 322 |
| Yellow Bullhead | 2 | ... | 1 | 3 | 2 | ... | ... | ... | ... | ... | ... | ... | ... | 8 |
| Yellow Perch | 10 | ... | 1 | ... | ... | 19 | 4 | 6 | 12 | 5 | ... | 1 | 6 | 64 |
| Iowa Darter | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2 | ... | ... | 2 | 4 |
| Largemouthed Black Bass | 3 | 29 | 14 | 13 | 1 | 8 | 18 | ... | ... | 1 | 5 | ... | 19 | 111 |
| Bluegill | 6 | 17 | 15 | 16 | 1 | 9 | 18 | ... | 1 | 2 | ... | ... | 5 | 90 |
| Pumpkinseed Sunfish | 10 | 24 | 11 | 25 | ... | 23 | 12 | 3 | 1 | 1 | 1 | 3 | 39 | 153 |
| Bluegill × Sunfish hybrid | ... | ... | ... | 1 | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 3 |
| Total no. specimens | 32 | 70 | 42 | 58 | 29 | 94 | 748 | 9 | 18 | 150 | 354 | 75 | 472 | 2151 |

[1] All specimens taken by this net were the larger specimens of the species (all adults or approaching maturity).

[2] The net positions and stations are indicated on the accompanying outline map.

[3] Included in this list are the 3 perch and 3 sunfish which were destroyed by predators; scale samples from these 6 fish were not obtained.

[4] The single bluegill, taken by the section of the net from A to C (see text), is included here.

[5] This net took only adults of the four species.

## Relative abundance of the different species within the lake

It is not to be supposed that any reliable comparison, in minute detail, in the relative abundance of all the species within the lake could be made from the present study. Such a comparison would require an intensive sampling over a considerable period of time in each type of habitat within the lake. However, the writer feels that certain general statements are justified.

The lake appears to be supporting populations of adult bass and bluegills which are more or less equal; the pumpkinseed sunfish seems to outnumber the bass and bluegills considerably (indicated by the catches of both gill nets and seines). The perch is less abundant than either of the three centrarchids, and the bullhead is less abundant than any of the four game species. The capture of only one dogfish might be taken to indicate that this fish is not sufficiently abundant to be a serious fish predator.

Among the forage species, four are quite abundant in the lake, namely: the Blackchinned Shiner, the Blacknosed Shiner, the Golden Shiner, and the Bluntnosed Minnow. The Chub Sucker and Iowa Darter are considered as little more than rare in abundance. The Common Shiner probably does not reproduce in the lake; the three individuals which were obtained might have been introduced (Dr. Pirnie stated that many creek minnows were dumped into the lake by bait-fishermen during the previous winter, and the presence in Wintergreen Lake of the three specimens which were collected might correctly be attributed to such an introduction).

## Relative distribution of the different species throughout the lake

Here again there is too great an element of uncertainty in making detailed comparisons. The following remarks on relative abundance are based entirely on the number of each species taken at each location, and the validity of these remarks depends entirely upon the amount of selectivity involved in making the collections due to the type of gear used and the method of its employ. Several enlightening facts are brought

out by a comparison of the data already presented:

The adult bass, bluegills, and sunfish were concentrated on or near the shallows, in water 10 feet or less in depth. The 800-foot gill net set in position A to B (through the deep part of the lake) for 26 1/2 hours took 2 bullheads, 10 perch, 3 bass, 6 bluegills and 10 sunfish; the same net set in the shallows along the NE shore (positions $E^1$ to D, $E^2$ to D, and $E^3$ to D) for 19 1/2 hours took 4 bullheads, 1 perch, 56 bass, 48 bluegills and 60 sunfish. This concentration was perhaps to be associated with the approaching spawning season. The greatest concentrations of young sunfish and bass were found in the "exhibit pond".

Te n of the fifteen adult perch were taken by the gill net in deep water near position A indicating somewhat of a concentration of this species in the deeper part of the lake. Along the shore shallows of the lake proper, young perch were more abundant than young bass, bluegills or sunfish.

The greatest concentration of Golden Shiners was found in the channel which has at times served as an outlet, however, the catch by the small-mesh gill net indicated that the open water of the lake may have had a large population of the adults of this species. The Blunt-nosed Minnow, the Blackchinned Shiner, and the Black-nosed Shiner were found to be abundant at several stations on the lake proper and in the "exhibit pond".

Relative abundance of the different age groups of the game species

There appeared to be a pronounced scarcity of young bass, bluegills and sunfish in the lake proper (23 of the 24 young bass and most of the young sunfish and bluegills collected were taken from the "exhibit pond" and the outlet).

The population of young game fish in the lake appears to be rather scarce as compared with that of other lakes with which the writer is acquainted. The apparent scarcity of these young may have been due to their concentration in the deeper part of the lake where they would not have been taken by the large-mesh gill net. That this was the condition is doubtful, however further investigations should be made to determine the abundance of the young of these game species in the lake.

The most striking discrepancy in the game fish fauna of the lake was the apparent absence of bass, bluegills, sunfish, and perch of the size range between that of yearlings and adults. While it is conceivable that gear-selectivity may have been entirely responsible for the almost total absence of the one- and two-year-olds of these four species in our catch, this is not probable. Had these juvenile stages been present in shallow water, some would have been taken by the 100-foot seine; had they been at all abundant in deep water some, especially sunfish and bluegills, would have been taken by the large-mesh gill net.

A determination of the relative abundance of the various age groups of the game species in the lake is a problem of prime importance in formulating a fish-management policy for the lake. The relative abundance of the various age groups of game species may be quite different in different lakes, and may vary in the same lake over a period of years. Examples of the following types of game fish populations in lakes have been observed by the writer:

1. A lake may be supporting a large population of adult game fish, but may be deficient in the numbers of the young and juvenile stages due to improper spawning conditions in certain years or to a poor survival of the young. Under these conditions those young which did survive would be expected to have a rapid growth. If such a lake is heavily fished, one would expect that the lack of several consecutive year groups would be reflected in a period of poor fishing returns.

2. A lake may have a relatively small population of young game fish, but sufficient, however, to maintain a maximum population of adult fish. Under these conditions a good growth rate would also be expected.

3. Reproduction and the survival of the young may be such as to build up a great population of young fish. It is commonly assumed, and probably erroneously so, that this condition is most desirable. However, under great population pressure, competition, and probably other factors, inhibit growth to some extent.

Wintergreen Lake apparently is a lake of the first or second category—the immature stages of the game species may not be sufficient to maintain the maximum fish production

of the lake (in which event some stocking or improvement of spawning conditions are desirable), or the population of young may be sufficient to maintain the present fish yield, in which event the "natural balance" might well be left undisturbed. It is certain that there is not an overabundance of young game fish in this lake. Furthermore, in the growth rate of game fish, Wintergreen Lake compares very favorably with other lakes of southern Michigan and with lakes of northern Indiana.

INSTITUTE FOR FISHERIES RESEARCH

Gerald P. Cooper

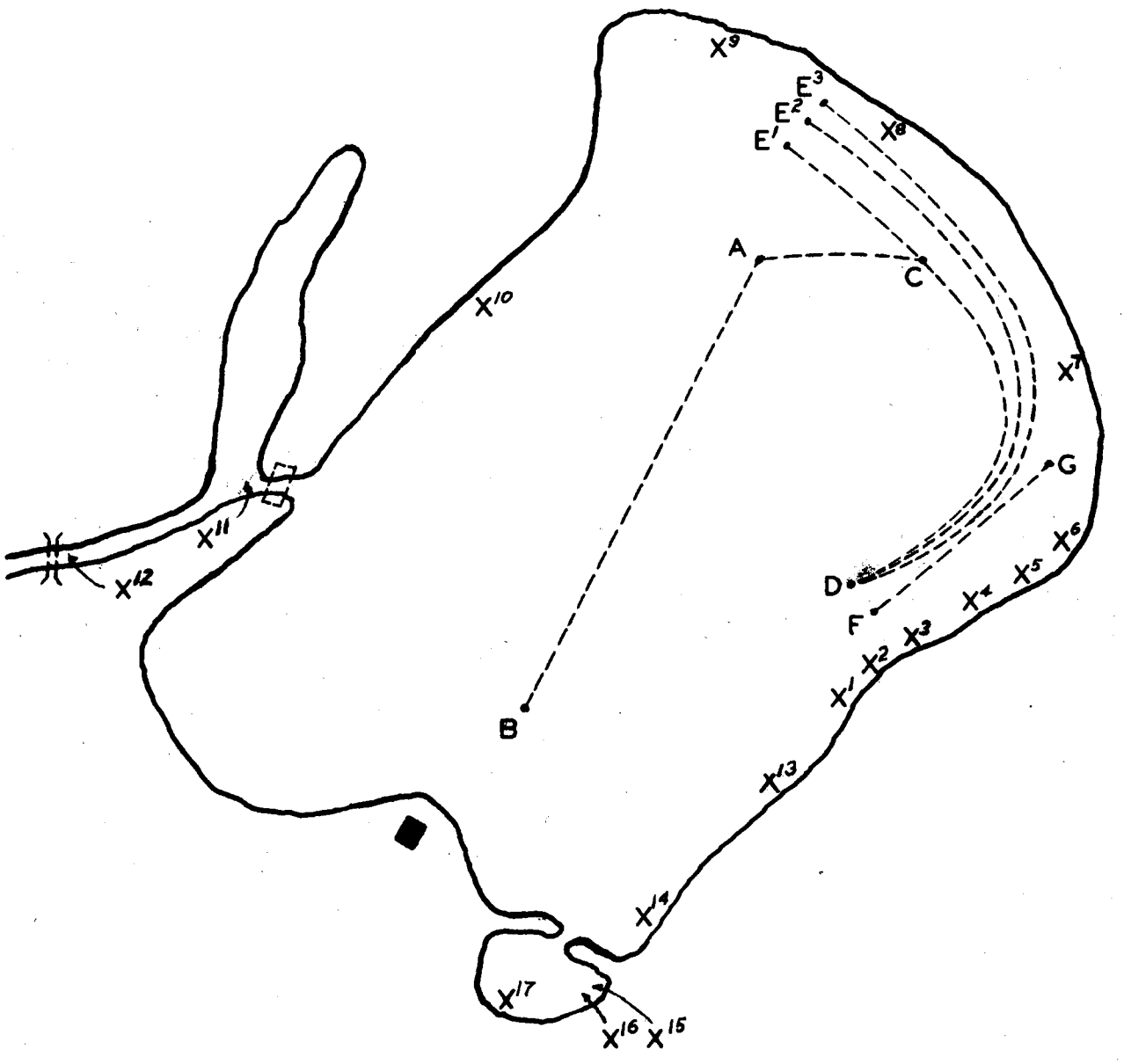
Gerald P. Cooper
Forage Fish Investigator

GPC:B

# WINTERGREEN LAKE

W. K. KELLOGG BIRD SANCTUARY, KALAMAZOO COUNTY, MICHIGAN

MAY 2-5, 1935




THE POSITIONS OF THE NET SETS ARE SHOWN AS BROKEN LINES. EACH LOCALITY SEINED IS INDICATED BY AN X.

INSTITUTE FOR FISHERIES RESEARCH
UNIVERSITY MUSEUMS
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ANN ARBOR, MICHIGAN

June 18, 1935

Correction to Report 289

On page 7, under the list of fishes given as:

"The preserved collection of these four hauls (about 95% of which were taken by the one seine haul through the bed of aquatic vegetation) included:

| | |
|---|---|
| Pumpkinseed Sunfish | 1 adult and 3 young |
| Golden Shiner | 1 adult & 16 young to juvenile |
| etc." | |

Add to this list:

| | |
|---|---|
| Bluegill | 1 young |
| Yellow Perch | 10 young |

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ANN ARBOR, MICHIGAN

June 18, 1935

Appendix to Report 289

# AGE AND GROWTH OF THE GAME FISH OF WINTERGREEN LAKE [1]

This appendix to Report 289 deals with the results of studies on age and growth of the four species of game fish (Yellow Perch, Largemouthed Black Bass, Pumpkinseed Sunfish, and Bluegills) collected during the examination of Wintergreen Lake on May 3-5, 1935. The material available for this study, and the methods by which it was obtained, are summarized in Table I.

Weights and lengths of a majority of the adult fish were taken in the field while the specimens were fresh; some of the adults and all of the young were weighed and measured after being in preservative fluid for about one month (see footnotes to Table I). Scales from practically all of the adult fish were mounted in glycerine-jelly and examined by means of a projecting machine; scales of all young fish were examined with the aid of a microscope.

In Table II are given for each of these four species the average standard lengths and the average weights of each year group. The size and weight range within each year group is not included in this report, however, it is available for future reference.

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[1] The material upon which this report is based, does not include material considered in previous reports.

Table I. The number of each species of game fish, examined for the present study, as collected by the various types of gear from the different localities within Wintergreen Lake, May 2-5, 1935.

| Species | Gill net 800 foot[1] | | Gill net[1] 300-foot | Seines[2] | | Fish trap | Total |
|---|---|---|---|---|---|---|---|
| | A-B[3] | A-C-D,[4] $E^1$-D, $E^2$-D, and $E^3$-D | F-G[5] | From lake[6] proper | From exhibit[7] pond | From outlet[5] | |
| Yellow Perch | 7 | 1 | ... | 53 | 6 | ... | 67 |
| Largemouthed Black Bass | 3 | 56 | 1 | 9 | 19 | 2 | 90 |
| Pumpkinseed sunfish | 7 | 60 | ... | 35 | 39 | ... | 141 |
| Bluegill | 6 | 48 | 1 | 13 | 5 | ... | 73 |
| Sunfish × Bluegill hybrid | ... | 1 | ... | ... | 2 | ... | 3 |
| Total | 23 | 166 | 2 | 110 | 71 | 2 | 374 |

[1] The gill nets took only adult fish.

[2] All young and juvenile fish were taken by seines. All young and juvenile fish were weighed and measured after being in preservative fluid for about one month.

[3] Of this group of fish, 1 perch, 3 sunfish and 2 bluegills were weighed and measured after being in preservative for about one month (formalin for four days; then alcohol). The remaining fish were weighed and measured while fresh.

[4] Of this group of fish, 13 bass, 15 bluegills and 24 sunfish were weighed and measured after being in preservative for about one month.

[5] Fish weighed and measured after being in preservative for about one month.

[6] About one-half of the specimens listed here are adults. These adults were weighed and measured while fresh.

[7] Almost all young fish.

Table II. Age and rate of growth of the game fishes of Wintergreen Lake. The average total length in inches, the average standard length in millimeters, and the average weight in grams are given for each age group of each sex (and for the sexes combined) of the four game-fish species. The standard lengths are computed; the total lengths are estimates based on the standard length.

| | Completed growing seasons | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Yellow Perch | I | II | III | IV | V | VI | VII | VIII |
| Females | | | | | | | | |
| Approximate total length in inches | .... | 4.8 | .... | .... | .... | 11.7 | 12.2 | 11.8 |
| Standard length in millimeters | .... | 104 | .... | .... | .... | 252 | 267 | 255 |
| Weight in grams | .... | 16.5 | .... | .... | .... | 370 | 332 | 340 |
| Number of specimens | .... | 1 | .... | .... | .... | 2 | 3 | 3 |
| Males | | | | | | | | |
| Approximate total length in inches | .... | .... | 7.8 | .... | .... | 9.8 | 9.7 | 10.2 |
| Standard length in millimeters | .... | .... | 172 | .... | .... | 214 | 211 | 222 |
| Weight in grams | .... | .... | 90 | .... | .... | 190 | 180 | 210 |
| Number of specimens | .... | .... | 2 | .... | .... | 3 | 1 | 1 |
| Both sexes | | | | | | | | |
| Approximate total length in inches | 3.4 | 4.8 | 7.8 | .... | .... | 10.5 | 11.7 | 11.3 |
| Standard length in millimeters | 72 | 104 | 172 | .... | .... | 229 | 253 | 247 |
| Weight in grams | 5.6 | 16.5 | 90 | .... | .... | 262 | 294 | 308 |
| Number of specimens | 51 | 1 | 2 | .... | .... | 5 | 4 | 4 |
| LARGEMOUTHED BLACK BASS | | | | | | | | |
| Females | | | | | | | | |
| Approximate total length in inches | .... | 8.7 | 10.4 | 11.6 | 12.0 | 12.5 | .... | .... |
| Standard length in millimeters | .... | 180 | 220 | 243 | 250 | 262 | .... | .... |
| Weight in grams | .... | 121 | 188 | 350 | 394 | 468 | .... | ..... |
| Number of specimens | .... | 1 | 1 | 16 | 27 | 2 | .... | .... |
| Males | | | | | | | | |
| Approximate total length in inches | .... | .... | 11.5 | 11.7 | 12.2 | 13.1 | .... | .... |
| Standard length in millimeters | .... | .... | 240 | 244 | 255 | 273 | .... | .... |
| Weight in grams | .... | .... | 375 | 355 | 419 | 396 | .... | .... |
| Number of specimens | .... | .... | 2 | 10 | 10 | 2 | .... | .... |
| Both sexes | | | | | | | | |
| Approximate total length in inches | 4.0 | 8.7 | 11.3 | 11.7 | 12.0 | 12.7 | .... | .... |
| Standard length in millimeters | 83 | 180 | 233 | 244 | 251 | 268 | .... | .... |
| Weight in grams | 10.6 | 121 | 313 | 352 | 400 | 432 | .... | .... |
| Number of specimens | 19 | 1 | 3 | 26 | 37 | 4 | .... | .... |
| BLUEGILL | | | | | | | | |
| Females | | | | | | | | |
| Approximate total length in inches | .... | .... | 7.5 | 8.5 | 8.8 | 9.4 | 9.3 | 9.4 |
| Standard length in millimeters | .... | .... | 152 | 169 | 176 | 188 | 185 | 187 |
| Weight in grams | .... | .... | 158 | 176 | 226 | 261 | 289 | 280 |
| Number of specimens | .... | .... | 14 | 2 | 6 | 9 | 5 | 4 |
| Males | | | | | | | | |
| Approximate total length in inches | .... | .... | 7.4 | 8.9 | 8.9 | 9.3 | 9.6 | .... |
| Standard length in millimeters | .... | .... | 149 | 179 | 178 | 185 | 195 | .... |
| Weight in grams | .... | .... | 151 | 215 | 230 | 265 | 292 | .... |
| Number of specimens | .... | .... | 13 | 2 | 3 | 3 | 3 | .... |

| | Completed growing seasons | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII |
| BLUEGILL (continued) | | | | | | | | |
| Both sexes | | | | | | | | |
| Approximate total length in inches | 2.0 | .... | 7.5 | 8.7 | 8.8 | 9.4 | 9.5 | 9.4 |
| Standard length in mm. | 40 | .... | 151 | 174 | 176 | 187 | 189 | 187 |
| Weight in grams | 1.9 | .... | 155 | 196 | 228 | 262 | 290 | 280 |
| Number of specimens | 9 | .... | 27 | 4 | 9 | 12 | 8 | 4 |
| PUMPKINSEED SUNFISH | | | | | | | | |
| Females | | | | | | | | |
| Approximate total length in inches | .... | 3.7 | 6.9 | 7.6 | 8.2 | 8.2 | 8.1 | .... |
| Standard length in millimeters | .... | 82 | 143 | 159 | 169 | 169 | 166 | .... |
| Weight in grams | .... | 21 | 160 | 219 | 225 | 237 | 217 | .... |
| Number of specimens | .... | 2 | 17 | 5 | 6 | 10 | 2 | .... |
| Males | | | | | | | | |
| Approximate total length in inches | .... | 4.7 | 6.9 | 7.3 | 8.1 | 8.1 | .... | .... |
| Standard length in millimeters | .... | 95 | 142 | 152 | 167 | 167 | .... | .... |
| Weight in grams | .... | 37 | 148 | 186 | 231 | 209 | .... | .... |
| Number of specimens | .... | 5 | 26 | 4 | 10 | 6 | .... | .... |
| Both sexes | | | | | | | | |
| Approximate total length in inches | 2.0 | 4.5 | 6.9 | 7.5 | 8.2 | 8.2 | 8.1 | .... |
| Standard length in millimeters | 41 | 91 | 142 | 156 | 168 | 168 | 166 | .... |
| Weight in grams | 2.2 | 33 | 152 | 204 | 229 | 227 | 217 | .... |
| Number of specimens | 48 | 7 | 43 | 9 | 16 | 16 | 2 | .... |
| BLUEGILL $\varphi$ × SUNFISH HYBRID | | | | | | | | |
| Approximate total length in inches | 2.4 | 7.1 | .... | .... | .... | .... | .... | .... |
| Standard length in millimeters | 47 | 145 | .... | .... | .... | .... | .... | .... |
| Weight in grams | 3 | 200 | .... | .... | .... | .... | .... | .... |
| Number of specimens | 2 | 1 | .... | .... | .... | .... | .... | .... |

In reports 280 and 289 the writer has made several general remarks on the growth rate of the game fishes of this lake. The present data appear to support most of the previous statements:

1. That the rate of growth of the game fish of this lake is very rapid, especially during the first three or four years of life, and compares very favorably with the growth of the same species in other lakes of southern Michigan and with lakes of northern Indiana.

2. That the growth of perch is quite evenly distributed throughout the different years of life.

3. That, among the bluegills and sunfish, the greatest growth is obtained during the second, third and fourth years, the average third years growth being phenomenal.

4. That greatest growth by the bass is obtained during the second, third and fourth years.

However, the probability of a dominant VII-year-class among the bluegills and perch is not validated.

The data given in Table II are sufficient only to indicate a general trend in rate of growth for each of the four species, there being no significant indication of a sexual dimorphism in growth rate. The number of specimens in the samples are apparently not sufficient to reveal, among the bass, bluegills and sunfish, the expected increased growth of the males over the females.

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Appendix 2 to Report 289

July 11, 1935

# A REPORT ON FURTHER COLLECTIONS OF FISHES FROM WINTERGREEN LAKE.

Since the completion of the "Appendix to Report 289 - Age and growth of the game fish of Wintergreen Lake", two collections of fishes and three scale samples have been received by the Institute from the Kellogg Bird Sanctuary staff. This report deals with the identification of the fishes in these two collections, and with the analysis of the game species in the collections relative to age groups.

The first collection (seined by D. L. Allen and F. E. Lyman from the north end of Wintergreen Lake on May 24, 1935) contained the following specimens (including eight species):

| | |
|---|---|
| Bluntnose Minnow | 11 adults |
| Black-chined Shiner | 11 adults |
| Black-nosed Shiner | 34 adults |
| Golden Shiner | 24 juveniles (yeadings) |
| Large-mouthed Black Bass | 7 yearlings (young of 1934) |

The lengths of these seven bass are as follows:

| | Standard length | Total length |
|---|---|---|
| | 115 mm. | 140 mm. |
| | 111 mm. | 133 mm. |
| | 108 mm. | 131 mm. |
| | 91 mm. | 112 mm. |
| | 87 mm. | 109 mm. |
| | 85 mm. | 107 mm. |
| | 85 mm. | 106 mm. |
| Average | 97 mm. | 120 mm. |

The 1934-35 winter annulus on the scales had not been formed at the time of capture (May 24); therefore it appears that these young bass had made no growth during 1935.

Yellow Perch — 12 yearlings (young of 1934)

The lengths of these 12 perch are as follows:

| | Standard length | Total length |
|---|---|---|
| | 83 mm. | 96 mm. |
| | 80 mm. | 93 mm. |
| | 79 mm. | 94 mm. |
| | 77 mm. | 91 mm. |
| | 71 mm. | 85 mm. |
| | 71 mm. | 83 mm. |
| | 70 mm. | 82 mm. |
| | 69 mm. | 80 mm. |
| | 68 mm. | 80 mm. |
| | 67 mm. | 79 mm. |
| | 66 mm. | 79 mm. |
| | 66 mm. | 78 mm. |
| Average | 72 mm. | 85 mm. |

These fish had made considerable growth during 1935. Scales taken from the side of the body, behind the pectoral fin, revealed 6 to 8 circuli of growth subsequent to the 1934-35 winter annulus.

Bluegill — 6 yearlings, 1 juvenile

| | Standard length | Total legnth | Completed growing seasons |
|---|---|---|---|
| | 52 mm. | 64 mm. | I |
| | 49 mm. | 62 mm. | I |
| | 48 mm. | 61 mm. | I |
| | 47 mm. | 60 mm. | I |
| | 45 mm. | 56 mm. | I |
| | 41 mm. | 52 mm. | I |
| Average | 47 mm. | 59 mm. | I |
| | 101 mm. | 127 mm. | II |

These fish (both yearling and juvenile( had added 2 to 5 scale circuli representing 1935 growth.

Pumpkinseed Sunfish — 3 yearlings and 30 II-year-olds

| | Standard length | Total length | Completed growing seasons |
|---|---|---|---|
| | 52 mm. | 65 mm. | I |
| | 50 mm. | 62 mm. | I |
| | 36 mm. | 46 mm. | I |
| Average | 46 mm. | 58 mm. | I |

| | Standard length | Total length | Completed growing seasons |
|---|---|---|---|
| | 112 mm. | 139 mm. | II |
| | 108 mm. | 133 mm. | II |
| | 107 mm. | 136 mm. | II |
| | 106 mm. | 131 mm. | II |
| | 102 mm. | 127 mm. | II |
| | 101 mm. | 125 mm. | II |
| | 100 mm. | 126 mm. | II |
| | 100 mm. | 123 mm. | II |
| | 99 mm. | 123 mm. | II |
| | 96 mm. | 119 mm. | II |
| | 96 mm. | 118 mm. | II |
| | 93 mm. | 116 mm. | II |
| | 93 mm. | 116 mm. | II |
| | 92 mm. | 115 mm. | II |
| | 92 mm. | 114 mm. | II |
| | 91 mm. | 114 mm. | II |
| | 91 mm. | 110 mm. | II |
| | 90 mm.× | 115 mm. | II |
| | 90 mm. | 113 mm. | II |
| | 90 mm. | 113 mm. | II |
| | 90 mm. | 113 mm. | II |
| | 89 mm. | 112 mm. | II |
| | 89 mm. | 111 mm. | II |
| | 88 mm. | 109 mm. | II |
| | 87 mm. | 109 mm. | II |
| | 87 mm. | 108 mm. | II |
| | 85 mm. | 106 mm. | II |
| | 82 mm. | 103 mm. | II |
| | 77 mm. | 97 mm. | II |
| Average | 94 mm. | 117 mm. | II |

Scales of these sunfish revealed 4 to 8 circuli representing growth during 1935.

The second collection (seined by D. L. Allen and F. E. Lyman from the "Exhibit Pond" at the south end of Wintergreen Lake on May 24, 1935) contained the following specimens (including eight species and one hybrid):

| | |
|---|---|
| Bluntnose Minnows | 6 juvenile to adult |
| Black-chined Shiner | 1 adult |
| Black-nosed Shiner | 10 adults |
| Golden Shiner | 2 juvenile to adult |
| Large-mouthed Black Bass | 5 yearlings (young of 1934) |

| | Standard length | Total length |
|---|---|---|
| | 96 mm. | 120 mm. |
| | 96 mm. | 119 mm. |
| | 95 mm. | 118 mm. |
| | 88 mm. | 111 mm. |
| | 81 mm. | 101 mm. |
| Average | 91 mm. | 114 mm. |

The scales of all five bass revealed no growth during 1935.

Yellow Perch — 1 yearling - S.L. 61 mm., T. L. 73 mm.

Considerable growth during 1935.

Bluegill — 2 yearlings

| | Standard length | Total length |
|---|---|---|
| | 49 mm. | 64 mm. |
| | 45 mm. | 59 mm. |
| Average | 47 mm. | 62 mm. |

Scales revealed 3 to 4 circuli representing 1935 growth.

Pumpkinseed Sunfish — 8 yearlings, and 25 II-year-olds

| | Standard length | Total length | Completed growing seasons |
|---|---|---|---|
| | 49 mm. | 61 mm. | I |
| | 48 mm. | 61 mm. | I |
| | 46 mm. | 58 mm. | I |
| | 46 mm. | 57 mm. | I |
| | 46 mm. | 57 mm. | I |
| | 45 mm. | 57 mm. | I |
| | 42 mm. | 52 mm. | I |
| | 40 mm. | 50 mm. | I |
| Average | 45 mm. | 57 mm. | I |
| | 94 mm. | 120 mm. | II |
| | 92 mm. | 116 mm. | II |
| | 88 mm. | 110 mm. | II |
| | 87 mm. | 110 mm. | II |
| | 86 mm. | 109 mm. | II |
| | 85 mm. | 107 mm. | II |
| | 85 mm. | 106 mm. | II |
| | 84 mm. | 106 mm. | II |
| | 84 mm. | 106 mm. | II |
| | 81 mm. | 104 mm. | II |
| | 81 mm. | 103 mm. | II |
| | 81 mm. | 103 mm. | II |
| | 80 mm. | 102 mm. | II |
| | 80 mm. | 101 mm. | II |
| | 80 mm. | 101 mm. | II |
| | 79 mm. | 100 mm. | II |
| | 79 mm. | 99 mm. | II |
| | 78 mm. | 98 mm. | II |
| | 77 mm. | 98 mm. | II |
| | 74 mm. | 95 mm. | II |
| | 74 mm. | 94 mm. | II |

| | Standard length | Total length | Completed growing seasons |
|---|---|---|---|
| | 74 mm. | 94 mm. | II |
| | 74 mm. | 94 mm. | II |
| | 74 mm. | 93 mm. | II |
| | 73 mm. | 92 mm. | II |
| Average | 81 mm. | 102 mm. | II |

The scales of these sunfish revealed 4 to 8 circuli representing growth in 1935.

Bluegill × Pumpkinseed Sunfish — One II-year-old - S.L. 80 mm., T. L. 103 mm.

The scales of this fish revealed somewhat more growth in 1935 than the growth of either the parent species.

In addition to these two collections, scale samples from three Large-mouthed Black Bass, taken from Wintergreen Lake, were received from Dr. Pienie. The data given on the scale sample envelopes, together with the age of each fish, are as follows:

| Date (1935) | Standard length (mm.) | Total length (mm.) | Weight (grams) | Sex | Conditions of sex organs | Gear | Completed growing seasons |
|---|---|---|---|---|---|---|---|
| July | 230 | 280 | 225 | Male | Spent | Hook | III |
| July 1 | 250 | 303 | 300 | " | " | line | V |
| July 1 | 295 | 355 | 450 | Female | Not active | .... | VII |

The scales of these three fish indicated that the III-year-old had made some growth during 1935, but neither of the two older fish had made any growth during this season.

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