

6.—A REPORT UPON THE FISHES OF KALAMAZOO, CALHOUN, AND ANTRIM COUNTIES, MICHIGAN.

BY CHARLES H. BOLLMAN.

In 1885 the Fish Commissioners of Michigan began a systematic survey of the lakes and rivers of that State with a view to ascertaining the results of the early efforts at stocking those waters, and also their adaptability to different kinds of fish. This information was only to be obtained by a careful examination of each body of water as to its quality, temperature, depth, inhabitants, and food-resources. Field parties were organized from among the employés of the State Commission, and their work has been continued during each summer down to the present time. An account of their investigations will be found in the seventh and eighth biennial reports of the State Board of Fish Commissioners, published at Lansing, Mich., in 1887 and 1888.

No professional naturalist was attached to these parties previous to 1888, and their researches regarding the inhabitants of the lakes and rivers were chiefly limited to the commoner species of fish. For the purpose of obtaining a more comprehensive knowledge of the fauna, the writer was employed by the U. S. Fish Commissioner to accompany the Michigan party in 1888, as naturalist, under an arrangement with the State Commissioners. The present paper contains a brief outline of the explorations made during that season, and a list of the fishes taken, together with such notes upon them as seem to have some permanent value. On account of its northern position the State of Michigan has comparatively few kinds of fishes. The number of species enumerated in the following list is proportionally still smaller, for the reason that the bodies of water examined in 1888 have all essentially the same characters with respect to temperature and nature of bottom (usually fine mud or pulverent vegetable matter), as well as to the flora and fauna. A set of the fishes collected has been placed in the U. S. National Museum at Washington. The invertebrates have not yet been studied.

The places visited may be divided according to the river basins into three principal groups, as follows:

I.—THE ST. JOSEPH SYSTEM.

1. *Long Lake*, Kalamazoo County, situated about 7 miles south of Kalamazoo. Length, 2 miles; width, three-quarters of a mile; greatest depth, 42 feet; surface temperature, 73° to 74°; bottom temperature, 52° to 53°; date of examination, July 8 to 11. The southern parts of this lake have gravelly and sandy shores, while those of the northern parts are marshy, and the lake is diversified by patches of bulrushes, *Potamogeton*, and other aquatic plants.

2. *Austin Lake*, Kalamazoo County, about a quarter of a mile from Long Lake and

connected with it by a small stream. This lake has been ruined by being drained, and now has a depth of only from 12 to 15 feet, while formerly it was nearly twice as deep. Its size is somewhat larger than that of Long Lake. Date of examination, July 12 and 13.

3. *Indian Lake*, Kalamazoo County. This lake lies several miles to the southeast of Long Lake. Its length is $2\frac{1}{4}$ miles; width, 1 mile; greatest depth, 76 feet; temperature at surface, 72° to 73° ; at bottom, 54° . Date of examination, July 11 and 12.

4. *Gourd-neck Lake*, Kalamazoo County, lies several miles to the southwest of Long Lake. Length, $1\frac{1}{4}$ miles; width, one-half mile; greatest depth, 50 feet; temperature at surface, 73° to 75° ; at bottom, 49° to 50° . Date of examination, July 12 to 14. Eastern shores somewhat gravelly, the remainder marshy, with a steep offset. Outlet wide at southern end.

5. *Rawson Lake*, Kalamazoo County, lies about $2\frac{1}{2}$ miles southwest of Vicksburgh. Length, $1\frac{1}{4}$ miles; width, one-half mile; greatest depth, 30 feet; temperature at bottom, 51° to 53° ; at surface, 72° to 74° . The lake is without gravelly shores, its central parts being rather shallow and filled with species of *Potamogeton*. The northern parts, especially around the inlet, contain water-lilies and *Utricularia* in large quantities. There are two inlets, the northern one from the preceding lakes, the southern from the following.

6. *Howard Lake*, Kalamazoo County, is situated just south of Rawson Lake, and is connected with it by a wide outlet and several small lakes. Length, three-fourths mile; width, one-fourth mile; greatest depth, 46 feet; temperature at surface, 72° to 73° ; at bottom, 44° . Date of examination of Rawson and Howard Lakes, July 16 to 20. Characters the same as those of Rawson Lake.

II.—THE KALAMAZOO SYSTEM.

1. *Goguac Lake*, Calhoun County, is located 1 mile south of Battle Creek. Length, $1\frac{1}{2}$ miles; width, one-half mile; greatest depth, 65 feet; temperature at surface, 73° to 75° ; at bottom, 43° to 51° . Date of examination, July 20 to 25. This is a very irregular lake, with sandy and gravelly shores and marshy places at the heads of the coves. It has no outlets or inlets.

2. *St. Mary's Lake*, Calhoun County, is located 4 miles north of Battle Creek. Length, 1 mile; width, one-fourth mile; greatest depth, 24 feet; temperature at bottom, 53° to 54° ; at surface, 74° . Date of examination, July 24 and 25. Characters the same as those of Goguac Lake.

3. *Barnum* and *Payne's Lakes*, Calhoun County. These are two unimportant lakes lying about 5 miles south of Battle Creek, each having a length of about 1 mile, and a width of one-fourth to one-third of a mile; greatest depth, 30 to 40 feet; temperature at surface, 73° ; at bottom, 49° . Date of examination, July 22 to 24. Shores muddy.

4. *Upper* and *Lower Brace Lakes*, Calhoun County. These lakes lie about $2\frac{1}{2}$ miles southeast of Marshall, and have the same characters as the two preceding ones, but with higher temperatures and less depth. Shores very muddy. Date of examination, July 30 to August 1. These two lakes are connected and flow into Wilder Creek.

5. *Lyon Lake*, Calhoun County, is situated about 3 miles south of the preceding lakes. Length, one-half mile; width, one-third mile; greatest depth, 30 feet; temperature at surface, 73° to 76°; at bottom, 67°. Date of examination, August 1 and 2. It has very clear water and sandy shores. There is neither outlet nor inlet.

6. The *Kalamazoo River* was examined at two points, namely, at Battle Creek and Marshall. It is a rapid stream with gravelly bottom. The quiet places are choked up with mud and débris. At Marshall the gill-nets were used and set above the dams.

III.—ELK RIVER SYSTEM.

1. *Torch Lake*, Antrim County. Length, 18 miles; width, 2½ miles; depth, about 320 feet; temperature at surface, 67° to 69°; at bottom, 32½° to 48°. The water is very clear and partakes of the character of that of the Great Lakes. Shores sandy and gravelly; vegetation scarce. It flows into Elk River by way of Torch River, Round Lake, and Elk Lake.

2. *Clam Lake*, Antrim County. This is a small lake flowing into Torch Lake by Clam River. Its waters are dark and its fauna is more southern in character than that of Torch Lake.

3. *Rapid River*, Antrim County. A small, rapid trout stream flowing into Torch River; temperature, 50° to 55°.

4. *Spencer Creek*, Antrim County, has the same character as Rapid River. There are two dams near the mouth, and above them two kinds of fish only are found, namely, *Salvelinus fontinalis* and *Cottus bairdi*. The rest of the species mentioned as found in Spencer Creek may be considered as also occurring in Torch Lake. These places were examined between August 8 and 18.

Following is a list of the species of fishes observed at the above localities:

1. *Petromyzon concolor* (Kirtland). *Lamprey-eel*.¹

One specimen found in Wilder Creek clinging to a dead *Catostomus teres*. This individual differs from any of the known specimens of *P. concolor* in having on each side of the mouth four teeth of the first concentric series bicuspid.

2. *Lepisosteus platystomus* (Rafinesque). *Gar*.

Long and Austin Lakes.

3. *Amia calva* Linnæus. *Lawyer*, *Dog-fish*, *Mudfish*.

Not common; Long Lake and Austin Lake.

4. *Ameiurus nebulosus* (Le Sueur). *Bull-head*.

Very common; Long, Austin, Indian, Gourd-neck, Rawson, Goguac, Barnum, St. Mary's, Upper and Lower Brace, and Lyon Lakes; Kalamazoo River, at Battle Creek and Marshall.

5. *Noturus flavus* (Rafinesque).

Kalamazoo River, at Battle Creek.

One individual found guarding its progeny under a stone.

¹The common names given are those used by Michigan fishermen.

6. *Catostomus teres* (Mitchill). *White Sucker*.

Common or abundant; Indian, Rawson, Goguac, St. Mary's, Barnum, Payne's, Upper and Lower Brace, and Torch Lakes; Kalamazoo River, at Battle Creek and Marshall.

7. *Catostomus nigricans* Le Sueur. *Stone-roller, Nigger-head, Hammer-head*.

Common; Kalamazoo, at Battle Creek and Marshall.

8. *Erimyzon sucetta* var *oblongus* (Mitchill). "*Pin Minnow*" (young).

Common; Long, Austin, Rawson, Howard, Barnum, and St. Mary's Lakes.

9. *Moxostoma duquesnei* (Le Sueur). *Golden Red-horse*.

Common; Lower Brace Lake; Kalamazoo River, at Battle Creek and Marshall.

10. *Pimephales notatus* (Rafinesque).

Abundant at all places.

11. *Notropis hudsonius* (De Witt Clinton).

Long, Austin, Indian, Gourd-neck, Rawson, Howard, and Clam Lakes. Common in the southern lakes, but not so in Clam Lake.

12. *Notropis megalops* (Rafinesque).

Abundant; Kalamazoo River, at Battle Creek and Marshall.

13. *Notropis atherinoides* (Rafinesque).

Not common; Kalamazoo River, at Battle Creek, Torch Lake, and Spencer Creek.

14. *Rhinichthys atronasmus lunatus* (Cope).

Common; Austin Creek, Torch and Clam Lakes and Spencer Creek.

Body much mottled, spots confluent above, gradually fading out towards belly; lateral band indistinct; fins plain. D. midway between C. and nostril; snout rather long; head 4-4½ in body; eye, 5-5½ in head; lat. l. 62-65.

In this paper I have considered the Michigan specimens as forming a variety of *atronasmus*, on account of the pattern of coloration. *Lunatus* is separated from *obtusius* by having the scales along lateral line less (62-65 instead of 70).

15. *Hybopsis kentuckiensis* (Rafinesque).

Common; Kalamazoo River, at Battle Creek and Marshall.

16. *Semotilus atromaculatus* (Mitchill).

Common; Howard Lake, Austin Creek, Kalamazoo River, at Battle Creek and Marshall.

17. *Notemigonus chrysoleucus* (Mitchill). *Golden Shiner*.

Not common; Long and Lyon Lakes.

18. *Coregonus clupeiformis* (Mitchill). *Common Whitefish*.

Torch Lake.

19. *Coregonus artedi* (Le Sueur). *Herring*.

Abundant; Torch Lake, Traverse Bay.

20. *Coregonus artedi sisco* (Jordan). *Sisco*.

Not common; Indian and Rawson Lakes.

21. *Coregonus tullibee bisselli*, subsp. nov.

Related to *Coregonus tullibee*, but presenting the following differences: Maxillary reaching to middle of eye; end of supplementary bone rounded; lower jaw longer when closed; supraorbital bone elongate pear-shaped; eye $4\frac{1}{2}$ – $4\frac{2}{3}$ in head; scales anteriorly scarcely larger in diameter than those on caudal peduncle; lat. l. 80–82; head $4\frac{1}{3}$ – $4\frac{1}{2}$; depth $3\frac{1}{2}$.

One specimen was caught in Rawson Lake and thirteen were taken in Howard Lake. The above description is based upon two specimens—one from each lake. I take great pleasure in dedicating this new variety to Mr. John H. Bissell, president of the Michigan Fish Commission.

22. *Salvelinus namaycush* (Walbaum). *Lake Trout, Mackinaw Trout.*

Common in Torch Lake.

23. *Salvelinus fontinalis* (Mitchill). *Brook Trout, Speckled Trout.*

Abundant; Torch Lake, Rapid River, Spencer and Austin Creeks

24. *Fundulus diaphanus menona* Jordan & Copeland.

Abundant; Goguae, St. Mary's, Upper and Lower Brace, and Lyon Lakes.

25. *Zygonectes notatus* (Rafinesque).

Rare; Rawson and Howard Lakes.

26. *Umbra limi* (Kirtland).

A few were taken in a small brook which flows into Howard Lake; one in Goguae Lake, and three in Rapid River.

27. *Lucius lucius* (Linnaeus). *Grass Pike, Pickerel.*

Common; Indian, Gourd-neck, Rawson, Goguae, Lower Brace, and Clam Lakes; Spencer Creek.

28. *Lucius vermiculatus* Le Sueur.

Common; Rawson and Goguae Lakes; Wilder Creek.

29. *Anguilla anguilla chrysypa* (Rafinesque). *Eel.*

Gourd-neck and Rawson Lakes.

30. *Pygosteus pungitius* (Linnaeus).

Common in Rapid River; not seen elsewhere.

31. *Eucalia inconstans* (Kirtland).

Not common; seen in Rapid River.

32. *Labidesthes sicculus* (Cope).

Common; Long, Austin, Gourd-neck, Rawson, Howard, Goguae, St. Mary's, and Lyon Lakes.

33. *Aphredoderus sayanus* Gilliams.

Two specimens taken in a small brook which flows into Howard Lake.
Scales in lateral line about 60.

34. *Pomoxis sparoides* (Lacépède). *Calico Bass, Strawberry Bass, Speckled Bass.*

Very common; Long, Indian, Austin, Gourd-neck, Rawson, Howard, Goguae, St. Mary's, Upper Brace, and Lyon Lakes.

35. *Ambloplites rupestris* (Rafinesque). *Rock Bass*.
Common; Long, Gourd-neck, Rawson, Goguac, Lower Brace, Torch, and Clam Lakes.
36. *Chænobryttus gulosus* (C. and V.). *Buffalo Bass*.
Common; Rawson and Lower Brace Lakes.
37. *Lepomis cyanellus* Rafinesque. *Buffalo Sun-fish*.
Common; Rawson, Goguac, and St. Mary's Lakes.
38. *Lepomis pallidus* (Mitchill). *Blue-gill, Bream*.
Abundant in all the lakes examined, with the exception of Torch Lake, where none were found; also taken in the Kalamazoo River.
39. *Lepomis megalotis* (Rafinesque).
Not common or rare; Rawson, Payne's, and Clam Lakes; Kalamazoo River.
40. *Lepomis gibbosus* (Linnæus). *Pumpkin-seed*.
Has the same distribution as *Lepomis pallidus*.
41. *Micropterus dolomieu* (Lacépède). *Small-mouthed Black Bass*.
Common in Torch Lake and the Kalamazoo River. Two young were taken in Goguac Lake.
42. *Micropterus salmoides* (Lacépède). *Large-mouthed Black Bass, Green Bass, Gray Bass, Oswego Bass*.
Abundant; Long, Austin, Indian, Gourd-neck, Rawson, Howard, Goguac, Payne's, Barnum, St. Mary's, Upper and Lower Brace, Lyon, Torch, and Clam Lakes; Kalamazoo River, at Marshall and Battle Creek; Spencer Creek.
43. *Etheostoma nigrum* (Rafinesque).
Common; Long, Goguac, Torch, and Clam Lakes; Kalamazoo River, at Battle Creek and Marshall; Spencer Creek.
44. *Etheostoma caprodes zebra* (Agassiz).
Common; Goguac and Torch Lakes; Spencer Creek.
45. *Etheostoma aspro* (Cope & Jordan).
One specimen found in a fish-box at Long Lake. It was said to have been caught in the Kalamazoo River, at Kalamazoo.
46. *Etheostoma cœruleum* Storer.
Common in the Kalamazoo River, at Battle Creek and Marshall.
47. *Etheostoma fusiforme eos* (Jordan & Copeland).
Rawson, Goguac, St. Mary's, and Thayer's Lakes. D IX, 11; A 11, 7; lateral line 58-60, tubes 15-22. Cheeks scaly.
None of the specimens observed in Rawson, Gognac, and St. Mary's Lakes were over 45^{mm} in length, while all from Thayer's Lake were 55^{mm} long.
48. *Etheostoma exilis* (Girard).
Clam Lake. D. VII, 10; A. 11, 7; lateral line extending to end of anal, scales 55; tubes interrupted, 37-40. Cheeks naked. This is probably also a variety of *E. fusiforme*.

49. *Perca flavescens* (Mitchill). *Yellow Perch*.
Abundant in all the lakes examined.
50. *Stizostedion vitreum* (Mitchill). *Wall-eyed Pike*.
Two specimens caught in Gourd-neck Lake.
51. *Cottus bairdi* Girard. *Miller's Thumb*.
Common; Rice Creek, Spencer Creek, and Rapid River; Torch Lake.
52. *Trigloporus thompsoni* Girard.
Fifteen specimens taken from the stomach of a *Salvelinus namaycush*, which was caught in Torch Lake.
53. *Lota lota* (Linnæus). *Ling, Lawyer*.
Common in Torch Lake.
- INDIANA UNIVERSITY, February 18, 1889.

7.—NOTES ON FISHES FROM THE LOWLANDS OF GEORGIA. WITH A DESCRIPTION OF A NEW SPECIES (*OPSOPCEODUS BOLLMANI*).

BY CHAS. H. GILBERT.

During the latter part of June, 1889, Mr. Charles H. Bollman, assisted by Mr. Bert Fesler, undertook the exploration of the lowland streams of the Southern United States in the interests of the U. S. Fish Commission. The work was but fairly begun, when Mr. Bollman was prostrated by an attack of fever, which proved fatal. The following notes are on the material collected by him. The streams examined are thus described by Mr. Bollman:

(a) *Brier Creek at Waynesborough, Ga.*—A cold, sluggish stream, with steep banks, and apparently hard, sandy bottom; about 10 feet deep, and 40 to 50 feet wide, and without shallow spots. The specimens were chiefly obtained in a very small lagoon, with muddy shores, a short distance from the main stream.

(b) *A small stream in the southern suburbs of Savannah.*—This is a small, sluggish stream, about a mile long. At the place seined it was 6 to 10 feet wide and 2 to 4 feet deep, with a very muddy bottom.

(c) *The Ogeechee River at Millen, Ga.*—At this point the river is deep and sluggish, and overhung with dense vegetation. Greatest width, 40 to 50 feet; depth, 4 to 10 feet. On account of the depth and the character of the shores, seining was done in a small running lagoon, a few miles southwest of Millen. Here the water was very muddy, the bottom being of mud in the shallower parts near shore, and of compact sand in the deeper portions. Fishes were most abundant in the shallower water near shore, none except minnows being found in the deeper running part.

(d) *Buckhead Creek, a tributary of the Ogeechee River at Millen.*—The stream was seined at the railroad bridge, 1 mile southwest of Millen. At this point the creek is 40 to 50 feet wide, and 8 feet deep in midstream, with a bottom of hard sand. Most of