to 22 or 23, and the region of greatest convexity in the dorsal valve has approached, somewhat, the beak. The youngest individual is conspicuously shorter on the hinge line than farther forward. In fact it in every respect approaches the generalized type of Brachiopod shell, as Beecher & Clarke have shown to be the case in the species of the Waldron fauna.*

The Cold-Blooded Vertebrates of Winona Lake and Vicinity.†

By Earl E. Ramsey.

Winona Lake is located in sections 15, 16, 17, 21 and 22 of Township 32 north, Range 6 east, in Kosciusko County, Indiana. The main body of the lake is about one mile southeast of Warsaw. It is one of the series of lakes belonging to the Mississippi drainage system and is drained into the Tippecanoe River. It lies about six miles south of the watershed between the St. Lawrence and the Mississippi basins.

The lake is irregular in outline and has an area of 0.98 square miles. The greatest length is from north to south and is somewhat more than one mile. The average width is about five-eighths of a mile. The greatest depth is 81 feet.

The lake, like all the small lakes of northern Indiana, is of glacial origin. The catchment basin is large as compared with the size of the lake itself. Unusually heavy rains change the lake level as much as two to two and one-half feet. The tributary streams are three in number. The largest is Cherry Creek, which flows into the lake on the southeast. For the most part it flows through woodland. Two other streams, the larger of which is Clear Creek, enter the lake at its extreme southern part. The output of Clear Creek is nearly as much as that of Cherry Creek. Numerous springs on the Winona Assembly grounds drain into the lake. Lands lying to the north are drained into Pike Lake and Center Lake, both of which lie about one mile northwest of Winona Lake.

The outlet is situated at the southern part of a small bay connecting with the main lake on the northwest. It empties into Tippecanoe River at a point about one mile northwest of Warsaw.

The shore line, for the most part, is low. On the north, a small stretch of cultivated land rises rapidly to a ten-foot elevation line. The Winona Assembly grounds on the east have the greatest elevation. This

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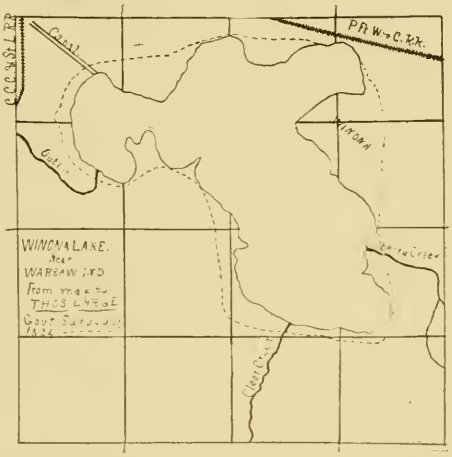
†Contributions from the Zoölogical Laboratory of the Indiana University, C. H. Eigenmann, Director, No. 39.

elevation is from ten to fifty rods back from the lake. The other parts of the ground lie below a ten-foot line. The south shore is uniformly low and swampy. On the west, an abrupt raise is found at Yarnelle's Landing. To the north of the landing, the shore is low, and the elevation gradual. Natural woodland is found at Yarnelle's, at the outlets of both Clear Creek and Cherry Creek and on the Assembly grounds.



The shores are about equally divided between sand and turf formation. A peninsula extending into the lake from the Winona grounds is of turf. On the south a great part of the shore, as well as the shore of the bay on the west of the main lake, is of such a formation. Other parts are sandy. In a general way, that part of the land which has lately been reclaimed from the lake has a coast line formed of decayed plant life—turf.

By reference to the map of Eagle Lake (now Winona Lake) prepared by the U. S. Survey in 1834, it will be seen that the lake was considerably larger at that time than now. The difference in the lake has been brought about, first by dredging the outlet channel and lowering the level of the lake; second, by the encroachment of plant life upon the lake proper, and the luxuriant plant life on the land partially dried by lowering the lake level. As noted farther on, the plant life of the lake is abundant. The dense banks of Scirpus, Nuphar, etc., tend to collect material that may float into them, and they also contribute their own growth to the formation of new lake bottom. A third agency which has acted in some parts of the lake—notably the southern part—is that of the ice. With the lowerin of the lake level, stretches of lake bottom were left barely covered by

water and were in most cases separated from the land by deeper water. As the ice formed, it pushed the ground higher on these shallow places. The ice cracks in excessively cold weather, the cracks fill with water and freeze again. This crowds the ice and the substratum of earth still farther shoreward. Very much of the south shore of the lake shows such a formation. The ice-beach near the outlet of Clear Creek is at least thirty inches above lake level and separates a dense swamp from the lake. In this swamp thus isolated from the main lake, the semi-aquatic plants readily establish themselves and thus finally reclaim the swamp land.

The plant life in the lake is abundant. A bank of Scirpus practically encircles the lake. Nuphar, Nymphaea, Typha, Potamogeton, Ceratophyllum and Chara are also abundant. The outlet is now entirely "overgrown" by Nuphar, Nymphaea, Typha and Scirpus arranged in water zones.

The average temperature of the water from July 6 to August 23, 1899, at a depth of two feet, was 80°; the air temperature for the same time was 81.5°. The deep water of the lake marked 41° and was, of course, subject to no diurnal changes, nor even to any considerable seasonal variation. The prevailing winds during the summer months are west to southwest.

THE FISHES.

The number of species of fishes thus far secured is forty-one. Considering the great variety of physical conditions, the number of species is small. But the number of individuals in each species is much more disappointing. The scarcity of the larger food fishes is due to the great amount of fishing in the lake. But the scarcity of the smaller fishes, the Cyprinidae, many species of the Darters, Labidesthes, etc., is not accounted for in this way.

To show the relative numbers of a very common form which serves as food for the larger species, I may take the Labidesthes sicculus. As many as a gallon of this form may be secured in either Turkey Lake or Tippecanoe Lake at a single haul of the seine. Not more than three or four dozen were secured in Winona Lake during the entire summer. This fact in itself will partially account for the scarcity of the larger food fishes. The same relative proportions are true of many other forms. The following list gives the species and locality from which they were secured. The column marked (N)* gives some notion of the relative abund-

*In some cases the number of specimens collected is marked; (+) indicates that the species is abundant; (×), not so abundant; (—), but few.

ance. Thirteen families are represented and thirty-three genera. The +'s in the other columns indicate the localities in which the various species are found.

SPECIES.	Cherry Creek.	Clear Creek.	Lake.	Outlet.	Tippecanoe R.	N.
Lampetra wilderi, Gage				+		1
Lepisosteus osseus (L)			+			1
Lepisosteus platostomus, Rafinesque			+			×
Amia calva, L			+			—
Ameiurus nebulosus (Le Sueur)			+			×
Ameiurus melas (Rafinesque)				+		2
Schilbeodes gyrinus (Mitchill)				+		3
Carpiodes (Sp——)*			+	+		2
Catostomus nigricans, Le Sueur	+	+	+	+		×
Catostomus commersoni (Lacépède)		+				—
Erimyzon sucetta oblongus (Mitchill)				+		×
Minytrema melanops (Rafinesque)		+				1
Campostoma anomalum (Rafinesque)	+	+				+
Pimephales notatus (Rafinesque)	+		+			+
Notropis whipplei (Girard)	+		+	+		+
Notropis cornutus (Mitchill)	+			+		×
Hybopsis kentuckiensis (Rafinesque)	+	+				—
Semotilus atromaculatus (Mitchill)	+	+		+		+
Abramis crysoleucus (Mitchill)			+			×
Umbra limi (Kirtland)	+					5
Lucius vermiculatus (Le Sueur)	+		+	+		×
Fundulus notatus (Rafinesque)			+			+
Fundulus dispar (Agassiz)				+		—
Labidesthes sicculus (Cope)	+		+	+		—
Pomoxis sparoides (Lacépède)			+			1
Ambloplites rupestris (Rafinesque)	+		+	+	+	+
Chænobryttus gulosus (Cuv. and Val.)	+		+	+		×
Lepomis pallidus (Mitchill)	+		+	+	+	+
Lepomis megalotis (Rafinesque)				+	+	×
Eupomotis gibbosus (Linnaeus)	+		+	+		×
Micropterus dolomieu Lacépède					+	5
Micropterus salmoides (Lacépède)	+		+	+	+	+
Percina caprodes (Rafinesque)	+		+		+	×
Hadropterus aspro (Cope and Jordan)	+		+		+	3
Boleosoma nigrum (Rafinesque)	+	+	+	+	+	+
Diplesion blennioides Rafinesque					+	2
Etheostoma iowæ, Jordan and Meek	+			+		—
Etheostoma coeruleum, Storer	+	+	+	+	+	+
Microperca punctulata, Putnam				+		—
Perca flavescens (Mitchill)	+		+	+		×
Cottus ictalops (Rafinesque)	+	+		+		+

*Two large specimens taken by fishermen were seen. The species was probably C. Velifer (Rafinesque), but no positive identification further than genus could be made.

BATRACHIANS.

This group is represented by but few species.

1. Necturus maculosus (Rafinesque). Three or four specimens were found by workmen who were deepening the channel of Cherry Creek.

2. Bufo lentiginosus americanus (Le Conte).

3. Acris gryllus gryllus (Le Conte).

4. Acris gryllus crepitans (Baird).

5. Hyla versicolor (Le Conte). But two specimens of this interesting little animal were taken.

6. Rana pipiens Kalm. This is the most abundant of the frogs.

7. Rana clamitans Latreille. The individuals of this species are nearly as numerous as those of R. pipiens.

8. Rana catesbeana Shaw. But one or two specimens found.

SNAKES.

Eight species of snakes have been found:

1. Storeria dekayi (Holbrook), is rare.

2. Clonophis kirtlandi (Kennicott). Only two or three specimens were taken.

3. Two varieties of the garter snake, Thamnophis sirtalis parietalis (Say), and Thamnophis sirtalis sirtalis L., were taken. This snake is the most abundant of the forms found in this locality. On July 19, a female bearing thirty-one well developed embryos was killed. On August 5, one kept in a pen gave birth to young. The number of young could not be ascertained.

4. Regina leberis (L.). The leather snake is abundant. It is third in this locality in point of number. On August 12, 1899, a gravid female was found having ten well developed embryos. Its haunts are along creeks.

5. Natrix sipedon (L.). This species is plentiful. On July 23, 1900, a female containing twenty-six embryos was killed. The water snake is a swamp-loving form, and is of a sullen and vicious disposition.

6. The blue racer, Bascanion constrictor (L) is the largest snake in this locality, and is comparatively abundant. When captured and put in a pen, it soon tames and seems to take delight in being handled. Its movements and shape are peculiarly graceful. Its food consists of frogs, garter snakes, etc. A specimen forty-two inches long swallowed a garter snake twenty-eight inches long. I have known it to lay its eggs about the middle of June, and have found the young hatching about the middle of September. Its egg-laying habit is worthy of note. One specimen selected the soft ground between two rows of potatoes and pushed her way under the ground. As she crawled along in this underground passage, the eggs, twenty-two in number, were laid in the channel which her body had made. Another laid her eggs in the hollow root of a half decayed stump. The eggs are white in color, and about one inch in length, and have a uniform diameter of one-half inch. The soft shell is so tough that it will sustain a weight of more than one hundred pounds without breaking. The young, when first hatched, are seven or eight inches in length. The first action when the little head is thrust through the shell is to stick out its tongue. The blue racer frequents the woods or high grass and weeds.

7. Lampropeltis doliatus triangulus (Boie) is found rarely.

8. Sistrurus catenatus (Rafinesque) is second in point of numbers. The garter snake is more plentiful than the prairie-rattler. During the summer of 1899 eleven specimens were caught, and nine were taken during the following summer. They are usually found in low land and run but little during the day unless disturbed. Nothing was learned concerning their food, since they persistently refused to eat when kept in confinement. A female kept in a pen gave birth to seven young on August 13. Several of the little ones were kept in a glass aquarium for a time. On August 17 they drank drops of water from a pipette and ate a few small bits of fresh meat. Three days later they began their first moult. They were about eight and one-half inches long at birth. A case was reported to me in which thirteen young were born. The adults are inoffensive and move slowly. They are easily captured by means of a noose slipped over their heads or by an insect net.

TURTLES.

The land and water forms together number eight species. Of these the soft-shelled turtle, the speckled tortoise, Blanding's tortoise and the box tortoise are rare. Even the commoner species are not very abundant. No more than two dozen eggs were found. They were of the Aromochelys odoratus (Latreille), and were laid in heaps of debris which had been washed up along the shore. The species are as follows:

1. Aspidonectes spinifer (Le Sueur).
2. Chelydra serpentina (L.).
3. Aromochelys odoratus (Latreille).
4. Graptemys geographicus (Le Sueur).
5. Chrysemys marginata (Agassiz).
6. Clemmys guttatus (Schneider).
7. Emydoidea blandingi (Holbrook).
8. Terrapene carolina (L.).

I desire to acknowledge the helpful suggestions of Dr. C. H. Eigenmann in the preparation of this brief report. Dr. S. E. Meek has also kindly aided me in preparing a partial catalogue of the fishes, and has mapped out the general plan of the paper.