STATE OF MICHIGAN
MICHIGAN GEOLOGICAL AND BIOLOGICAL SURVEY

Publication 10. Biological Series 3.
THE HERPETOLOGY OF MICHIGAN

BY
ALEXANDER G. RUTHVEN,
CRYSTAL THOMPSON AND HELEN THOMPSON

MEMORANDA TOWARDS A BIBLIOGRAPHY OF THE ARCHAEOLOGY OF MICHIGAN

BY
HARLAN I. SMITH

PREPARED UNDER THE DIRECTION OF
ALEXANDER G. RUTHVEN
CHIEF NATURALIST

PUBLISHED AS A PART OF THE ANNUAL REPORT OF THE BOARD OF GEOLOGICAL SURVEY FOR 1911.

LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD CO., STATE PRINTERS
1912

Contents

The Herpetology of Michigan. 3
General Introduction, by Alexander G. Ruthven. 3
The Amphibians of Michigan, by Crystal Thompson and Helen Thompson. 4
Introduction. 4
Literature. 4
Methods of Study. 5
Methods of Collecting and Preserving Specimens. . 5
Collecting 5
Keeping Live Material 6
Preservation of Specimens 6
Description of Species 7
Key to Michigan Amphibia 7
Necturus maculosus 8
Ambystoma tigrinum 9
Ambystoma punctatum 9
Ambystoma jeffersonianum 10
Plethodon erythronotus 11
Hemidactylium scutatum 12
Diemictylus viridescens 13
Bufo americanus 13
Hyla versicolor. 14
Hyla pickeringii. 15
Acris gryllus. 16
Chorophilus nigritus. 16
Rana pipiens. 17
Rana palustris. 18
Rana clamitans. 19
Rana cantabrigensis. 19
Rana septentrionalis. 20
Rana catesbeana. 21
Glossary. 22
The Reptiles of Michigan, by Alexander G. Ruthven. 23
Introduction. 23
Literature. 23
Methods of Study. 24
Methods of Collecting and Preserving Specimens. 26
Collecting 26
Cages 27
Preservation of Specimens 27
Description of Michigan Reptiles. 27
Class Reptilia. 27
Keys to the Orders and Suborders of Michigan Reptiles. 28
Order Squamata——Suborder Sauria (Lizards) 28
Key to the Genera and Species of Michigan Lizards. 28
Eumeces quinquilineatus 28
Order Squamata—Suborder Serpentes (Snakes). 29
Key to the Snakes of Michigan. 29
Storeria dekayi 30
Storeria occipitomaculata 31
Heterodon platyrhinus 32
Elaphe obsoletus 33
Elaphe vulpinus 34
Natrix sipedon 35
Regina leberis 36
Clonophis kirtlandii 37
Liopeltis vernalis 37
Diadophis punctata 38
Bascanion constrictor 39
Lampropeltis doliatus triangulus. 41
Thamnophis sauritus 42
Thamnophis butlerii 43
Thamnophis sirtalis 44
Sistrurus catenatus. 46
Order Testudinata (Turtles). 48
Key to the Genera and Species of Michigan Turtles 48
Platypeltis spinifera 48
Chelydra serpentina 50
Kinosternon odoratum 52
Chrysemys cinerea 53
Chrysemys bellii 54
Clemmys guttata 55
Graptemys geographica 56
Emydoidea blandingii 57
Terrapene carolina 58
Glossary 59
General Bibliography. 60
Memoranda Towards a Bibliography of the Archaeology of Michigan, by Harlan I. Smith. 62

List of Illustrations.

Figures.

Figure 1. Diagram of Mouth of Frog to Show Position of Teeth 6
Figure 2. Diagram of Mouth of Salamander to show Position of Teeth. 6
Figure 3. Distribution of *Necturus maculosus*. 8
Figure 4. Distribution of *Ambystoma tigrinum*. 9
Figure 5. Distribution of *Ambystoma punctatum* 10

Figure 6. Distribution of *Ambystoma jeffersonianum*.. 11
Figure 7. Distribution of *Plethodon erythronotus*.. 11
Figure 8. Distribution of *Hemidactylium scutatum*.. 12
Figure 9. Distribution of *Diemictylus viridescens*.. 13
Figure 10. Distribution of *Bufo americanus*.....14
Figure 11. Distribution of *Hyla versicolor*. 15
Figure 12. Distribution of *Hyla pickeringii*. 16
Figure 13. Distribution of *Acris gryllus*. 16
Figure 14. Distribution of *Chorophilus nigritus*. 17
Figure 15. Distribution of *Rana pipiens*. 18
Figure 16. Distribution of *Rana palustris*.....18
Figure 17. Distribution of *Rana clamitans*. 20
Figure 18. Distribution of *Rana cantabrigensis*.. 20
Figure 19. Distribution of *Rana septentrionalis*. 21
Figure 20. Distribution of *Rana catesbeana*. 21
Figure 21. Head of snake, side view, to show arrangement of scales. 25
Figure 22. Head of snake, side view, to show arrangement of scales. 25
Figure 23. Scales on the body of a snake. 26
Figure 24. Carapace of *Emydoidea blandingii*, to show position of plates.....26
Figure 25. Plastron of *Emydoidea blandingi*i, to show position of plates. 26
Figure 26. Plastron of *Chelydra serpentina*. 26
Figure 27. Plastron of *Kinosternon odoratum*. 26
Figure 28. Distribution of *Eumeces quinquilineatus*.....29
Figure 29. Distribution of *Storeria dekayi*.....31
Figure 30. Distribution of *Storeria occipitomaculata*. 31
Figure 31. Distribution of *Heterodon platyrhinus*. 32
Figure 32. Distribution of *Elaphe obsoletus*. 33
Figure 33. Distribution of *Elaphe vulpinus*.. 35
Figure 34. Distribution of *Natrix sipedon*.....36
Figure 35. Distribution of *Regina leberis*.....36
Figure 36. Distribution of *Clonophis kirtlandii*. 37
Figure 37. Distribution of *Liopeltlis vernalis*. 38
Figure 38. Distribution of *Diadophis punctata*. 39
Figure 39. Distribution of *Bascanion constrictor*. 40
Figure 40. Distribution of *Lampropeltis doliatus triangulus*. ...42
Figure 41. Distribution of *Thamnophis sauritus*. 42
Figure 42. Distribution of *Thamnophis butlerii*. 44
Figure 43. Distribution of *Thamnophis sirtalis*.....46
Figure 44. Distribution of *Sistrurus catenatus*. 48
Figure 45. Distribution of *Platypeltis spinifera*.....50
Figure 46. Distribution of *Chelydra serpentina* 51
Figure 47. Distribution of *Kinosternon odoratum*. 52
Figure 48. Distribution of *Chrysemys cinerea*. 53
Figure 49. Distribution of *Chrysemys bellii*.. 54
Figure 50. Plastron of *Chrysemys cinerea*. 54
Figure 51. Plastron of *Chrysemys bellii*. 55
Figure 52. Distribution of *Clemmys guttata*. 56
Figure 53. Distribution of *Graptemys geographica*.. 57
Figure 54. Distribution of *Emydoidea blandingii*. 58
Figure 55. Distribution of *Terrapene carolina*. 59

Plates.

Plate I. *Hemidactylium scutatum*, *Plethodon erythronotus*, *Necturus maculosus* and eggs of *Diemictylus viridescens*. 67
Plate II. A. *Ambystoma jeffersonium, Diemictylus viridescens, Ambystoma tigrinum* and *A. punctatum*. 68
Plate II. B. *Plethodon erythronotus* and eggs. 68
Plate III. A. *Bufo americanus*. 68
Plate III. B. *Hyla versicolor* and *H. pickeringii*. 68
Plate IV. A. *Chorophilus nigritus* and *Rana cantabrigensis*. ..69
Plate IV. B. *Rana palustris* and *R. pipiens*. 69
Plate V. *Rana clamitans*. 69
Plate VI. *Chelydra serpentina, Graptemys geographica, Thamnophis sauritus* and *Elaphe obsoletus*.....69
Plate VII. *Terrapene carolina*, *Platypeltis spinifer, Emydoidea blandingi, Clemmys guttata. Chrysemys cinerea,* and *Kinosternon odoratum*. 70
Plate VIII. Nest and eggs of *Eumeces quinquilineatus*. 70
Plate IX. A. *Elaphe vulpinus*. 70
Plate IX. B. *Heterodon platyrhinus*. 71
Plate X. *Bascanion constrictor*, on a limb ten feet from the ground. Photos taken near Hamburg, Livingston County, by Emil Body. 71
Plate XI. A. *Platypeltis spinifera*. 71
Plate XI. B. *Sistrurus catenatus*.....71
Plate XII. *Thamnophis sirtalis*. 71
Plate XIII. A. White's Woods near Ann Arbor. Habitat of *Rana pipiens, R. cantabrigensis, R. palustris, R. clamitans, Chorophilus nigritus, Acris gryllus, Hyla pickeringii, Diemictylus viridescens, Bufo americanus, Ambystoma tigrinum, A. punctatum, Thamnophis sirtalis* and *Lampropeltis doliatus triangulus*. 72
Plate XIII. B. Margin of pond in White's Woods near Ann Arbor, habitat of *Diemictylus viridescens* (land form.) 72
Plate XIV. A. Pond south of Cassopolis. Habitat of *Rana pipiens*. 72
Plate XIV. B. Shore of Charity Island, Saginaw Bay. Habitat of *Ambystoma jeffersonianum*. 72
Plate XV. A. Christiann Creek, Cass County. Habitat of *Rana catesbeana*. 72

Plate XV. B. Pine Barrens at Port Austin. Habitat of *Hyla versicolor* and *Heterodon platyrhinus*. 72

Plate XVI. A. Carp River, Ontonagon County. Habitat of *Rana septentrionalis* and *Chrysemys bellii*. 73

Plate XVI. B. Pond in White's Woods near Ann Arbor. Habitat of *Ambystoma tigrinum, A. punctatum* and *Acris gryllus*.73

Plate XVII. A. Woods of Charity Island. Habitat of *Lampropeltis doliatus triangulus*. 73

Plate XVII. B. Decaying log in woods at Port Austin. Breeding place of *Plethodon erythronotus*. 73

Plate XVIII. A. Pond near Geddes, Washtenaw County. Habitat of *Rana palustris* and *R. clamitans*.....73

Plate XVIII. B. Undergrowth in woods near Port Austin. Habitat of *Plethodon erythronotus*. 74

Plate XIX. Moss covered stumps in Cady's Woods south of Ann Arbor. Habitat of *Hemidactylium scutatum*. 74

Plate XX. General view in woods near Port Austin. Habitat of *Plethodon erythronotus*. 74

LETTER OF TRANSMITTAL.

To the Honorable the Board of Geological and Biological Survey of the State of Michigan:

Governor Chase S. Osborn, President.
Hon. D. M. Ferry, Jr. Vice President.
Hon. L. L. Wright, Secretary.

Gentlemen:—I beg to present herewith as a part of the report for 1911 of the Board of Geological and Biological Survey, Publication No. 10, being a contribution to the biological survey of the state authorized by Act No. 250 of the Session of 1905.

Very respectfully,
R. C. ALLEN,
Director.

Ann Arbor, Mich., October 1, 1911.

R. C. Allen, State Geologist, Lansing, Michigan:

Sir:—I transmit herewith a report upon the amphibians and reptiles of Michigan, prepared under my direction, to form a part of the series of monographs on Michigan forms that the biological division proposes to issue, and a bibliography of Michigan archaeology compiled by Mr. Harlan I. Smith of the Victoria Memorial Museum. According to our plan for the series, the papers in this report attempt to summarize our present knowledge of the subjects treated and in such a way that the results may be used by teachers and local naturalists and archaeologists.

Respectfully,
ALEXANDER G. RUTHVEN,
Chief Naturalist.

THE HERPETOLOGY OF MICHIGAN.

GENERAL INTRODUCTION.

BY ALEXANDER G. RUTHVEN.

In view of the geographical situation of Michigan, it might be expected that its reptile and amphibian faunas would by this time be at least as well known as those of other states east of the Mississippi River. As it is our knowledge of the status of these groups in the state is astonishingly meager. It is true that all of the species known to occur in the state are well known to herpetologists, as they are, without exception, forms that occur commonly elsewhere in eastern North America, but of the actual number of forms that occur within our limits and the distribution, habits and variations of these we have as yet most inadequate data. Furthermore, there are practically no general works on the amphibians and reptiles of the state for the use of students and other persons interested in natural history.

Recognizing the need of a summary of the herpetology of Michigan the survey set aside out of the appropriation for 1907, $250.00 for the preparation of a work on the reptiles of Michigan and out of the appropriation for 1911, $200.00 for the preparation of a report on the amphibians of the state. The writer took personal charge of the reptile work, and with the appropriation engaged Miss Frances Dunbar, assistant in zoology in the University of Michigan, to assist him. The second appropriation was given to Miss Crystal Thompson and Miss Helen Thompson, who have had charge of the amphibian work under the direction of the writer.

In the pursuit of the work two ideas have been kept in mind: first, to make the results of genuine scientific value as a summary of our knowledge of the status of the groups in the state, and, second, to present the results in such form that they may be readily grasped by students and teachers and used as a reference work in the schools of the state. In order to place Michigan herpetology on a firm basis only those species are included (a) of which the writers have examined specimens[1] from authentic Michigan localities, or (b) of which specimens have been examined by competent authorities, or (c) that have been reported to us by reliable observers who could unmistakably describe them. We have rigidly excluded all records by persons who possibly did not know the forms in question. It is believed; therefore, that the work is reliable as far as it goes, and, altho it is of course incomplete, for there are large areas in the state from which no or only a few records have been obtained, we trust that it will serve as a basis for future work and as an incentive to further investigation. It should be added that all descriptions of species are based on Michigan specimens unless otherwise stated.

January 1, 1912.

[1]All specimens referred to in this report are in the University of Michigan Museum of Natural History unless otherwise stated.

THE AMPHIBIANS OF MICHIGAN.

BY CRYSTAL THOMPSON AND HELEN THOMPSON.

INTRODUCTION.

One of the greatest difficulties encountered by the general student when he attempts the study of Michigan amphibians is the lack of a general work on the subject. Many papers have been published, but these are principally local lists and are so widely scattered that they are not generally available. The general books on the group are quite adequate for the determination of species, but they do not, as a rule, give the correct distribution of the forms in the state, so that, aside from the disadvantage of having to deal with many more forms in the keys than we have within our limits, the further objection to their use is that one can scarcely tell from them what species to expect in any region.

It is the purpose of this paper to present in a concise and convenient form the present knowledge of the amphibian fauna of Michigan. The work is necessarily far from complete because of the lack of data from many parts of the state, but it is hoped that it will prove of assistance to students. It should also serve to arouse an interest in this group of vertebrates that will result in the accumulation of data on the intrastate distribution of the species, particularly as an effort has been made to show just how much information is at hand for each section.

LITERATURE.

The published papers that deal either entirely with Michigan amphibians, or that include definite records for Michigan are as follows:

1. Sager, Abram. Report to the State Geologist. Senate Doc., State of Michigan, 1839, 294-305. Includes a catalogue of the amphibians of the state. The following species are listed: *Bufo musicus* (*americanus*), *Hyla versicolor*, *Rana clamitans*, *Rana halecina* (*pipiens*), *Rana palustris*, *Rana sylvatica*, *Rana gryllus* (*Acris gryllus*), *Salamandra symetrica* (*Diemictylus viridescens*), *Salamandra cinera* (*Plethodon erythronotus*), *Menobranches lateralis* (*Necturus maculosus*).

2. Holbrook, John Edwards. North American Herpetology, Vol. IV, 1842. Holbrook states, on the authority of Dr. Kirtland, that *Rana sylvatica* is common in the woods of Michigan.

3. Miles, M. A Catalogue of the Mammals, Birds, Reptiles and Molluscs of Michigan. First Biennial Report of the Geological Survey of Michigan, 1861. This, as the name implies, is merely a catalogue of the species supposed to occur in Michigan. The list of amphibians includes: *Bufo americanus*, *Acris crepitans* (*gryllus*), *Hyla versicolor*, *Hyla pickeringii*, *Helocaetes triseriatus* (*Chorophilus nigritus*), *Rana catesbeana*, *Rana fontinalis* (*clamitans*), *Rana pipiens*, *Rana palustris*, *Rana sylvatica*, *Ambystoma punctatum*, *Ambystoma luridum* (*tigrinum*), *Ambystoma laterale* (*jeffersonianum*), *Diemictylus viridescens*, *Plethodon cinereus*, *Necturus lateralis* (*maculosus*). There are a few footnote references to localities.

4. Milner, James W. Report on the Fisheries of the Great Lakes. Report of the U. S. Fish Commission, 1872-3. Milner reports *Necturus* from Grand Haven, Ecorse and the Detroit River.

5. Smith, W. H. The Tailed Amphibians, including the Caecilians; A Thesis presented to the Faculty of Michigan University, 1877. Descriptions are written of the specimens in the University of Michigan Museum. In no case is the specific locality given.

6. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan. Supplement to Science News, 1879. Under Amphibia Smith lists: *Rana halecina* (*pipiens*), *Rana palustris*, *Rana temporaria* var. *sylvatica*, *Rana clamitans*, *Rana catesbyana*, *Bufo lentiginosus*, *Hyla versicolor*, *Hyla pickeringii*, *Chorophylus triseriatus*, *Acris gryllus* var. *crepitans*, *Plethodon erythronotus*, *Plethodon erythronotus* var. *cinereus*, *Notophthalmus viridescens* (*Diemictylus viridescens*), *Ambystoma punctatum*, *Ambystoma opacum*, *Ambystoma tigrinum*, *Ambystoma jeffersonianum* and *Menobranchus lateralis* (*Necturus maculosus*). The species known to occur at Ann Arbor are starred.

7. Smith, W. H. Report on the Amphibians and Reptiles of Ohio. Report of the Geological Survey of Ohio, Vol. IV, 1882. Mentions *Plethodon erythronotus*, *Ambystoma tigrinum* and *Ambystoma opacum* as coming from Ann Arbor.

8. Cope, E. D. Batrachia of North America, Bulletin 34, U. S. National Museum, 1889. Specimens of *Necturus maculosus*, *Ambystoma tigrinum*, *Plethodon cinereus*, *Plethodon glutinosus*, *Rana clamitans* and *Rana palustris* are listed from Michigan.

9. Kirsch, Philip H. A Report on the Investigations in the Maumee River Basin during the summer of 1893. Bulletin U. S. Fish Commission, Vol. XIV, 1894. In the list of amphibians observed in the Maumee River Basin, *Rana sylvatica* and *Rana clamitans* are recorded from near Hudson, Mich.

10. Clark, H. L. Notes on the Batrachians and Reptiles of Eaton County. Fourth Ann. Report Michigan Academy of Science, 1902. This list includes the species found in Eaton County by the writer and those reported to him by reliable observers.

11. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibans of Ontonagon County, Michigan. Sixth Ann. Report Michigan Academy of Science, 1904. Records the amphibians collected by the writer in Ontonagon County.

12. Ruthven, Alexander G. The Cold-Blooded Vertebrates of the Porcupine Mountains and Isle Royale,

Michigan. Ann. Report of the Geological Survey of Michigan, 1905. The list of amphibians, includes all of the data “available to the author on the occurrence of these animals in the Northern Peninsula."

13. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. Seventh Ann. Report Michigan Academy of Science, 1905. A list of amphibians whose presence in the state "is vouched for by at least one of the writers" (M. Gibbs, F. N. Notestein, H. L. Clark), together with the localities from which records were obtained. It includes in the bona fide list; *Necturus maculosus*, *Ambystoma maculatum* (*punctatum*), *Ambystoma tigrinum*, *Ambystoma jeffersonianum*, *Hemidactylium scutatum*, *Plethodon cinereus* and *P. cinereus erythonotus*, *Plethodon glutinosus*, *Diemictylus viridescens, Bufo lentiginosus americanus, Acris gryllus*, *Chorophilus nigritus triseriatus*, *Hyla versicolor*, *Hyla pickeringii*, *Rana pipiens*, *Rana clamitans*, *Rana palustris*, *Rana sylvatica* and *Rana sylvatica cantabrigensis*, *Rana septentrionalis* and *Rana catesbeana*. Unfortunately the sources of the individual records are not given.

14. Smith, Bertram G. The Breeding Habits of *Ambystoma punctatum* Linn. American Naturalist, Vol. XLI, 1907. Work on the breeding habits of *Ambystoma punctatum* was conducted at the University of Michigan and the material upon which the work was based was collected in the vicinity of Ann Arbor.

15. Hankinson, T. L. A Biological Survey of Walnut Lake, Michigan. Report Geological Survey of Michigan, 1908. A list of the amphibians found at Walnut Lake, Oakland County, during the spring and summer of 1906.

16. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Report Geological Survey of Michigan, 1909. A summary of the amphibian fauna of Isle Royale, based largely upon the results of the University of Michigan Museum expeditions to the island in 1904 and 1905.

17. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians. Eleventh Ann. Report Michigan Academy of Science, 1909. This paper places on record some miscellaneous data upon the amphibians of Michigan. The writer refers the Michigan wood frogs to *Rana cantabrigensis* rather than *Rana sylvatica*.

[1]18. Smith, Bertram G. The Nests and Larvae of Necturus. Biological Bulletin, Vol. XX, 1911. A larval specimen taken from the Detroit River, Nov. 24, 1906, is described.

[1]Since this bibliography was compiled two papers have been published, Thompson, 1911, and Ruthven, 1911a, containing records from Cass and Huron counties.

METHODS OF STUDY.

The amphibians are a group of animals that will furnish many interesting problems to Michigan students. In the first place, while most observers of nature know something of their habits and considerable has been published on the subject, there is still much to be done upon the species to be found within our limits. Added to this is the fact that the species are not difficult to observe in the field after one becomes familiar with their haunts.

In taking up the systematic study of amphibians, it is desirable first to become familiar with the general characters of the group. The best method of doing this is to dissect a specimen, following the directions in some manual on the subject. The anatomy is treated in most vertebrate zoologies. The Frog Book, by Mary O. Dickerson, gives an excellent account of the characters used in the classification of the tailless forms, but unfortunately there is nothing at present available on the tailed amphibians. Other books which will prove helpful are, The Batrachians and Reptiles of the State of Indiana, by O. P. Hay, A Manual of the Vertebrate Animals of the Northern United States, by David Starr Jordan, and The Batrachia of North America, by E. D. Cope, although the latter is at present difficult to obtain and is for the most part technical and rather difficult for the beginner.

The external characters are sufficient for the identification of the Michigan species and are alone used in this work. The points to be considered in the identification are:—first, presence or absence of a tail in the adult state. This at once separates the two orders found in this region, the Salientia (tailless forms) and Caudata (tailed forms). In identifying the Salientia the following characters are used,—general external appearance, proportionate length of head and body, proportionate length of hind limb and body, presence or absence of parotid glands, presence or absence of lateral glandular folds, teeth, presence or absence of disks on fingers and toes, ground color and pattern. The characters used in the identification of the Caudata are,—general external appearance, proportionate length of body and tail, shape of tail, number of costal grooves, number of toes on the hind feet, character and position of teeth (Fig. 2), ground color and pattern.

Teachers may outline laboratory and field work from the following suggestions. The collecting and identifying of species should precede or go along with the study of habits. The spring is the best time to observe the species in the field, for this is the breeding season and the associated habits are most interesting. Particular points to be noted are,—time of appearance in the spring, habitat, food habits, time of breeding, characteristic notes of the different species, method of fertilizing the eggs, nature of egg masses, time of hatching of eggs, habits and metamorphosis of larvae.

METHODS OF COLLECTING AND PRESERVING SPECIMENS.

Collecting: Since most of the species come to the streams or ponds to breed in the spring this is the best season for collecting. They may also be collected during the entire summer and fall, but as most of the species leave the ponds after breeding and become more

solitary, they are much more difficult to find. However, during the summer many frogs will be found along the borders of ponds and lakes, along the banks of streams, near springs, and in marshes, woods and fields. The toad and the tree frogs as a rule retreat from the water after the breeding season is past.

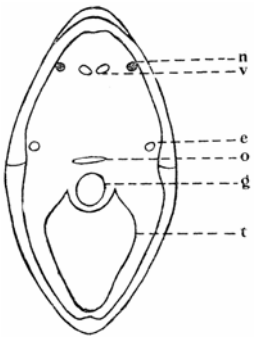

Figure 1. Diagram of Mouth of Frog to Show Position of Teeth.
n, Internal nares; *v*, Vomerine teeth; *e*, Eustachian tubes; *o*, Oesophagus; *g*, Glottis; *t*, Tongue,

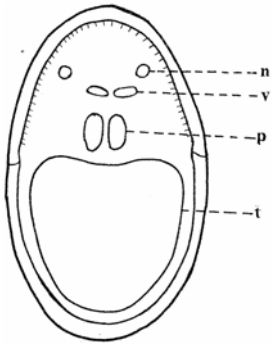

Figure 2. Diagram of Mouth of Salamander to show Position of Teeth.
n, Internal nares; *v*, Vomerine teeth; *p*, Paresphenoid teeth; *t*, Tongue.

The Caudata, or tailed amphibians, with the exception of *Hemidactylium scutatum*, *Plethodon erythronotus* and *Necturus maculosus*, may be found in the spring in small ponds where they have gone to breed. At other times during the year they, with *Hemidactylium scutatum* and *Plethodon erythronotus*, are to be found under logs, moss, and in and around decaying stumps and logs in the woods. Some may also be found, before entering the water in the spring, under logs and stumps in woody places. *Necturus maculosus* may be caught at all seasons of the year in the larger lakes and streams. *Plethodon erythronotus* never enters the water. It may be found under the bark of decayed logs and similar places. *Hemidactylium scutatum*, so far as is known, does not enter the water. It may be collected, during the spring at least, under loose moss and in old stumps in low, wet woods. The two year old form of *Diemictylus viridescens* may be found in decaying logs with the other species, but younger and older forms occur in the ponds at all seasons.

Amphibians may be readily caught with the hands or by means of a net. The best net to use is a long handled dip net of small mesh and deep enough to prevent the escape of frogs after they are caught. The net is useful in collecting frogs or toads when in the water, or for scooping them out of the mud at the bottom of ponds. A 22 caliber rifle shooting cartridges loaded with dust shot (No. 14), or a 28 gauge shot gun loaded with light loads of powder and dust shot, are very effective means of collecting large series of frogs.

The tailed amphibians are rather slow in their movements, and when on land they can be readily picked up by hand. When observed in the open water they may be easily caught in the dip net. Digging up with the net the leaves and mud from the bottom of ponds in woody places will usually result in the finding of several specimens.

Specimens may be carried from the field in a minnow pail in which there is enough water to keep them moist. When it is necessary to keep several collections separate, the animals may be placed in cheesecloth bags with some wet moss. Small specimens should be kept separate from the large ones so that the former may not be injured.

Keeping Live Material: It is often desirable to keep amphibians alive in the laboratory and the following suggestions may be found useful. Toads and frogs may be kept in large glass jars, covered over the top with netting and containing some moss and a small amount of water. Flies and earthworms placed in the jars will be eaten readily. The frogs should be sorted according to size and those of approximately the same size placed in the same jar, otherwise the large individuals will eat the smaller ones.

The small tailed amphibians which are terrestial in habit, *Hemidactylium scutatum* and *Plethodon erythronotus* may be kept in bacteria dishes with a little damp moss. If the moss is renewed frequently they will find sufficient numbers of insects and larvae in it to keep them in good condition. The Ambystomas and *Diemyctilus viridescens* should be kept in dishes containing moss, bark and dead leaves with some water at one side, so that they may enter it at will. They will eat insects, worms and small pieces of meat if offered to them. Small tadpoles placed in the water will furnish food for *Diemyctilus viridescens*.

The aquatic forms will need a larger supply of water. Necturus should be kept in a tank containing running water to the depth of two or three inches. There should be some floating plants or other objects under which they may partially conceal themselves. Raw beef cut in small pieces and presented on the end of a fine wire will sometimes be taken as food. If this method of feeding is not successful, small frogs and fish may be eaten if placed in the tank. Necturus will remain in good condition for a few weeks without food.

Preservation of Specimens: Amphibians which are to be permanently preserved should be properly killed and put up in a preserving fluid, for a poorly preserved specimen is usually worse than none. The best method of killing is to drown the animals. This can easily be done by

placing them in small cheesecloth bags and immersing them in water so that no air can reach them. The air should be excluded from the bag by gently kneading it in the hands while under water. The amphibians will drown within twelve hours.

After killing, the specimens should be placed in 4% formalin for at least a week to harden. The formalin must be allowed to enter the body cavity or otherwise the internal organs will decompose before the preservative can penetrate to them. This is best accomplished by injecting the formalin into the body cavity, by means of a hypodermic syringe, but if this is not convenient, the abdomen may be slit open with a pair of scissors. When thoroughly hardened, the specimens should be transferred to from 55% to 60% alcohol for permanent storage. It is important that the alcohol be of this strength, for stronger solutions will shrivel them and weaker will not properly preserve them. Each specimen should be provided with a tag tied rather loosely about the body just in front of the hind legs. This label should give the locality, date, name of collector and habitat unless a catalog is kept, in which case a number may be placed on the label and in the notebook with the habitat data.

DESCRIPTION OF SPECIES

KEY TO MICHIGAN AMPHIBIA

a¹. Tailed throughout life. *Caudata.*

b¹. External gills persistent in adult. *Proteidae.*

c¹. Body lizard-like. Limbs four, equally developed. External gills. Color brown, spotted with black. Four toes on each foot. . . . . *Necturus maculosus,* p. 23.

b². Adult without external gills. Limbs well developed. Eyelids present. *Mutabilia.*

c¹. No parasphenoid teeth; vomero-palatine teeth in parallel or posteriorly diverging series that do not extend posteriorly over the parasphenoid. Body lizard-like. Costal grooves distinct. Tail compressed. *Ambystomidae.*

d¹. Costal grooves 12. Back dark brown with large irregular yellow spots. Body and head stout. Plantar tubercles well developed . . . . . *Ambystoma tigrinum,* p. 26.

d². Costal grooves 11. Body and head broad. Back black with series of bright yellow spots on each side of vertebral column. No plantar tubercles. Transverse line of teeth in three parts, central separated from the lateral by a slight interval; central patch usually straight but may curve forward in the middle. *Ambystoma punctatum,* p. 28.

d³. Costal grooves 12. Back bluish black, uniform or with pale blue spots. Head and body slender. No plantar tubercles. Teeth in four patches, the two central in a nearly straight line. . . . . *Ambystoma jeffersonianum,* p. 30.

c². Parasphenoid teeth present. Body cylindrical. Tail round, tapering to tip. *Plethodontidae.*

d¹. Color brownish black, usually with a broad red or ashy dorsal band. Body slender. Inner toes rudimentary. Costal grooves 16 to 19. . . . . *Plethodon erythronotus,* p. 32.

d². Color light brown spotted with dark, a lighter stripe down the back. Under surface yellowish white with dark inky spots. Body slender. Four toes on each foot. Tail very long, separated from the body by a distinct depression. Costal grooves 13. . . . . *Hemidactylium scutatum,* p. 34.

c³. Parasphenoid teeth absent. Vomero-palatine teeth in transverse or posteriorly diverging series extending posteriorily over the parasphenoid. Tail compressed. Outer and inner toes on hind foot rudimentary. *Salamandridae.*

d¹. Costal grooves indistinct. Color varying from olive green to reddish brown above. . . . . *Diemictylus viridescens,* p. 36.

a². Tail absent in adult. Body short and broad. Hind limbs adapted for leaping. *Salientia.*

b¹. No maxillary teeth. Parotid glands present. Skin warty. *Bufonidae.*

c¹. Parotids oval. Cranial crests divergent behind. . . . . *Bufo americanus,* p. 39.

b². Maxillary teeth present. Parotid glands lacking. Fingers and toes enlarged at ends to form adhesive disks. *Hylidae.*

c¹. Disks large. Color green, gray or brown with irregular dark blotches. Irregular dark star-shaped blotch on upper part of back. . . . . *Hyla versicolor,* p. 41.

c². Disks medium. Oblique dark cross on back. Dark mark between eyes. Limbs barred. . . . . *Hyla pickeringii,* p. 43.

c³. Disks small. Color variable with three oblique blotches on sides. Dark triangular spot between eyes. Light line from eye to arm. . . . . *Acris gryllus,* p. 45.

c⁴. Disks small, scarcely discernable. Color changeable. Three longitudinal dark stripes on back. Dark line from eye to arm. . . . . *Chorophilus nigritus,* p. 47.

b³. Maxillary teeth present. Parotid glands lacking. No adhesive disks. *Ranidae.*

c¹. Lateral folds large. Color green with two irregular rows of rounded dark spots edged with lighter color on back. Legs barred or spotted. . . . . *Rana pipiens,* p. 49.

c². Color brown with two irregular rows of oblong square blotches of dark brown on the back, the spots without edgings of lighter color. . . . . *Rana palustris*, p. 51.

c³. Lateral folds conspicuous. Color brownish green with small dark spots. Legs spotted or barred with dark. Web broad leaving last two joints of fourth toe free. . . . . *Rana clamitans*, p. 53.

c⁴. Lateral folds present. Ground color variable. Arms and legs barred. A black patch in ear region. Length of hind limb to heel equals distance from anus to some point in front of eye. . . . *Rana cantabrigensis*, p. 55.

c⁵. No lateral folds. Color light olive brown with blotches of darker color. Legs spotted or branded. . . . . *Rana septentrionalis*, p. 57.

c⁶. No lateral folds. Color greenish brown with darker spots. Fold of skin from eye to arm curving behind ear. Hind feet webbed, leaving last joint of fourth toe free. . . . . *Rana catesbeana*, p. 59.

NECTURUS MACULOSUS Rafinesque.

MUD PUPPY.

(Pl. I.)

Description: Body elongate, thick and cylindrical. Head broad, flat and depressed. Muzzle rounded; mouth large, upper lip overhanging lower. Eyes small, situated near front of head; nostrils at end of snout. Three bushy external gills on each side of neck. Gular fold prominent, fourteen costal furrows and a dorsal groove. Limbs small but well developed, digits four in number. Tail greatly compressed. Skin very smooth and slimy. Two series of teeth in almost parallel rows. Premaxillary series short, forming an angle anteriorly. Vomero-palatine series longer, extending from the angle of the premaxillaries to the angle of the jaw.

Ground color varies from dark to ashy brown above, paler below. Upper surface usually mottled with darker color and with small light spots. Gills bright red. In young specimens a dark lateral band is sometimes found.

Measurements: Specimen No. 41723.

Total length	.243
Length of head and body	.155
Width of head	.034

Habits and Habitat: *Necturus maculosus* is wholly aquatic and is rather dull and sluggish during the day time. It usually rests on the bottom with the gills spread out and may sometimes be seen crawling slowly about. When disturbed, the gills are contracted close to the sides and the animal swims rapidly away by means of the large, flat, paddle-like tail. The fact that it is frequently taken throughout the winter would seem to indicate the absence of a hibernating period.

At night the Necturus, which is extremely voracious, swims about in search of its food, which consists mainly of small crustacea, worms, fish and their eggs, and insects. In captivity it will sometimes eat small pieces of meat, but only when it has been for some time without food. It is frequently caught on hooks or in nets by fishermen, who commonly regard it as very poisonous. This fallacy is no doubt due to the coat of slime which is emitted when the animal is irritated. Adult specimens can also inflict a rather painful bite with their sharp, strong teeth, and it is hard to dislodge them when they have secured a good hold. The flesh is reported excellent by those who have eaten it.

Very little is known of the breeding habits of Necturus. The animals are usually found in pairs in the autumn, and it is possible that this is the mating season. Hay (l892a, p. 12) states that eggs were taken from the Detroit River about the middle of July, while according to Eycleshymer (1906, p. 133), who has studied their habits in the small lakes of Wisconsin, "the best time for collecting is during the middle and latter parts of the month of May." The nest is much like that of a fish, consisting of a small excavation in the sand under some sheltering object, such as a log, board or stone. The eggs are found attached to this shelter "by the slender stalks of the gelatinous envelopes" (Smith, 1911, p. 191), and cover a surface of from six to twelve inches in diameter. Smith (1911) found the average number of eggs in a nest to be sixty-six. They are about the size of a pea, and lack the pigment which is characteristic of the eggs of most amphibians. Further details of development have not been worked out.

Distribution: Eastern United States, mostly north and west of the Alleghanies, abundant in the Great Lake region. (Jordan. 1899.)

Figure 3. Distribution of *Necturus maculosus*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Dickinson, Cheboygan, Huron, Livingston, Washtenaw and St. Joseph Counties. The

writers have also examined specimens from Gratiot and Eaton Counties. Reported from Keweenaw (Isle Royale). Wayne and Oakland Counties (Cope, 1889); Wayne, St. Clair, Allegan, Kalamazoo, Eaton, Montcalm and Van Buren Counties (Gibbs, Notestein and Clark, 1005); Ottawa County (Milner, 1874); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879); Ottawa and Wayne Counties (Milner, 1874).

AMBYSTOMA TIGRINUM (Green).

TIGER SALAMANDER.

(PI. IIa.)

Description: Body large and thick. Head flat and not as broad as body in adult specimens. Eyes prominent, nares small. Parotid region much swollen. Gular fold prominent, extending upward on sides of neck. Also a groove running from corner of mouth to eye. Twelve costal furrows and a distinct dorsal groove. Limbs stout; toes depressed, tapering from a broad base to the tips which are hardened and horny in appearance. Two distinct plantar tubercles. Tail long and compressed, equal in length to distance from snout to groin. Skin smooth and glossy, and covered with mucous pores which are not as prominent as in *Ambystoma punctatum*. Vomero-palatine teeth in a straight or slightly curving series across roof of mouth. Tongue large and fleshy, free on sides and attached at ends.

Ground color brownish black above, lighter beneath. Bright yellow spots scattered irregularly over entire surface of body. These spots may be few or many in number and are sometimes confluent to form more or less definite stripes.

Measurements: Specimen No. 36030.

Total length	.205
Length of head and body	.100
Width of head	.026

Habits and Habitat: This species, as a rule, spends most of the year under stones, logs, in decaying stumps and in holes or burrows made by other animals. However, it has been known to remain in the water during the summer. It is voracious and carnivorous, eating worms, insects and at times small frogs. According to Metzdorff (Gadow, 1901, p. 113), the breeding season of *Ambystoma tigrinum* is from April to June and occasionally in December. Smith (1882, p. 721) states that "they have been observed in great numbers in the 'Cathole,' at Ann Arbor, Michigan, swimming vigorously on March 10th, and their eggs were found a few days later." The male enters the water and deposits spermatophores, which are taken up into the cloaca of the female. The eggs are usually laid the day after fertilization, in masses containing from six to ten, and are attached to stems or leaves of water plants. The larvae emerge after an interval of about two weeks. The latter were formerly supposed to be a distinct species, "Axolotl", due to the fact that metamorphosis may be delayed and breeding take place during the larval stage. Under normal conditions, however, the adult form is reached in about one hundred days after hatching.

Distribution: Northeast to Minnesota and south. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Calhoun, Washtenaw, Lenawee and Livingston Counties. Reported from Wayne and Washtenaw Counties (Cope, 1889); Montcalm, Washtenaw, Kalamazoo, Eaton and Allegan Counties (Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1879; Smith, 1882).

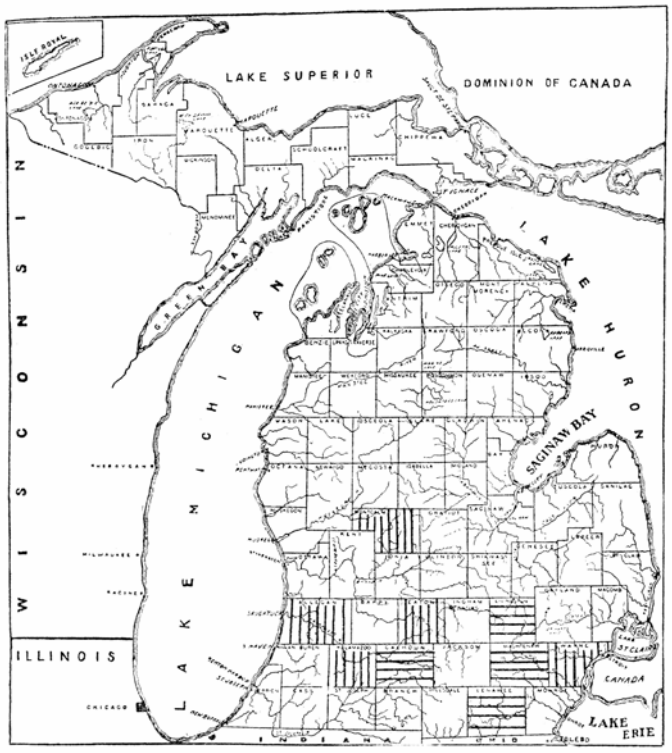

Figure 4. Distribution of *Ambystoma tigrinum*. Horizontal ruling, specimens examined; vertical ruling, reports only.

AMBYSTOMA PUNCTATUM (Linnaeus).

SPOTTED SALAMANDER.

(PI. IIa.)

Description: Body short and stout. Head broad and slightly rounded, with parotid region greatly swollen. Eyes prominent, nares small. Gular fold prominent, connected by a ridge with mi other slight fold behind the eye. Eleven costal furrows and a slight dorsal groove. Limbs moderately developed; toes slightly depressed; plantar tubercles indistinct. Tail compressed, with a well marked indentation along each side. Skin smooth and glossy, surface pitted with mucous pores which are most prominent in the parotid region and on the tail. Transverse line of teeth in three patches, the central separated from laterals by slight interval at inner edges

of posterior nares. Central patch may curve forward in the middle.

Ground color blue black or black with large yellow blotches arranged in a more or less irregular row on each side of vertebral column. Legs also spotted. Under surface paler than upper.

Measurements: Specimen No. 35787.

Total length	.145
Length of head and body	.081
Width of head	.0165

Habits and Habitat: *Ambystoma punctatum* is nocturnal in its habits and is found under logs and stones in damp, woody places. It resembles *Ambystoma tigrinum* in its food habits. When in the water the animal swims rapidly by means of the broad, flat tail. Like the other members of the genus, this species goes to the water to deposit its eggs. This migration to the ponds takes place in March or April. The males enter the ponds and deposit spermatophores on sticks and leaves just at the surface of the water. These spermatophores are small, white, mushroom-like bodies, the cap-shaped tops containing the sperm. Several are usually deposited in one place and fertilization probably takes place in the same manner as in *Ambystoma tigrinum*. After fertilization the eggs are laid in oval masses, the whole mass being embedded in gelatine. They are attached to some support in the water, either grass stems or small sticks. When hatched the young larvae are about half an inch in length and metamorphosis does not occur until a length of about two inches has been reached.

Figure 5. Distribution of *Ambystoma punctatum*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Distribution: Nova Scotia to Nebraska, south to Georgia. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Manistee and Washtenaw Counties. Reported from Eaton County (Clark, 1902; Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1907; Smith, 1879).

AMBYSTOMA JEFFERSONIANUM (Green).

Jefferson's Salamander.

(Pl. IIa.)

Description: Body long and slender. Head elongate and flat; eyes large and prominent; nares small, situated at end of snout; mouth large. Gular fold distinct, rising on sides of neck. Another fold extends across the throat from a point just behind the corner of the mouth and is met by a groove running from the corner of the eye. Twelve costal furrows and a dorsal groove. Limbs well developed; toes long, slender and much depressed; no plantar tubercles. Tail compressed and somewhat shorter than body. Skin smooth and covered with numerous pores which may be clearly seen under a lens. Teeth in four patches, the two central extending to the inner nares, where they are met by the two lateral patches which form the posterior border of the inner nares. Tongue large and thick.

Ground color bluish or brownish black above, paler below. Surface with or without pale blue spots.

Measurements: Specimen No. 37926.

Total length	.118
Length of head and body	.070
Width of head	.010

Habits and Habitat: *Ambystoma jeffersonianum* is secretive, and during the day is found in damp, dark places. It is usually found under logs and stones. It is extremely active, and, according to Gadow (1901, p. Ill), a good climber, "easily escaping out of high-walled bell-glasses."

Little has been done on the breeding habits of this salamander. Smith (1911a, p. 19) states that the early spawning season "suggests the possibility of an autumnal fertilization." Hahn (1908, pp. 550-552) has taken the eggs in late segmentation stages on Feb. 28, at Mitchell, Ind., while Smith (1911a, p. 17) found the first eggs on April 5, at Syracuse, New York. They are laid in small grape-like masses that are usually hung on a leaf or stick. Piersol (1910) has found the number of eggs in a single mass to be about twenty. The hatching probably takes place in from thirteen to eighteen days and transformation occurs some time during July or August.

This species resembles *Plethodon glutinosus*. which-has been reported from Kent (Gibbs, Kotestein and Clark, 1905), Wayne (Cope, 1889) and Marquette (Ruthven, 1906) Counties. However, the specimens listed from Wayne and Marquette Counties are in the University Museum and have been re-identified as *Ambystoma jeffersonianum*. The two species may be distinguished

by the fact that the parasphenoid teeth are present in *Plethodon glutinosus* and absent in *Ambystoma jeffersonianum*. We have not seen specimens of the former from the state.

Figure 6. Distribution of *Ambystoma jeffersonianum*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Distribution: Pennsylvania to Virginia and north to Canada, (Jordan, 1899.)

Michigan: Specimens in the University Museum from Marquette, Cheboygan, Manistee, Arenac (Charity Island), Huron, Ionia, Ingham, Livingston, Wayne and Washtenaw Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Eaton County (Clark, 1903); Eaton and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1879); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a).

PLETHODON ERYTHRONOTUS (Green).

RED-BACKED SALAMANDER.

(Pls. I, IIb.)

Description: Body long, slender and cylindrical. Head small; mouth very large, upper jaw slightly protruding; eyes large; nares small and situated laterally. Gular fold prominent, reaching up to the dorsal stripe and met there by a groove running from the corner of the eye. This groove is in turn bisected by a groove extending upward from the corner of the mouth. Costal folds distinct; the number varying from sixteen to nineteen. A distinct dorsal groove. Limbs extremely slender, inner toes rudimentary. Tail cylindrical. Vomero-palatine teeth extending backward in two converging rows, Parasphenoid teeth in two patches behind the nares. Color brownish black on sides, usually with a broad ashy or red dorsal stripe which is mottled with brown. Under surface yellowish, also mottled with a darker color.

Measurements: Specimen No. 3580½.

Total length	.089
Length of head and body	.045
Width of head	.005

Habits and Habitat: The red-backed salamander is entirely terrestrial in its habits. It is usually found under rocks and in decaying logs in moist, woody places and occasionally on low shrubs and plants. It is very active, the adult disappearing rapidly and hiding under leaves and moss when disturbed, unless accompanied by its young. The food consists mainly of insects, larvae, small snails and worms, which are caught by means of the projectile tongue. The eggs are found in grape-like bunches of from six to eleven attached to the under surface of stones or the bark of decaying trees and are brooded by the female. They are laid, according to Hahn (1908), in May, but have not been found at Ann Arbor until June (Smith, 1882). The writers took eggs in a late stage of development at Port Austin, Huron County, Aug. 5, 1911. The larvae, which are at first provided with branchiae, are usually found with the parents and are apparently fed by them. When young the animal is very light in color, growing darker with age.

Figure 7. Distribution of *Plethodon erythronotus*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Prof. Cope (1889) recognizes two sub-species of Plethodon, *P. cinereus* and *P. cinereus* var. *erythronotus*, which have both been reported from Michigan. There are no apparent differences in structure, proportions and general character between

these two forms. The distinction is entirely one of color, *erythronotus* having a red dorsal stripe, *cinereus* an ashy one. Also, the writers have found the two varieties in the same region, and not infrequently in one log. Without doubt the differences in color are only individual.

Distribution: Eastern United States. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Ontonagon, Baraga, Dickinson, Cheboygan, Benzie, Manistee, Huron, Ingham, Washtenaw and Lenawee Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Eaton County (Clark, 1902); Wayne County (Cope, 1889); Eaton, Montcalm and Antrim Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Ontonagon, Baraga and Marquette Counties (Ruthven, 1906); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879; Smith, 1882).

HEMIDACTYLIUM SCUTATUM (Schlegel).

FOUR-TOED SALAMANDER.

(Pl. I.)

Description: Body short and cylindrical. Head broad, muzzle blunt, upper jaw projecting over lower. Eyes large. Gular fold distinct but not prominent, and rising on the sides of the neck. Another depression extending from the eye to the gular fold. Skin with slight depressions that give it a scuted appearance. Thirteen distinct but not prominent costal grooves. A dorsal groove and a slight depression extending along the sides from limb to limb. This lateral depression forks anteriorly and sends out a branch to the middle of the head between the eyes. Limbs very slender but well developed. Toes four in number, the inner toe and inner and outer fingers rudimentary; third toe the longest. Tail very long, separated from body by a distinct depression, slightly compressed, large at base and tapering gradually to a point. Vomero-palatine teeth in two series just behind internal nares. Parasphenoidal patches distinctly separated. Tongue attached anteriorly, and slightly free posteriorly.

Ground color dark brown, spotted with darker color, and becoming dark gray on the sides. Limbs, snout and tail lighter in color than back, and blotched with dark above. Small light spot on shoulder just above arm.

Measurements: Specimen No. 42140.

Total length	.067
Length of head and body	.031
Width of head	.005

Habits and Habitat: The four-toed salamander is a rare species in Michigan, having been found in only three counties in the state. Clark (1902) reports five specimens, which have been examined by the writers, from Eaton County as follows: "A single specimen of this uncommon salamander was collected May 13, 1901. It was found in the earth on the roots of a violet, which had been pulled up. So far as I can learn, it has not previously been collected in Michigan. Four other specimens, two males and two females, were taken together in April, 1902, under a log. The females were fully twice as large as the males." There are at present three live specimens in the University of Michigan Museum. One of these was taken in a woods about five miles south of Ann Arbor during the summer of 1910, and was presented to the Museum by Miss Jessie Phelps. The other two specimens were taken by the writers in the same woods in April, 1911. A single specimen was collected by N. A. Wood at White Fish Point, Chippewa County in August, 1912.

Figure 8. Distribution of *Hemidactylium scutatum*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Very little is known of the habits of this salamander. Smith (1882, p. 723) states that "it has been found in April under old logs and rails in open woods, at some distance from the water, and was very quick and lively in its movements." The woods in which the Washtenaw County specimens were taken is low and damp. One was found under loose moss and one was just inside the bark of a rotten stump. The movements are lively and erratic, the animal sometimes jumping for some distance. The food probably consists of insects and worms, the writers have observed it to eat small flies in captivity. The eggs are laid under moss or bark, and the salamander, at least in the adult condition, avoids the water. Individuals sometimes emit a sharp squeal when annoyed.

Distribution: From Massachusetts and Canada westward to Illinois and south to Georgia. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Washtenaw and Chippewa Counties. Reported from Eaton County (Clark, 1902; Gibbs, Notestein and Clark, 1905); Washtenaw County (Ruthven, 1911).

DIEMICTYLUS VIRIDESCENS Rafinesque.

GREEN NEWT.

(Pls. I, IIa.)

Description: Body slender and slightly compressed. Muzzle rounded; upper jaw extending a little beyond the lower; eyes large; exterior nares close together. Limbs slender, anterior about half the size of the posterior. First finger and first and fifth toes rudimentary. Tail much compressed and as long, if not longer, than the head and body. Skin finely wrinkled; costal grooves indistinct. On either side of the head below the eye there may be a row of four pits, but these are frequently lacking. Vomero-palatine teeth in two longitudinal rows which converge close to the internal nares. Tongue attached posteriorly and anteriorly but free on the sides.

Ground color varies from reddish brown to olive green above; lower surface pale yellow. Body covered with small black spots especially noticeable on the lower surface because of the lighter ground color. On either side of the vertebral line a row of small red spots, each having a black border.

Measurements: Specimen No. 37937.

Total length	.100
Length of head and body	.048
Width of head	.008

Habits and Habitat: This newt is aquatic in its habits, the adult spending most of its time in the water. It frequents places with a soft bottom and hides under leaves and water plants. In large ponds it is usually found in the more sheltered places. It is carnivorous in food habit and extremely voracious. The food consists chiefly of water insects, small molluscs, worms and tadpoles. When kept in captivity the animal becomes very tame and will readily eat small pieces of meat, worms and small tadpoles. It sometimes emits a sharp squeak when disturbed. The breeding season extends from April to June. During this season the genital openings of the male become swollen, and transverse horny plates appear on the posterior surface of the hind limbs and on the under side of the tips of the toes. A spotted crest also appears along the upper and lower sides of the tail. The male deposits spermatophores similar to those of *Ambystoma punctatum* except that they are fewer in number. In order to insure the fertilization of the eggs there is a preliminary "Liebes spiel". The eggs are laid singly between the leaves of water plants or in other like situations. According to Jordan (1893), the egg laying season for one individual lasts about seven or eight weeks. The young larvae hatch after a period of about thirty days. After the gills are absorbed, the young animal leaves the water and the color changes to a, dark red. This stage was formerly considered a distinct species and called *D. miniatus*; careful observation, however, has shown that, after the first two or three years of its life, the animal returns to the water and assumes the adult viridescent coloration.

Figure 9. Distribution of *Diemictylus viridescens*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Distribution: Eastern United States, abundant north and northeast. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Houghton, Marquette, Cheboygan, Huron, Arenac (Charity Island), Ionia and Washtenaw Counties. The writers have also examined specimens from Eaton County. Reported from Eaton County (Clark,. 1902; Gibbs, Notestein and Clark, 1905); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879).

BUFO AMERICANUS Le Conte.

AMERICAN TOAD.

(Pl. IIIa.)

Description: Body short and depressed. Head very broad, upper jaw protruding slightly and notched in the center. Eyes large. Parotid glands large and kidney shaped. Fronto-parietal crests extend back between the eyes and are joined at right angles by the post-orbital crests which extend back of the eyes to a point above the ears. Skin conspicuously warty above; under surface granulated. Toes partly webbed. Two dark-colored metatarsal tubercles, the outer small, the inner with a cutting edge. Jaws without teeth.

Ground color varies from grayish to brownish black, with large irrgular spots of dark brown which show more plainly on the specimens which are lighter in color.

There is frequently a light vertebral stripe. Under surface a dusky lemon color, sometimes with smaller irregular blotches of dark brown. Throat of male black.

Measurements: Specimen No. 3011¼.

Length of head and body	.0845
Length of hind limb to heel	.0565
Width of head	.032

Habits and Habitat: The common American toad is our best known amphibian. This is due to its abundance and to the fact that it is common in gardens and around houses so that it is frequently seen. It appears with the first warm spring days and is found in shaded places until fall, when it burrows into the ground and hibernates until spring. It is nocturnal in habit, coming out in the dusk of evening to search for food, which consists mostly of insects and their larvae. During the day it sits in its burrow, which it makes by backing into the soft earth or dense vegetation, and sleeps. It is so protectively colored that it is usually very hard to distinguish from the clods of earth or the background of partially shaded vegetation in its usual haunts.

The popular belief that toads are poisonous is erroneous. On the contrary they are very beneficial to man, since about 88% of their food consists of garden pests. They may at times, especially when roughly handled, excrete a colorless, odorless and harmless fluid from the skin, which makes them somewhat moist. There is also an excretion from, the parotid gland region, and this is slightly poisonous if taken internally. The latter affects the mucous membrane of the mouth and protects the toad when seized by dogs and other enemies.

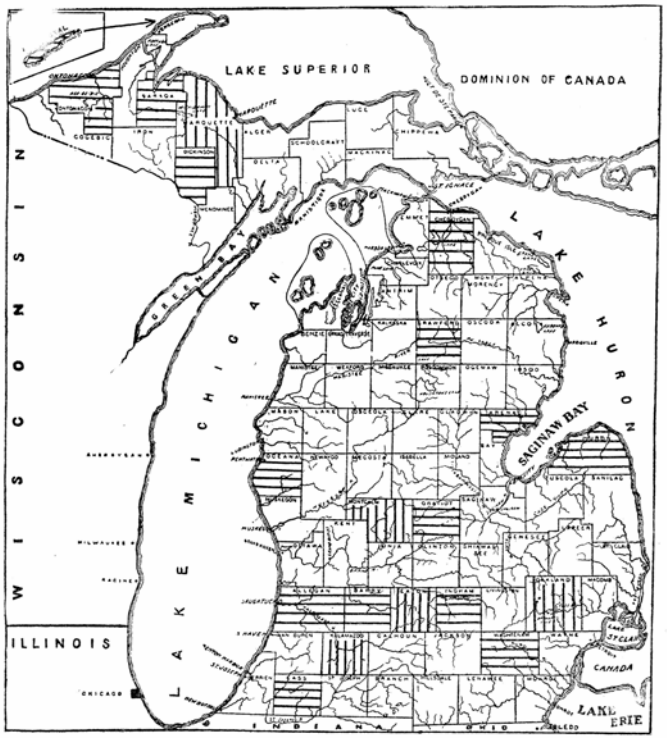

Figure 10. Distribution of *Bufo americanus*. Horizontal ruling, specimens examined; vertical ruling, reports only.

The breeding season lasts from April to July. The first specimen observed by the writers in 1911 was found on the evening of April 26, and the next day large numbers were seen on their way to the ponds. The males seem to outnumber the females and struggle together for their possession. When disturbed, the male utters a peculiar chirping sound somewhat like the scolding of a chicken. The song consists of a sweet high trill that is bird-like in its quality.

The eggs are laid in the water in two very long strands each consisting of a row of eggs embedded in a gelatinous mass. They hatch, in about four days, and the larvae remain in the water until the final metamorphosis which occurs in July. The toad does not start breeding until it is about four years old, and it may live for many years. Miss Dickerson tells of one that lived for thirty-six years and then was killed by an accident.

Distribution: Eastern North America, west to Arizona and Mexico. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Baraga, Ontonagon, Dickinson, Cheboygan, Crawford, Oceana, Arenac (Charity Island), Huron, Ingham, Washtenaw, Barry, Allegan and Cass Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Ontonagon County (Cope, 1889); Eaton, Kalamazoo, Washtenaw and Montcalm Counties (Gibbs, Notestein and Clark, 1905) ; Oakland County (Hankinson, 1908) ; Ontonagon County (Ruthven, 1904a); Keweenaw (Isle Royale), Ontonagon, Baraga and Marquette Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

HYLA VERSICOLOR Le Conte.

COMMON TREE FROG.

(Pl. IIIb.)

Description: Form toad like. Muzzle blunt in outline. Eyes prominent. Toes webbed nearly to tips; fingers and toes with large adhesive disks. Upper surface of body slightly warty. Lower surface granulated. A large fold of skin across the chest. Vomero-palatine teeth in two patches just behind internal nares. Tongue very large and fleshy, slightly notched behind.

Ground color gray, green or brown with irregular dark blotches. A large irregular dark star on upper part of back. Limbs barred with dark brown. A dark ear patch and a light spot under the eye. Under parts pale yellow, brighter posteriorly. Throat sometimes mottled with darker. Concealed leg surfaces vermiculated with brown.

Measurements: Specimen No. 30805.

Length of head and body	.044
Length of hind limb to heel	.0375
Width of head	.0165

Habits and Habitat: The common tree frog, or tree toad as it is frequently called, is the most familiar of our Hylidae. It lives for the most part in trees, bushes and vines. It is not confined to the woods alone but lives also in orchards and in the vines around houses. The large size of the disks on the fingers and toes allow it to cling to smooth vertical surfaces and enable it to catch and hold to branches when it climbs from place to place among the trees and bushes. It is more active toward night when it is searching for food. The latter consists of insects and larvae, found on the tree in whose leafy branches it makes its home. In the winter it hibernates in hollows of trees or in the moss at their roots. This species has the power of changing its color, although the change is not rapid. There is a range of colors from very light yellow and green to dark brown and green. The color, under ordinary circumstances, corresponds with that of the object on which the frog is resting. The eggs are laid in May, in small groups or singly. They are attached to water plants or grass stems and hatch in about forty-eight hours. After hatching, the development is rapid, the final metamorphosis taking place in about seven weeks.

Figure 11. Distribution of *Hyla versicolor*. Horizontal ruling, specimens examined; verical ruling, reports only.

Distribution: Canada, south to Texas and Kansas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Dickinson, Cheboygan, Oceana, Huron, Livingston, Oakland, Washtenaw, Wayne and Cass Counties. Reported from Eaton County (Clark, 1902); Washtenaw and Wayne Counties (Cope, 1889); Eaton, Montcalm, Kent, Ottawa, Barry and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Marquette County (Ruthven, 1906); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

HYLA PICKERINGII Holbrook.

SPRING PEEPER.

(Pl. IIIb.)

Description: Body short and stout. Muzzle pointed, upper jaw extending beyond lower. Ears small. Feet moderately webbed, disks relatively large. Under surface granulated. A fold of skin across the chest. Vomero-palatine teeth in two patches behind internal nares. Tongue large, slightly notched, and free behind.

Ground color varies from light to dark brown. A dark V between the eyes and a large oblique dark cross on the back. Limbs indefinitely barred with darker. A dark band from the snout through the eye to the side. Under surface pale yellow, granulated, darker posteriorly. Usually darker blotches on throat and chest.

Measurements: Specimen No. 37906.

Length of head and body	.021
Length of hind limb to heel	.0155
Width of head	.0065

Habits and Habitat: The spring peeper is the smallest of the Hylidae. During the summer it may be found among fallen leaves and moss in damp places, the color being admirably adapted for concealment in such situations. Its search for food, which consists mainly of small insects and worms, may frequently take it to gardens and orchards, and it has even been found in greenhouses. During the winter months it hibernates under the moss and leaves or in hollow trees. The breeding season begins early and lasts until May. The frogs sing in chorus and their bird-like call is one of the most familiar sounds of spring. The male croaks when hidden under moss or grass. The eggs are laid in April, usually singly, though occasionally in small masses, and are attached to water plants. They are very small, "so small that they look like tiny plant seeds" (Dickerson, 1906, p. 145). The time of development varies from six to twelve days according to the temperature, and metamorphosis takes place in about two months after hatching, the little tadpoles usually leaving the water before the transformation is completed.

Distribution: Eastern North America, Canada to South Carolina. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Dickinson, Houghton, Baraga, Huron, Washtenaw, Cass and St. Joseph Counties. Reported from Eaton County (Clark, 1902); Wayne and Washtenaw Counties (Cope, 1889); Van Buren, Eaton, Kalamazoo, Antrim and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Ontonagon, Baraga, and Houghton Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

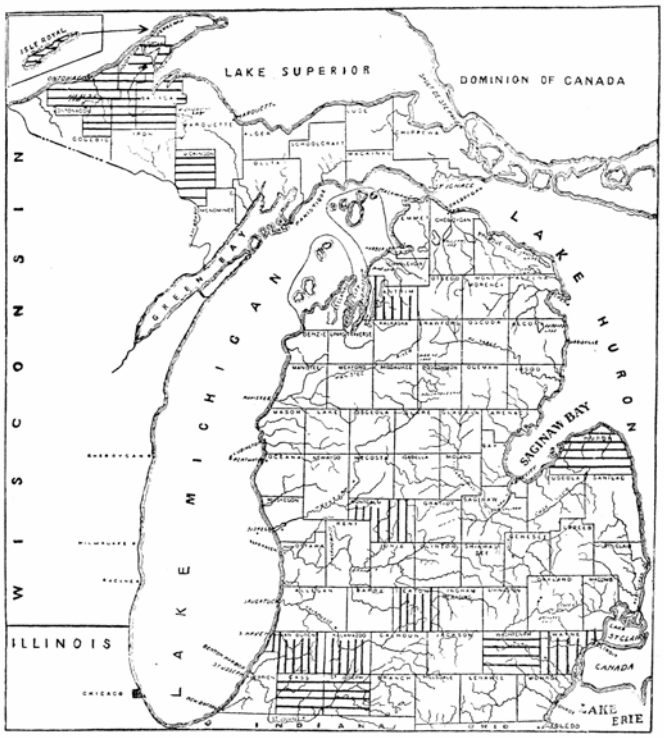

Figure 12. Distribution of *Hyla pickeringii*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

ACRIS GRYLLUS Le Conte.

CRICKET FROG.

Description: Form frog like. Muzzle very long and pointed. Disks on fingers and toes small, scarcely noticeable. Toes webbed almost to tips. Sole tubercles moderate in size. Skin above with numerous conspicuous smooth warts. Under surface slightly granulated posteriorly. A fold of skin across the chest. Vomerine teeth in two patches between internal nares. Tongue attached in front and along mid-line.

Ground color variable, usually brown or green with a dark triangular mark between the eyes. Three oblique blotches on the sides. Limbs barred or spotted with dark. A light line from eye to arm. Upper lip light spotted with darker. Concealed surface of femur with a longitudinal dark stripe. Under surface yellowish white, throat mottled with darker. Coloration of male may be so dark that markings do not show.

Measurements: Specimen No. 30473.

Length of head and body	.024
Length of hind limb to heel	.025
Width of head	.0085

Habits and Habitat: The cricket frog is a tree frog that is entirely terrestrial in its habits. It is unable to climb trees because of the extreme smallness of the disks on its fingers and toes, and its agility and ability to accomplish rapid changes in coloration are probably its principal protection from enemies. It is usually found in large numbers along the banks of streams or ponds. When disturbed it jumps into the water with a series of high leaps and buries itself in the mud, from which it soon emerges. This species hibernates during the cold weather but soon becomes active again during warm periods. The food consists of small insects. These frogs sing in chorus during the months of April and May and the isolated call may be heard all summer. The song resembles the chirping of a cricket, hence the common name, cricket frog. The eggs are laid in April or May. The development is rather slower than that of the rest of the Hylidae. Miss Dickerson has found the tadpoles in the water in August and thinks that metamorphosis takes place in September.

Figure 13. Distribution of *Acris gryllus*.
Horizontal ruling, specimens examined: vertical ruling, reports only.

Distribution: New York to Florida, west to Texas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Cheboygan, Livingston, Washtenaw, Calhoun, Allegan and St. Joseph Counties. Reported from Eaton County (Clark, 1902); Antrim and Eaton Counties (Gibbs, Notestein and Clark, 1905); Cass County (Thompson, 1911).

CHOROPHILUS NIGRITUS (Le Conte).

SWAMP TREE FROG.

(Pl. IVa.)

Description: Body frog like. Head long and pointed; upper jaw protruding. Eyes prominent. Toes slightly webbed; disks small, hardly noticeable. A conspicuous fold across chest. Skin granulated on back and lower surface. Vomero-palatine teeth near the posterior part of internal nares. Tongue medium in size.

Ground color changeable, varying from light to dark brown. A dark stripe begins at the snout and runs back through the eye to the posterior part of the body. Upper lip with a light stripe and bordered with dark. Usually three dark longitudinal stripes on the back; center stripe on the vertebral line and sometimes forking posteriorly and behind the eyes. Limbs indistinctly barred or spotted. Under surface yellowish white. Throat of male yellow.

Measurements: Specimen No. 37921.

Length of head and body	.017
Length of hind limb to heel	.015
Width of head	.006

Habits and Habitat: The swamp tree frog is found in marshes and damp places throughout the summer and fall. During this time it is solitary and its call is rarely heard. It is also seldom seen because of the small size and protective coloration. When disturbed it disappears in the water, but it is a very poor swimmer and soon comes back to land. This species is probably, like *Acris gryllus*, unable to climb trees because of the small size of the disks on the fingers and toes. The food consists of small insects. It comes from its hibernation early. The song is very loud. When croaking, the male sits upright in the water, supporting himself with grass, leaves or twigs, and sings with the head and vocal pouch out of the water. When disturbed, he sits perfectly still and does not resume his song until the source of alarm has passed. The eggs are laid in March or April in small masses containing from five to twenty, and are attached to water plants. The development is rapid, the eggs hatching in about two weeks. Metamorphosis is completed early in June.

Distribution: Entire United States and north in Canada to the Hudson Bay region. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Dickinson, Huron, Washtenaw and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Antrim and Eaton Counties (Gibbs, Notestein and Clark, 1905); Huron County (Ruthven, 1911a).

RANA PIPIENS Shreber.

LEOPARD FROG.

(Pl. IVb.)

Description: Body long and slender. Head long and pointed at the snout. Lateral folds prominent; there may be several smaller folds between them. Skin smooth above; under surface of thighs slightly granular. A glandular fold extending from corner of mouth over the shoulder. Legs long and very powerful; feet partly webbed, webs deeply indented. Tubercles under joints of toes prominent. Vomerine teeth in two patches between internal nares.

Ground color green, gray or brown above. Lateral folds lighter; between them two irregular rows of rounded dark spots edged with lighter. Several rows of smaller rounded spots below lateral folds. Under surface yellowish white, frequently with dark spots across pectoral region. A dark line extending from muzzle to shoulder through eye; light lines above and below the darker line make the latter more noticeable. Upper surfaces of limbs transversely barred or blotched with darker. Concealed surface of femur vermiculated with brown.

Measurements: Specimen No. 37869.

Length of head and body	.087
Length of hind limb to heel	.077
Width of head	.022

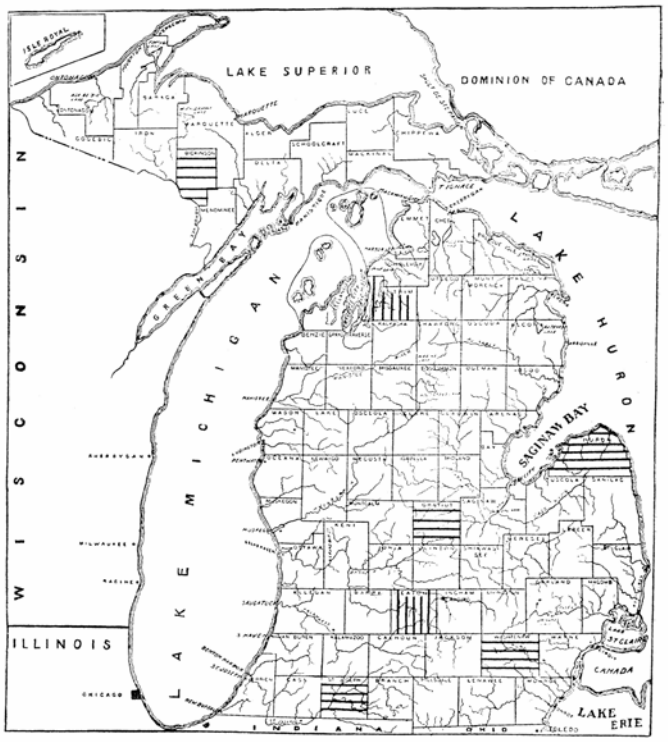

Figure 14. Distribution of *Chorophilus nigritus*. Horizontal ruling, specimens examined: vertical ruling, reports only.

Habits and Habitat: The leopard frog is the best known of the Ranidae, because of its great numbers and its habit of travelling away from the ponds into the fields in search of food. Its green coloring probably serves as a protection from its enemies. The leopard frog also possesses the power of changing the ground color to a limited degree to suit the surroundings. When kept in the laboratory in a dish containing moss, brown specimens turn green in a few days. The food consists of worms, insects and small frogs. It becomes very tame in captivity and may be easily handled. Like the rest of the Ranidae, the species hibernates during the cold weather in the mud and under stones, but, according to Hay (1892a, p. 66), its note may be heard "during the warmer days of midwinter," and it is often seen at such times.

This frog is one of the first to appear in the spring, the breeding season being in March and April. When it first appears it is almost black in color, but soon becomes

lighter. The eggs are laid in the shallow water of ponds in large masses which may float freely in the water but are usually attached to sticks or plants. Hankinson (1908) found unsegmented eggs, which had evidently been recently deposited, in Oakland County, April 8, 1907. The time of hatching varies according to temperature, but under ordinary conditions the tadpole will appear in about ten days. The metamorphosis is completed in July or August and it is for this reason that this species is more apt to be raised than *Rana catesbeana* by dealers. Its legs are esteemed as an article of food, and it is also reared or collected in considerable numbers to supply biological laboratories.

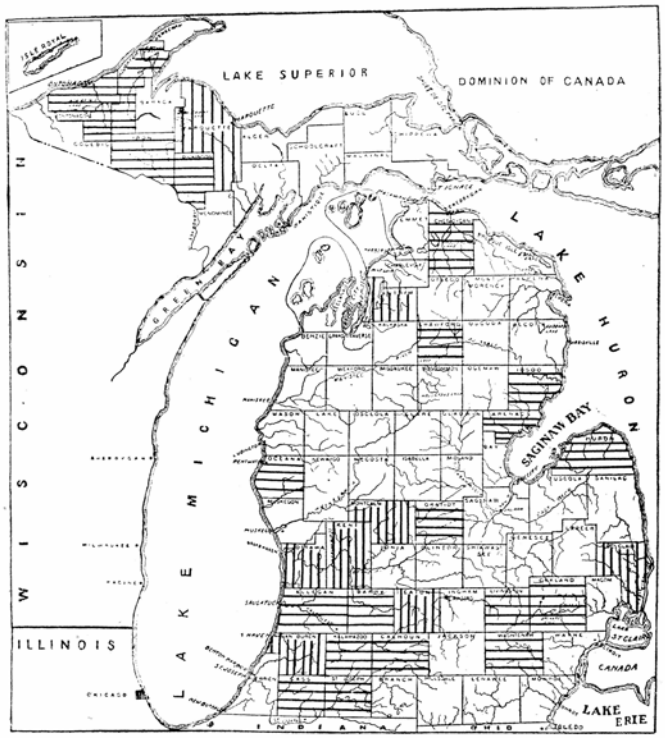

Figure 15. Distribution of *Rana pipiens*. Horizontal ruling, specimens examined: vertical ruling, reports only.

Distribution: Common in North America, east of Sierra Nevada Mountains. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Houghton, Ontonagon, Iron, Dickinson, Cheboygan, Crawford, Iosco, Arenac (Charity Island), Huron, Oceana, Barry, Oakland, Livingston, Washtenaw, Allegan, Calhoun, Kalamazoo, Cass and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); St. Clair County (Cope, 1889); Eaton, Van Buren, St. Joseph, Montcalm, Kent, Ottawa, Antrim, Kalamazoo and Barry Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Ontonagon County (Ruthven, 1904a); Ontonagon, Houghton and Marquette Counties (Ruthven, 1906); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

RANA PALUSTRIS Le Conte.

PICKEREL FROG.

(Pl. IVb.)

Description: Body slender. Lateral fold very broad but not elevated. Skin more or less smooth. Under surface of thighs slightly granular. Eyes prominent. Glandular fold from eye to shoulder. No external vocal pouch.

Ground color always some shade of brown, with two rows of more or less square spots of dark brown between the lateral folds, and two rows of smaller brown spots beneath. Lateral folds lighter than ground color. Under surface white anteriorly, bright yellow posteriorly. The yellow may extend along the sides and out under the fore arms. A conspicuous light line from eye to shoulder. Upper surface of limbs barred with brown. Jaws marked as in *R. pipiens*. A brown spot on the snout and one above each eye.

Measurements: Specimen No. 41911.

Length of head and body	.070
Length of hind limb to heel	.061
Width of head	.019

Figure 16. Distribution of *Rana palustris*. Horizontal ruling, specimens examined: vertical ruling, reports only.

Habits and Habitat: In habits *Rana palustris* closely resembles *Rana pipiens*. It lives along streams, ditches, about cold springs and ponds, and is very hard to capture because of its great agility and its protective coloration. When resting on a pile of dried leaves, such as is often found along the banks of streams or ponds, it is almost impossible to distinguish the frog from its surroundings. When frightened it makes several long leaps in quick succession. The food probably consist of

insects, small Crustacea and snails. The common name "pickerel frog" is due to the fact that the species is frequently used as bait in pickerel fishing. It is of no food value because of the disagreeable odor.

The breeding season of *Rana palustris* is April and May. The croaking of the males is said to resemble the sound made by the tearing of coarse cloth. The eggs are laid during May and the early development is rapid. The metamorphosis usually takes place in July or August, but under adverse conditions transformation may be delayed until the next year.

Distribution: Eastern North America, north to Hudson's Bay and west to the Great Plains. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Washtenaw, Barry, Calhoun, Kalamazoo, Livingston and Cass Counties. Reported from Wayne County (Cope, 1889); Wayne, Kalamazoo, Montcalm and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Washtenaw County (Smith, 1879); Cass County (Thompson, 1911).

This species has been reported from Michigan by several writers, but until this year there were, with the exception of one from Livingston County, no specimens in the University Museum. The writers have found it to be rather common in the vicinity of Ann Arbor, and have taken it in Kalamazoo and Calhoun Counties and in large numbers in Cass County (Thompson, 1911), and have received two specimens collected by Miss Jessie McNall in Barry County, so that the species is without doubt quite common throughout the southern part of the southern peninsula. The Ontonagon record is erroneous and the other records need to be verified for the species is easily confused with *R. pipiens*.

RANA CLAMITANS Latreille.

GREEN FROG.

(Pl. V.)

Description: Body stout. Head thick, muzzle pointed. Eyes large and close together. Skin of back rough. Back of femur granulated. Lateral folds conspicuous. Toes broadly webbed, leaving last two joints of fourth toe free. Tubercles on joints of toes and inner sole tubercles distinct. Ear of male larger than eye. Vomerine teeth in two patches between or behind the internal nares.

Ground color variable, usually brownish green with small dark spots. Head and shoulders bright green. Sometimes a light band, widening anteriorly, from shoulder to jaw. Limbs barred with darker. Posterior part of femur finely vermiculated with brown. Under surface yellowish white, throat of female spotted.

Measurements: Specimen No. 36827.

Length of head and body	.079
Length of hind limb to heel	.062
Width of head	.028

Habits and Habitat: The green frog is thoroughly aquatic in its habits, never travelling far from the water. It may be found along the edge of small streams, pools and cold springs. It is rather-solitary and timid, when frightened disappearing quickly in the water. It is very much like the bullfrog in appearance and habits, but may be readily distinguished by the lateral folds and the smaller webs on the feet. The food consists of insect larvae, small crustaceans, small frogs and insects. It comes early from hibernation. The song, which is low pitched and explosive in character, is usually heard in March. The eggs are laid in April, in large masses supported in the water by twigs or water plants. The early development is rapid, but metamorphosis is delayed till the second summer and sometimes the third. Hay (1892a) states that the tadpoles are vegetarians and never carnivorous.

Distribution: Common throughout eastern North America, including Canada and Florida. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Baraga, Ontonagon, Houghton, Dickinson, Cheboygan, Crawford, Alcona, Iosco, Arenac (Charity Island), Huron, Oceana, Barry, Livingston, Oakland, Wayne, Washtenaw, Cass and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); St. Clair and Wayne Counties (Cope, 1889); Eaton, Van Buren, Antrim, Kalamazoo and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Lenawee County (Kirsch, 1895); Baraga and Ontonagon Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

RANA CANTABRIGENSIS Baird.

WOOD FROG.

(Pl. IV a.)

Description: Body slender, muzzle pointed. Upper surface slightly granulated; posterior surface of femur granular. Lateral folds conspicuous. Toes long and slender, webbed almost to the tip. Inner sole tubercle present. Vomerine teeth in two patches between or behind internal nares.

Ground color varies from light to reddish and dark brown. Triangular dark spot back of eve covering ear. Light line along upper jaw reaching to shoulder. Limbs barred. Sides may be obscurely spotted with dark. Concealed surface of femur vermiculated. Under surface yellowish white, sometimes mottled with dark.

Measurements:. Specimen No. 34243.

Length of head and body	.039
Length of hind limb to heel	.032
Width of head	.014

Habits and Habitat: The northern wood frog, *Rana cantabrigensis*, is one of the most terrestrial of our frogs and is usually found in thick, wooded places, among

dead leaves or moss. It is very difficult to see because of the protective coloration, the dark brown or grayish coloring blending into the surroundings to such an extent that one may almost step on individuals before seeing them, and the black ear patch and the light line along the side of the head also seem to be protective. When disturbed the frog is very active, leaping quickly away. It becomes very tame in captivity. The wood frog is among the first of the Ranidae to come out in the spring. The hoarse clacking song of the males may be heard during the latter part of March and early in April. The male has no external vocal pouch, but the throat and the parts of the body over the lungs expand. Unlike the males of other species, he floats or swims in the water while croaking. The eggs are laid in ponds, either in the woods or fields, in masses which are usually attached to water plants. They are very small and are surrounded by a gelatinous envelope. The time of development varies greatly according to temperature. Eggs brought into the laboratory hatch in four days, but the development of those left in the ponds is much slower. Metamorphosis usually takes place some time during May or June. The young tadpoles are very carnivorous, living mostly on decaying animal matter in the ponds.

Figure 17. Distribution of *Rana clamitans*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Distribution: Northern. "Reported from Illinois, Michigan, Wisconsin and Minnesota northward to Great Slave Lake on the west and St. James Bay on the east." (Dickerson, 1906, p. 212.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Baraga, Dickinson, Mackinac, Cheboygan, Iosco, Huron, Livingston and Washtenaw Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Eaton, Kalamazoo, Antrim, Van Buren and Montcalrn Counties (Gibbs, Notestein and Clark, 1905); Lenawee County (Kirsch, 1895) ; Ontonagon County (Ruthven, 1904a); Keweenaw (Isle Royale), Baraga and Ontonagon Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a).

Figure 18. Distribution of *Rana cantabrigensis*. Horizontal ruling, specimens examined; vertical ruling, reports only.

RANA SEPTENTRIONALIS Baird.

NORTHERN FROG.

Description: Body stout. Head rounded, narrow in front. Eyes large and close together. Skin smooth, slightly granulated on sides and posterior part of femur. Feet fully webbed. Inner sole tubercle large with cutting edge. Vomerine teeth in two patches just behind internal nares.

Ground color light olive brown, usually with large dark brown blotches. Upper surface of jaw from snout to eye lighter in color. Large irregular blotches or bands on limbs. Under surface light yellow. Concealed surface of femur strongly vermiculated with brown.

Measurements: Specimen No. 40275.

Length of head and body	.062
Length of hind limb to heel	.051
Width of head	.020

Habits and Habitat: The northern or mink frog is distinctly aquatic. It has been said not to frequent lakes or ponds, but in the Northern Peninsula Ruthven (1910) has found it more characteristic of the inland lakes than of the streams. When frightened, it stays for a long time

under water. It is solitary in habits, and never strays far from the shores of the rivers and lakes. The food consists of water insects and small fish. The eggs of this frog are laid in June and July, and are attached to water plants. Two years are required for the full development and metamorphosis (Dickerson, 1906, p. 225). When annoyed it gives off a strong musky odor, somewhat resembling that of the mink, and because of this odor it is frequently called the "mink frog."

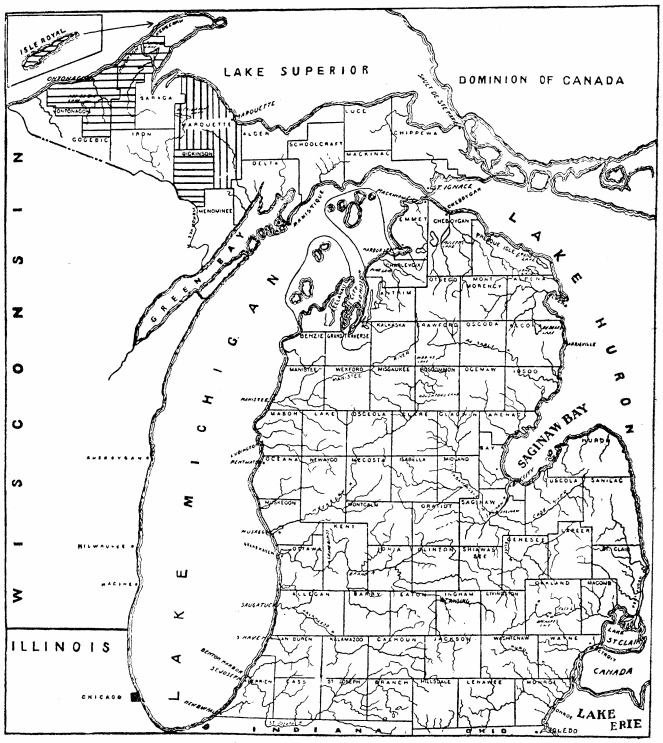

Figure 19. Distribution of *Rana septentrionalis*. Horizontal ruling, specimens examined; vertical ruling, reports only.

Distribution: Adirondack Mountains to Minnesota and Ontario. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Houghton and Dickinson Counties. Reported from Ontonagon and Marquette Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Dickinson County (Ruthven, 1910).

RANA CATESBEANA Shaw.

COMMON BULLFROG.

Description: Body large and stout, head broad. Eyes large and prominent. Ear of male larger than eye. Glandular fold from eye to arm, curving behind ear. No lateral folds. Back and under surface slightly granular. Feet webbed, leaving last joint of fourth toe free. Inner sole tubercle distinct.

Ground color greenish brown, sometimes spotted with darker. Limbs spotted or barred. Under surface yellowish white, usually mottled with darker.

Measurements: Specimen No. 40913.

Length of head and body	.130
Length of hind limb to heel	.098
Width of head	.047

Habits and Habitat: *Rana catesbeana*, the common bullfrog, is the largest of our frogs. It does not always follow, however, that the individual *R. catesbeana* is larger than the individual *R. clamitans* or *R. pipiens*, since the size depends upon the food and environment. The bullfrog is aquatic in its habits, being found during the summer in large ponds or lakes, usually those with mud bottoms and with deep as well as shallow water. It is a powerful swimmer, due to the fact that the toes are fully webbed and the hind limbs are long and well developed. The food consists of fish, young turtles, young water birds, frogs, small snakes and insects.

Figure 20. Distribution of *Rana catesbeana*. Horizontal ruling, specimens examined; vertical ruling, reports only.

The bullfrog is solitary in habit except during the breeding season and even then it sings alone and not in chorus. The song consists of a deep bass note that resembles the roaring of a bull; from this it gets the common name, the bullfrog. It is late in coming from its hibernation quarters, the eggs being laid in May or early June. Metamorphosis does not take place until the second year and may be delayed until the third if the environment is unfavorable. This species is of great economic importance because of its value as food; the legs being considered a great delicacy by many people. The frog may be caught in the day time on a hook and line baited with a bit of red flannel. They are frequently hunted at night with lanterns, the light blinding them so that they may be easily speared by the hunter.

Distribution: East of the Rocky Mountains, including Florida and Texas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Cheboygan, Iosco, Huron, Livingston, Washtenaw and Cass Counties. Reported from Eaton County (Clark, 1902); Eaton, Kalamazoo, Van Buren, Antrim, Montcalm, Kent, Ottawa, Barry and St. Joseph Counties (Gibbs, Notestein and Clark, 1905); *Ontonagon County (Ruthven, 1904a); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879); Cass County (Thompson, 1911).

*_Rana catesbeana_ has been reported from Ontonogan County by Ruthven (1904a) but the specimens were later identified by Stejneger as somewhat anomalous specimens of _Rana clamitans_ (Ruthven, 1906).

GLOSSARY.

Angle of the jaw.—Point of articulation of the two jaws.

Anus.—External opening of the intestine.

Branchiae.—External branched gills.

Caudal fin.—The tail fin.

Compressed.—Flattened from side to side.

Coetal grooves.—Grooves on the sides of the body, indicating the position of the ribs.

Cranial crests.—Bony ridges extending back between the eyes.

Depressed.—Flattened from above downward.

Disks.—The enlarged and adhesive pads on the ends of the fingers and toes.

Dorsal groove.—A depression along the back.

Femur.—The upper or proximal bone of the leg.

Fronto-parietal crests.—Crests in front of, and between the eyes.

Genital openings.—External openings of the genital ducts.

Gills.—Organs for breathing the air contained in water.

Glandular.—Swollen and gland like.

Gular fold.—A transverse fold of skin across the throat.

Hibernate.—To refrain from an active condition, to remain in a torpid state over winter.

Lateral folds.—Gland like folds extending along the sides of the back.

Maxillary.—The bone of the upper jaw, back of the premaxillary. It forms the greater part of the upper jaw and may bear teeth.

Maxillary teeth.—Teeth borne on the maxillary bone.

Metamorphosis.—Change from the larval to the adult condition.

Metarsal tubercles.—Tubercles on the toes.

Mucous membrane.—Membrane lining the mouth.

Nares.—Nostrils; the external openings are called external nares, the internal openings internal nares.

Palatine.—A pair of bones just behind the vomers and extending transversely across the skull.

Parasphenoid.—The large broad bone in the roof of the mouth which forms the floor of the brain case.

Parasphenoid teeth.—Teeth borne on the parasphenoid bone.

Parotid glands.—Elevated glandular bodies found back of the, eye in toads.

Pectoral.—Pertaining to the shoulder or breast.

Plantar tubercles.—Tubercles on the palm.

Postorbital crests.—Bony crests extending behind the eye.

Premaxillary.—The two bones, one on either side, in front of the maxillaries. They unite to form the anterior angle of the upper jaw.

Premaxillary teeth.—Teeth borne on the premaxillary bone.

Protective coloration.—Coloration of such a character that it serves to conceal the animal in the natural surroundings.

Rudimentary.—Not well developed. Degenerate.

Scuted.—Having scutes or scales.

Segmentation.—The cleavage of the eggs which takes place after fertilization.

Sole tubercles.—Small callous like projections on the sole of the foot.

Spawning.—The act of depositing the eggs.

Sperm.—The male sex element.

Spermatophores.—Small mushroom like bodies containing the sperm, deposited in the water by the male of some species during the breeding season.

Vermiculated.—Covered with fine irregular color marks.

Vertebral.—Pertaining to the vertebrae or spinal column.

Viridescent.—Greenish.

Vomer.—A pair of bones in front of the parasphenoid and forming the floor of the olfactory capsule.

Vomero-palatine teeth.—Teeth borne on the vomerine and palatine bones.

THE REPTILES OF MICHIGAN.

BY ALEXANDER G. RUTHVEN.

INTRODUCTION.

In the opinion of the writer, the inadequateness of the available information on the reptiles of Michigan may be attributed in part to the fact that there is no available manual on the subject suitable for the use of local students. The literature consists, with few exceptions, of a few general and local lists and incidental references to Michigan specimens in general works on herpetology. Aside from their limitations as lists the more general papers are all more or less erroneous and antiquated, and the local lists at best deal with too widely separated localities to be of general interest. The other records have, of course, the disadvantage of being widely scattered. It is hoped that this report will furnish an, accurate summary of our present knowledge of the subject, and also serve to encourage further work.

LITERATURE.

The publications which treat either entirely or in part of Michigan specimens are as follows:

1. Sager, Abraham. Senate Doc., State of Michigan, 1839, pp. 294-305. A list of Michigan reptiles collected by the State Geological and Natural History Survey. No localities or other data given. Copied in Senate Documents of the same year.

2. Holbrook, J. E. North American Herpetology, 1842. Gives "Michigan" in the range of several species.

3. Baird, S. F. and Girard, C. Catalogue of North American Reptiles, 1853. Specimens of *Elaphe vulpinus*, *Storeria dekayi*, *Sistrurus catenatus*, *Natrix sipedon* and *Regina leberis* listed from Michigan and two new species, *Bascanion foxii* and *Nerodia agassizii*, described on the basis of Michigan material.

4. Hallowell, Edward. Proc. Acad. of Nat. Sci. Philadelphia, 1856, p. 310. A description of a specimen of *Eumeces quinquelineatus* from the neighborhood of Flint, Michigan, as a new species—*Plestiodon vittigerum*.

5. Agassiz, Louis. Contributions to the Natural History of the United States, I, 1857. Several species of turtles recorded from Michigan.

6. Miles, Manly. A Catalogue of the Mammals, Birds, Reptiles and Molluscs of Michigan. 1st. Bien. Rept. Geol. Surv. of Mich., 1861, pp. 219-241. A list of the reptiles known to occur in the state with a few foot-note records of localities.

7. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan, Supp. to Science News, 1879. A list of Michigan reptiles based on the specimens in the University of Michigan Museum and the private collection of the writer. No data is given but those found in the vicinity of Ann Arbor are indicated by a star.

8. Gibbs, M. Forest and Stream, XXXIX, 1892, p. 7. I have not been able to consult this article.

9. Stejneger, Leonhard. Rept. U. S. Nat. Mus., 1893, pp. 337-487. States that *Sistrurus catenatus* is common in parts of Michigan.

10. Kirsch, Philip. Bull. U. S. Fish Comm., XIV, 1895, p. 333. Several species of reptiles listed from points in lower Michigan.

11. Cope, E. D. The Crocodilians, Lizards and Snakes of North America. Rept. U. S. Nat, Mus., 1898 (1900), pp. 153-1270. Contains records of Michigan specimens of several species.

12. Gibbs, M. Herpetology of Kalamazoo County, Michigan. Wolverine Naturalist, Feb. 1900, pp. 12-13. *Crotalus horridus* (one specimen) and *Sistrurus catenatus* recorded from Kalamazoo County with notes on the habits of the latter.

13. Clark, H. L. Notes on the Reptiles and Batrachians of Eaton County, Michigan. 4th. Ann. Rept. Mich. Acad. Sci. 1902, pp. 192-194. A list of the reptiles of Eaton County, with miscellaneous notes on size, abundance, variation, etc.

14. Clark, H. L. The Water Snakes of Southern Michigan., Amer. Naturalist, XXXVII, 1903, pp. 1-23. A careful statistical study of the water snake (*N. sipedon*) on the basis of material collected in Eaton County, Mich. The writer concludes that the red-bellied specimens (*erythrogaster*) represent a distinct species. Notes on the habits of *N. sipedon* and *Regina leberis*.

15. Clark, H. L. Notes on Michigan Snakes, 5th Ann. Rept. Mich. Acad. Sci., 1903, pp. 172-174. Miscellaneous notes on *Natrix sipedon*, *Bascanion constrictor*, *Elaphe obsoletus*, *Lampropeltis doliatus triangulus*, and the garter-snakes.

16. Clark, H. L. The Short-Mouthed Snake (*Eutainia brachystoma* Cope) in Southern Michigan. Proc. Biol. Soc. Wash., XVI, pp. 83-88. A discussion of the characters, variation and habits of specimens of *Thamnophis butleri* colllected in Eaton county.

17. Sperry, W. L. Variation in the Common Garter Snake (*Thamnophis sirtalis*). 5th Ann. Rept. Mich. Acad. Sci., 1903, pp. 175-179. A discussion of the variation, scutellation and tail-length of specimens of *T. sirtalis* from Eaton County. Some of the specimens are referred (erroneously) to *T. sirtalis parietalis*.

18. Ruthven, Alexander G. Butler's Garter Snake. Biol. Bull., VII, 1904, pp. 289-299. In this paper the writer records *Thamnophis butleri* from several localities in southern Michigan, shows the distinctness of the form from *T. sirtalis* and that the specimens refered by Clark to *T. brachystoma* are referable to it, discusses the habits, distribution, characters, variations and affinities and gives the synonomy and a list of the known specimens.

19. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibians of Ontonagon County, Michigan. 6th Ann. Rept. Mich. Acad. Sci., 1904, pp. 188-192. Records of the species collected by the writer in the Porcupine Mountains, Michigan, in 1903, with notes on their occurrence.

20. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 109-110. This list, compiled with the assistance of Morris Gibbs and P. Notestein, purports to be a list of Michigan reptiles with the localities (principally counties) in which the species have been observed. Unfortunately it is based principally upon records the sources of which are not given so that, while it is quite accurate as a list of Michigan species, the careful student cannot accept the localities as reliable.

21. Notestein, F. N. The Ophidia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 112-125. The writer of this paper has endeavored to give a synopsis of the reptiles of the state with keys to make possible the easy determination of specimens. In reality what he has done is to describe the species that may occur in the state without giving any state records, so that, while the paper will assist in determining Michigan specimens, it cannot be considered as a monograph on Michigan herpetology. The paper is, furthermore, marred by very numerous typographical errors which, altho it must be said not the fault of the writer, greatly impair its usefulness to the general student.

22. Whittiker, C. C. The Status of *Eutaenia brachystoma*,. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 88-92. The writer compares the published description of the type specimen of *Thamnophis brachystoma* with material of *T. butleri* and concludes that *brachystoma* is a synonym of the latter.

23. Whittiker, C. C. Variation in the Blue Racer. 7th Ann. Rept, Mich. Acad. Sci., 1905, pp. 100-102. A brief account of the natural history and a discussion of the variation in scutellation and proportionate size of extremities observed in 58 specimens of *Bascanion constrictor* from Eaton County.

24. Gibbs, Morris. Bibliography for the Amphibia and Reptilia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, p. 111. A list of the papers "which directly refer to Michigan herpetology so far as known to the (writer."

25. Ruthven, Alexander G. The Co<ld-Blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Rept. Geol. Survey Mich. for 1905 (1906), pp. 107-112. Lists the species (5 snakes and 1 turtle) known to occur in the northern peninsula of Michigan with notes on the habits and habitats. The list is based principally on specimens secured by the expeditions of the University of Michigan Museum and upon the field notes of the writer.

26. Hankinson, T. L. A Biological Survey of Walnut Lake, Michigan. Rept. Mich. Geol. Surv., 1907 (1908), pp. 153-288. Contains a list of eight species of reptiles from the vicinity of Walnut Lake, Oakland County.

27. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Rept. Geol. Surv. Mich. for 1908 (1909), pp. 329-333. A summary of the herpetology of Isle Royale based principally upon the data secured by the University of Michigan Museum expeditions.

28. Ruthven, Alexander G. Variations and Genetic Relationships of the Garter-Snakes. Bull. U. S. Nat. Mus., 61, 1908. Contains Michigan records of *Thamnophis butleri*, *T. sirtalis*, and *T. sauritus* and notes on the habits of these species.

29. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, 11th Ann. Rept. Mich. Acad. Sci., 1909, pp. 116-117. The writer shows that the Michigan specimens of wood-frog are referable to the species cantabrigensis, extends the northward range of *Thamnophis butleri* to Huron County, summarizes the distribution of *Heterodon platyrhinus* and *Elaphe vulpinus* in the state, giving new records, and shows that Porcupine Mountain specimens of *Chrysemys* are *C. bellii.*

30. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, II. 12th Ann. Rept. Mich. Acad. Sci.; 1910, p. 59. Records *Rana septentrionalis*, *Elaphe vulpinus* and *Chrysemys bellii* from Dickinson County.

31. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, III. 13th Ann. Rept Mich. Acad. of Sci., 1911, pp. 114-115. Contains a summary of the distribution of *Diadophis punctata* and a list of the species known from Cheboygan County.

32. Ruthven, Alexander G. Amphibians and Reptiles in A Biological Survey of the Sand Dune Region on the South Shore of Saginaw Bay, Michigan. Mich. Geol. and Biol. Surv., Pub. 4, Biol. Ser. 2, 1911, pp. 257-272. A discussion of the reptile-amphibian fauna of the northern part of Huron County; fifteen species of reptiles recorded.

33. Thompson, Crystal. Notes on the Amphibians and Reptiles of Cass County, Michigan. 13th Ann. Rept. Mich. Acad. Sci., 1911, pp. 105-107. Records thirteen species of reptiles from Cass County.

METHODS OF STUDY.

The reptiles are a group which, in the opinion of the writer, has been much neglected by students of natural history. The result of this is shown by the small amount of material on habits and local distribution that has accumulated. Much of this neglect of a very interesting group is due to the wide spread aversion to reptiles, particularly to lizards and snakes. The truth is that most of this aversion is acquired and can be more or less easily overcome. It is due in no small part to the absurd stories that still pass current in the periodicals. We venture to say that if the statement were published in the