A ZOOGEOGRAPHICAL ANALYSIS OF THE HERPETOFAUNA IN NORTHERN MICHIGAN AND ADJACENT ISLE ROYALE

Thesis for the Degree of M. S. MICHIGAN STATE UNIVERSITY Wendel John Wagner Johnson 1965 • • •

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#### ABSTRACT

# A ZOOGEOGRAPHICAL ANALYSIS OF THE HERPETOFAUNA IN NORTHERN MICHIGAN AND ADJACENT ISLE ROYALE

by Wendel John Wagner Johnson

The objectives of this study were twofold: (1) to ascertain more accurately the geographic ranges of the amphibians and reptiles inhabiting northern Michigan and; (2) to examine critically animals from selected areas of Isle Royale and from the Upper and Lower Peninsulas of Michigan in an effort to establish any clinal trends that may exist.

The field work consisted of a 13-day collecting trip from August 12 to August 25, 1963, and a more extensive survey from June 15 to August 7, 1964. Specimens were obtained from all ecological habitats in the 15 counties of the Upper Peninsula of Michigan and Isle Royale.

Seines, minnow traps and dip nets were utilized for acquiring the aquatic forms while most of the terrestrial species were encountered by turning logs and rocks. Preserved materials from The University of Michigan Museum of Zoology, Michigan State University Museum, and the Michigan State University Department of Zoology were also utilized. Complete scalation counts were made on all reptiles and pertinent body and leg measurements were taken with a meter stick and vernier caliper on the amphibians.

The geographical ranges of existing herpetofauna have been more accurately defined. There are no large geographic barriers to species dispersal in the Upper Peninsula. Temperature appears to be a deterrent to keep more species from entering the northern Peninsula. The various species occur in mosaic patterns in suitable habitats across the Upper Peninsula.

The origin of the Isle Royale herpetofauna is from Canada to the north and east. The northern Peninsula was repopulated after the last glacial retreat, primarily from Wisconsin to the west and south, and secondarily from southern Michigan and Canada to the south and east. THESP

# A ZOOGEOGRAPHICAL ANALYSIS OF

#### THE HERPETOFAUNA IN NORTHERN MICHIGAN

#### AND ADJACENT ISLE ROYALE

Ву

Wendel John Wagner Johnson

# A THESIS

Submitted to Michigan State University in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Zoology

THESIS

#### ERRATA SHEET

Page 22 line 22 reads (Abies sp.) should be (Abies sp.)

111 - 1

- Page 24 line 2 reads (1950 divides should be (1950) divides
- Page 24 line 18 reads (Betula papyifera) should be (Betula papyrifera)
- Page 27 line 13 reads (Drocera sp.) should be (Brosera spp.)
- Page 40 Table 2 reads (40.0-47.7) should be (40.0-46.7)
- Page 41 line 20 reads (per. comm.), should be (per. comm.).
- Page 44 line 8 reads a counting should be a difference in counting
- Page 43 Table 7 reads 81.8 spots should be 81.8 stripes
- Page 57 line 5 reads Conant, op. cit. (Map 21) should be Conant, (op. cit., map 21)
- Page 59 line 17 reads across to should be across the
- Page 67 line 9 reads cological should be ecological
- Page 72 Opheodyrs should be Opheodrys
- Page 76 Tabel 17 Chrysemys picta marginata is not recorded from Baraga county.
- Page 70 Tabel 17 Chrysemys picta belli should be 0 instead of for Barags county.
- Page 85 line 4 reads of salamanders, one should be of snakes. One species of turtle, two species of snakes, six species of frogs, and three species of salamanders occur on Isle Royale.

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#### INTRODUCTION

The herpetofauna of the Northern Peninsula of Michigan has not been intensively studied. The Herpetology of Michigan, University of Michigan Handbook, Number 3, published by Alexander G. Ruthven, Crystal Thompson and Helen T. Gaige (1928) is the most recent comprehensive work involving this region. Previous to this handbook there was a similar publication by the same authors (Ruthven, et al.) in 1912. Ruthven made several studies of specific areas of the Northern Peninsula (1904, 1906, 1909, 1910) and Ruthven and Crystal Thompson (1915). The localities for these previous herpetological expeditions are shown in Figure 1. Since 1928 there have been relatively few studies involving the amphibians and reptiles inhabiting this area. Manville (1948) did a survey of the vertebrates of the Huron Mountains and listed the herpetofauna in that area. Logier and Toner (1961) have published and revised a checklist of the herpetofauna of Canada and Alaska but do not include any areas south of the Canadian border. Conant (1958) illustrates ranges for all reptiles and amphibians of the United States and Canada east of the 100th Meridian, but because of the

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#### FIGURE 1

PREVIOUS HERPETOLOGICAL STUDIES

IN THE NORTHERN PENINSULA

- 1 Ruthven, Alexander G., 1904
- 2 Ruthven, Alexander G., 1906
- 3 Ruthven, Alexander G., 1909
- 4 Ruthven, Alexander G., 1910
- 5 Thompson, Crystal, and Helen Thompson, 1913
- 6 Gaige, Helen T., 1915
- 7 Gaige, Helen T., 1915a
- 8 Evans, Arthur T., 1916
- 9 Manville, Richard H., 1948



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extremely large area covered by the ranges listed for all species found in northern Michigan are necessarily quite general. A note published by Hensley (1964) was the most recent work dealing exclusively with this area.

The objectives of this study are: (1) to ascertain more accurately the geographic ranges of the amphibians and reptiles inhabiting northern Michigan and; (2) to examine critically animals from selected areas of Isle Royale and from the Upper and Lower Peninsulas of Michigan in an effort to establish any clinal trends that may exist.

The areas under consideration are the Northern Peninsula of Michigan and Isle Royale in Lake Superior. The Northern Peninsula, comprising 16,353 square miles, is bordered on the south by Lake Michigan, Lake Huron on the east, Lake Superior on the north, and continues into Wisconsin on the west. The maximum east-west dimension is 325 miles and it is 240 miles from Menominee to Copper Harbor at the tip of the Keweenaw Peninsula. Isle Royale lies fifty miles northwest of Copper Harbor, and 12 miles south of the Minnesota-Canada shoreline. It measures 45 miles in a northeast-southwest direction, has a maximum width of nine miles wide, and includes 210 square miles.

Climatological Features

Because of its position between two of the Great Lakes, the Upper Peninsula of Michigan has a more moderate and island-like temperature than any other area in the interior of the continental United States. United States Weather Bureau records indicate that  $40^{\circ}$  F. is the mean average annual temperature for the entire Peninsula, however average daily temperatures and frost free days vary considerably between areas. For example the cities located near the lake shores have more moderate winter and summer temperatures. The coldest regions of the Upper Peninsula are in Iron and Gogebic counties. Watersmeet in Gogebic county has a January mean average of 12.5° F. (See Fig. 2); this is the lowest mean temperature observed for January according to data from fifteen Upper Peninsula weather stations. In contrast to this St. Ignace, which is bordered by Lake Michigan, in Mackinac county, has the highest mean temperature of 21.1° F. for the same month. There is no gradient in temperature from south to north in the Peninsula, but instead the rule of modification of temperature by the Great Lakes is apparent throughout the Upper Peninsula. Incomplete monthly weather records from the

# FIGURE 2

Graph of the mean monthly and annual temperatures at five weather stations in Northern Michigan, (1931-1952).



Degrees Fahrenheit

Mott Island Station on Isle Royale make a complete comparison with the Northern Peninsula impossible. However, the records from May to November show that mean summer temperatures on Isle Royale are cooler than in the Northern Peninsula by several degrees as would be expected by its more northerly location. This location would indicate that Lake Superior is exerting a modifying effect on the climate similar to that seen in the areas along the Great Lakes.

Another indication of the modifying influence by Lake Superior is seen in the difference in the number of frostfree days between weather stations located on Lake Superior and those stations farther inland. Areas along the southern border of Lake Superior seldom have killing frosts after May 15 or before October 1, whereas, other areas of the Peninsula may expect killing frost until June 10 and as early as September 1 in the fall. In certain regions of Iron and Dickinson Counties the growing season for plant crops is only 75 to 100 days.

Baten and Eickmeier (1955), have shown that Green Bay, Wisconsin, receives as much as 16 percent more sunshine than Marquette, Michigan during various times of the year. This is because of increased cloud cover over Marquette,

Michigan. As indicated in Figure 3 the difference in percent of sunshine is greatest in the months of November, December, January and February and least in the summer months. Weather Bureau records from 1927 to 1953, indicate a warming trend over the preceding 27 years.

During the period from 1901 to 1931, total annual precipitation in the Upper Peninsula ranged from an average of 26 inches in western Marquette county and portions of Luce, Chippewa and Mackinac counties to an average of 34 inches per year in Iron County. However records from 1931 to 1952 show that the St. Ignace area had the least rain with an average annual amount of 26.68 inches and the Chatham and Munising station in Alger county had the most precipitation with averages of 33.72 and 33.84 inches respectively. Figure 4, shows the isohyets of northern Michigan. The preceding climatic conditions corroborate with those cited by Kendeigh (1961), for the Pine-Hemlock ectone of the Upper Peninsula. This area is a transition zone between the more temperate deciduous forest of southern Michigan and the cooler boreal forest of Canada to the north.

# FIGURE 3 COMPARISON OF PERCENTAGES OF POSSIBLE SUNSHINE AT GREEN BAY, WISCONSIN AND MARQUETTE, MICHIGAN

(1902-1952)



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FIGURE 4

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Surface Geology and Soils

The rocks of the western Upper Peninsula, dating from Precambrian times, are much older than those of the eastern sector and are predominantly igneous and metamorphic with minor amounts of sedimentaries. These rocks are of many types, such as, greenstones, granites, gneisses, and schists, and have been folded and partly, or wholly recrystallized. They vary in hardness and consequently weather unevenly forming a rugged, hilly relief. Bedrock outcropping is most extensive in the western Upper Peninsula in the Huron Mountains east of Keweenaw Bay, the Keweenaw Peninsula, the Porcupine Mountains in Ontonagon county on the border of Lake Superior, the Gogebic Range from Ironwood to Lake Gogebic, and the Iron Mountain area bordering Wisconsin. Isle Royale has topography and geology similar to the Keweenaw Peninsula fifty miles to the southeast of it.

The subsurface geology of the Northern Peninsula, east of a line running from Marquette to Faithorn in Menominee county (Fig. 1), is Lower Paleozoic in age and is all of a sedimentary origin.

The present topography of the Northern Peninsula like so much of the rest of the Midwest is a direct result of

Pleistocene glaciation and post-Pleistocene erosion. Pollen profiles and other paleobotanical evidence dated by carbon-14 methods indicate that the last substage, the Valders, of any consequence to the Upper Peninsula, of the Wisconsin stage, retreated from northern Michigan approximately 9,000 years ago. As the various glaciers passed over and retreated from the Northern Peninsula drift deposits were left over most of the area. Much of the rugged relief of the western counties of the Peninsula and Isle Royale has been modified by these thick glacial deposits. A series of ancestral Great Lakes developed from the impounding of glacial melt waters. Many of these lakes stood at a higher level than the present ones as shown by ancient elevated shorelines (Hough, 1963), and covered parts of the eastern Upper Peninsula. Today the results of this inundation can be noted by the extensive swamps and also by lake-clay plains (Fig. 5).

A post-Lake Algonquin stage of the ancestral Great Lakes had the most pronounced effect on the eastern half of the Northern Peninsula of Michigan by inundating parts of the area. Ancient beaches and sandy shorelines have been found in parts of Alger, Chippewa, Delta, Luce, Mackinac, and Schoolcraft counties. Since the retreat



FIGURE 5. Map of the Surface Features of Northern Michigan

of the glacier there has been continual uplift of the ancient lake shorelines in the Northern Peninsula as a result of isostatic rebound of the crust from the release of pressure when the glacier melted.

The topography of Isle Royale consists of a series of parallel ridges running in a southwest-northeast direction. Mount Desor is the highest point on the Island, 1394 feet above sea level. The relief of the western counties, generally between 650 and 1400 feet above sea level, reaches a peak of 2023 feet in the Porcupine Mountains in Ontonagon county. In contrast, the generally low relief of the eastern Upper Peninsula is characterized by swamps interspersed with morainal ridges and averages 250 feet above Lake Michigan.

The drainage of the Northern Peninsula is in two main directions, northward to Lake Superior and to Lake Michigan on the south (Fig. 6). Lake Huron, to the east, receives a relatively small amount of water from this region. The two primary drainages into Lake Superior are the Ontonagon River in Ontonagon county and the Tahquamenon River in Luce and Chippewa counties. The drainage from Ontonagon county consists of a series of small streams running parallel to each other into Lake Superior. The drainage there


FIGURE 6. Map of the Principle Drainage Systems of Northern Michigan

is down a steep gradient whereas the gradient of the Tahquamenon River is not as extreme.

The streams flowing into Lake Michigan have much larger watershed areas. The Manistee River in Schoolcraft, Mackinac, and Luce counties is the most extensive drainage system and involves an area of about 1400 square miles. Smaller rivers such as the Menominee, Ford, and Sturgeon also drain into Lake Michigan. Only a few small streams in Chippewa and Mackinac counties flow into Lake Huron. The poor drainage of the Peninsula is apparent when one realizes that 25 percent of the total area is characterized by swamps and lakes. The drainage between ridges on Isle Royale is very poor and has resulted in the formation of extensive peat swamps in these areas.

Whiteside, Schneider, and Cook (1959), have found that the major local differences in Michigan soils are associated with variations in the texture of their parent materials and the drainage conditions under which the soils are formed. All soils of the Upper Peninsula are classified as podzolic. However, the western sector of the Peninsula and the southern part of the eastern Upper Peninsula have soils formed from consolidated rock and in these regions the soils are shallow and bedrock may reach the surface. There is no free lime in

the soils west of a line running from Marquette to Faithorn (Fig. 1) and the result is a soil that is acidic to a depth of several feet. The soils east of this line contain free lime and are consequently basic in nature. There are thirty different soil associations in the Northern Peninsula of Michigan, according to Whiteside et al. (1959) and these are grouped in seventeen land divisions. Actually there are only eight land divisions of any extent and these are characterized in a table (Table 1). Figure 7 locates these features. In addition, there are eleven other smaller land divisions defined for the region, included in land division H, but will not be considered herein.

TABLE 1.

A B	Undulating to hilly soils Gently rolling to very hilly soils
В	Gently rolling to very hilly soils
С	Hilly and mountainous
D	Level to rolling soils
Е	Level to rolling well-drained soils
F	Level to hilly
G	Low, moist, and wet areas
Н	A combination of many small land
(Modified from Whiteside	

Locality	Soil Constituents
Western Upper Peninsula at elevations of 1300 to 1900 feet above sea level	Sandy loams to silt loams, overlaying either reddish, sandy loams, loams, or course sandy glacial drift Acidic
Western Upper Peninsula at elevations of 1400 to 1800 feet above sea level	Acid, stony sand to sandy loam parent material. Course stony soil
Rough, steep, and mountainous areas in the western part of the Upper Peninsula; including iron and copper ranges and the Huron and Porcupine Mountains at elevations of 1200 to 2000 feet above sea level; also Isle Royale	Sands, sandy loams, and silt loams over bedrock of granite, basalts, slate, shale, or schist. Soils are excessively stony and bouldery with outcrops common
Drumlin area of Menominee county and east part of Alger county	Well-drained limy, sandy loams, and loam <b>s</b>
Very extensive in the eastern Upper Peninsula; including Alger, Delta, Chippewa, Luce, Mackinac, Menominee, and Schoolcraft counties	Well-drained sands from materials low in lime
Parts of Alger, Luce, Schoolcraft, Chippewa, and Mackinac counties	Dominantly sands, loamy sands, and sandy loams
Most of Schoolcraft, large parts of Chippewa, and Luce, and also areas in Alger, Delta, Mackinac, and Menominee counties	Wet and dry sands with closely associated peats. The mineral soils were developed from sandy parent material
Scattered small areas throughout the Upper Peninsula	Clays, loams, sandy loams, sand, etc.



Vegetational Features

A sequence of climatic and vegetational changes followed the retreat of the last glacier in northern Michigan. Potzger (1942), by means of pollen analysis of bog samples in the Upper Peninsula, postulates that after the retreat of the glacier there were four major climatic changes with resultant changes in vegetation. When the glacier was near at hand, the climate was cool and moist and the region was characterized by a sprucefir dominant forest. A warmer drier period halted glaciation and this brought about the pine maximum. It is at the height of this warming trend that the "steepe peninsula" described by Schmidt (1938) occurred. As the climate became warmer, and more moist, the hemlock (Tsuga canadensis) and many broadleafed genera (Acer, Betula, Populus, etc.) appeared. Eventually, as the climate deteriorated again, there was a slight increase in spruce (Picea <u>sp.</u>), fir (<u>Abies</u> <u>sp.</u>), paper birch (<u>B. papyrifera</u>), and yellow birch (B. lutea), with a concurrent decrease in the amount of pine present. Despite the pollen evidence suggesting a decrease in pine, the predominant forest in the Northern Peninsula of Michigan at the time of settlement by white man was the white pine (Pinus strobus) (Fig. 8).

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Soil types determine the contemporary vegetation differences of the Northern Peninsula. Braun (1950 divides the flora of the Peninsula into two main association; the maple-beech climax community on the fine-grained and loamy soils of the eastern sector; and the maple-basswood climax association of the more mature soils of the western sector. The western boundary of beech (Fagus grandifolia), coincided exactly with the north-south line from Marquette to Faithorn (Fig. 1). West of this line basswood (Tilia americana) replaces beech as the co-dominate with sugar maple (Acer saccharum). In the former two associations hemlock is often a sub-dominate or even a co-dominate. In many areas secondary deciduous communities of aspen (Populus tremuloides) are replacing other forest types such as white pine, and white spruce (Picea glauca), and seem to adapt well to areas that have been recently logged-off. Other deciduous communities of poplar (Populus sp.), paper or canoe birch (Betula papyifera), gray birch (B. populifolia), yellow birch (B. lutea), and maple (Acer rubrum), and balsam fir (Abies balsamea), are found in areas where the conditions necessary for the climax forest have not yet been reached.

Two types of coniferous forests exist in the Northern

Peninsula. On the higher, sandy areas there are locations of jack pine (<u>Pinus banksiana</u>), red pine (<u>P. resinosa</u>), and white pine. These stands are quite extensive along the Wisconsin-Michigan border. Jack pine has increased in acreage in areas where fires have destroyed the original forest. Red oak (<u>Quercus borealis</u>), white oak (<u>Q. alba</u>), and red maple may also be secondary species in jack pine-red pine communities on sandy soils.

Bog forests are quite extensive in the lower, wetter areas of northern Michigan such as the Manistee and Tahquamenon drainages. These forests are characterized by a climax stand of white spruce, northern white cedar (<u>Thuja</u> <u>occidentalis</u>), and balsam fir; whereas, the seral stages may support tamarack (<u>Larix laricina</u>), paper birch, and black spruce (<u>P. mariana</u>).

The deciduous communities support relatively rich ground cover as compared to the pine stands. The ground cover, including <u>Trillium grandiflorum</u>, <u>Smilicina racemosa</u>, and such shrubs as <u>Sambucus pubens</u>, and <u>Lonicera canadensis</u>, is abundant from May all through the summer. Of all the hardwood communities, the hemlock-yellow birch-red maple has the richest undergrowth with the most species and individuals. The aspen stands have a ground cover of bracken fern

(<u>Pteridium aquilinum</u>), and/or sweet fern (<u>Comptonia pere-</u> <u>grina</u>), that often completely covers the forest floor.

The pine stand ground cover, which is represented by such herbaceous species as Aster macrophyllus, Clintonia borealis, Oryzopsis sp., and Pteridium sp., creates a very barren situation because of the sparsity of individual plants and the dry condition of the forest floor. Baraga Plains, in Baraga county is an outwash plain that supports an almost 100 percent jack pine stand. The sand deposit there is quite deep and extensive. The soil has very little ability to hold water and is acidic. Another area farther east in Alger county that is of interest zoogeographically despite a barren appearance is the Kingston Plains. This region originally supported a mature white pine forest until lumbering cleared the area of all trees about sixty years ago. Since then there has been virtually no reforestation and all that stands on the very sandy soils now are scattered white birches, many white pine stumps and a ground cover of low grasses, ferns, and club mosses (Lycopodineas). Scattered in this area are several small shallow lakes and ponds. These plains are bordered by a hemlockhardwood forest with the corresponding rich ground cover.

The vegetation of Isle Royale, as described by Holt in Adams (1908), may be divided into four units: bog societies, shore societies, forests, and burnings. The bog societies are similar to the bogs of northern Michigan with black spruce and balsam fir as climax dominants. Bog species here however are different from the Upper Peninsula in that they tend to be found in places other than bogs. For instance, the black spruce may be found on dry ground away from the bog, and tamarack may be found occasionally on high dry ridges. This kind of wide ranging occurrence is common for these species farther north in the boreal forest. Skunk cabbage (Symplocarpus foetidus), sundews (Drocera sp.), pitcher plant (Sarracenia purpurea), and several small grasses (Graminea), provide the ground cover.

The shore communities are characteristically composed of lichens on the bare exposed bedrock and farther away from shore low junipers (Juniperus sp.) and ground hemlock (<u>Taxus canadensis</u>) are present and are followed by northern white cedar and white spruce in the interior of the island. The hardy vegetation along the shore is predominantly Canadian in origin.

There are approximately 21 species of trees on Isle

Royale and 13 of these are deciduous. There are two climax forests, excluding the bog communities. The boreal forest with balsam fir, white spruce, and canoe birch is the primary forest cover on the Island, and also is of Canadian origin. This forest extends around the periphery of the Island. The ground is very damp in this forest and supports a variety of herbaceous plants including, <u>Oxalis</u> <u>acetosella</u>, <u>Aralia nudicaulis</u>, <u>Cornus canadensis</u>, <u>Pyrola</u> <u>virens</u>, <u>Maianthemum canadense</u>, <u>Linnaea borealis</u>, <u>Mitella</u> <u>nuda</u>, and <u>Rubus parviflorus</u> the most common shrub cover on Island. Farther inland, the birches become more dominant and pure stands of birch are found in several sites such as Ransom Clearing.

The second climax community, a forest of sugar maple and yellow birch occurs only in the southwestern part of the Island. This forest, which grows only in the interior away from the immediate influence of Lake Superior, is the northernmost extension of sugar maple. There is a very good understory of sugar maple seedlings, western thimbleberry (<u>Rubus parviflorus</u>) and several smaller wildflowers and herbaceous plants.

### METHODS AND MATERIALS

The field work consisted of a 13-day collecting trip from August 12 to August 25, 1963, and a more extensive survey from June 15 to August 7, 1964. Both the spring and summer activity periods of the animals were thereby included in the study. All 15 counties of the Northern Peninsula, including Isle Royale, were eventually visited, (Fig. 9). An effort was made to collect intensively in each of the major ecological habitats within each county.

A total of 941 specimens, involving 18 species of amphibians and 12 species of reptiles were collected during the course of the study.

Several collecting techniques were employed in securing study specimens. Seines, minnow traps and dip nets were utilized for acquiring the aquatic forms while most of the terrestrial species were encountered by turning logs and rocks. All road-kills were identified, recorded, and preserved when feasible. Complete locality data was recorded for each specimen.

The amphibians were fixed in a 10 percent formaldehyde solution and stored in 65 percent ethyl alcohol. Reptiles were injected and fixed in formaldehyde and



FIGURE 9. Map of Collecting Localities for the 1963 and 1964 Field Surveys

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stored in 75 percent ethyl alcohol.

Specimens housed in The Museum, Michigan State Universith, and The University of Michigan Museum of Zoology, Ann Arbor, were also examined to insure adequate samples for comparative study and to complete the distributional records for each of the species known to inhabit the Upper Peninsula.

All measurements are expressed in millimeters with the range of variation shown in parentheses.

Complete scalation counts were made on all reptiles and pertinent body and leg measurements were taken on the amphibians. In all specimens collected which exhibited distinctive patterns, color differences were noted. In order to eliminate ontogenetic variation, adult specimens were utilized where possible and the sexes of many species were considered separately. The parameters of geographic variation were chosen from measurements that are known to vary clinally from previous zoogeographical studies of amphibians and reptiles (i.e. Smith, 1961). The body and tail length measurements of snakes were determined by means of a meter stick and a vernier caliper was used to measure head, leg, and snout-vent lengths of salamanders and frogs. Where possible, the means for all parameters

were obtained with the range for the various measurements also listed. The Student's t-test was employed to ascertain significant differences between the means recorded for the various populations of the same species.

# A PHYLOGENETIC LIST OF THE AMPHIBIANS AND REPTILES OF THE NORTHERN PENINSULA OF MICHIGAN

Class Amphibia

Order Caudata

Family Proteidae

Necturus maculosus maculosus Rafinesque

Family Ambystomidae

Ambystoma laterale Hallowell

Ambystoma maculatum (Shaw)

Ambystoma tigrinum tigrinum (Green)

Family Salamandridae

<u>Notophthalmus</u> <u>viridescens</u> <u>louisianensis</u> (Wolterstorff)

Notophthalmus viridescens viridescens (Rafinesque)

Family Plethodontidae

Plethodon cinereus cinereus (Green)

Hemidactylium scutatum (Schlegel)

Order Salientia

Family Bufonidae

Bufo americanus americanus Holbrook

Family Hylidae

Hyla crucifer crucifer Wied

Hyla versicolor versicolor Le Conte

<u>Pseudacris triseriata maculata</u> (Wied)

Family Ranidae

Rana catesbeiana Shaw

Rana clamitans melanota (Rafinesque)

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Rana palustris palustris Le Conte

Rana pipiens pipiens Schreber

Rana septentrionalis Baird

Rana sylvatica Le Conte

Reptilia

Order Chelonia

Family Chelydridae

## Chelydra serpentina serpentina Linnaeus

Family Emydidae

Chrysemys picta belli (Gray)

Chrysemys picta marginata Agassiz

<u>Clemmys</u> insculpta Le Conte

Emydoidea blandingi (Holbrook)

Order Squamata

Suborder Sauria

Family Scincidae

Eumeces fasciatus (Linnaeus)

Suborder Serpentes

Family Colubridae

Diadophis punctatus edwardsi (Merrem)

Elaphe vulpina vulpina (Baird and Girard)

Heterodon platyrhinos Latreille

Lampropeltis triangulum triangulum (Lacepede)

Natrix sipedon sipedon Linnaeus

<u>Opheodrys</u> <u>vernalis</u> <u>vernalis</u> Harlan

Regina septemvittata (Say)

<u>Storeria occipitomaculata occipitomaculata</u> Storer

Thamnophis sauritus septentrionalis (Linnaeus)

Thamnophis sirtalis sirtalis (Linnaeus)

Family Crotalidae

Sistrurus catenatus catenatus Rafinesque

### ACCOUNTS OF THE SPECIES

Amphibians accounted for the majority of specimens collected on the field surveys. Several species are quite abundant and almost all the habitats surveyed had some amphibians species present. The following list indicates the species diversity in various parts of Michigan:

	Isle Royale	Upper Peninsula	Lower Peninsula
Frogs and Toads	6	10	12
Salamanders	3	7	8
Total Species	9	17	20

One northern Peninsula species, <u>Rana septentrionalis</u>, does not occur in southern Michigan. One subspecies <u>Pseudacris triseriata maculata</u> occurs on Isle Royale and in adjacent Ontario whereas the subspecies in southern Michigan is <u>P. triseriata triseriata</u>. All other species found in the Upper Peninsula occur in southern Michigan. All species found on Isle Royale also occur in adjacent Ontario (Table 16).

Seventeen species of reptiles occur within the political boundaries of the fifteen counties of the Upper Peninsula.

Three of these species occur (See Table 17) only on Bois Blanc Island (Mackinac county) in Lake Michigan and are not found in the Upper Peninsula mainland. The following chart indicates the richness of the reptilean fauna of Michigan:

	Isle Royale	Upper Peninsula	Lower Peninsula
Turtles	1	4	9
Lizards	0	1	1
Sna <b>kes</b>	2	11	17
Total Species	3	16	27

There are no reptiles endemic to the Upper Peninsula and all occur in the Lower Peninsula. Reptiles present on Isle Royale also occur in adjacent Canada (Table 17).

The collection records for reptiles in the Upper Peninsula and Isle Royale are very few and much more field work needs to be done before the exact ranges of all species present are known. The classification of the following checklist of species is based primarily upon K. P. Schmidt's sixth edition of <u>A Checklist of North American Amphibians and</u> <u>Reptiles</u> (1953).

The species accounts are based on the following sources:

literature references; field collections made during the study; and preserved material available in The Museum at Michigan State University (MSUM), The University of Michigan (UMMZ), and The Department of Zoology, Michigan State University (MSUDZ).

Detailed accounts are included for only those forms which have exhibited zoogeographical differences ascertained by this study. The number of animals examined is shown in parentheses following the county headings.

Class Amphibia

Order Urodela

Family Proteidae

# Necturus maculosus Rafinesque

This species is recorded from all but Gogebic, Keweenaw, Marquette and Ontonagon counties (Table 16) but was not collected during this study. It is recorded from Benson Creek on Isle Royale (Adams 1908) and also from Passage Island (Adams, op. cit.) four miles northeast of Isle Royale. Conant (1958, map 154) lists the Lake Winnebago Mudpuppy (<u>N. m. stictus</u>) as extending into Delta, Dickinson, Iron, Marquette and Menominee Counties from northeast Wisconsin. The nominate subspecies (<u>N. m. maculosus</u>) occurs throughout the rest of the Peninsula and Isle Royale.

Family Ambystomidae

### Ambystoma laterale Hallowell

This species apparently occurs throughout the Upper Peninsula and also extends to Isle Royale (Table 16). The author collected a single specimen from Isle Royale, nine individuals from Alger county and several larvae from Schoolcraft county. The results of an analysis of specimens (from Isle Royale and the mainland) is shown on Table 2, and corroborates the interpretation as proposed by Uzzell (1964). Literature references are unreliable concerning identification, however, specimens collected from Iron, Marquette, and Alger counties have been examined by the author and previous workers and identified as <u>A</u>. <u>laterale</u>.

# Ambystoma maculatum Shaw

Conant (1958, map 163), indicates this species occurs throughout the Upper Peninsula, however, there are museum records available for only Alger, Gogebic, Iron, Luce, Mackinac and Marguette counties.

TABLE	2
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Geographic Variation in Ambystoma laterale

	Isle Royale (1)	Alger County (9)
Snout-vent length	60.0	48.2 (3759.)
Tail length as a percentage of total length	45.8	42.7 (40.0-47.7)
Number of costal grooves	12	12
Number of costal grooves between adpressed limbs	0.5	0.67
Internasal distance	4.0	3.1
Total length	110.0	84.8 (62108.)

# TABLE 3

Geographic Variation in Notophthalmus viridescens

	Marquette County (20)	Alger County (11)	Ch <b>ippewa</b> County (11)	I <b>sle</b> Royale (5)
Percentage of individuals with toe five shorter than				
toe one	68.4	100.0	80.0	100.0
Percentage of individuals with spots with complete black	5			
ring	31.6	22.2	100.0	100.0

### Ambystoma tigrinum tigrinum Green

Until 1964, this species was not believed to be present in the Upper Peninsula of Michigan (Conant, 1958). Hensley (1964) obtained several neotenic individuals from Merwin Lake in Alger county. This is 175 miles north and west of the previously recorded most northern record for the species in Michigan. The specimens were taken from a small lake in the Kingston Plains region. During this study several other small lakes in the immediate vicinity of Merwin Lake were intensively collected without success. However, additional collecting will, in all probability, produce other localities for the species in the Upper Peninsula.

# Family Salamandridae

### Notophthalmus viridescens Rafinesque

This species is represented by two subspecies, <u>N</u>. <u>v</u>. <u>viredescens</u> and <u>N</u>. <u>v</u>. <u>louisianensis</u> and intergrades thereof in the Upper Peninsula (Table 3). The Isle Royale population appears from personal collections to be strictly <u>N</u>. <u>v</u>. <u>viridescens</u>, the red-spotted newt; an interpretation also verified by Dr. Charles F. Walker (per. comm.), Conant (1958, map 159) includes the entire Upper Peninsula within

the range of <u>N</u>. <u>v</u>. <u>louisianensis</u>. <u>N</u>. <u>v</u>. <u>viridescens</u> has several red spots on each side surrounded with a black ring and the outer-most hind toe is shorter than the innermost toe while <u>N</u>. <u>v</u>. <u>louisianensis</u> may have red spots but these are only partially ringed in black or not at all and the innermost toe is smaller than the outermost. The populations from Isle Royale and Chippewa county agree with the characteristics of <u>N</u>. <u>v</u>. <u>viridescens</u> whereas those from Alger and Marquette counties appear to be an intergrade between <u>N</u>. <u>v</u>. <u>viridescens</u> and N. <u>v</u>. <u>louisianensis</u>.

Bishop (1943, pp. 99) has more properly illustrated the ranges of these subspecies with an area of intergradation through Alger and Schoolcraft counties. The data herein appears to corroborate this interpretation although there is an insufficient number of specimens from western upper Michigan.

#### Family Plethodontidae

# Plethodon cinereus cinereus Green

The red-backed salamander is found in all 15 counties of the Upper Peninsula, but not on Isle Royale. Table 4 indicates there is very little geographic variation in representative samples from the Upper Peninsula. However,

	West	ern	Cent	cal	East	ern	IIIi-
	Upper Pe	ninsula	Upper Pei	ninsula	Upper Pe	ninsula	nois*
	Baraga	Gogebic	Alger	Delta	Chippewa	Mackinac	
	County	County	County	County	County	County	
	(22)	(6)	(11)	(6)	(29)	(8)	(18)
Snout-vent							
length	(3447.)	(3752.)	(3552.)	(46~-56.)	(35~53.)	(38~50)	(25-47.)
Tail length as a percentage							
of total length	44.9	46.9	47.9	42.9	45.7	45.9	51.9
Number of	16.2	17.0	16.6	16.1	16.5	16.4	19.1
costal grooves	(12-17)	(16–18)	(16-17)	(12-17)	(16–17)	(12-17)	(18–20)
Number of costal grooves							
between							
adpressed limbs	7.7	8.9	8.3	7.7	7.9	7.9	7.9
Number of	11.3	11.4	13.5	12.1	11.6	11.6	10.7
vomerine teeth	(7–14)	(8-14)	(9-14)	(6-17)	(9-16)	(9-12)	(1-15)

Geographic Variation in Plethodon cinereus cinereus

TABLE 4

\*Smith, 1961.

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comparison with the collection from Illinois shows major differences. The Illinois population (Smith, 1961) has a smaller snout-vent length and the tail is a larger percentage of the total length. Furthermore, in Illinois specimens have fewer vomerine teeth but this is a highly variable character and the number ranges between 10.7 and 13.0 in the Illinois samples (Smith, op. cit.). The difference in costal grooves may be due to a counting technique.

All individuals caught were of the red-back phase. So far as is known, there are no lead phase individuals on record for the Upper Peninsula and Wisconsin. Breckenridge (1944) in Minnesota said the lead phase is also not found in Minnesota. Smith (op. cit.) reported that both phases are found in Illinois but the red-backed phases occur 66 percent of the time. The frequency of the patterns vary from area to area in southern Michigan.

## Hemidactylium scutatum Schlegel

This very secretive salamander was not collected during this study. There are museum records for only Alger, Chippewa and Gogebic counties. Mr. Martin Kopenski, an instructor at Northern Michigan University, states that (per. comm.) the four-toed salamander is abundant in certain areas

in the vicinity of Marquette. The species probably occurs throughout the Upper Peninsula where appropriate habitat is available. Its occurrence on Isle Royale has not yet been reported.

Order Salientia

Family Bufonidae

#### Bufo americanus americanus Holbrook

This species is recorded from all 15 counties of the Upper Peninsula in addition to Isle Royale. Table 5 shows five characters contrasted between three selected samples of <u>Bufo a. americanus</u>. The Isle Royale and eastern Upper Peninsula series agree quite closely but differ with varying degrees from the Northern Illinois specimens described by Smith (1961). The Michigan populations have more dorsal spots with two or more warts, smaller heads relative to body length, smaller parotoid glands relative to body length, a lighter ventral pattern, and are larger in body length.

Family Hylidae

# Hyla crucifer crucifer Wied

The spring peeper is recorded from Isle Royale and all 15 counties of the Upper Peninsula (Table 16). Two

TABLE	5
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Geographic Variation in <u>Bufo</u> <u>americanus</u> <u>americanus</u>

	Isle Royale	Eastern Upper Peninsula*	Northern Illinois**
	(12)	(14)	(11)
Head length as a percentage of body length	24.7	25.2	28.6
Paroid length as a percentage of body length	18.9	18.9	19 <b>.4</b>
Percentage of individuals with one wart/dorsal spot	50.0	54.5	64.0
Ventral pattern***	3.75	3.71	3.9

\* Alger, Chippewa, and Schoolcraft counties.

\*\* Smith, 1961.

\*\*\* Ventral pattern values: (1) venter immaculate or with
one pectoral spot; (2) a few scattered spots on breast
region; (3) a zone of dark spots across the breast; (4)
entire venter spotted; and (5) venter predominately
dark.

populations (Isle Royale and mainland) were compared and Table 6 gives the mean values of several parameters measured. Unfortunately, a larger sample was not attained from Isle Royale and therefore a valid comparison could not be made with the mainland populations. However, on the basis of these limited data, there appears to be a slight variation in body proportions.

### Hyla versicolor versicolor Le Conte

The gray treefrog is recorded in Alger, Dickinson, and Marquette counties. A. G. Ruthven in Adams (1908) mentioned a record in The University of Michigan Museum (UMMZ 7457) for Isle Royale but was unable to verify it at the time and since then the species has not been recorded from the Island. Conant (1958, map 221) indicates that this species does not inhabit the eastern half of the Upper Peninsula. However, a metamorphosing tadpole (which had both front and hind legs with large disks on the digits) was collected in a seine at the Seney National Wildlife Refuge in Schoolcraft county and was the only individual of this species collected in the field.

TABLE	6
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Geographic Variation in <u>Hyla</u> <u>crucifer</u> <u>crucifer</u>

	Isle Royale	Eastern Upper
	(3)	(15)
Head length as a percentage of body length	30.7	28.9
Tibia length as a percentage of body length	50.3	48.2
Snout-vent length range	19.1-33.6	20.6-29.0
Number of bars on tibia	1.8	2.4

\*Alger, Luce, and Mackinac counties.

# TABLE 7

# Geographic Variation in <u>Pseudacris</u> triseriata

	Isle Royale (12)	Southern Michigan* (11)
Snout-vent length	2.28 cm. (1.85-2.58)	2.66 cm. (2.53-2.88)
Head length as a percentage of total length	25.6 (22.3–29.4)	25.3 (19.4–26.9)
Tibia length as a percentage of total length	40.4 (37.2–50.4)	43.5 (39.5–45.1)
Percentage with spots or stripes on dorsum	90.9 spots	81.8 spots

\*Clinton county.

Pseudacris triseriata maculata (Wied)

Twelve individuals of this species from Isle Royale were compared with eleven individuals from Clinton county in southern Michigan (Table 7). The results show that there are differences in tibia lengths and body markings and there are therefore two subspecies involved; <u>P. t. maculata</u> on Isle Royale and <u>P. t. triseriata</u> in southern Michigan. Dr. Charles F. Walker (per. comm.) verified the Isle Royale population as <u>P. t. maculata</u>. There are no specimens recorded from the Upper Peninsula although Conant (op. cit., map 235) shows the entire Northern Peninsula as a zone of intergradation between these two subspecies. The population on Isle Royale is limited to the rock pools on the periphery of the Island.

# Family Ranidae

# Rana catesbeiana Shaw

The bullfrog was not seen or collected on either field survey. There are museum records from Baraga, Chippewa, Luce, Mackinac, Marquette and Schoolcraft counties and this agrees quite closely with Conant (op. cit., map 24). Personal conversation with Mr. David Johnson, a Michigan Conservation Officer, revealed that bullfrogs were introduced
into Marquette county by individuals attempting to raise them commercially. The validity of this report has not been proven.

#### Rana clamitans melanota (Rafinesque)

The green frog is one of the most abundant amphibians in Upper Michigan. The species is recorded from all 15 counties and Isle Royale. Measurements of 87 specimens from selected localities in the Upper Peninsula and seven specimens from Isle Royale revealed no significant differences in tibia and femur lengths as correlated with snout-vent lengths. The Isle Royale population had the smallest snout-vent length (76.6 as compared to 85.9 average in mainland specimens) of all the individuals, and also had the lowest percentage of individuals with the belly unmarked (51.1 as compared to an average of 85.5 on the mainland). The number of specimens from Isle Royale was quite low and this may account for the variation from the Upper Peninsula samples or there may be selection pressure for these characteristics.

#### Rana palustris palustris Le Conte

The pickerel frog is recorded from Chippewa, Marquette, and Menominee counties. Conant (op. cit., map 239) includes the entire Upper Peninsula within the range of this species. No specimens were taken during the field surveys despite the fact that large numbers of <u>Rana clamitans</u> and <u>R</u>. <u>pipiens</u> were collected. This may be attributed to the fact that <u>Rana palustris</u> has a more restricted habitat which was collected less often than those areas preferred by the other two species mentioned.

#### Rana pipiens pipiens Schreber

Second only to the green frog in abundance, the Leopard frog (<u>R</u>. <u>p</u>. <u>pipiens</u>) is recorded from all counties but is not known from Isle Royale. Body measurements of 54 specimens from selected populations in western, central, and eastern Upper Michigan failed to show significant differences in variation. However, there seems to be a slight increase in dorsal spotting from west to east (average number 14.4 as compared to 16.2) as well as a reduction in the occurrence of the snout spot (94.7 to 81.8%).

#### Rana septentrionalis Baird

The mink frog (not found in the Southern Peninsula of Michigan) occurs in all counties of the Northern Peninsula in addition to Isle Royale. Table 8 contrasts three

ТА	BLE	8

Geographic Variation in <u>Rana</u> <u>septentrionalis</u>

	Isle Royale	Western Upper Peninsula*	Eastern Upper Peninsula**
	(2)	(18)	(7)
Head length as			
a percentage of			
total length	33.9	26.9	28.0
Tibia length as			
a percentage of			
total length	49.1	46.5	46.1
Femur length as			
a percentage of			
total length	50.6	48.0	47.4
Number of spots			
on dorsum	8.5	6.7	8.3

\* Baraga, Dickinson, Houghton, Iron, and Marquette counties.

.

\*\* Alger, Mackinac, and Schoolcraft counties.

populations which show only slight variational trends. The small number of specimens collected from Isle Royale and the eastern Upper Peninsula may skew the results.

#### Rana sylvatica Le Conte

The wood frog is found on Isle Royale and all 15 counties of the Upper Peninsula. Some authors divide this species into several subspecies according to various body proportions and colorations. Schmidt and Necker (1935) identified the specimens from Illinois, Indiana and Michigan as <u>R</u>. <u>s</u>. <u>cantabrigensis</u> despite the fact that their specimens correspond to their <u>R</u>. <u>s</u>. <u>sylvatica</u> body proportions. They based their conclusion on body coloration.

Smith (1961) emphasizing slightly different body proportions, found that specimens from northeastern Illinois are classified as <u>R</u>. <u>s</u>. <u>cantabrigensis</u>. Others claim that since these subspecific characteristics are part of a general north-south gradient, there should be no formal subspecies named (Conant, 1958; Logier and Toner, 1961).

Table 9 provides data on specimens selected from widely diverse areas in Michigan and which represent populations from the presumed ranges of both forms. Utilizing these data in another manner (Table 10) the status of the Michigan

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TABLE

Geographic Variation in Rana sylvatica

٥.٥	9.5	0.0	14.0	Percent with dorsal stripe
93.8	57.1	75.0	57.1	Percent with interorbital bar
87.5	71.4	87.5	85.7	Percentage with breast marked
(42.5-56.5) 52.4	( <b>4</b> 7.6-57.9) 52.3	(48.5-55.6) 52.5	(49.7-57.3) 51.1	Femur length as a percentage of body length
(53 <i>.</i> 7 <del>.</del> 58.4) 55.6	(51.2-56.9) 53.5	(51.0-57.8) 55.1	(49.2-58.8) 54.2	Tibia length as a percentage of body length
(28 <b>.4</b> -33.1) 29.9	(26. <b>4</b> -30.6) 28.7	(26.1-30.9) 28.7	(27.9-33. <b>4</b> ) 29.5	Head length as a percentage of body length
Southern Michigan*** (16)	Eastern Upper Peninsula** (21)	Western Upper Peninsula* (8)	Isle Royale (7)	

Baraga, Dickinson, Keweenaw, and Marquette counties

\*

\*\* Alger, Chippewa, and Delta counties

\*\*\* Barry, Clinton, and Ingham counties

# Five Characteristics Distinguishing Subspecies in <u>Rana sylvatica</u>

	Dorsal	Breast	Tibia	Tibia	Head	Tota	als
	Stripe	Spotted	Short	55% BL*	33% BL*	С	S
Southern Michigan**	S	С	S	S	С	2	3
Eastern Upper Peninsula**	С	С	S	С	С	4	1
Western Upper Peninsula**	S	с	S	S	С	2	3
I <b>sle</b> Royale**	С	С	S	С	С	4	1
	• -		_		······································		

C Affinities closer to <u>Rana</u> <u>sylvatica</u> <u>cantabrigensis</u>

.

S Affinities closer to <u>Rana</u> <u>sylvatica</u> <u>sylvatica</u>

\* Body length

\*\* Same counties as Table 9.

population is further clarified when the five supposedly diagnostic characters are evaluated.

The results show that the southern Michigan and western Upper Peninsula populations agree more closely with the characteristics of <u>R</u>. <u>s</u>. <u>sylvatica</u> and that the Isle Royale and eastern Upper Peninsula samples agree with the characteristics for <u>R</u>. <u>s</u>. <u>cantabrigensis</u>. These results, therefore, are inconclusive and until parameters are established that more clearly distinguish the races, the species is herein regarded as showing only clinal variation.

Class Reptilia

Order Chelonia

Family Chelydridae

#### Chelydra serpentina serpentina Linnaeus

Seven specimens of this species were collected during the 1964 field survey including the first reported observation of the snapping turtle in Iron county (5.5 miles west of Beachwood). The species is recorded from all but Alger, Houghton, Keweenaw, Luce, and Ontonagon counties and probably occurs in these counties. It is very abundant at the Seney National Wildlife Refuge in Schoolcraft county. The snapping turtle has not been recorded from Isle Royale. Family Emydidae

#### Chrysemys picta (Schneider)

Two subspecies, Chrysemys picta belli and C. p. marginata and intergrades thereof are present in Northern Michigan. Conant, op. cit. (map 21), indicates that the two subspecies intergrade in the eastern half of the Upper Peninsula with C. p. belli coming in from Wisconsin and C. p. marginata entering the peninsula from southern Michigan and Canada to the east. There are, however, recorded intergrades from both Chippewa and Gogebic counties (Table 17) (UMMZ) indicating that the entire Peninsula is an area of intergradation. An adult female C. p. belli was collected by the author on Isle Royale thus confirming the subspecies present on that Island. The species has not been recorded from Delta, Iron, Keweenaw (except Isle Royale) and Mackinac counties. This again appears to be a case of insufficient collecting surveys.

#### <u>Clemmys</u> insculpta (Le Conte)

The wood turtle is recorded from Dickinson, Gogebic, Menominee, and Schoolcraft counties. It was not collected in either the 1963 or 1964 field surveys, however, it presumably is found throughout the entire Northern Peninsula (Conant, op. cit.).

#### Emydoidea blandingi (Holbrook)

One skeleton of this species was collected along Sturgeon Creek one-half mile west of Loretto in Dickinson county. This specimen consisted of an old partly disarticulated shell (plastron) but positive identification was possible. The Blanding's turtle is also recorded from Marquette county.

Order Squamata Suborder Sauria

Family Scincidae

#### Eumeces fasciatus (Linneaus)

This is the only species of lizard which occurs in the Northern Peninsula of Michigan and is recorded only from Menominee and Marquette counties. These records are interesting in that the collection sites are approximately 40 and 100 miles respectively north of the previously reported northern limit of this species in Wisconsin. In certain areas near Marquette the five-lined skink is quite abundant. Suborder Serpentes

Family Colubridae

#### Diadophis punctatus edwardsi (Merrem)

The ring-necked snake is recorded in Iron, Mackinac, Marquette, and Schoolcraft counties. Museum material examined by the author included fifteen specimens from several areas in the Upper Peninsula and nine specimens from Leelanau county in the Southern Peninsula. In addition nine individuals from Illinois (Smith, op. cit.) were compared to these two populations. Table 11 illustrates the considerable individual variation within various populations of the subspecies <u>edwardsi</u>, particularly with respect to the supralabial and infralabial scales. Ventral and caudal scale counts are higher in the northern populations. However, due to an insufficient number of specimens, it was not possible to discern clinal morphological variations in an east-west direction across to Northern Peninsula.

#### <u>Elaphe vulpina vulpina</u> (Baird and Girard)

The "pine snake" as it is called in the Northern Peninsula, entered the Peninsula from Wisconsin to the south and is recorded as far east as Alger and Schoolcraft counties.

# Geographic Variation in <u>Diadophis</u> <u>punctatus</u> <u>edwardsi</u>

		Northern Michigan*	Southern Michigan**	Illinois***
		(15)	(9)	(9)
Number of ventra	ls	156.5	155.7	
Males			156.7	144.6
Females			155.3 <sup>·</sup>	152.5
Number of caudal	.s	53.8	49.7	
Males			50.3	48.7
Females			49.3	41.5
Tail length as a	L			
percentage of		21 6	10.0	
total length		21.6	19.2	
Males			19.6	20.1
Females			18.9	16.7
Percentage with				
supralabials	8+8	53.3	66.0	
Males	7+7	26.6	0.0	55.5
Females	8+7	13.3	33.0	
Percentage with				
infralabials	8+8	93.3	11.0	41.7
Males	7+7	0.0	55.5	8.3
Females	8+7	6.6	33.3	29.1
Percentage with				
chin spotting		26.7	77.8	33.3
Percentage with				
dots on venter		40.0	33.3	

\* Iron, Mackinac, Marquette, and Schoolcraft counties

\*\* Leelanau county

\*\*\* Smith, 1961

Geographic Variation in <u>Elaphe</u> vulpina vulpina

	Nor	thern	Illinois*	*
	Mich: (:	1gan* 17)	(40)	
Percentage with 25 dorsal scales in				
region	68	3.4	97.0	
Percentage with supralabials 8+8	78	3.9	83.0	
Percentage with infralabials 11+11	33	3.0	61.0	
Number of ventrals: Males	200	0.0		
Females	204	4.0		
Number of caudals: Males	63	3.0	64.0	
Females	50	5.4	54.7	
Tail length as a percentage of total length:				
Males	1	5.9	16.0	
Females	14	4.8	13.0	
	Northeast Illinois (9)	Northw Illino (13	est Nort is Micl ) (1	thern higan 17)
Number of dorsal blotches	41.4 (37-52)	38.6 (35-41	38. ) (34-4	.6 44)

Dickinson, Iron, Marquette, and Menominee counties
Smith, 1961

Nineteen individuals of this species were collected from Dickinson, Iron, Marquette, and Menominee counties. In addition to the counties listed above <u>Elapha vulpina</u> is also recorded from Delta county. A Michigan Conservation Officer in Chippewa county mentioned seeing a pine snake near Whitefish Point. However, there are no recorded collections from that area.

A comparison of specimens from northern Illinois and northern Michigan revealed that the dorsal blotch count increased from south to north, present in Smith's (op. cit.) specimens from several areas in Illinois, did not hold true for the northern Michigan populations (Table 14). Smith (per. comm.) suggests that this may be an influence of the eastern subspecies <u>E</u>. <u>v</u>. <u>gloydi</u> which has a higher dorsal blotch count. Comparisons also indicated considerable variance in other parameters such as the anterior scale row count, supralabials, and infralabial counts between the two populations.

#### Heterodon platyrhinos Latreille

The eastern hognose snake was not collected in the field by the author. However, there are two specimens from 12 miles west of Stephenson (Menominee county) in the Museum

of Zoology at the University of Michigan. These are the first specimens reported from the Upper Peninsula and this occurrence extends their range farther north than illustrated by Conant (op. cit., map 108). The author, while collecting in the Stephenson area, had been told of the "Blow Snakes" near Banat which is eight miles northwest of Stephenson. The Banat area is characterized by dry sandy soils with predominantly white, red, and jack pine forests. These conditions are similar to habitat preferred by the eastern hognose where it is found farther south.

#### Lampropeltis triangulum triangulum

The milk snake was not collected by the author in either field survey, however, the species is recorded (UMMZ) from Marquette and Mackinac counties. Conant (1958, map 130) gives the northern limit of <u>Lampropeltis triangulum tri-</u> <u>angulum</u> in Wisconsin as Green Bay, but does show an isolated record from the Huron Mountains in Marguette county. The species is not present on Isle Royale but is present throughout southern Michigan and Ontario east of Chippewa and Mackinac counties.

#### Natrix sipedon sipedon Linnaeus

The common water snake appears to be restricted to the eastern half of the Upper Peninsula. It is found in Alger, Chippewa, Delta, Mackinac, and Schoolcraft counties. The northern water snake is reported by a resident of Saint Ignace to be fairly common along certain areas of the Lake Michigan shoreline in Mackinac county. It appears that this species has entered the Upper Peninsula from Canada to the east and perhaps Michigan to the south. This species was not collected by the author.

#### Opheodrys vernalis vernalis (Harlan)

Ten specimens of this species were examined (eight of which were collected in the field) and all agree with the description given by Grobman (1941) for <u>O</u>. <u>v</u>. <u>vernalis</u>. No significant variation was observed in the specimens studied. This species is recorded from all counties except Houghton, Keweenaw and Ontonagon.

#### , Regina septemvittata (Say)

The queen snake is not recorded from the Upper Peninsula mainland. However, there is a record (UMMZ) from Bois Blanc Island (Mackinac county) in Lake Michigan. Conant (op. cit., map 91) indicates the northern limit of this

species as the middle of the Southern Peninsula of Michigan, but does show an isolated collection site from the Straits of Mackinac.

#### Storeria occipitomaculata occipitomaculata Storer

Recorded from Isle Royale and all 15 counties, the redbellied snake is one of the most common snakes in northern Michigan. An analysis of 115 individuals from throughout the Upper Peninsula revealed very little geographical variation in most parameters with only the infralabials and supralabials showing some individual and geographical differences. Four selected populations are compared in Table 11 of illustration.

The width of the red-colored venter increases in the more northern samples. However, using the t-test these differences are not significant at the five percent level.

#### Thamnophis sauritus septentrionalis (Linnaeus)

The ribbon snake's northern range limit is Bois Blanc Island but it is not found on the mainland of the Northern Peninsula. There has been some confusion among herpetologists about the occurrence of this species in the Upper Peninsula and Isle Royale. However, Dr. Charles F. Walker

# Geographic Variation in <u>Storeria occipitomaculata occipitomaculata</u>

	Southern Michigan*	Isle Royale	Northern Upper Peningula**	Eastern Upper Peningula***
	(12)	(18)	(44)	(18)
Number of				
ventrals	123.6	122.4	122.1	120.8
Number of				
caudals	44.4	43.5	44.8	44.3
Number of				
caudals	167.3	165.9	167.0	165.3
Width of red	l			
ventrals	3.15	3.8	3.3	3.3
Tail length a percentage	as			
length	21.3	20.8	21.4	20.2
Percentage with supra-				
labials 6+6	100.0	94.8	82.2	88.9
Percentage				
with infra- labials 7+7	75.0	66.1	54.5	61.1

 Clinton, Ingham, Midland, Oscoda, Otsego, and Roscommon counties
 \*\*\* Chippewa, Luce, and Mackinac counties

\*\* Gogebic, Houghton, Keweenaw, and Ontonagon counties

(per. comm.) has informed me that the specimen from Isle Royale identified as <u>Thamnophis sauritus</u> (UMMZ 7452) is lost and quite likely was actually <u>Thamnophis sirtalis</u>. There are at the present time no specimens of <u>Thamnophis sauritus</u> recorded from Isle Royale or the Upper Peninsula.

#### Thamnophis sirtalis sirtalis Linnaeus

From numbers collected by the author this is the most abundant reptile in the Upper Peninsula and the species with the widest eological tolerances. The eastern gartersnake is recorded from all but Dickinson and Keweenaw counties on the Peninsula. Individuals from various areas were analyzed and the data is presented in Table 14. The results support the findings of Ruthven (1908) in his extensive work on variation in the genus <u>Thamnophis</u>. The ventral and caudal scale counts appear to be lower in the eastern than in the western extremes of the Northern Peninsula. However, larger collections are needed before an actual geographical gradient may be determined.

Superficially, the Isle Royale specimens appear to be influenced by the red-sided gartersnake (<u>T. s. parietalis</u>) found in Minnesota and Canada to the north and west (Fig. 10). Examination of the data, however, indicates that the

Geographic Variation in Thamnophis sirtalis sirtalis

	Isle Royale	Western Upper Peninsula*	Eastern Upper Peninsula**	Southern Michigan***
	(10)	(15)	(5)	
Number of ventrals				152.0
Males	149.0			
Females	152.0	153.2	150.6	
Number of caudals				
Males	80.0			73.0
Females	68.2	71.1	64.2	64.0
Percentage wit red pattern	h 44.4	0.0	20.0	
Percentage wit bars on supra- labials 4+5	h 55.5	42.8		

\* Baraga, Gogebic, Iron, and Ontonagon counties

\*\* Chippewa and Mackinac counties

\*\*\* Eaton county, Sperry (1901)

FIGURE 10

## FREQUENCY OF RED LATERAL COLOR





similarities are merely a local color variation in <u>T</u>. <u>s</u>. <u>sirtalis</u>. A specimen exhibiting a blue melanistic phase of <u>T</u>. <u>s</u>. <u>sirtalis</u> was also collected from the Island. This variation was partially described in 1908 by Ruthven and apparently the population has maintained the variation since that time.

The sex ratio of <u>T</u>. <u>sirtalis</u> collected was unusual in that of the 46 specimens in which the sex was determined only four were males.

Family Crotalidae

#### Sistrurus catenatus catenatus Rafinesque

This is another species recorded (UMMZ) from Bois Blanc Island and not from the Northern Peninsula mainland. It occurs throughout the Southern Peninsula of Michigan but the range is terminated at the straits.

#### HABITATS AND DISTRIBUTION

A particular species occupies a mosaic distribution throughout its range and has a certain preferred habitat to which it is largely limited. Table 15 lists six major habitat types from which animals were collected during the course of the study. Collecting time was not evenly distributed among these habitats; therefore the results may be slightly inaccurate. However, the results do show primary habitat preferences.

The terrestrial habitats were not exploited as well by the amphibians (Table 15). The importance of water in their daily metabolic needs limits their available habitats. The reptiles, on the other hand, were not limited by water requirements and were nearly equally distributed between aquatic and terrestrial habitats.

The coniferous forests described earlier in the Introduction support a very limited herpetofauna. The lack of adequate ground cover and the acidity of the soil present eological barriers that are overcome by few amphibians or reptiles.

The deciduous forest, which includes a variety of plant associations, harbors several more species than the coniferous

Hat	oitat Pref	erences of	Species Co	ollected		
	£	errestrial			Aquatic	
Species	Conif- erous	Decid- uous	Open field-	Bog – swamp	Lake pond,	Streams- rivers
	forests	forests	forest		shore-	
Ambystoma laterale	ı	+	I	I	+	I
Notophthalmus viridescens	I	I	I	ı	+	I
Plethodon cinereus	I	+	I	1	I	I
Bufo americanus	+	+	+	I	+	+
Pseudacris triseriata	I	I	I	I	+	I
Hyla crucifer	+	+	ı	I	+	+
Hyla versicolor	I	I	I	I	+	I
Rana clamitans	+	1	I	+	+	+
Rana pipiens	I	I	+	+	+	+
Rana septentrionalis	I	I	I	+	+	+
Rana sylvatica	I	+	ı	+	+	+
Chelydra serpentina	I	ı	I	I	+	+
Chrysemys picta	ł	+	+	ı	+	+
Emydoidea blandingi	I	1	I	I	I	+
Elaphe vulpina	I	ł	+	I	I	I
<b>Opheodyrs vernalis</b>	+	I	+	I	ı	I
Storeria occipitomaculata	I	1	+	I	+	I
Thamnophis sirtalis	+	+	+	I	+	+
Total number of species	Ŋ	7	7	4	14	10

forest. The increased species diversity and species abundance of plants of the ground cover provide habitat for such characteristic species as <u>Plethodon cinereus</u>.

The open field-forest edge category is actually a combination of many habitats, namely, abandoned barns, bedrock outcroppings and sandy outwash plains, in addition to old fields. The several species (Table 15) that were present in these various habitats all exhibited one common characteristic; that is, the ability to survive under relatively dry conditions.

For amphibians, the bog-swamp offered a suitable habitat for four species, all ranids. The lake-pond environment was the most productive collection area; however, it was also the habitat in which most collecting time was spent. Ten species of amphibians and four reptilean species were taken from this area. Three ranids (<u>Rana clamitans, pipiens</u> and <u>septentrionalis</u>) have exhibited very definite spatial relations in regard to each other in this lake-shoreline habitat. <u>Rana pipiens</u> was often found well away from water or along the shoreline; <u>R</u>. <u>clamitans</u> was found to stay close to the shoreline either in water or on land; and <u>R</u>. <u>septentrionalis</u> was usually found well out into the water.

The river-stream habitat did not harbor as many species as the quite similar lake-pond habitat. This may be explained by the slightly more rigorous environmental conditions of a flowing body of water.

Tables 16 and 17 are summaries of the geographical range according to counties of each species as discussed under the species account. The Northern Peninsula has been divided into an eastern and western section in order to distinguish better between species with a primarily eastern or western distribution in the Upper Peninsula. Although counties are not a natural method of defining species ranges, it was the most feasible method in the limited amount of time available.

County Distribution of Amphibians in Northern Michigan\*

		-	Vest	eri	Ъ Б	per	Pe	nin	sula	ខ អ្ន	stei	E	npp	er	eni	nsu	La
	Species	godepŗc	Ontonagon	Iron	υοημδηομ	Кемеепаw	Baraga	Діскілвол	eltuer elti	atploy atst	әәитшоиәм	тдег	БдĹэŪ	Schoolcraft	aong		
	Ambystoma laterale	+	+	+	I	+	+	1	+	•	-		-	0	+	+	
	Ambystoma maculatum	+	I	+	I	I	I	ł	+			+	1	1		+	
	Ambystoma t. tigrinum	ł	I	I	ł	I	ł	I			•	+	1	•	ſ	1	
Ì.	Bufo a. americanus	Φ	+	•	+	+	Ф	•	9	•	•	4	9	•	•	9	
``\	Hyla c. crucifer	•	+	+	+	ł	0	+	9 +	•	+		+		•	•	
	Hyla v. versicolor	I	I	I	I	I	I	+	•			+	-	' 0		ł	
	Hemidactylum scutatum	+	I	I	I	I	I	I	•			+	1		+	ł	
	Necturus m. maculosus	I	ı	I	+	I	+	I	T I		•	+		+	+	+	
	Necturus maculosus stictus	I	I	I	I	I	ł	+	•		ī		+			1	
	Notophthalmus v. louisianensis	I	I	I	I	I	•	1	+		,	+	1	+	1. <b>1</b>	, <b>I</b>	. •
	Notophthalmus v. viridescens	I	I	+	+	+	+	1	+		+	•	+	О			
•	Plethodon c. cinereus	•	+	+	+	+	•	+	•		+	•	•	•	•	0	
	Pseudacris triseriata maculata	I	I	ı	I	I	ł	I	Ð	•	•		1			I	
	Rana catesbeiana	I	ł	I	I	I	+	I	•					+	+	+	
۰.	Rana clamitans melanota	•	⊕	•	•	•	•	+	<b>e</b>		•		•		•	•	
	Rana p. palustris	I	I	I	I	I	I	I	' +		•		Ì		+	I	
1	Rana p. pipiens	•	•	•	•	•	•	•	•		•	•	+		•	•	
Ϊ,	Rana septentrionalis	Φ	+	•	•	+	0	+	<b>e</b>	•	+		+	т Ф	+	0	
	Rana sylvatica	+	+	+	+	Ð	Ð	Ð	<del>0</del>	•	+	•	•	9	0	Ð	
			•				. 1										

\* 0 = species collected during study; + = records at UMMZ, MSUM, and MSUDZ; and- = not recorded from county.

County Distribution of Reptiles in Northern Michigan\*

- = species not recorded from county; and BB = recorded only from Bois Blanc Island. Chrysemys picta belli X C. p. marginata and same as +;

#### DISCUSSION

#### Results of Population Comparisons

Of the sixteen species examined for geographical variation very few showed significant differences between various There were more differences between the Illinois populations. and Michigan populations than between those from various northern Michigan localities. The ecological conditions are more divergent and the geographic distances are greater between northern Michigan and Illinois than between various areas of northern Michigan. More important perhaps than the distance between the Michigan and Illinois localities is the fact that the Michigan specimens are nearer the northern limit of many of the species. It has been noticed by other workers (Mayr, 1963) that at the periphery of a species' range there is less individual variation than at the center of its range. This, however, is not necessarily the case with all species. Elaphe v. vulpina, for example, showed more individual variation in the Michigan individuals at the periphery of their range than the Illinois specimens which were near the center of the species range. Other species, such as Plethodon cinereus, Opheodrys vernalis, and Storeria occipitomaculata, showed very little individual variation in

most parameters and thereby substantiated Mayr's observation.

There was very little evidence for any distinct morphological or color gradients. One species, <u>Rana pipiens</u>, showed a slight increase in dorsal spotting from west to east. However, the different species on the whole tended to vary more individually than geographically. Clinal variation usually occurs parallel to some environmental gradient (Mayr, op. cit.) and there is very little environmental distinction (see Introduction) from east to west across the Upper Peninsula.

In four of eight instances, where species from Isle Royale were compared to Upper Peninsula mainland populations (Tables 2, 6, 8 and 9) the Island specimens were larger. The other four species did not show significant differences between populations. The Isle Royale populations exhibit marked influence from Canada. Two subspecies of amphibians, in Canada, have inhabited the Island. <u>Notophthalmus v</u>. <u>viridescens</u> and <u>Pseudacris triseriata maculata</u> have apparently reached Isle Royale from adjacent Canada to the north.

Environmental Correlations with Distribution

The uniform climate of the Upper Peninsula does not present large barriers for the species present. The land

adjacent to the Great Lakes has a somewhat modified climate but almost all species that occur along the lake also occur at suitable habitats farther inland. However, species migrating into the Upper Peninsula from Wisconsin, southern Michigan or Canada would find the climate of the periphery of the Peninsula more suitable to habitation and may follow the shoreline into the Peninsula.

The microclimate does play an important role in species distribution and along with other microenvironmental factors determines the mosaic distribution pattern of the various species across the Upper Peninsula and Isle Royale.

There does not appear to be any distinct correlations between species distribution and any large scale geological features of the Upper Peninsula. The acid soil west of a line from Marquette to Faithorn (see Fig. 1) does not appear to limit the distribution of species. The soils map shows some differences, when correlated with the types of species present on the various land divisions; however, the real difference in distribution is again at the microgeographical level.

The limiting edaphic conditions are the sandy outwash and lake plains for terrestrial amphibians. Areas such as the Baraga Plains and Kingston Plains present a very sterile

habitat for most amphibians and reptiles because of the dry sandy soil present.

The alteration of the presettlement vegetation has probably not been detrimental to the existing herpetofauna. As mentioned previously the northern Peninsula was almost entirely coniferous forest before logging practices and this type of habitat supports a poorer herpetofauna than the hemlock-hardwood and sugar maple forests now present on much of the cutover land. The actual relationship, however, is between the herpetofauna and the ground vegetation of the various forest types. The ground cover present in the deciduous forests supported a richer herpetofauna than the sparse cover of the coniferous forest floor.

# Post-Glacial Repopulation of the Upper Peninsula of Michigan and Isle Royale

After the last glacier retreated from the Midwest there was a series of climatic changes with accompanying changes in the vegetation (Braun, 1950). Schmidt (1938) suggested a "steppe peninsula" in animal distribution to correspond to the "prairie peninsula" suggested by botanists. During this "steppe" period, approximately 5,000 years ago, the climate in the Midwest was arid and hot and many plains species of plants and animals migrated into Wisconsin, Illinois, Indiana,

Michigan, and even as far east as Ohio. At the close of this hot-arid stage the climate became more cool and mesic, and many plains species died off or retreated west to the plains area (Smith, 1957). Schmidt (1938), however, listed the following species as evidence of the "steppe peninsula": Ambystoma t. tigrinum, Rana p. pipiens, Heterodon nasicus, Coluber constrictor, Elaphe vulpina, Natrix kirtlandi, Thamnophis butleri, Sistrurus catenatus, Emydoidea blandingi, <u>Terrepene</u> ornata, and <u>Chrysemys</u> picta marginata. This may explain the present day existence of Ambystoma t. tigrinum, Chrysemys picta marginata, Elaphe vulpina, Emydoidea blandingi, and Rana p. pipiens in the Upper Peninsula of Michigan. Ambystoma t. tigrinum, recently found in Alger County, is perhaps a relict population left behind after the "steppe peninsula."

Other species, such as <u>Chrysemys picta belli</u> and <u>Elaphe</u> <u>vulpina</u> spread northward after the retreat of the glacier and did not find a biotic barrier because of the impoverished condition of the coniferous forest fauna according to Schmidt (op. cit.).

The frequency of the two color phases of <u>Plethodon</u> <u>cinereus</u> may be evidence as to the direction by which this species repopulated the Upper Peninsula after the glaciers.

The lead and red-backed phases vary in frequency throughout the Southern Peninsula of Michigan. However, the red-backed phase appears to be the only phase occurring in the Upper Peninsula. Breckenridge (1944) states that the red-backed phase is the only one to occur in Minnesota. Records are lacking for Wisconsin but the lead phase apparently has not been reported from that state. In Illinois (Smith, 1961) the red-backed phase occurs 66 percent of the time. The frequencies of the color phases appear to indicate that Plethodon cinereus has entered the Northern Peninsula by way of Wisconsin from the west rather than from Michigan.

In addition to <u>Chrysemys picta belli</u>, <u>Elaphe vulpina</u>, and <u>Plethodon cinereus</u> several other species, namely, <u>Emydoidea blandingi</u>, <u>Eumeces fasciatus</u>, and <u>Hyla versicolor</u>, have distributions in the Upper Peninsula that indicate a re-entrance of the Northern Peninsula from Wisconsin on the west.

There is also evidence for repopulation of the Northern Peninsula from Canada and Michigan on the east and south. <u>Notophthalmus v. viridescens, Natrix sipedon and Chrysemys</u> <u>picta marginata</u> all exhibit present-day distributions in Northern Michigan which appear to stem from Canada and southern Michigan. This eastern influence on the Upper

Peninsula appears to have been more recent than the "steppe peninsula" influence because of the northern part of the southern Peninsula of Michigan was less influenced by the "steppe peninsula"; and therefore heat-dependent species such as amphibians and reptiles were slower to move northward in southern Michigan.

The origin of the Isle Royale herpetofauna appears to be primarily from Ontario, Canada located to the north and east. Lake Superior surface currents (Fig. 11) indicate there is a counter-clockwise current along the shore and egg masses and individuals could have been carried by "rafts" to Isle Royale. Aquatic species such as <u>Chrysemys picta</u> <u>belli</u>, <u>Necturus maculosus</u> and <u>Notophthalmus viridescens may</u> have swam to the Island from Canada or Minnesota which is only 10 to 15 miles north of the Island. Why such ubiquitous species as <u>Plethodon cinereus</u> and <u>Rana pipiens</u> have not reached the Island is difficult to say.

Once a species has reached the Upper Peninsula there are very few topographic obstacles to keep it from extending across the Peninsula.


FIGURE 11. Map of the Surface Currents of Lake Superior

( C. C. Adams, 1908)

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## CONCLUSIONS

1. Ten species of frogs and seven species of salamanders occur within the political boundaries of the Northern Peninsula of Michigan; as do four species of turtles, one species of lizard, and eleven species of salamanders, one species of turtle, and two species of snakes.

 There are no large geographic barriers to species dispersal in the Upper Peninsula. Temperature appears to be a deterrent to keep more species from entering the Northern Peninsula. The various species occur in mosaic patterns in suitable habitat across the northern Peninsula.
There is apparent more individual variation within populations of the herpetofauna of the northern Peninsula than geographic variation between populations from various areas.

4. There were no distinct variation gradients present in an east-west direction across the northern Peninsula. <u>Rana pipiens</u> showed a slight increase in the dorsal spot count from west to east.

5. Northern Peninsula populations exhibited slight variations from those examined from Illinois. Isle Royale populations were slightly larger in size than those of the Upper Peninsula.

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6. The origin of the Isle Royale herpetofauna is Canada located to the north and east. The northern Peninsula was repopulated after the last glacial retreat, primarily from Wisconsin on the west and south and secondarily from southern Michigan and Canada on the south and east.

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