ILLINOIS NATURAL HISTORY SURVEY
Bulletin

Printed by Authority of the State of Illinois

The Amphibians and Reptiles of Illinois

PHILIP W. SMITH

STATE OF ILLINOIS
OTTO KERNER, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
WILLIAM SYLVESTER WHITE, *Director*
NATURAL HISTORY SURVEY DIVISION
HARLOW B. MILLS, *Chief*

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*Employed on co-operative projects with one of several agencies: University of Illinois, Illinois Agricultural Extension Service, Illinois Department of Conservation, National Science Foundation, United States Department of Agriculture, United States Fish and Wildlife Service, United States Public Health Service, and others.

This paper is a contribution from the Section of Faunistic Surveys and Insect Identification.

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FOREWORD

For the better part of a century the *Bulletin* has published research reports on the ecology, biology, and taxonomy of the flora and fauna of Illinois. The present number is a worthy continuance of these scientific contributions. It was prepared under those legal charges to the Board of Natural Resources and Conservation, the agency which controls, guides, and governs the activities of the Natural History Survey, to "conduct a natural history survey of the State giving preference to subjects of educational and economic importance," and "To publish, from time to time, reports covering the entire field of zoology and botany of the State."

It is probable that no other groups of animals have such staunch friends and adamant adversaries as do the amphibians and the reptiles, the subjects of this contribution. They are important to us in many ways, and, if they were not, "the characteristically human desire to investigate the unknown . . . provides an incentive to study them," as the author of this paper states.

We humans are likely to be selfish in our dealings with the so-called lower animals and to measure the worth of these animals only in terms of their economic effect upon us. We find that many amphibians and reptiles add materially to the well-being of people—some by the destruction of harmful insects and rodents, others by affording additions to our diet, as with frog legs or (to the adventurous palate) rattlesnake flesh.

Those people with an aesthetic bent find in amphibians and reptiles a great deal of grace and beauty. Those interested in curious things find their inquisitiveness satisfied among animals which have no legs, or which can change color, or which breathe largely through their skins, or which go through generation after generation without really growing up. Those who look for antiquity find that giant amphibians and reptiles developed, prospered, and passed on as living entities long before Nature began to experiment with the upright bipedal animals we call humans.

Amphibians and reptiles are excellent organisms to study if one is interested in the variability of living things, as Dr. Philip W. Smith has amply demonstrated in this article.

The movement of animals over the face of the earth in times past has intrigued biologists since the time of Aristotle. How did the present Illinois amphibians and reptiles reach the state? If they came from outside its limits, from what direction did they emigrate? What were the reasons for this movement? Illinois has proved to be a meeting place for many forms which apparently came from all directions, and many were unable to get past it or to invade it completely. Of the 94 species discussed here, only 25 are state-wide in their distribution. The other 69 have met limiting barriers somewhere in Illinois. For many species, parts of the state represent uninhabited islands, with the populations lapping at the shorelines on two, three, or four sides, but unable to overflow the highlands. For other species, parts of the state seem to represent pools, small pockets of animals which cannot get out of circumscribed areas.

The study on which the present report is based was initiated in June, 1947, and was one of the principal research projects of the Section of Faunistic Surveys and Insect Identification until June, 1953. The manuscript was completed in May, 1957, and was submitted for publication at that time. Budgetary reasons necessitated setting it aside until July, 1959. Although some revision has been necessary to bring the nomenclature and certain concepts up-to-date, the manuscript is approximately the same as that submitted in May, 1957, and only the most pertinent of the recent literature has been incorporated.

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Harrison Garman
1858—1944

Karl P. Schmidt
1890—1957

Alvin R. Cahn
1892—

Clifford H. Pope
1899—

Fred R. Cagle
1915—

Important contributors to the knowledge of the Illinois herpetofauna.

The Amphibians and Reptiles of Illinois

PHILIP W. SMITH

The amphibians and reptiles comprise two classes of vertebrate animals. The class Amphibia includes three present-day orders, the Caudata (salamanders), Salientia (frogs and toads), and the Gymnophiona (caecilians). The class Reptilia includes four present-day orders, the Testudines (turtles), Squamata (lizards and snakes), Crocodylia (crocodilians), and Rhynchocephalia (*Sphenodon*). In the fauna of Illinois, amphibians are represented by salamanders, toads, and frogs; reptiles by turtles, lizards, and snakes. Altogether 109 different kinds of these animals have been found in the state.

In our natural economy the amphibians and reptiles, because of their predation on insects and destructive rodents, are on the side of man. Their exact role in the so-called balance of nature is at this time poorly known, but their existence is probably of some importance to other organisms in the over-all fauna. To many people amphibians and reptiles are fascinating and colorful creatures, and the characteristically human desire to investigate the unknown and to accumulate knowledge provides an incentive to study them. The increase in popularity in recent years of these animals is reflected by the number of people who now have pet turtles, lizards, and snakes.

Four of our Illinois snakes are poisonous. Although these snakes are uncommon in most parts of the state, a few persons are bitten by them, and many persons worry needlessly because harmless species are mistaken for poisonous species. It is advisable for everyone who spends much time out-of-doors to learn to distinguish the poisonous species; this can be done readily with the information in this bulletin.

A detailed study of the present-day Illinois amphibians and reptiles is bringing to light important data that help the scientist to look back into the past history of the earth and its life. Illinois has contributed especially significant data to biogeography, particularly in helping to disclose the movements of animals in and around Illinois during the advance and retreat of the glaciers of the Pleistocene.

The objectives of this report on the amphibians and reptiles of Illinois are threefold. The first is to provide a critical review of the species and subspecies known to inhabit Illinois. The second is to present detailed distributional information for these animals in the hope that the data may contribute to the knowledge of the ecology and biogeography of Illinois. The third is to call attention to variation trends that I have discerned within Illinois and that will enable future investigators to utilize character analyses for populations occurring in limited parts of the state.

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The co-operation of several institutions and a great many persons has materially increased our knowledge of the herpetofauna of Illinois. The institutional and private collections that have made their holdings available to me are as follows: Chicago Academy of Sciences, Chicago, Illinois (CAS); Carthage College, Carthage, Illinois (CC); Chicago Natural History Museum, Chicago, Illinois (CNHM); collection of Charles W. Myers, St. Louis, Missouri (CM); Cornell University, Ithaca, New York (CU); Eastern Illinois University, Charleston, Illinois (EIU); collection of Fred A. Shannon, Wickenburg, Arizona (FAS); field zoology collection accumulated at the University of Illinois by the late H. J. Van Cleave, Urbana, Illinois (HJVC); Illinois Natural History Survey, Urbana, Illinois (INHS); Illinois State Museum, Springfield, Illinois (ISM); collection of James C. List, Paducah, Kentucky (JCL); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZ); Nebraska State Museum, Lincoln, Nebraska (NSM); Principia College, Elsah, Illinois (PC); collection of Richard A. Edgren, Chicago, Illinois (RAE); collection of Robert C. Schroder, Rock Island, Illinois (RCS); Rockford

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I am indebted to my former major professor, Hobart M. Smith, to my immediate superior, Herbert H. Ross, and to my wife, Dorothy M. Smith, for continuous help throughout the course of this study.

PREVIOUS HERPETOLOGICAL INVESTIGATIONS

Three reports on the amphibians and reptiles of Illinois have appeared. One of these is a briefly annotated check list, one a key only, and one an excellent account, which is, however, more than 60 years old. Four papers dealing with limited groups of the herpetofauna and approximately half a dozen papers treating the species of limited re-

gions within Illinois have been published. The great majority of the references to Illinois in the literature are incidental, either citing specimens collected at localities in Illinois or merely stating that Illinois is within the range of the species.

The earliest specific reference to an amphibian or reptile in Illinois appears to be an observation by Thomas Say (1823) in the account of Long's expedition to the Rockies, just 5 years after Illinois became a state. Say records in his narrative that he observed a female of the then recently described *Graptemys geographica* laying eggs on the bank of the Ohio River near Shawneetown. Fifteen years later Holbrook (1838) described *Emydoidea blandingi* from the Fox River of northern Illinois. Gebhard (1854) recorded the first amphibian for the state by citing a specimen of *Hemidactylum* [sic] from Illinois. Kennicott (1855) prepared the first regional list with his catalog of Cook County quadrupeds. His list records 12 amphibians and 21 reptiles still recognized as part of the Cook County fauna. Later Kennicott (1856) described *Natrix kirtlandi* from West Northfield, and (1859) *Virginia valeriae elegans* from "southern Illinois," and *Ophibolus evansii* from "central Illinois." During the next 25 years such authors as Cope, Cooper, Yarrow, Jordan, and Kennicott published papers containing incidental references to the herpetofauna of Illinois.

Davis & Rice (1883*a*) published the first state list; their check list correctly recorded 29 species of amphibians and 54 reptiles, as well as a number of other species whose occurrence is now known to be quite impossible in Illinois. In the same decade Schneck (1880–1886), a physician and naturalist in Mount Carmel, was active in the Wabash River valley, and his several short notes in the *American Naturalist* recorded a number of reptiles in southeastern Illinois. Cope (1888) described *Lampropeltis triangulum syspila* from Richland County and (1889) *Hyla phaeocrypta* from Mount Carmel. Harrison Garman (1889, 1890) recorded the animals occurring in the Mississippi River bottoms near Quincy and reported several species for the first time from the state. Hay (1881–1892), studying the herpetology of Indiana, contributed to the knowledge of the Illinois herpetofauna by citing Illinois localities for several species. Cope (1892) described *Thamnophis sirtalis semifasciata* from Des Plaines in northeastern Illinois.

The synopsis by Harrison Garman (1892), until now the only comprehensive report on the Illinois amphibians and reptiles, credited correctly 31 species of amphibians and 58 reptiles to Illinois, but unfortunately perpetuated most of the errors of Davis & Rice. Hurter (1893–1911) added several species to the known fauna of southwestern Illinois and, in his *Herpetology of Missouri,* described *Chrysemys treleasei* from Madison, St. Clair, and Monroe counties, Illinois.

In the early part of the present century, Robert Ridgway was responsible for a great quantity of Illinois material which found its way into the United States National Museum. Ridgway was also responsible for a number of erroneous records, presumably based on his recollections of species probably misidentified in the field. Shelford (1913) cited a number of species for northeastern Illinois in his *Animal Communities of Temperate America.* Gaige (1914) recorded 16 species of amphibians and reptiles for Richland County, and Hankinson (1910–1917) reported the common species of Coles County. Weed (1922, 1923) studied the amphibians and reptiles of the Meredosia area, and Blanchard (1924*b*) reported several new records for Monroe and Randolph counties. Van Cleave (1928) prepared tabular keys for the identification of the snakes of Illinois.

About 1930 K. P. Schmidt stimulated an interest in the amphibians and reptiles of the Chicago region, and his popular accounts of the amphibians (1929, 1930) were followed by a number of papers by Walter L. Necker and others. Schmidt & Necker (1935) published a useful report on the Chicago area species and cited specific localities for all the known amphibians and reptiles listed. W. F. Stanley, working for the Illinois Natural History Survey, accumulated a considerable number of Illinois snakes through co-operation of the Civilian Conservation Corps. Burt (1928–1931) cited Illinois specimens in several brief papers on the herpetofauna of the Midwest. Goodnight (1937) prepared a key to the salamanders of Illinois, and Cahn (1937) published his excellent monograph of the turtles of the state.

About 1940 Cagle began publishing the results of his studies on the fauna of southern Illinois and in 1941 he published an illustrated key to the amphibians and reptiles known for the entire state. This much-needed key was the third paper to treat all amphibian and reptile groups of Illinois. Thirty species of amphibians and 67 of reptiles were recorded as occurring in the state. Owens (1941) reported the common species in Macoupin County, and Lueth (1941) wrote a popular manual of the snakes of Illinois. Peters (1942) listed the species known to occur in Cumberland County, and Cagle (1942*a*) published a detailed account of the herpetofauna of Union and Jackson counties. Pope (1944*b*) summarized the distributional information of the several papers on the amphibians and reptiles of the Chicago area in his extremely useful handbook on the species occurring in northeastern Illinois. Langebartel (1947) reported the snakes known to occur in Hancock County and added *Carphophis amoenus vermis* to the known fauna of the state. P. W. Smith (1947) analyzed the herpetofauna of east-central Illinois and recorded 50 species and subspecies for that part of the state. Edgren & Stille (1948) published several papers on the species inhabiting the Chicago region and they added numerous distributional records for northeastern Illinois. Minton & Minton (1948) cited a number of specimens from southern Illinois, and Grimmer & Langebartel (1948) reported *Eurycea longicauda melanopleura* as a state record for Illinois. P. W. Smith (1948) added *Plethodon dorsalis* and *Gastrophryne carolinensis* to the known amphibian fauna and confirmed the suspected occurrence of *Desmognathus fuscus* and *Scaphiopus holbrooki* in Illinois.

Smith & Burger (1950) reported the first Illinois specimens of *Masticophis flagellum, Elaphe guttata,* and *Tantilla gracilis,* and P. W. Smith (1951) described and named *Pseudacris streckeri illinoensis* and *Kinosternon flavescens spooneri* from western Illinois sand prairies. Bennett (1953) added *Cemophora doliata* to the known snake fauna. P. W. Smith (1953–1957) summarized the known distribution in Illinois of *Tropidoclonion lineatum* and *Hyla avivoca;* resurrected the name *semifasciata* for the population of garter snakes occurring in northeastern Illinois; called attention to a south-north clinal reduction in number of body blotches in snakes, a reduction that presumably is a manifestation of Gloger's Rule; and offered a reconstruction of the post-Wisconsin biogeography of Illinois and neighboring states. Smith & Minton (1957) summarized distributional data for Indiana and Illinois and discussed postglacial dispersal patterns of amphibians and reptiles.

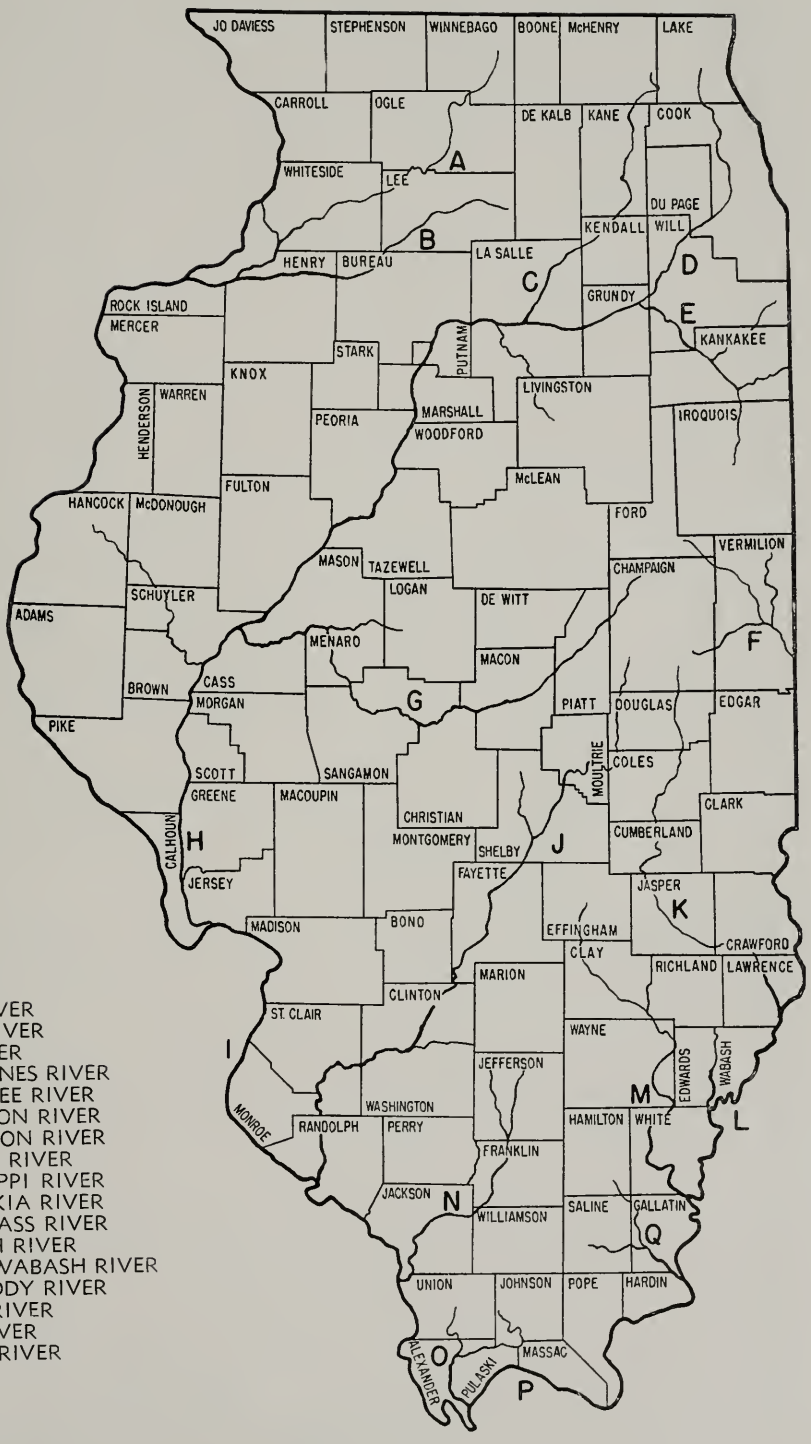
ILLINOIS AS A HERPETOFAUNAL REGION

The natural areas of Illinois have had a great amount of human alteration within historic times. Many natural habitats have been transformed into cities or cornfields, others greatly reduced in extent, and still others variously modified from their original condition. In a sense, all of the habitats are relictual, separated from each other by expanses of cultivated fields. The state could be described as a great corn desert containing remnants of many habitat types.

Although herpetological collecting is relatively poor in most parts of the state, Illinois has an unusually large number of recorded species and subspecies. The richness of its fauna, from the standpoint of numbers of species, is due to its great length from north to south, its ecologically intermediate position, its biogeographical history, and its variety of habitat types.

Physical Features

Illinois, fig. 1, has a maximum length of approximately 385 miles from north to south and a maximum width of 215 miles from east to west. The state, which contains 56,400 square miles, is moderately well drained by rivers flowing into the Mississippi on the west, the Ohio on the south, and the Wabash on the east. The greater part of the state is a flat or rolling plain. The elevation, which averages about 600 feet for the entire state, decreases from north to south. The lowest part of Illinois is in Alexander County, at the southern tip, approximately 300 feet above sea level. The Shawnee Hills, which extend across the state near the southern tip, the unglaciated area in extreme northwestern Illinois, and a narrow belt of rock bluff and dissected hills along the Mississippi River have moderate relief; the first two areas have elevations slightly over 1,000 feet.



A. ROCK RIVER
B. GREEN RIVER
C. FOX RIVER
D. DES PLAINES RIVER
E. KANKAKEE RIVER
F. VERMILION RIVER
G. SANGAMON RIVER
H. ILLINOIS RIVER
I. MISSISSIPPI RIVER
J. KASKASKIA RIVER
K. EMBARRASS RIVER
L. WABASH RIVER
M. LITTLE WABASH RIVER
N. BIG MUDDY RIVER
O. CACHE RIVER
P. OHIO RIVER
Q. SALINE RIVER

Fig. 1.—Map of Illinois showing counties and major rivers.

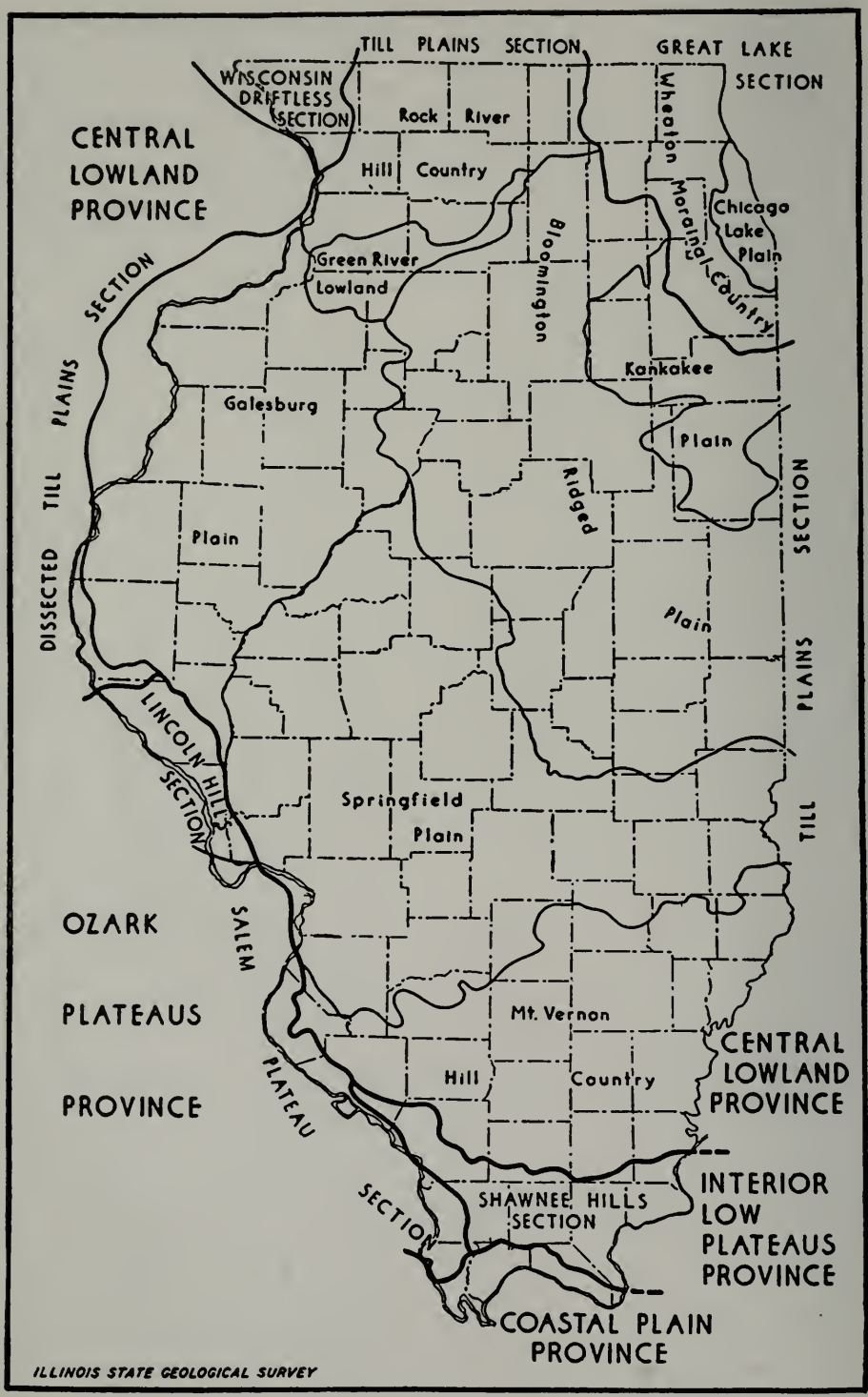


Fig. 2.—Physiographic divisions of Illinois. From Leighton, Ekblaw, & Horberg (1948).

The present topography reflects the Pleistocene history of the area. Although four stages of glacial advance, separated by interglacial periods of milder climate, are known to have occurred, the Illinoian lobe (over 100,000 years ago) and the Wisconsin lobe (about 20,000 years ago) are largely responsible for the physiography of Illinois. Much of the northern half of the state is covered with thick deposits of relatively re-

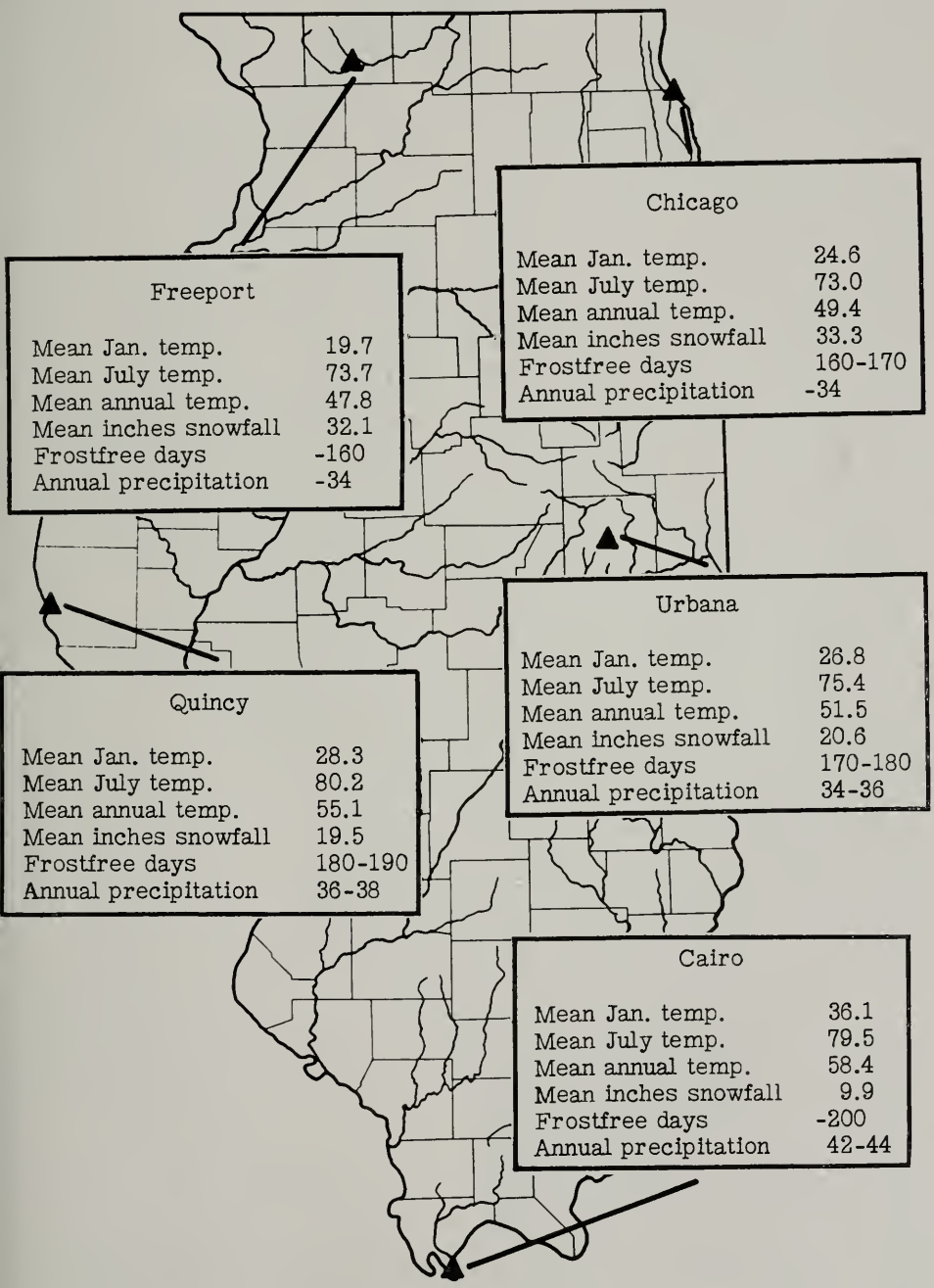


Fig. 3.—Temperature and precipitation data for five Illinois cities. Data from Page (1949).

cent Wisconsin till. Superimposed on this in gradually increasing depths to the west are deposits of fertile loess. The flat or rolling plains are marked by series of low concentrically arranged recessional moraines, the southernmost of which is the Shelbyville terminal moraine.

The glaciated area south of the Shelbyville moraine has deposits of older, less fertile Illinoian till, and moraines are no longer evident. This region has slightly more relief than the area north of the Shelbyville moraine, since the processes of erosion have had a longer time to cut valleys.

Rock outcrops are prominent features in the landscape in the Shawnee Hills, in the northwestern unglaciated area, and along the large rivers. Rock strata appear above the glacial till in small areas throughout the state, particularly in extreme eastern and western Illinois.

The physiographic divisions of Illinois have been described by Leighton *et al.* (1948). These divisions are shown in fig. 2.

Climatic Features

Illinois has a continental climate. The isotherms are in general from east to west and indicate an increase in temperature from north to south. The difference in average temperatures between northern and southern Illinois is much less marked in summer than in winter. The isohyets are somewhat less regular than the isotherms; in general, the annual precipitation increases from north to south. Union County receives a greater amount of rainfall than any other county.

The influence of latitude on temperature and the geographic variation in precipitation are illustrated by statistics taken over a period of several years at scattered Illinois localities, fig. 3.

Biotic Provinces

According to the Merriam (1894) classification, Illinois contains three life zones. Extreme northern Illinois is regarded as Transition, extreme southern Illinois as Austroriparian, and the area in between as Carolinian. According to the Shantz & Zon (1924) classification, Illinois includes four vegetation types. Extreme northeastern Illinois is classed as Marsh Grass, most of northern and central Illinois as Tall Grass Prairie, southern Illinois, except for the lowermost tip, as Oak-Hickory Forest, and extreme southern Illinois as River Bottom Forest (cypress-tupelo-red gum). According to Dice (1943), the state has three biotic provinces. The northern half is regarded as Illinoian; the southern half, except for the southern tip, as Carolinian; and extreme southern Illinois as Austroriparian. Kendeigh (1951) indicates the presence of two biomes in Illinois. The northern half is predominantly Grassland Biome, the southern half Temperate Deciduous Forest Biome. The forest is subdivided into three associations, the largest of which is an ecotone between oak-hickory forest and humid prairie. The animal communities are regarded as a Deciduous Forest Biociation, a Deciduous Forest-Edge Biocies, and a Prairie Biociation.

All of these classifications are based on the vegetation or biota of the entire continent, and the boundaries are necessarily inexact in any minute geographical area. It is noteworthy that all of them indicate that the southern tip of this state is ecologically distinct, and most of them indicate in central Illinois an ecological break that roughly coincides with the southern limit of Wisconsin glaciation.

A detailed classification of zones in Illinois is expressed by Vestal (1931), who based his divisions upon forest types. In many parts of the state, the distribution of the herpetofauna parallels remarkably the distribution of these types. Vestal's map of Illinois has the following eight divisions: Grand Prairie, Western Division, Jo Daviess Hills, Mississippi Border, Southern Division, Wabash Border, Ozark Hills, and Tertiary Division, as shown in fig. 4.

Herpetofaunal Divisions

Although the herpetofaunal distribution tends to coincide with the vegetational divisions of Vestal (1931), certain differences exist that should be recognized. The distinctive herpetofaunal divisions are outlined below and shown in fig. 5.

I. Prairie or former prairie
   - A. Sand areas
   - B. Grand Prairie (broad sense)
   - C. Outlier prairies

II. Forest
   - A. Northeastern Illinois Mesic Forest
   - B. Western Division

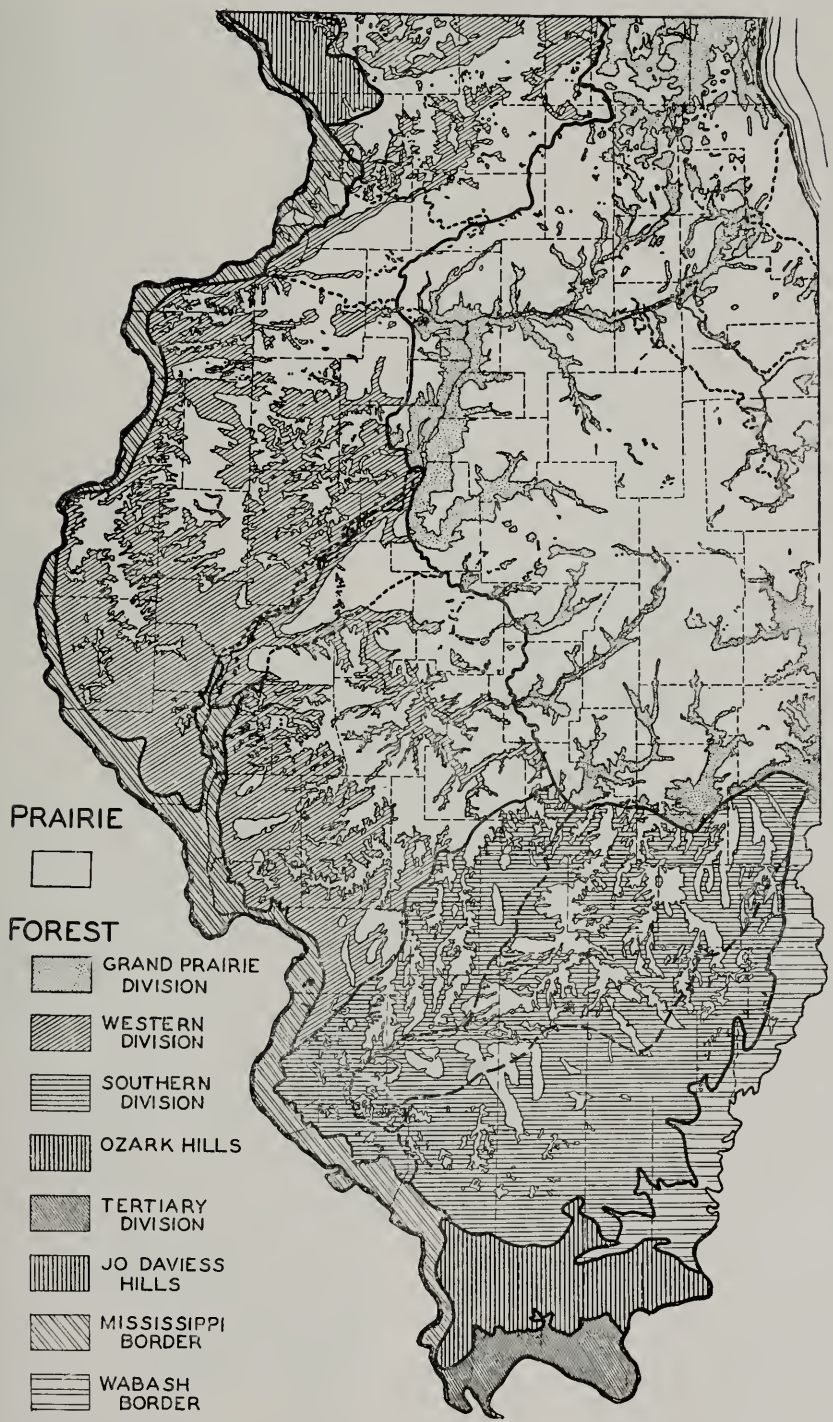


Fig. 4.—Vegetation map of Illinois, based on original cover. From Vestal (1931). Forest occupies a relatively small per cent of Illinois at present.

Fig. 5.—Herpetofaunal divisions of Illinois. The similarity of herpetofaunal, vegetationa and physiographic divisions is notable. Coincidence of boundaries is most pronounced at th southern limits of Pleistocene glaciation and the northern border of the Coastal Plain.

C. Upper Mississippi Border
D. Lower Mississippi Border
E. Southern Division
F. Wabash Border
G. Shawnee Hills
H. Austroriparian

Ninety-four species of amphibians and reptiles occur in Illinois; 25 are state-wide in distribution and 69 occupy limited parts of the state. The edges of ranges of these 69 have been plotted on one map, fig. 6. It is evident from this map that the ranges of the various species are not uniformly shingled over the state but that the range edges of many tend to coincide. Some areas are relatively uniform ecologically and have few species reaching the edges of their ranges therein. Fig. 6 demonstrates the validity of fig. 5.

The Sand Areas.—The areas of sand prairie, which are relatively small, are chiefly in central and northern Illinois. The largest area extends along the east side of the Illinois River from Woodford County south to northern Scott County. Smaller sand areas occur in Jo Daviess, Carroll, Rock Island, Whiteside, Mercer, and Henderson counties, along the east side of the Mississippi River; in Ogle and Lee counties; in Winnebago County; in Kankakee and Iroquois counties. Small areas of sandy loam occur in Lawrence, La Salle, and Lake counties. A typical sand prairie habitat is shown in fig. 7.

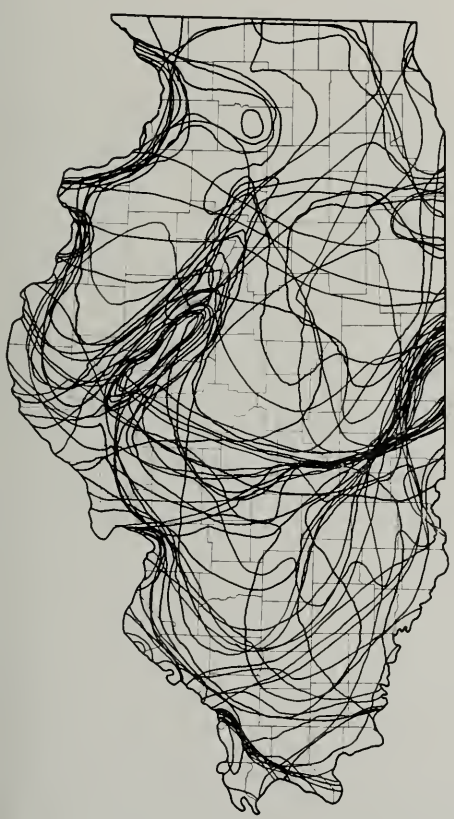


Fig. 6.—Limits of distribution of the amphibians and reptiles of Illinois. Each line represents the edge of range of a species. In some areas, lines coincide.

The most abundant reptiles of the sand areas are *Cnemidophorus sexlineatus, Pituophis melanoleucus sayi, Coluber constrictor flaviventris, Heterodon platyrhinos, Heterodon nasicus, Terrapene ornata,* and *Trionyx muticus.* The distinctive species of amphibians and reptiles are *Pseudacris streckeri illinoensis, Kinosternon flavescens spooneri,* and some of the reptiles mentioned as abundant are also characteristic. A depauperate salamander fauna and the local predominance of *Bufo woodhousei fowleri* over *Bufo americanus americanus* are also characteristic of this division.

The Grand Prairie.—This division as here defined comprises all original prairie, except the sand areas, north of the southern limit of Wisconsin glaciation. It includes accordingly the Grand Prairie (in the strict sense), the Mendota Prairie, and most of the prairies included in Vestal's Western Division. Much of this area has fertile soil, consisting of Wisconsin glacial till and loess, and is now extensively cultivated. It has been characterized by various authors as muck prairie, black-soil prairie, and heavy-soil prairie. The eastern part of the area was formerly dotted with marshes and ponds, most of which have been drained.

The most abundant species of amphibians and reptiles are *Bufo americanus americanus, Thamnophis radix, Elaphe vulpina, Pituophis melanoleucus sayi;* probably *Sistrurus catenatus* and *Emydoidea blandingi* were once abundant. The distinctive species are *Natrix kirtlandi, Tropidoclonion lineatum, Opheodrys vernalis,* as well as some of the above species indicated as abundant. Although none of these is entirely restricted to the Grand Prairie, each reaches its greatest abundance in the region.

The Outlier Prairies.—These fingers of prairie, which interdigitate with forest in the

Fig. 7.—A typical sand prairie habitat near Thomson, Whiteside County, Illinois.

southern half of Illinois, were included by Vestal in the Southern Division. The northern edges of this division are not sharply delimited from the Grand Prairie, and the Springfield District of Vestal is, in fact, ecotonal in herpetofaunal composition. The soil is rather poor, consisting of clay loam with hardpan a foot or two below the surface.

The abundant species are *Ambystoma texanum, Bufo woodhousei fowleri, Coluber constrictor, Lampropeltis calligaster,* and *Heterodon platyrhinos.* The distinctive species are *Rana areolata* and *Terrapene ornata.* A few relict colonies of *Opheodrys vernalis, Thamnophis radix, Sistrurus catenatus,* and *Natrix grahami* link this division with the Grand Prairie. The erratic occurrence of some of these scattered colonies is difficult to explain. It seems unlikely that cultivation is solely responsible.

Northeastern Illinois Mesic Forest.—The forested moraines and bogs near Lake Michigan contain a relatively rich fauna and are distinctive chiefly because of the occurrence of northern and eastern elements. The abundant species are *Ambystoma maculatum, Rana sylvatica, Lampropeltis triangulum triangulum, Storeria occipitomaculata,* and *Natrix septemvittata.* The distinctive species are *Ambystoma laterale, Hemidactylium scutatum, Clemmys guttata,* and *Thamnophis sirtalis semifasciata.*

The Western Division.—The small patches of woodland and gallery forest along rivers and creeks of this division are rather remarkable for their impoverished fauna. Although apparently suitable habitat for many forest species is available, most of the species known in adjacent divisions have not been found in these forested areas. *Acris crepitans, Pseudacris triseriata triseriata, Rana pipiens pipiens, Rana clamitans, Thamnophis sirtalis,* and *Lampropeltis triangulum* are moderately common; all are more abundant in other parts of Illinois.

The Upper Mississippi Border.—This division, which includes the forested bluffs of the Mississippi River and the Jo Daviess County driftless area, is much richer in number of species than the Western Division. The extensive rock habitat and the continuity of forest along the Mississippi, which serves as an avenue for the northward dispersal of southern animals, probably accounts for the large number of species in this area.

The common species are *Natrix sipedon, Diadophis punctatus, Elaphe obsoleta, Thamnophis sirtalis,* and *Rana clamitans.* The distinctive species are *Eurycea longicauda melanopleura, Carphophis amoenus vermis, Diadophis punctatus arnyi,* and *Rana palustris.*

The Lower Mississippi Border.—The bluffs and dissected upland along the Mississippi River south of St. Louis have a spe-

cies composition and an order of relative abundance similar to that of the Upper Mississippi Border. This division has more affinities with the Shawnee Hills, however, and has, in addition, several western and southern elements not found elsewhere in the state. The distinctive species are *Tantilla gracilis, Masticophis flagellum, Elaphe guttata emoryi,* and *Gastrophryne carolinensis.*

The Shawnee Hills.—This division is characterized by forested, dissected upland with sheer bluffs and rock outcrops. The streams, usually fast and clear, have rocky bottoms. The area is rich in numbers of species and individuals. The abundant species are *Ambystoma opacum, Plethodon glutinosus, Eurycea longicauda, Eurycea lucifuga, Hyla crucifer, Hyla versicolor, Sceloporus undulatus, Scincella laterale, Eumeces* spp., *Agkistrodon contortrix, Elaphe obsoleta, Coluber constrictor, Thamnophis sauritus, Virginia valeriae,* and *Terrapene carolina.*

The Southern Division.—The forest of this part of Illinois is largely restricted to river bottoms and land generally unsuited for farming. The habitat is similar to that in the Shawnee Hills but has less relief and few rock outcrops and rocky streams.

The unintentional creation of parklike savannas by removal of forest provides ideal habitat for forest-edge species. The thickets, brambles, and grass (*Andropogon*) glades characteristic of this habitat are inhabited by *Bufo woodhousei fowleri, Ambystoma texanum, Heterodon platyrhinos, Coluber constrictor, Opheodrys aestivus, Storeria dekayi,* and *Natrix sipedon pleuralis.* The interior of the woodlands contain *Eumeces* spp., *Elaphe obsoleta, Lampropeltis triangulum syspila,* and *Hyla versicolor.*

The Wabash Border.—The area along the Wabash River in southeastern Illinois is similar to the Southern Division, differing primarily in the higher percentage of forested land and the mesic condition of this forest. Characteristic species are *Hyla cru-*

Fig. 8.—A typical austroriparian habitat at Horseshoe Lake, Alexander County, Illinois.

cifer, Pseudacris triseriata feriarum × *triseriata, Eumeces fasciatus,* and *Terrapene carolina.* Additional characteristic species are *Rana sylvatica, Natrix septemvittata, Natrix erythrogaster neglecta, Eurycea bislineata, Plethodon cinereus,* and *Elaphe obsoleta obsoleta* × *spiloides.*

The Austroriparian Division.—This area is the Tertiary Division of Vestal (1931), the River-Bottom Forest of Shantz & Zon (1924), and the Austroriparian of earlier authors. It includes the floodplains, fig. 8, of the Mississippi and Ohio rivers in Alexander, Pulaski, Massac, Pope, western Union, and southwestern Jackson counties. A number of species characteristic of the Gulf Coast extend up the Mississippi River valley into this division. Some of these species are *Ambystoma talpoideum, Hyla cinerea, Hyla avivoca, Scaphiopus holbrooki, Farancia abacura, Natrix cyclopion, Natrix sipedon confluens, Cemophora doliata, Agkistrodon piscivorus, Pseudemys floridana,* and *Macroclemys temmincki.*

PRESENTATION OF DATA

The bulk of the data for this report was accumulated during the years 1947–1953. Field work was conducted in almost all parts of the state and was particularly intensive in the peripheral areas. Records for the approximately 8,000 specimens in the Illinois Natural History Survey collection were supplemented by Illinois records from the major museums of this country, several state institutions, and a few private collections.

Complete synonymies for all Illinois species and subspecies have been compiled, but, because of their bulkiness, they have been replaced by skeleton synonymies; the synonymy for each species or subspecies consists of a chronological outline of all names and name combinations that have been applied to the taxon in the Illinois literature. Only the initial usage of a name or name combination is cited. The remaining bibliographic references and lists of published records from the time of the original description through the appearance of the sixth edition of the official check list (Schmidt 1953) are on file at the Illinois Natural History Survey offices, where they are available to anyone interested in the historical aspects of the Illinois herpetofauna.

The initial citation in every case is to the original description, whether or not Illinois is mentioned; the specific or subspecific name is followed by the name of the describer (with no comma separating them), the year the description was published, the pagination of the description, and, in parentheses, the type locality. A citation other than the original description refers to the first usage of the name in literature pertaining to Illinois; a comma follows the specific or subspecific name, and the reference is abbreviated to author, year, and pagination. The complete reference for each citation is given in the "Literature Cited" section of this paper.

If a citation refers to two different entities as now understood, the name appears in the synonymies of both forms involved and is followed by "part" in parentheses. When the citation refers to specimens or populations of intergrades between two subspecies, the name ordinarily is included in the synonymies of both forms and is followed by "I" in parentheses. The various names and name combinations have been carefully evaluated, and most of them have been definitely allocated by judicious use of our present knowledge of distribution. In a few cases some doubt about assignment of the name remains; in each of these cases the name is prefaced by a question mark. In several instances questionable records in the literature have been clarified by examination of the museum specimens on which the records were based.

The diagnosis for each species is brief and includes only those characters or combinations of characters serving to distinguish an animal from related or similar animals. In most instances it is designed merely to supplement the keys. Exceptions are made, however, for those populations which depart in structure, pattern, or color from published descriptions of the species or subspecies.

The section on variation in each species or subspecies includes a discussion of sexual dimorphism, ontogenetic variation, and geographic variation within Illinois. In an animal that occurs in a limited part of the state, individual variation is summarized. It has been assumed, in accordance with present species concepts, that each individual population probably differs to some extent from all others. Extremes and means of

counts and measurements rather than more detailed statistics are given, since they illustrate general trends and do not require correction factors for the small size of the samples. In most cases, the grouping of the samples analyzed has been selected with an eye to the probable natural limits of freely interbreeding populations. In some cases, however, the grouping has been dictated by the availability of specimens.

The habits section for each species or subspecies is intended only to give a brief summary of behavior, feeding habits, and life history information. Although a wealth of published information is available for some of the species, little of this information is based on Illinois animals. The information in the present paper, for the most part, pertains only to Illinois populations; geographic variation in habits as well as in morphology is to be expected.

The section on distribution of each species or subspecies in Illinois contains a general statement of the range of the animal in the state, an indication of its general abundance, apparent correlations of its range and the environmental features, and the extent of the intergrading areas of subspecies. In the interest of saving space, lists of locality records and specimens examined have been omitted. This information is on file at the Illinois Natural History Survey offices and can be transcribed for persons wishing to know precise localities and catalog numbers of specimens on which a record is based. Published records believed valid but not substantiated by museum specimens are listed alphabetically by counties and specific localities and followed by references to the literature cited.

The accompanying maps indicate graphically the known Illinois localities for the various species. Localities from which specimens have been examined are indicated by dots; localities for which there are literature records believed valid, but from which I have not seen specimens, are indicated by hollow circles. The presumed range of a species that does not occur throughout Illinois is indicated by parallel hatching and is based in part on the distribution of apparently suitable habitat. In the case of a species having two or more subspecies in Illinois, the range of each subspecies is indicated by a different pattern, and the intergrading area by an overlap of these patterns to form a crosshatch pattern. The map of the United States that accompanies each Illinois map indicates the total known range of a species and in most cases is from Conant (1958).

SYSTEMATIC ACCOUNT

Amphibians and reptiles comprise two distinct classes of vertebrate animals. The modern species are survivors of those groups of vertebrates that first colonized land. They are intermediate between the bony fishes of an aquatic environment and the birds and mammals of a terrestrial environment. In general, the organ systems of amphibians reflect the series of profound changes necessary for the transition from water- to air-breathing, from swimming to locomotion on land, and from an environment emphasizing the need for water excretion to one requiring water conservation. The organ systems of reptiles reflect the various modifications which made their land colonization more successful than that of the amphibians.

In addition to gross differences in organ systems, there are numerous other anatomical features distinguishing the amphibians from the reptiles. These differences are treated in any standard textbook of comparative anatomy. The most obvious features distinguishing the amphibians from the reptiles are as follows:

Skin without scales or plates; front feet with 4 or fewer toes; toes without claws; eggs with gelatinous coating; typically with an aquatic larval stage ..... Class Amphibia, p. 21

Skin with scales or plates, or both; front feet, if present, with 5 toes; some toes with claws; eggs with a tough membranous or limy covering; no larval stage ..... Class Reptilia, p. 113

Check List of the Amphibians and Reptiles of Illinois

Class Amphibia
- Subclass Lepospondyli
  - Order Caudata
    - Family Cryptobranchidae
      - *Cryptobranchus alleganiensis alleganiensis* (Daudin)
    - Family Ambystomatidae
      - *Ambystoma laterale* Hallowell
      - *Ambystoma maculatum* (Shaw)

Ambystoma opacum (Gravenhorst)
Ambystoma talpoideum (Holbrook)
Ambystoma texanum (Matthes)
Ambystoma tigrinum tigrinum (Green)
Family Salamandridae
Notophthalmus viridescens louisianensis Wolterstorff
Family Plethodontidae
Eurycea bislineata rivicola Mittleman
Eurycea longicauda longicauda (Green)
Eurycea longicauda melanopleura (Cope)
Eurycea lucifuga Rafinesque
Hemidactylium scutatum (Schlegel)
Plethodon cinereus cinereus (Green)
Plethodon dorsalis Cope
Plethodon glutinosus glutinosus (Green)
Desmognathus fuscus conanti Rossman
Family Proteidae
Necturus maculosus maculosus (Rafinesque)
Family Sirenidae
Siren intermedia nettingi Goin
Subclass Apsidospondyli
Order Salientia
Family Pelobatidae
Scaphiopus holbrooki (Harlan)
Family Bufonidae
Bufo americanus americanus Holbrook
Bufo americanus charlesmithi Bragg
Bufo woodhousei fowleri Hinckley
Family Hylidae
Acris crepitans blanchardi Harper
Pseudacris triseriata feriarum (Baird)
Pseudacris triseriata triseriata (Wied)
Pseudacris streckeri illinoensis Smith
Hyla avivoca avivoca Viosca
Hyla cinerea (Schneider)
Hyla crucifer crucifer Wied
Hyla versicolor versicolor Le Conte
Family Ranidae
Rana areolata circulosa Rice & Davis
Rana catesbeiana Shaw
Rana clamitans melanota (Rafinesque)
Rana palustris Le Conte
Rana pipiens pipiens Schreber
Rana pipiens sphenocephala Cope
Rana sylvatica sylvatica Le Conte
Rana sylvatica cantabrigensis Baird
Family Microhylidae
Gastrophryne carolinensis carolinensis (Holbrook)
Class Reptilia
Subclass Anapsida
Order Testudines
Family Chelydridae
Chelydra serpentina serpentina (Linnaeus)
Macroclemys temmincki (Troost)
Family Kinosternidae
Sternothaerus odoratus (Latreille)
Kinosternon flavescens spooneri Smith
Kinosternon subrubrum subrubrum (Lacépède) × *hippocrepis* Gray
Family Testudinidae
Clemmys guttata (Schneider)
Emydoidea blandingi (Holbrook)
Terrapene carolina carolina (Linnaeus)
Terrapene ornata ornata (Agassiz)
Chrysemys picta marginata Agassiz
Chrysemys picta belli (Gray)
Pseudemys scripta elegans (Wied)
Pseudemys floridana hoyi (Agassiz) × *concinna hieroglyphica* (Holbrook)
Graptemys geographica (Le Sueur)
Graptemys pseudogeographica (Gray)

Family Trionychidae
Trionyx muticus muticus Le Sueur
Trionyx spinifer spinifer Le Sueur
Subclass Lepidosauria
Order Squamata
Suborder Sauria
Family Iguanidae
Sceloporus undulatus hyacinthinus (Green)
Family Anguidae
Ophisaurus attenuatus attenuatus (Cope)
Family Teiidae
Cnemidophorus sexlineatus sexlineatus (Linnaeus)
Family Scincidae
Scincella laterale (Say)
Eumeces fasciatus (Linnaeus)
Eumeces laticeps (Schneider)
Suborder Serpentes
Family Colubridae
Carphophis amoenus helenae (Kennicott)
Carphophis amoenus vermis (Kennicott)
Farancia abacura reinwardti Schlegel
Diadophis punctatus arnyi Kennicott
Diadophis punctatus edwardsi (Merrem)
Diadophis punctatus stictogenys Cope
Heterodon nasicus nasicus Baird & Girard
Heterodon platyrhinos Latreille
Opheodrys aestivus (Linnaeus)
Opheodrys vernalis blanchardi Grobman
Coluber constrictor flaviventris Say
Masticophis flagellum flagellum (Shaw)
Elaphe guttata emoryi (Baird & Girard)
Elaphe obsoleta obsoleta (Say)
Elaphe obsoleta spiloides Duméril, Bibron, & Duméril
Elaphe vulpina vulpina (Baird & Girard)
Pituophis melanoleucus sayi (Schlegel)
Lampropeltis calligaster calligaster (Harlan)
Lampropeltis getulus holbrooki Stejneger
Lampropeltis getulus niger (Yarrow)
Lampropeltis triangulum triangulum (Lacépède)
Lampropeltis triangulum syspila (Cope)
Cemophora doliata (Linnaeus)
Thamnophis sauritus proximus (Say)
Thamnophis radix radix (Baird & Girard)
Thamnophis sirtalis sirtalis (Linnaeus)
Thamnophis sirtalis semifasciata (Cope)
Tropidoclonion lineatum lineatum (Hallowell)
Virginia valeriae elegans (Kennicott)
Storeria dekayi wrightorum Trapido
Storeria occipitomaculata occipitomaculata (Storer)
Natrix cyclopion cyclopion (Duméril & Bibron)
Natrix erythrogaster flavigaster Conant
Natrix erythrogaster neglecta Conant
Natrix grahami (Baird & Girard)
Natrix kirtlandi (Kennicott)
Natrix rhombifera rhombifera (Hallowell)
Natrix septemvittata (Say)
Natrix sipedon sipedon (Linnaeus)
Natrix sipedon pleuralis Cope
Natrix sipedon confluens Blanchard
Tantilla gracilis hallowelli Cope
Family Crotalidae
Agkistrodon piscivorus leucostomus (Troost)
Agkistrodon contortrix mokeson (Daudin)
Sistrurus catenatus catenatus (Rafinesque)
Crotalus horridus horridus Linnaeus

The preceding check list contains 109 named species and subspecies of amphibians and reptiles known in Illinois. The numer-

Table 1.—Number of species and subspecies in the herpetofauna of Illinois and some other states.

GROUP	ILLINOIS	INDIANA (MINTON, PERSONAL COMMUNICATION)	KANSAS (H.M. SMITH 1956)	MINNESOTA (BRECKENRIDGE 1944)	GEORGIA (MARTOF 1956)
Salamanders	19	20	10	5	57
Frogs and toads	21	14	24	13	34
Turtles	17	15	13	8	35
Lizards	6	6	16	3	15
Snakes	46	33	46	16	59
Crocodilians	0	0	0	0	3
Total	*109*	*88*	*109*	*45*	*203*

ical distribution of species and subspecies in each group for Illinois and for some other states that have been recently surveyed are shown in table 1.

Species Deleted From the Illinois List

In recent years the natural range of a species of amphibian or reptile has become increasingly difficult to determine because numerous individuals have been carried by human agency into areas new to them. Many snakes, turtles, and lizards have been captured by travelers, taken from their natural ranges, kept for a while as pets, and then released or allowed to escape. More than a dozen extralimital species of amphibians and reptiles, obviously escapees, released pets, or "banana-bunch" waifs, have come to my attention in the course of this survey, and perhaps there are many more never reported to a biologist. Although reports of the alligator and boa constrictor in Illinois are rather easily dismissed, reports of other species may be troublesome to evaluate.

The evaluation of numerous museum specimens for which the locality data are suspected of being in error presents a serious problem. Some errors result from lack of accuracy in cataloging, others from carelessness in storing or labeling specimens. Many of these errors are introduced into the literature by specialists who study the specimens and cite the locality data, even though the data appear to be dubious. Errors are perpetuated by other specialists who cite the published records. On the basis of our present knowledge, the Illinois records for the following species are regarded as having been based on error, and these species are here excluded from the list of Illinois amphibians and reptiles until additional evidence is available.

Pseudotriton ruber ruber (Latreille).—This eastern salamander has had an unusually complicated history. Yarrow (1882*a*) cited a specimen of *Spelerpes ruber* from Aux Plaines, Illinois. The species was credited to Illinois by Davis & Rice (1883*a*), Hay (1887*a*), and H. Garman (1892) on the authority of Yarrow.

The confusion of *P. ruber* and another red salamander, *maculicaudus* (equals *Eurycea lucifuga*) probably led to the assumption by Stejneger & Barbour (1917) that *P. ruber* occurred in Illinois. Dunn (1926) questioned the Aux Plaines record, and Schmidt & Necker (1935) deleted the species from the known fauna of the Chicago area. However, Goodnight (1937), on the authority of Yarrow, included the species in his key. The Aux Plaines locality is almost 400 miles northeast of the westernmost generally accepted record for the species, and no specimens are known from other parts of Illinois, from Indiana, or from western Kentucky. Accordingly, *P. ruber* should be dropped from the list of Illinois salamanders.

Pseudobranchus striata (Le Conte).—H. Garman (1892) remarked: "So many southern species inhabit the south part of the State that it would not be surprising if *Pseudobranchus striata* should also be found to occur there." The species has, however, never been found north of southern Georgia.

Hyla squirella Bosc.—The squirrel treefrog was credited to Illinois by Davis & Rice (1883*a*), H. Garman (1892), Hart &

Gleason (1907), Cagle (1941), Brown (1950), and Schmidt (1953). The early references to the species in the state were probably based on misidentified specimens of related hylids; the later references may have been based on the assumption that *squirella* occurred in extreme southern Illinois in view of its alleged occurrence in western Kentucky. Recently, at the suggestion of Roger Conant and through the courtesy of Roger Barbour, I examined the Kentucky specimens and found them to be aberrant specimens of *Pseudacris triseriata feriarum*. The nearest valid record of *H. squirella* is approximately 300 miles south of Illinois, and the species should therefore be dropped from the list of Illinois amphibians.

Sternothaerus carinatus (Gray).—This Gulf Coast species was reported as occurring in Illinois by Davis & Rice (1883*a*, 1883*b*), Jordan (1888), H. Garman (1892), and Hay (1892*a*), but it was correctly deleted from the list of Illinois turtles by Cahn (1937).

Terrapene carolina triunguis (Agassiz).—The evidence for deleting this subspecies is presented in the discussion of geographic variation of *T. c. carolina* on page 135.

Chrysemys picta dorsalis Agassiz.—The evidence for deleting this subspecies is presented in the discussion of geographic variation of *C. p. marginata* on page 140.

Chrysemys picta picta (Schneider).—Yarrow (1882*a*) recorded the eastern painted turtle from Mount Carmel, and H. Garman (1890) questioned the record. Cahn (1937) deleted the subspecies from the Illinois list.

Clemmys insculpta (Le Conte).—The belief that the wood turtle might be found in northern Illinois was expressed by Stejneger & Barbour (1933, 1939, 1943), Ditmars (1936), Cahn (1937), Logier (1939), Breckenridge (1944), and McCauley (1945). Cahn summarized the possibility that the species might occur in this state, pointing out that a record is extant from a locality only 11 miles north of the Wisconsin-Illinois state line. There is, however, some question about this record, and *C. insculpta* should be dropped from the known turtle fauna of Illinois until additional evidence is available.

Trionyx ferox ferox (Schneider).—Kennicott (1855) included this southern turtle in his Cook County list, but his specimen undoubtedly belonged to *T. spinifer spinifer*, as Schmidt & Necker (1935) pointed out. H. Garman (1892) presumed that *ferox* might occur in the Ohio and Mississippi rivers, but Neill (1951*a*) showed that *ferox* is unknown north of southern Georgia.

Phrynosoma cornutum (Harlan).—Ditmars (1907) included western Illinois in the range of the Texas horned lizard, although his inclusion was presumably based on nothing more than a guess. Several specimens of this lizard have been found in Illinois, most of them in urban areas, but these are almost certainly irregulars in the fauna, inasmuch as *P. cornutum* is one of the most popular of reptile pets.

Carphophis amoenus amoenus (Say).—The references to *Carphophiops amoenus* in Illinois by Garman (1892), Cope (1900), Jordan (1929), and Ditmars (1929) were based on atypical or misidentified specimens of the subspecies *helenae*. These references antedate the present subspecies concepts; *amoenus* is now known to be replaced by *helenae* west of the Appalachians.

Abastor erythrogrammus (Holbrook).—Robert Ridgway was apparently responsible for inclusion of Illinois in the range of the rainbow snake by Jordan (1878, 1888), Cope (1877, 1895*a*), S. Garman (1883, 1884), Davis & Rice (1883*a*), and H. Garman (1892). There is no other evidence that the species occurs north of Louisiana in the Mississippi River valley.

Heterodon simus (Linnaeus).—The reports of the southern hognosed snake in Illinois by Davis & Rice (1883*a*), Jordan (1888), H. Garman (1892), Hart & Gleason (1907), and Van Cleave (1928) undoubtedly refer to *H. nasicus*. The species *simus* is now known to occur no closer to Illinois than coastal North Carolina.

Lampropeltis calligaster rhombomaculata (Holbrook).—The reports of the mole snake in Illinois by Davis & Rice (1883*a*, 1883*b*), H. Garman (1892), and Jordan (1888) undoubtedly refer to misidentified specimens of *L. c. calligaster*. The latter subspecies replaces *L. c. rhombomaculata* in the areas north and west of eastern Mississippi.

Lampropeltis triangulum elapsoides (Holbrook).—The Illinois references to this southern snake (Davis & Rice 1883*a*, 1883*b*; Jordan 1888; H. Garman 1892)

belong in the synonymy of *L. t. syspila*. *L. t. elapsoides* occurs no closer to Illinois than eastern Kentucky.

Coluber constrictor constrictor Linnaeus. —The evidence for deleting this subspecies is presented in the introductory remarks concerning subspecies of *Coluber constrictor* on page 196.

Elaphe guttata guttata (Linnaeus).—The corn snake was reported as occurring in "southern Illinois" or at Mount Carmel by Yarrow (1882*a*), Davis & Rice (1883*a*), Hay (1887*b*, 1892*a*), H. Garman (1892), Cope (1900), Myers (1926), Van Cleave (1928), Minton (1944), and Perkins (1949). All of these authors, however, merely presumed that the corn snake might occur in the state, or cited Yarrow (1882*a*) as authority for inclusion of Illinois in the range of the species. Schmidt & Necker (1935) deleted the species from the list of Chicago area reptiles. Of the generally accepted records of *E. g. guttata,* the nearest to Illinois is for specimens from Edmonson County, Kentucky. Although the existence of a population of this species in southeastern Illinois is possible, it is much more likely that early authors confused this snake with the superficially similar *Lampropeltis calligaster*.

Virginia striatula (Linnaeus).—The brown snake was credited to Illinois by Cope (1877), Davis & Rice (1883*a*, 1883*b*), H. Garman (1892), Van Cleave (1928), Cagle (1942*a*), and Ditmars (1945). Cagle (1941) noted that Illinois specimens were lacking, but he believed the species might occur in southwestern Illinois. Marlin Perkins of the Chicago Lincoln Park Zoo stated that he saw the species near Murphysboro, and his recollection was cited by Ditmars and Cagle. His visual record is highly questionable, however, inasmuch as *V. striatula* can be distinguished with certainty from *V. valeriae* only with the aid of a magnifying lens. Accordingly, it seems advisable to delete this species from the list of Illinois snakes.

Virginia valeriae valeriae (Baird & Girard).—Yarrow (1882*a*), Hay (1892*a*), and Cope (1900) undoubtedly misidentified specimens of *V. v. elegans* when they recorded the nominate subspecies in Illinois. *V. v. valeriae* does not occur west of southern Ohio, being replaced by the subspecies *elegans* in the Midwest.

Thamnophis elegans hammondi (Kennicott).—Wright & Wright (1952) mentioned that an old record for *"Tropidonotus hammondi"* in Illinois had been published. They listed this among the problematical records, and I have been unable to find the original paper on which the record is based. There can be no doubt that either *T. sirtalis* or *T. radix* was mistaken for *hammondi,* which is a coastal California subspecies.

Thamnophis elegans vagrans (Baird & Girard).—The Rocky Mountain garter snake was included in Illinois reports by Davis & Rice (1883*a*), H. Garman (1892), and Wright & Wright (1952). Undoubtedly, a specimen of *T. sirtalis* was misidentified as *T. e. vagrans*.

Thamnophis butleri (Cope).—Ditmars (1922) noted that Butler's garter snake occurred in eastern Illinois. Davis (1932), having examined the large series of *Thamnophis* in the Chicago museums, pointed out that there were no Illinois records of *butleri*. Necker (1938), Ditmars (1939), Cagle (1941), A. G. Smith (1951), and Wright & Wright (1952) nevertheless presumed that the species was to be found in northeastern Illinois. Conant (1950) pointed out *T. butleri* was unknown in Illinois, although colonies exist in Wisconsin and southern Michigan. In view of the hundreds of garter snakes available from the Chicago area and the absence of specimens of *T. butleri,* I believe the species should be dropped from the list of Illinois reptiles.

Thamnophis sauritus sauritus (Linnaeus).—The evidence for deleting this subspecies is presented in the discussion of geographic variation of *T. s. proximus* on page 226.

Thamnophis sirtalis parietalis (Say).—The evidence for deleting this subspecies is given under the discussion of geographic variation of *T. s. sirtalis* on pages 231–2.

Natrix rigida (Say).—Davis & Rice (1883*a*), Jordan (1888), and Wright & Wright (1952) mentioned Illinois in defining the range of this Gulf Coast water snake. It is almost certain that Davis & Rice misidentified a specimen of *N. grahami* or *N. septemvittata* and that, on their authority, other authors listed the species as occurring in the state.

Natrix sipedon fasciata (Linnaeus).—The inclusion of this name in the Illinois literature is probably due to the confusion in

the nomenclature of *N. sipedon* races rather than to misidentification of specimens. Hurter (1911), Löding (1922), and Haltom (1931) apparently applied the name *fasciata* to the race now known as *confluens*; Davis & Rice (1883*a*), H. Garman (1892), Gaige (1914), and Wright & Wright (1952) to the race now known as *pleuralis*. *N. s. fasciata*, as now understood, does not occur north of Louisiana in the Mississippi valley.

Micrurus fulvius subsp.—Ditmars (1939) and Cagle (1941) recorded the coral snake as occurring as far north as southern Illinois. Pope (1944*a*) excluded Illinois from the range of the species. Perkins (1949) noted that a dubious record of *M. f. fulvius* exists from southern Illinois. Although there are old records for the coral snake in Ohio and Indiana, Conant (1951) and Link (1951) have shown rather conclusively that these specimens were probably transported from more southern localities.

One specimen (SIU 440) labeled "Cairo" is in the collection of Southern Illinois University. This example, a female with a total length of 513 mm., has 15 scale rows, 209 ventrals, 40 caudals, 7 upper and lower labials per side, 11 black body bands, and 3 black tail rings. No other data accompany the specimen except "Cairo" on an outside label. Since the nearest unquestionable record for the species is in central Arkansas, I am inclined to believe that the specimen was probably collected farther south and subsequently placed in a bottle which happened to bear the label "Cairo."

Agkistrodon contortrix contortrix (Linnaeus).—The evidence for deleting this subspecies is presented in the discussion of geographic variation of *A. c. mokeson* on pages 266–7.

Sistrurus miliarius streckeri Gloyd.—A. E. Brown (1901) expressed the possibility that the pigmy rattlesnake might extend eastward to southwestern Illinois. Until the species is found in Illinois or at least adjacent localities in Missouri, it should not be included in the Illinois fauna.

Crotalus horridus atricaudatus Latreille.—The evidence for deleting this subspecies is presented in the discussion of geographic variation of *C. h. horridus* on page 271.

In addition to species credited to Illinois in the literature, I have seen specimens of such obvious waifs as the caiman and python.

Class AMPHIBIA

Salamanders and Frogs

Amphibians probably were derived from Crossopterygian fishes early in the Devonian Age. They share with the Crossopterygians a great many anatomical similarities; also, they possess numerous distinguishing characters, most of which are adaptations for a life on land rather than in the water. There are relatively few modern amphibians. The fossil record is sufficiently good to allow recognition of about 10 extinct orders in addition to the three living orders. Two subclasses of amphibians are recognized, the Lepospondyli and the Apsidospondyli. The subclass Lepospondyli contains two living orders, the Gymnophiona (caecilians of the tropics) and the Caudata (salamanders). The subclass Apsidospondyli contains one modern order, the Salientia (frogs and toads).

The relationships of the subclasses, orders, suborders, and families represented in Illinois may be summarized in the following synopsis.

Subclass LEPOSPONDYLI.—Vertebral centra formed directly from mesenchyme; arcualia partially ossified.
- Order CAUDATA.—Tail well developed; at least two limbs present.
  - Suborder CRYPTOBRANCHOIDEA.—Angulare free; gill slits present; external gills absent.
    - Family CRYPTOBRANCHIDAE.—Large; flattened; wrinkled; free, fleshy flanges on limbs.
  - Suborder AMBYSTOMATOIDEA.—Angulare and articulare fused; gill slits and external gills usually absent in adult stage.
    - Family AMBYSTOMATIDAE.—Lungs and costal grooves present.
  - Suborder SALAMANDROIDEA.—Parasphenoid teeth present; gills usually absent in adult stage.
    - Family SALAMANDRIDAE.—Costal grooves and nasolabial grooves absent; vomeropalatine teeth in long, posteriorly diverging series.
  - Suborder PLETHODONTOIDEA.—Lungs absent; vomerine and palatine teeth usually present.
    - Family PLETHODONTIDAE.—Costal grooves and nasolabial grooves present.

Family AMPHIUMIDAE. — Limbs much reduced; toes 3–3 or less.

Suborder MUTABILIA. — Angulare and prearticulare fused; no maxillary bone; pterygoid and palatine teeth in continuous series.

Family PROTEIDAE.—Large aquatic salamanders, each with 3 pairs of bushy, red gills; toes 4–4; no nasolabial grooves.

Suborder MEANTES.—External gills present; no hind limbs.

Family SIRENIDAE.—Teeth absent; toes 4–0; margins of jaws with horny sheaths.

Subclass APSIDOSPONDYLI.—Vertebral centra formed from subdivision of the sclerotome; arcualia cartilaginous.

Order SALIENTIA.—Tail typically absent in adult stage; pelvic girdle and enlarged hind limbs modified for jumping.

Suborder ANOMOCOELA.—Sacral vertebrae procoelous, fused to coccyx; eight presacral vertebrae uniformly procoelous or amphicoelous.

Family PELOBATIDAE.—Cutting tubercle on metatarsus; cranial crests absent.

Suborder PROCOELA.—Sacral and presacral vertebrae uniformly procoelous; free urostyle; sacral vertebrae with two condyles.

Family BUFONIDAE.—Teeth absent; Bidder's organ in both sexes.

Family HYLIDAE.—Teeth present; intercalary cartilages and toe pads present.

Suborder DIPLASIOCOELA.—Eight vertebrae; sacral vertebrae biconcave; presacral vertebrae procoelous.

Family RANIDAE.—Vomerine teeth present; no transverse fold of skin on head; tympanum usually distinct; mouth large.

Family MICROHYLIDAE.—Vomerine teeth absent; transverse fold of skin behind head; tympanum usually invisible; head narrow and mouth small.

For ease in identification, the Illinois species of Amphibia are diagnosed in two large keys, the salamanders (the order Caudata) in one and the frogs and toads (the order Salientia) in the other. Illinois representatives of these two orders may be separated as follows:

Tail absent in adult stage; hind legs conspicuously large and modified for jumping . . . . . Order Salientia, p. 66

Tail present in adult stage; hind legs not conspicuously large and modified for jumping . . . . . Order Caudata, p. 22

Order CAUDATA

Salamanders

Nineteen species and subspecies of salamanders occur in Illinois. Another species, *Amphiuma means* Garden, has been included in the key, as it may eventually be found in the southern part of the state.

Most salamanders are terrestrial as adults, fig. 9, and aquatic as larvae, but even the adults are chained to moist habitats by their susceptibility to desiccation. A few salamanders remain in water throughout their lives; these are permanently gilled species, which are termed neotenous. The species occurring in Illinois range in size from the 4-inch *Hemidactylium* to the 24-inch *Cryptobranchus.* Most species are nocturnal; they remain hidden under logs or rocks during the day and come forth to search for food at night, when the relative humidity is higher. Salamanders are predatory, feeding chiefly on those invertebrates most readily available. They are rather sluggish in their movements and harmless to man. Their defense when captured consists of secreting slime. Some salamanders, like lizards, readily lose their tails, which they use as means of escape. While a predator is occupied by a detached, wriggling tail, the animal to which the tail belonged may escape by crawling away. A few salamanders can climb; some can jump by violently uncoiling their bodies.

Typically, the seasonal life history of salamanders begins with a spring migration to a pond, the males usually preceding the females by a day or so. When the females arrive, a nuptial dance ensues, the males swimming over the females and nudging them from time to time. Males deposit sperm packets known as spermatophores on submerged sticks or vegetation, and the females receive these packets with their cloacal lips, fertilization thus being internal. The females attach their eggs, each surrounded

by concentric layers of jelly, to vegetation or debris in the water. In a few days to several weeks, gilled larvae hatch from the eggs and each larva rather quickly develops four legs. Typically, metamorphosis occurs in a few months. The newly transformed adults are difficult to identify for a few days before the characteristic features of mature adults appear.

There are several departures from this typical life cycle. At least one species practices external fertilization, the male depositing sperm over the newly laid eggs in the manner of most fishes. Some species differ in having a fall mating and fall oviposition. It is not certain that in all species the female picks up the entire spermatophore, and it is probable that in some species sperm cells escape from the packet and swim into the vent of the female salamander. In a few species the eggs are laid near a stream or pond, and the hatchlings must crawl to water or wait until the hatching site is flooded by rains. The most striking deviation from the typical life cycle is found in the genus *Plethodon*. In all species of this genus, the larval period is spent within the large eggs, which are deposited in rock crevices or rotten logs on land. At hatching the miniature salamanders are ready for a terrestrial existence. Other variations in life histories are noted in the habits sections of the following species accounts.

Eight of the 19 Illinois salamanders are predominantly eastern in distribution, occurring in Illinois in the Wabash Border counties and in some cases extending varying distances northward or southward in the Mississippi River valley but circumventing the central prairie. One of the eastern species, *Desmognathus fuscus,* has apparently entered Illinois via the Mississippi River valley, since the nearest record outside Illinois is in western Kentucky rather than Indiana. The eight eastern components are *Cryptobranchus alleganiensis, Ambystoma maculatum, A. opacum, Eurycea bislineata rivicola, E. longicauda longicauda, Plethodon dorsalis, P. glutinosus glutinosus,* and *Desmognathus fuscus.*

Three species, *Ambystoma texanum, A. tigrinum,* and *Eurycea longicauda melanopleura,* have ranges centering to the west of Illinois. The first two species are relatively wide ranging and they completely traverse Illinois. The third is an Ozark species found only in the extreme western part of the state.

Three species, *Ambystoma talpoideum, Notophthalmus viridescens louisianensis,* and *Siren intermedia nettingi,* are clearly southern animals. The first species extends northward along the Mississippi River to the southern tip of the state; *Siren* extends northward along the major rivers in the southern two-thirds of Illinois; *Notophthalmus* occurs as far north as the northern boundary of the state.

Three species, *Ambystoma laterale, Plethodon cinereus cinereus,* and *Hemidactylium scutatum,* northern in distribution, extend southward into Illinois.

Two species cannot be classified according to distribution. *Necturus maculosus maculosus* has a range in which Illinois is approximately centered. *Eurycea lucifuga* is unassignable because of the peculiar restriction of this species to areas containing limestone caves.

Key to the Order Caudata
(Salamanders)

1. One pair of legs (Sirenidae) ..... *Siren intermedia nettingi*
   Two pairs of legs 2
2. Legs vestigial; 3 or fewer toes; body eel-like (Amphiumidae) ..... *Amphiuma means tridactylum*
   Legs well developed; 4 or more toes; body not eel-like 3
3. Four toes on each hind foot 4
   Five toes on each hind foot 5
4. Feathery external gills; total length to 18 inches (Proteidae) ..... *Necturus maculosus maculosus*
   No external gills; total length less than 4 inches (Plethodontidae) ..... *Hemidactylium scutatum*
5. Body flattened and longitudinally wrinkled; one gill slit on each side of neck; toes with free fleshy margins, fig. 10 (Cryptobranchidae) ..... *Cryptobranchus alleganiensis alleganiensis*
   Body terete, not wrinkled; no gill slits; toes without fleshy flanges 6
6. Costal grooves present, fig. 9 7
   Costal grooves absent (Salamandridae) .. *Notophthalmus viridescens louisianensis*
7. Nasolabial grooves absent, fig. 11 (Ambystomatidae) 8
   Nasolabial grooves present, fig. 12 (Plethodontidae) 16
8. Premaxillary teeth in two or more series; neck distinctly wider than head; lingual plicae at oblique angles to median longitudinal furrow, fig. 13 ..... *Ambystoma texanum*

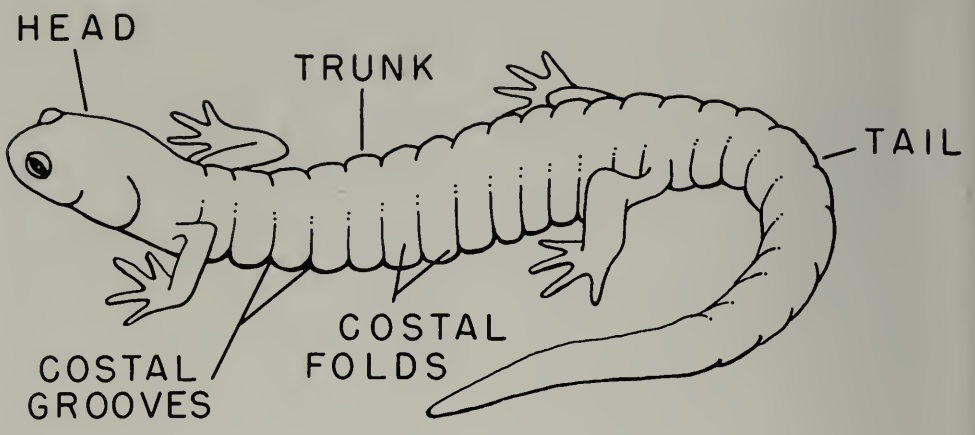


Fig. 9.—Lateral view of a salamander, *Ambystoma texanum.*

Premaxillary teeth in a single series; head wider than neck; lingual plicae radiate, fig. 14 9

9. Pattern consisting of 4 to 8 silvery white crossbands on dorsum . . . . . *Ambystoma opacum*
Pattern not consisting of white crossbands 10

10. Body long and slender; toes of adpressed limbs barely overlapping . . . . . *Ambystoma laterale*
Body stout; toes of adpressed limbs overlapping by length of longest finger or more 11

11. Groundcolor black or brown, with yellow spots 12
Groundcolor black or brown, without yellow spots 13

12. Two dorsolateral rows of subequal yellow spots; venter and lower sides brown and unspotted *Ambystoma maculatum*
Irregularly spaced and unequal yellow spots on back and sides and often on venter . . . *Ambystoma tigrinum tigrinum*

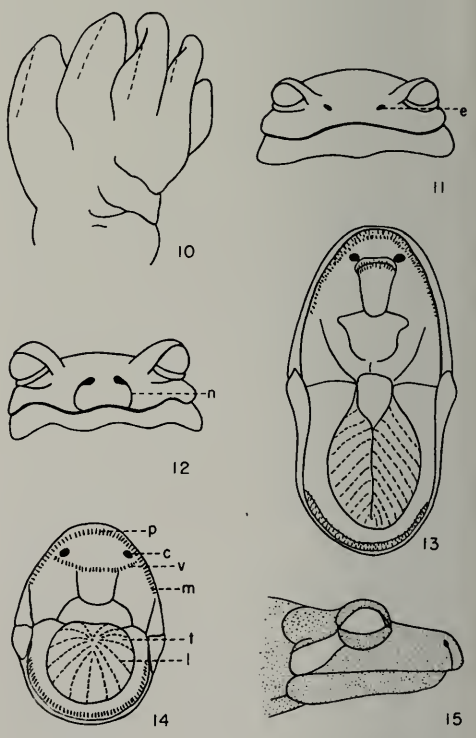
13. Head width 23 per cent or more of snout-vent length *Ambystoma talpoideum*
Head width less than 23 per cent of snout-vent length 14

14. Snout-vent length over 50 mm.; back dark or with brassy flecks . . . . . Immature *Ambystoma tigrinum tigrinum*
Snout-vent length under 50 mm.; back dark and with or without flecks . 15

15. Dorsum brown, often with brassy flecks; venter yellow or white . . . . . Immature *Ambystoma maculatum*
Dorsum black or brown, often with irregular white blotches; venter brown Immature *Ambystoma opacum*

16. Light line from eye to angle of jaw, fig. 15; tail triangular in cross section . . . . *Desmognathus fuscus conanti*
No light line from eye to angle of jaw; tail not triangular in cross section 17

17. Tongue with a central pedicel, free all



Figs. 10–15.—Characteristics of salamanders: 10, hind foot of *Cryptobranchus alleganiensis;* 11, face view of *Ambystoma opacum;* 12, face view of *Plethodon glutinosus;* 13, open-mouth view of *Ambystoma texanum;* 14, open-mouth view of *Ambystoma opacum;* 15, head of *Desmognathus fuscus; c,* choana; *e,* external naris; *l,* lingual plica; *m,* maxillary teeth; *n,* nasolabial groove; *p,* premaxillary teeth; *t,* tongue; *v,* vomerine teeth. A dissecting microscope is necessary to see most of these structures.

around; groundcolor of dorsum yellow, orange, or red; venter yellow or white 18
Tongue attached in front, free behind and at sides; groundcolor of dorsum black, brown, or dark gray; venter gray, brown, or black 21
18. Three or more costal folds between adpressed limbs; yellow, with brown dorsolateral stripes . . . . . *Eurycea bislineata rivicola*
Two or fewer costal folds between adpressed limbs 19
19. Body red or red-orange, with numerous irregular black spots or dashes scattered over back and sides *Eurycea lucifuga*
Body yellow or orange-yellow, with distinct dorsolateral stripes . . 20
20. Sides of tail with many vertical dark bars *Eurycea longicauda longicauda*
Sides of tail dark and without vertical bars *Eurycea longicauda melanopleura*
21. Costal grooves 15 or fewer; belly uniform gray or black; back flecked with white; maximum length 180 mm. . . . . *Plethodon glutinosus glutinosus*
Costal grooves 16 or more; belly usually mottled; back not spotted with white; maximum length 110 mm. 22
22. Middorsal red, orange, or yellow longitudinal stripe 23
No middorsal red, orange, or yellow stripe 25
23. Middorsal stripe zigzag in shape . . *Plethodon dorsalis*
Middorsal stripe with straight edges 24
24. Costal grooves 16–19, usually 17; tail usually less than snout-vent length; middorsal stripe usually widest on base of tail *Plethodon dorsalis*
Costal grooves 17–20, usually 19; tail usually longer than snout-vent length; middorsal stripe widest at mid-body *Plethodon cinereus cinereus*
25. Fore legs and breast region with red suffusion; costal grooves usually 17 or 18; tail usually less than snout-vent length *Plethodon dorsalis*
Fore legs and breast region without red markings; costal grooves usually 18 or 19; tail usually longer than snout-vent length *Plethodon cinereus cinereus*

CRYPTOBRANCHIDAE

This family contains two genera of large, permanently aquatic salamanders, one of which occurs in the Orient and the other in the eastern United States.

Cryptobranchus Leuckart

Two subspecies are currently recognized in this monotypic genus. The nominate race, which occurs in extreme eastern Illinois, is widespread in eastern North America; the other race is confined to Ozarkian streams of southeastern Missouri and adjacent Arkansas.

Cryptobranchus alleganiensis alleganiensis (Daudin)
Hellbender

Salamandra alleganiensis Daudin 1803:231 (type locality: Allegheny Mountains in Virginia).
Cryptobranchus alleganensis, Goodnight 1937: 301.
Menopoma alleghenience, Davis & Rice 1883*a*: 26.
Menopoma alleghaniensis, Brendel 1857:254.
Cryptobranchus alleghaniensis, H. Garman 1892:380–1.

Diagnosis.—A large aquatic salamander (largest Illinois specimen 440 mm. in total length), fig. 16, with a flattened, much wrinkled body; 5 toes on each hind foot; loose folds of skin along sides of body and posterior margins of legs; 1 gill slit on each side of throat; dark dorsum and slightly less dark venter; without external gills.

Variation.—Bishop (1941) found that males of this species were proportionately broader bodied and heavier than females. During the breeding season, the male can be recognized by the swollen ridge surrounding the vent.

Bishop (1941) believed that transformation occurs in the second year. The newly transformed hellbenders differ from large adults by their more prominent black spots.

Four Illinois specimens are extant. One of these, CAS 294, is obviously very old and is accompanied only by the label "southern Illinois." It is a female, 225 mm. in snout-vent length; although faded, it still has scattered inky flecks on the dorsum and sides of the tail. Three recent specimens, reported by Stein & Smith (1959), range from 267 to 285 mm. in snout-vent length, 418 to 440 mm. in total length; internarial distances are 2.0, 2.2, and 3.5 times the spiracular diameters. Two of the three are bluish slate in color; one is dirty brown; two are uniformly colored except for very faint mottling; one is minutely flecked with olive. One (from the Ohio River at Cave in Rock) has rather heavy pigmentation on the lower jaw and a spiracle diameter of only 4.5 mm. and thus approaches the Ozarkian race, *Cryptobranchus alleganiensis bishopi*. The others are in every way typical of the nominate subspecies; in dor-

sal pattern, one of the most reliable subspecific characters, all four Illinois specimens are assignable to *C. a. alleganiensis*.

Habits.—The hellbender is permanently aquatic, occurring in fast-running water of rivers and large creeks. Although essentially nocturnal, in the spring many of these salamanders are caught on baited hooks during the day. According to Bishop (1941), the lungs of the hellbender are well developed, and captive individuals rise to the surface at intervals to gulp air.

Hellbenders are ugly in appearance and unpleasant to handle because of their extreme sliminess. In food habits they are predatory, eating crustaceans, fishes, mollusks, insects, and even their own eggs and young.

Bishop (1941), who summarized the life history of *C. a. alleganiensis*, noted that in the eastern United States breeding aggregations are found in August. Fertilization is external. Approximately 300 to 400 eggs, each of which is about 6 mm. in diameter and surrounded by concentric rings of jelly, are laid in multiple strands, which become twisted into a single rosary-like string. Egg masses deposited by several females may be found under one flat rock. The nest site may be attended by a male who aerates the eggs by his movements. Eggs laid in mid-September hatch in mid-November. During the 2-year larval period, the young hellbenders, which are gilled, gradually acquire the characteristics of the adults.

Fig. 16.—An adult *Cryptobranchus alleganiensis alleganiensis* from Harrison County, Indiana. (Photo by Isabelle Hunt Conant.) The groundcolor is slate gray; the scattered irregular blotches are black.

Illinois Distribution.—Although *C. a. alleganiensis* was long presumed by many authors to occur in Illinois waters, actual specimens with locality data were not available until recently. Prior to 1900, the several references to the species apparently were based on hearsay records of fishermen and on the likelihood that the species occurred in the Ohio River down to the mouth of the Wabash River. Blatchley (1899) mentioned a Vigo County, Indiana, specimen presumably taken in the Wabash River.

Stein & Smith (1959) summarized and evaluated all of the reports for Illinois. Unquestionable recent records for the Ohio and lower Wabash rivers bordering Illinois indicate that the species occurs in the south-

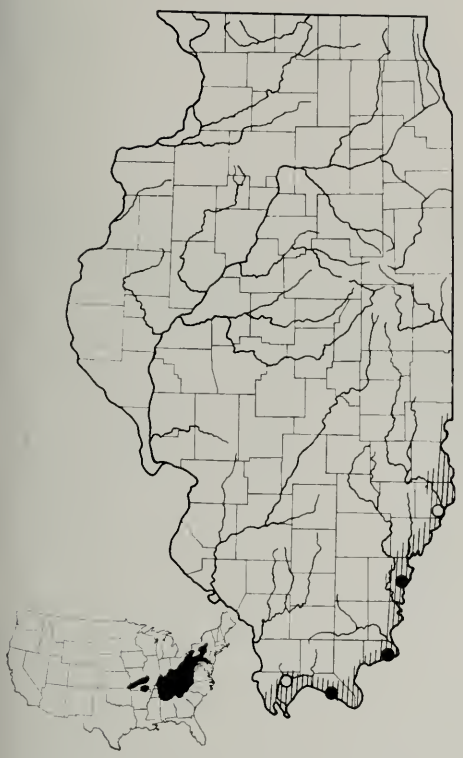


Fig. 17.—Distribution of *Cryptobranchus alleganiensis alleganiensis*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States. The Blatchley record referred to on page 26 is not plotted.

eastern part of this state and may ascend short distances up the major tributaries of the Ohio and Wabash rivers, fig. 17.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: Lawrence County: Lawrenceville, Wabash River at Vincennes [Indiana] (Stein & Smith 1959); Pulaski County: near Ullin (Stein & Smith 1959).

AMBYSTOMATIDAE

The family includes three genera in the United States and Canada, two of which are confined to the Pacific Northwest and one of which is transcontinental.

Ambystoma Tschudi

This North American genus contains 12 species known in the United States and Canada; several of these species consist of two or more subspecies. Six species and subspecies occur in Illinois.

Ambystoma laterale Hallowell
Blue-Spotted Salamander

Amblystoma laterale Hallowell 1858:352 (type locality: borders of Lake Superior near Marquette, Michigan).
Amblystoma jeffersonianum laterale, Davis & Rice 1883*a*:26.
Ambystoma laterale, Minton 1954:178.
Amblystoma jeffersonianum nec Green, Davis & Rice 1883*a*:26.
?Amblystoma jeffersonianum jeffersonianum nec Green, Jordan 1888:178.
Ambystoma jeffersonianum nec Green, Hay 1892*a*:431.
Amblystoma jeffersonianum fuscum, H. Garman 1892:372–3.
?Plethodon glutinosus nec Green, Shelford 1913:181, 183.

Diagnosis.—A medium-sized, slender, dark brown, black, or blue-black salamander (largest Illinois specimen 124 mm. in total length), fig. 18, with discrete pale blue or bluish white flecks on venter, sides, and sometimes on the dorsum; usually 12 or 13 costal grooves, counting impressed lines in groin and axilla; toes of adpressed limbs separated or overlapping by no more than 1 costal fold; head of moderate size, distinctly wider than neck.

Variation.—Males of this species possess greatly swollen vents during the breeding season. At other times the sexes are difficult to distinguish. Minton (1954) noted that toes of adpressed limbs touch or overlap more frequently in males than in females.

The toes of the adpressed limbs touch or overlap by as much as 1 costal fold in specimens under 40 mm. in snout-vent length; toe tips vary from an overlap of one-half costal fold to a separation of as much as 3 folds in specimens over 40 mm. Juveniles are relatively larger headed than adults.

None of our specimens can be assigned to the related *Ambystoma jeffersonianum*. Inclusive of the impressed lines in the axilla and the groin, there are 12–12 costal grooves in four specimens, 13–13 in eight specimens, and 14–14 in one specimen. Vomerine teeth

are usually in 4 series, but sometimes the median pair is fused. Vomerine tooth counts for four specimens range from 27 to 39, averaging 32. Maxillary and premaxillary tooth counts for five specimens range from

Stille (1954*b*) found that in the Chicago region the eggs of this species are laid singly or in small clumps attached to litter on the bottoms of the shallow forest ponds. Egg laying occurs in late March and early April.

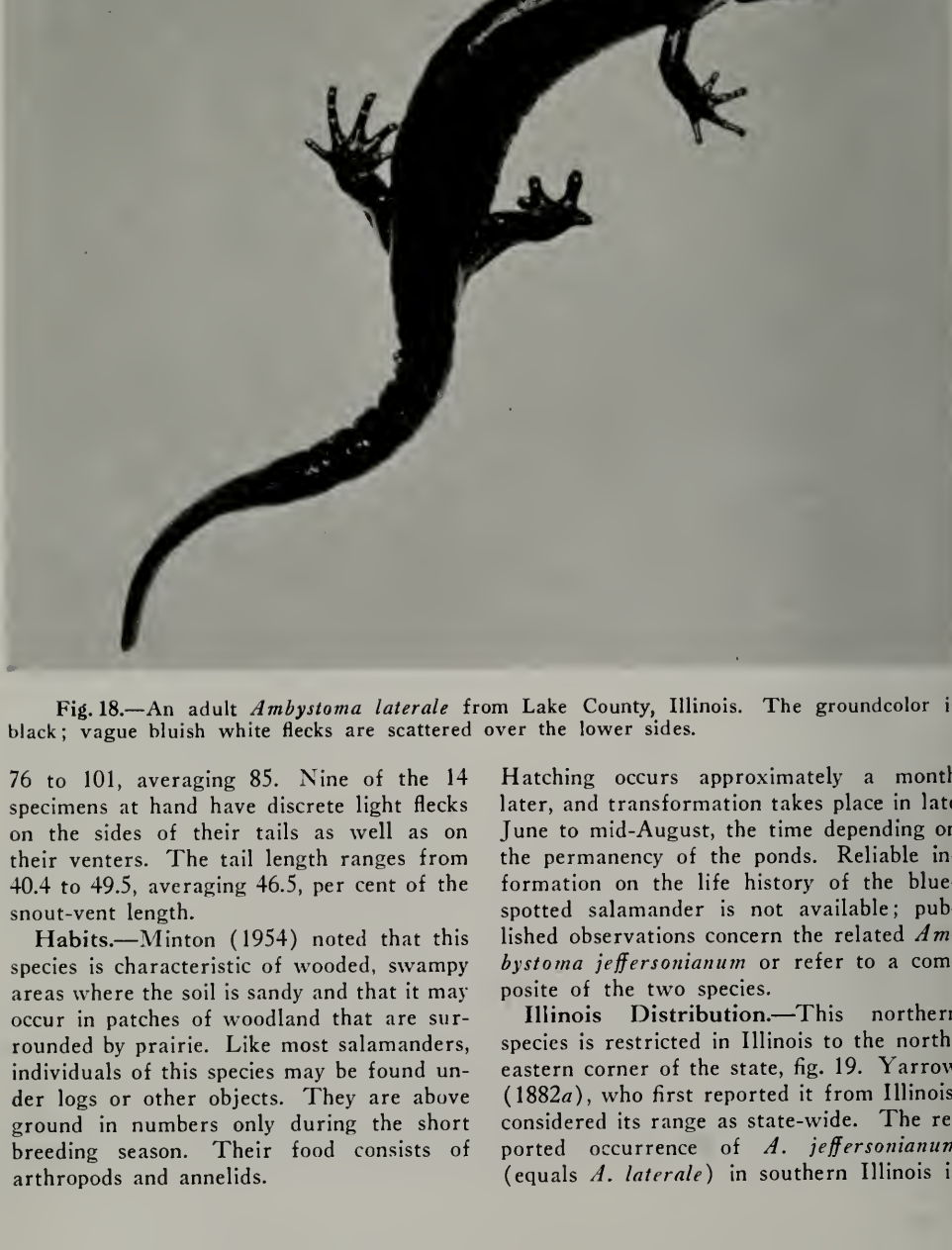


Fig. 18.—An adult *Ambystoma laterale* from Lake County, Illinois. The groundcolor is black; vague bluish white flecks are scattered over the lower sides.

76 to 101, averaging 85. Nine of the 14 specimens at hand have discrete light flecks on the sides of their tails as well as on their venters. The tail length ranges from 40.4 to 49.5, averaging 46.5, per cent of the snout-vent length.

Habits.—Minton (1954) noted that this species is characteristic of wooded, swampy areas where the soil is sandy and that it may occur in patches of woodland that are surrounded by prairie. Like most salamanders, individuals of this species may be found under logs or other objects. They are above ground in numbers only during the short breeding season. Their food consists of arthropods and annelids.

Hatching occurs approximately a month later, and transformation takes place in late June to mid-August, the time depending on the permanency of the ponds. Reliable information on the life history of the blue-spotted salamander is not available; published observations concern the related *Ambystoma jeffersonianum* or refer to a composite of the two species.

Illinois Distribution.—This northern species is restricted in Illinois to the northeastern corner of the state, fig. 19. Yarrow (1882*a*), who first reported it from Illinois, considered its range as state-wide. The reported occurrence of *A. jeffersonianum* (equals *A. laterale*) in southern Illinois is

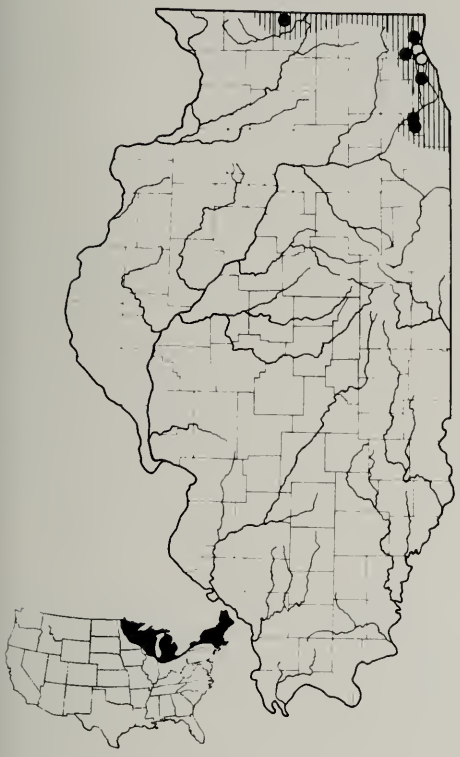


Fig. 19.—Distribution of *Ambystoma laterale*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

in error and actually is based on specimens of the superficially similar *A. texanum*. The occurrence of the species in the southern half of the state was not challenged by many subsequent authors, probably because of 48 USNM specimens from southern Illinois localities cataloged as *A. jeffersonianum*. I have examined these specimens (4096 [38] "S. Ill."; 8837, 12050 [3], 12056 [2], 12058-60 Mount Carmel; 8777 Belleville) and have found them to be *A. texanum*.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map, fig. 19, by hollow symbols: LAKE COUNTY: Beach, Highland Park (Schmidt & Necker 1935).

Ambystoma maculatum (Shaw)
Spotted Salamander

Lacerta maculata Shaw 1802:304 (type locality: Carolina, revised to vicinity of Charleston, S. C., by Schmidt 1953).
Ambystoma maculatum, Schmidt 1930:10–1.
Ambystoma punctata, Kennicott 1855:593.
Amblystoma punctatum, Cope 1868:177.
Ambystoma punctatum, O'Donnell 1937:1066–7.

Diagnosis.—A large, stout, blue-black, slate-colored, or brownish black salamander (largest Illinois specimen 190 mm. in total length), fig. 20, with 2 rows of yellow-white or orange-yellow, usually rounded, spots extending from the head well onto the tail; sides and venter slate color to

Fig. 20.—A subadult *Ambystoma maculatum* from Alexander County, Illinois. The groundcolor is dark brown or black; discrete yellow spots tend to be arranged in two rows down the back.

Table 2.—Ontogenetic variation in Illinois *Ambystoma maculatum*, as illustrated by a series from Alexander County. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	JUVENILE (8)		ADULT (11)	
	Range	Mean	Range	Mean
Snout-vent length (mm.)	35.2–45.0	.....	59.0–79.0	.....
Snout-vent length as percentage of total length	51.0–60.0	55.0	48.3–52.4	50.0
Number of vomerine teeth	24–42	33.2	43–59	52.0
Number of premaxillary-maxillary teeth	91–117	102.5	108–140	129.0
Position of toe tips with legs adpressed	+ 2 – + 5	.....	– 1 – + 2	.....

Table 3.—Geographic variation in adult Illinois *Ambystoma maculatum*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	SOUTHERN ILLINOIS (15)		EAST-CENTRAL ILLINOIS (4)		NORTHEASTERN ILLINOIS (10)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	59–80	.....	67–80	.....	74–101	.....
Total length (mm.)	112–167	.....	154–170	.....	165–190	.....
Vomerine teeth	38–59	51.0	35–64	47.5	39–70	55.5
Premaxillary-maxillary teeth	108–140	129.0	122–140	128.3	127–161	136.5
Body spots	9–17	13.0	11–15	12.7	14–16	15.7
Costal grooves	11–13	11.8	11–12	11.2	12–13	12.4

brown without irregular yellow spots or blotches; usually 12 costal grooves, sometimes 11 or 13; 1 or no palmar tubercles.

Variation.—During the breeding season the male of *Ambystoma maculatum* has a greatly swollen vent and darker colored venter. At other seasons, according to Bishop (1941), the female may be recognized by a wider, more convex head, greater distance between the fore and hind legs; and a shorter tail.

Juveniles have smaller dorsal spots than adults. In specimens less than 40 mm. from snout to vent, the spots are less regularly arranged, less prominent, and no greater in size than the eyes. Specimens 45 mm. in snout-vent length and larger have conspicuous yellow spots against a dark groundcolor, and the individual spots are larger than the eyes. The chins and venters are yellowish white in juveniles, becoming dark brown or slate color in adults. Also, juveniles differ from adults in having proportionately longer legs, shorter tails, and smaller numbers of teeth. This variation is summarized in table 2.

Although meager, the series available for study indicate some geographic variation within the state. Ten adults from northeastern Illinois (Lake County) average considerably larger in size, possess more teeth and a higher number of body spots, and have a slightly higher average costal groove count than specimens from elsewhere in the state. An occasional specimen has a pair of bright orange spots on the head that are in sharp contrast to the yellow body spots. Salamanders from other parts of the state sometimes have orange spots on their heads, but the color difference is less conspicuous than in the northeastern specimens.

The large number of vomerine and premaxillary-maxillary teeth may be directly correlated with the large size of the northern salamanders. The other slight differences suggest that two subspecies may be discerned eventually in *A. maculatum*. Intrastate variation in the species is summarized in table 3.

Habits.—According to Pope (1944*b*), *A. maculatum* is common in deciduous and mixed woods in northeastern Illinois. Cagle (1942*a*) reported that it is abundant in low oak-hickory forests adjacent to swamps and creeks in southern Illinois. The species can be found in numbers throughout the

summer under logs in the swampy floodplain forest at Horseshoe Lake in Alexander County, where the numerous shallow woodland ponds seemingly afford ideal breeding sites. The spotted salamander remains hidden under logs or rocks during the day but may be found wandering about on the forest floor at night. It feeds on arthropods, mollusks, and annelids.

Early in the spring spotted salamanders migrate to a woodland pond to congregate and breed. The aggregation performs a sort of nuptial dance, after which the males deposit spermatophores on sticks and other litter, and the females lay eggs in clusters, usually of several dozen, on debris and vegetation in the pond. The eggs hatch in less than a month, and the larvae transform between late June and mid-August.

Illinois Distribution.—The spotted salamander is found in wooded regions in northern, eastern, and southern Illinois, fig. 21. Like that of many other eastern forest animals, the range of the species in Illinois is bisected by the Grand Prairie, and populations extend short distances northward from the south and southward from the north in the forested Mississippi River valley in western Illinois, but apparently they do not meet. In eastern Illinois the distribution is sporadic; permanent woodland ponds are necessary for the occurrence of *A. maculatum*. A record (UIMNH 1745) from Urbana, which is in a prairie region, is open to some doubt.

The general occurrence of this salamander from the Gulf Coast to well into Canada indicates that temperature is less important as a controlling factor than the presence of mesic forest. Although the forested areas in central Illinois appear to afford suitable habitat, they tend to become dry in late summer; there is no evidence that the species occupies these regions. The published record for Macoupin County (Owens 1941) is a misidentification based on two CNHM specimens that are actually *A. tigrinum*.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Palos Park (Schmidt & Necker 1935); Northfield (Cope 1868); DU PAGE COUNTY: Wooddale (Stille & Edgren 1948); UNION COUNTY: Anna (Cagle 1942*a*); Union County State Forest (Minton & Minton 1948); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*).

Fig. 21.—Distribution of *Ambystoma maculatum*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Ambystoma opacum (Gravenhorst) Marbled Salamander

Salamandra opaca Gravenhorst 1807:431 (type locality: New York).
Amblystoma opacum, Cope 1868:175.
Ambystoma opacum, Hurter 1911:78.

Diagnosis.—A medium-sized, stout, black salamander (largest Illinois specimen 121 mm. in total length), fig. 22, with 3 to 8 silvery to grayish white crossbands on the back and 4 to 8 white rings around the tail; dorsal crossbands widened laterally, usually forming a pair of dorsolateral light stripes; head wide; toes of adpressed limbs touching to broadly overlapping.

Fig. 22.—An adult *Ambystoma opacum* from Union County, Illinois. The groundcolor is black; the crossbands are white.

Variation.—Males of this species can be distinguished from females by the silvery white crossbands which contrast more sharply against the blue-black groundcolor than do the grayish white bands of the females. In preserved specimens the prominently swollen vent of the male, which is larger than that of the female at all seasons, offers the simplest method of determining the sex.

Subadults less than 30 mm. from snout to vent are usually quite unlike adults in pattern. The chins and venters are light brownish to light slate color, and the dorsal patterns consist of occasional, poorly defined, light blotches on the black groundcolor and often white "frosting" on the heads and anterior parts of the bodies. The adpressed limbs of this size group overlap by 2 or 3 costal folds. Specimens 30 to 35 mm. in snout-vent length have essentially the patterns of the adults except that the white crossbands anteriorly are less well defined; the venters are blue-black, and the brown or gray chins show evidence of darkening. Specimens 40 to 47 mm. in snout-vent length are proportionately shorter-legged, the adpressed limbs overlapping 1½ to 1 costal fold. Individuals 48 mm. and larger in snout-vent length vary in the degree of overlap of adpressed limbs from 1 costal fold to barely touching. The number of teeth appears to vary with size of the individual.

No definite trends in geographic variation within Illinois have been discerned in this species. Individual variation for a sample of 41 specimens from southern and eastern Illinois is as follows: snout-vent length 32 to 59 mm.; total length 57 to 121 mm.; number of costal grooves 11 to 13 (average 12.1); toes of adpressed limbs varying from barely touching to overlapping by 3½ costal folds; number of head and body bands 3 to 8 (average 5.8); number of tail rings 4 to 8 (average 6.2); number of vomerine teeth 29 to 63 (average 48.0); number of premaxillary-maxillary teeth 79 to 147 (average 110.0).

Habits.—*Ambystoma opacum* is a woodland animal, more tolerant of aridity than *A. maculatum* but apparently less tolerant of low temperatures. Since fall and winter rains insure floodplain pools that last long enough for the transformation of the *opacum* larvae, a suitable breeding site is probably less important as a limiting factor for this species than for *maculatum*.

The marbled salamander is usually found in wooded hilly regions and can be collected under rocks and logs throughout the summer, sometimes in surprisingly dry situations. In September individual salamanders migrate onto floodplains or into swamps and may be found, often in abundance, under logs or sticks, in heavily shaded areas subject to flooding with the autumnal rains. At Horseshoe Lake, Alexander County, however, the species is extremely abundant throughout the summer, and it appears at least as successful there, in the floodplain swamps, as in upland areas.

The food of the marbled salamander consists of arthropods, annelids, and mollusks.

The courtship of this species is similar to that of the spotted salamander, except that it takes place in the fall rather than in the spring and on land rather than in the water. The males deposit spermatophores in damp places, and the females pick them up with their cloacal lips; then each female

deposits approximately 100 eggs in a protected depression. Incubation depends on the length of time before the eggs are inundated, and the hatching time is accordingly variable. Normally, metamorphosis occurs the following June or July.

Fig. 23.—Distribution of *Ambystoma opacum*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Illinois Distribution.—*A. opacum* occurs throughout the southern third of Illinois, north along the Indiana-Illinois border probably to Iroquois County, fig. 23, but it appears to be abundant only in the southern fourth of the state.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: RANDOLPH COUNTY: (Hurter 1911); UNION COUNTY: Cobden (H. Garman 1892); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*).

Ambystoma talpoideum (Holbrook)
Mole Salamander

Salamandra talpoidea Holbrook 1838:117, pl. 39 (type locality: sea islands on the border of South Carolina).
Amblystoma talpoideum, Cope 1868:173.
Ambystoma talpoideum, Hay 1892*a*:582.

Diagnosis.—A medium-sized, extremely stout, broad-headed salamander (largest Illinois specimen 114 mm. in total length), fig. 24, blue-black or brownish black and usually unmarked above except for a suggestion of a longitudinal light stripe on the basal third of the tail; usually 11 costal grooves, counting the impressed line above the hind limbs; head width 22 to 32 per cent of the snout-vent length; snout-vent length 52 to 58 per cent of total length; toes overlapping when legs are adpressed; midventral dark stripe usually conspicuous.

Table 4.—Ontogenetic variation in Illinois *Ambystoma talpoideum*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	SNOUT-VENT LENGTH (MM.)					
	33–40 (5)		41–50 (4)		50–61 (7)	
	Range	Mean	Range	Mean	Range	Mean
Total length (mm.)	58–72	.....	78–89	.....	91–114	.....
Costal folds overlapped by adpressed limbs	4–6	5.1	2.5–4.0	3.3	0.5–2.5	1.6
Vomerine teeth	36–40	38.5	40–49	43.2	39–65	52.5
Premaxillary-maxillary teeth	82–101	91.4	101–115	107.3	102–124	115.0
Head width as percentage of snout-vent length	26.4–32.1	28.2	26.1–28.8	27.2	22.4–25.5	24.5

Variation.—During the breeding season *Ambystoma talpoideum* males may be distinguished from females by their swollen vents. I have not been able to find external characters for sexing specimens taken at other seasons.

Young individuals are proportionately longer-legged, are wider-headed, are more bluish in color, are more often flecked with gray, and have fewer teeth than adults. These trends are summarized in table 4.

Bishop (1941) recorded the maximum length for this species as 97 mm. Four of the 16 Horseshoe Lake, Alexander County, specimens exceed that length, and INHS 5267 is 17 mm. longer than Bishop's largest specimen. Costal groove counts are 11–11 in 14 specimens and 10–10 in two specimens. Variation in dentition and body proportions is shown in table 4. The usual color is blue-gray, but occasionally large specimens are gray-brown. The midventral dark longitudinal stripe may be margined on either side by a light area and a secondary dark lateroventral stripe. In most living specimens the dorsal portion of the base of the tail is lighter than the rest of the body.

Comparative material from South Carolina and Louisiana, lent through the courtesy of the late E. B. Chamberlain and of F. R. Cagle, agrees rather closely in most details with Illinois samples. Larvae and adults in the series from South Carolina have a somewhat more prominent ventral pattern, and two of the three Louisiana specimens are at variance with both the Illinois and the South Carolina series in the presence of numerous minute tubercles on the sides of the tails, a condition suggestive of sexual dimorphism.

Habits.—The mole salamander is apparently similar to the marbled salamander in

Fig. 24.—Adult *Ambystoma talpoideum* from Alexander County, Illinois. The groundcolor is dark brown or bluish black; the flecks and often the dorsal crest of the tail are gray.

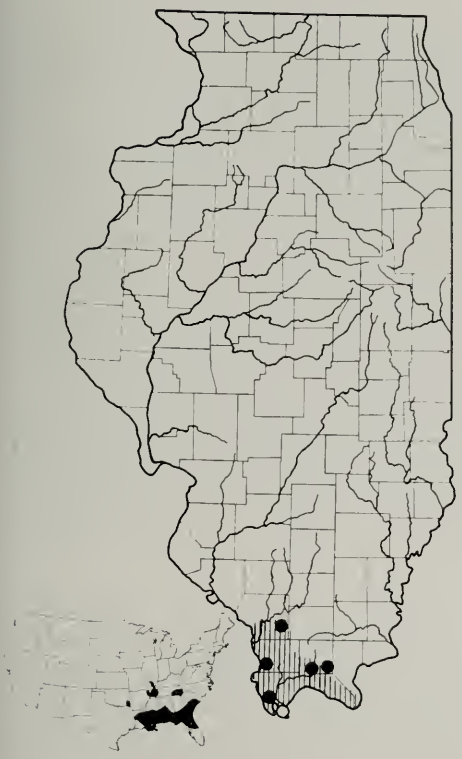


Fig. 25.—Distribution of *Ambystoma talpoideum*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species as currently known.

habits, as the two species have been found together within or under rotten logs in cypress swamps. Although as many as five specimens of *A. talpoideum* have been collected in one day at Horseshoe Lake, Alexander County, this species is decidedly less common than *A. texanum, opacum,* or *maculatum*. *A. talpoideum* presumably feeds upon worms, mollusks, and arthropods.

Life-history data for this species in Illinois consist of one observation of a breeding aggregation on November 8. Mosimann & Uzzell (1952) report that in South Carolina oviposition occurs in late December and that the 10 to 41 eggs are in compact masses attached to small sticks and grass stems in shallow ponds. The larval stage is of approximately 3 to 4 months duration.

Illinois Distribution.—*A. talpoideum,* an uncommon species, is known at present in Illinois only from Alexander, Jackson, Johnson, and Union counties, fig. 25. I have examined the specimens reported by Cagle (1942*a*) from near Anna and 6 miles southwest of Jonesboro (CAS 2512 and 2002) and have found them to be *A. texanum.*

The range of *A. talpoideum* is yet to be delineated in the Mississippi River valley.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: ALEXANDER COUNTY: Cairo (Cope 1868).

Ambystoma texanum (Matthes)
Small-Mouthed Salamander

Salamandra texana Matthes 1855:266 (type locality: woods near Colorado River and Cummings Creek bottom, Fayette County, Texas; revised to Rio Colorado bottomland by Schmidt 1953).
Ambystoma texanum, Stejneger & Barbour 1933:7.
Amblystoma microstomum, Cope 1868:207.
Ambystoma microstomum, Hurter 1911:73.
Chondrotus microstomus, Cope 1889:101–3.
Ambystoma jeffersonianum nec Green, Hay 1892*a*:431 (part).
Amblystoma jeffersonianum jeffersonianum nec Green, Yarrow 1882*a*:50.
Amblystoma jeffersonianum platineum nec Cope, Yarrow 1882*a*:151.
Ambystoma talpoideum nec Holbrook, Cagle 1942*a*:175 (part).

Diagnosis.—A moderate-sized, slate-colored, blue-black, or brownish black salamander (largest Illinois specimen 171 mm. in total length), fig. 26, often with lichen-like patches of gray on the sides of the tail and trunk; head narrow and mouth small; gular region conspicuously swollen and wider than greatest width of head; vomerine teeth less than 35 and never extending laterally beyond the choanae; maxillary-premaxillary teeth usually in 2 or more rows in front, the continuous series containing less than 100 teeth; toes of adpressed limbs touching in subadults or separated by 1 to 4 costal folds in large adults; costal grooves 13 to 15.

Variation.—Males of *Ambystoma texanum* have prominently swollen vents during the breeding season. At all seasons, they are slightly smaller and have longer tails, stouter legs, and wider heads than females.

Fig. 26.—An adult *Ambystoma texanum* from Calhoun County, Illinois. The groundcolor is dark brown or black, usually with flecks of gray scattered over the back and sides of the animal.

Trends in ontogenetic variation are expressed chiefly by proportions and color and are illustrated by a sample of 22 specimens from Horseshoe Lake, Alexander County, table 5.

Geographic variation within Illinois is rather slight. A sample (14 specimens) from the southern tip of the state tends to have smaller individuals, slightly lower tooth counts, and perhaps a higher frequency of subadults with distinct gray frosting on the dorsum than samples from elsewhere in the state. In 32 per cent of the 14 southern Illinois specimens a single row of premaxillary teeth is characteristic, whereas in only 6 per cent of 37 specimens from other parts of Illinois is a single row characteristic; 2 or 3 rows are typical.

Individual variation for a sample of 51 adults is as follows: snout-vent length 50 to 90 mm.; total length 89 to 155 mm.; number of costal grooves 13 to 15 (average 14.2); number of vomerine teeth 18 to 33 (average 25.0); number of maxillary-premaxillary teeth 58 to 101 (average 75.0). A specimen from McLean County has a bifid tail, an anomaly due to an injury to the tail of the animal.

Habits.—The small-mouthed salamander is the most common *Ambystoma* in the state. It occurs in woodlands, prairie, pastured areas, and even in the intensively cultivated black soils of central Illinois. Adults are encountered during the summer months in various habitats, such as rocky hillsides, creek beds, and floodplain swamps. They feed on earthworms, slugs, and arthropods. They are nocturnal and fossorial.

Table 5.—Ontogenetic variation in Illinois *Ambystoma texanum*. Figures in parentheses are numbers of specimens.

Characteristic	Snout-Vent Length (mm.)		
	33–40 (9)	41–54 (7)	56–64 (6)
Snout-vent length as percentage of total length	55.6–59.5	52.3–57.0	49.8–58.0
Toes of adpressed limbs	Touch	−½	−2½
Number of vomerine teeth	15–27	20–26	18–27
Number of maxillary-premaxillary teeth	32–73	61–77	61–72
Color of venter	Light	Light or dark*	Dark

*Preserved specimens of this size group frequently have sharply bicolored sides.

Breeding occurs in late February and throughout March in most of Illinois. Almost any standing water is apparently suitable as a breeding site inasmuch as eggs have been observed in ditches, flooded fields, woodland streams, and even in cisterns. The egg masses, each usually consisting of 6 to 30 eggs, are deposited on sticks or vegetation in shallow water. Often eggs and spermatophores are present on the same object. The eggs hatch in a few days, the time depending upon the temperature of the water. The larvae transform into adults from late May through July.

Illinois Distribution.—This species in Illinois occurs north to Henry and Kankakee counties, fig. 27, and it is abundant in both woodland and prairie regions. The apparent gaps in range in extreme western Illinois and south-central Illinois, as shown on the map, are probably merely indicative of little field work in these regions during early spring. The absence of records from Adams County, a relatively well-collected area, is puzzling.

Fig. 27.—Distribution of *Ambystoma texanum*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: 3 mi. N Carbondale (Cagle 1942*a*); KNOX COUNTY: Galesburg (H. Garman 1892).

Ambystoma tigrinum tigrinum (Green)
Eastern Tiger Salamander

Salamandra tigrina Green 1825:116 (type locality: near Moorestown, N. J.).
Amblystoma tigrinum, Cope 1868:183–4.
Ambystoma tigrinum, Hurter 1911:75.
Ambystoma tigrinum tigrinum, Dunn 1918:457.
?Ambystoma lurida, Kennicott 1855:593.
?Amblystoma copianum, H. Garman 1892:215.
Ambystoma maculatum nec Shaw, Owens 1941: 183.
?Ambystoma sp., P. W. Smith 1951:192.

Diagnosis.—A rather large, blue-black or brownish black salamander (largest Illinois specimen 330 mm. in total length), fig. 28, with irregularly arranged yellow blotches, which are unequal and variously shaped, on the back and sides; costal grooves 12 or 13, sometimes 11 or 14; toes of adpressed limbs usually overlapping by 2 or more costal folds; 2 palmar tubercles distinct on freshly preserved specimens.

Variation.—In *Ambystoma tigrinum tigrinum,* the male differs from the female in having a longer vent and a longer tail. During the breeding season, the vent of the male is strongly protuberant.

Newly metamorphosed specimens, 50 to 60 mm. from snout to vent, are gray, brown, or olive, often with numerous indistinct dark spots above. Slightly older examples are black above, with a few very small yellow spots. The pattern of the adult is found in specimens 65 to 75 mm. in snout-vent length. The proportionate length of the legs decreases and the number of teeth increases with an increase in size. This variation is summarized in table 6.

No well-defined geographic variation within Illinois has been discerned for the eastern tiger salamander, although a difference in size between northern and southern specimens is indicated. Fifteen speci-

Fig. 28.—An adult *Ambystoma tigrinum tigrinum* from Randolph County, Illinois. The groundcolor is dark brown or black; the yellow spots are irregular in size and arrangement. In some large adults the spots are obscured.

mens now available from the southern third of the state are less than 100 mm. from snout to vent, and numerous other examples observed but not preserved were well under this length. Fifteen specimens out of 49 now at hand from the northern half of Illinois exceed 100 mm. in snout-vent length. Pope (1944*b*) noted that the species attains its maximum size in the Chicago area. The largest specimen known (330 mm. in total length) is from Quincy, Illinois (Langebartel 1946). Lengths and costal groove counts for three samples are given in table 7.

There is considerable individual variation in markings. Several of the large individuals are so dark that the spotted patterns are barely discernible. Other specimens, usually smaller individuals, are boldly marbled with black and yellow. Three large

Table 6.—Ontogenetic variation in Illinois *Ambystoma tigrinum tigrinum*. Figures in parentheses are numbers of specimens.

Characteristic	Snout-Vent Length (mm.)					
	51–61 (8)	64–73 (9)	75–83 (8)	86–96 (11)	97–105 (10)	106–115 (7)
Total length (mm.)	104–117	109–161	139–169	159–208	160–228	215–240
Costal folds overlapped by adpressed limbs	9–2½	4–2½	5–1	5–1	2½–1	2½–0
Vomerine teeth	38–55	33–59	44–64	48–74	43–83	52–79
Premaxillary-maxillary teeth	82–116	59–114	102–132	103–148	117–153	110–151

Table 7.—Geographic variation in Illinois *Ambystoma tigrinum tigrinum*. Figures in parentheses are numbers of specimens.

Characteristic	Southern Half of Illinois (7)		Northern Half of Illinois			
			Eastern (22)		Western (18)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	51–93	.....	61–112	.....	55–115	.....
Costal grooves	11–12	11.7	12–14	12.6	12–13	12.5

specimens from central Illinois are light olive, with black spots and mottling.

Habits.—Like the small-mouthed salamander, the tiger salamander is nocturnal and fossorial. Accordingly, it is seldom seen unless it is discovered under a log or rock, or within some steep-sided excavation. Although this salamander is not abundant, it persists in the most disturbed areas, often occurring within cities and in intensively cultivated regions. Its food consists of almost any kind of animal it can overpower. Captive salamanders of this species take earthworms and hamburger readily.

The number of individuals found abroad late in the fall suggests that a migration to the breeding ponds occurs at that season. Actual breeding, however, occurs early in the spring. Loose clusters of 25 to 100 eggs are attached to objects on the bottom of a pond. The incubation period depends on the temperature, probably averaging about 3 weeks. The larvae grow rapidly and in central Illinois transform in July. At metamorphosis the larvae of this species are about twice the size of other *Ambystoma* larvae.

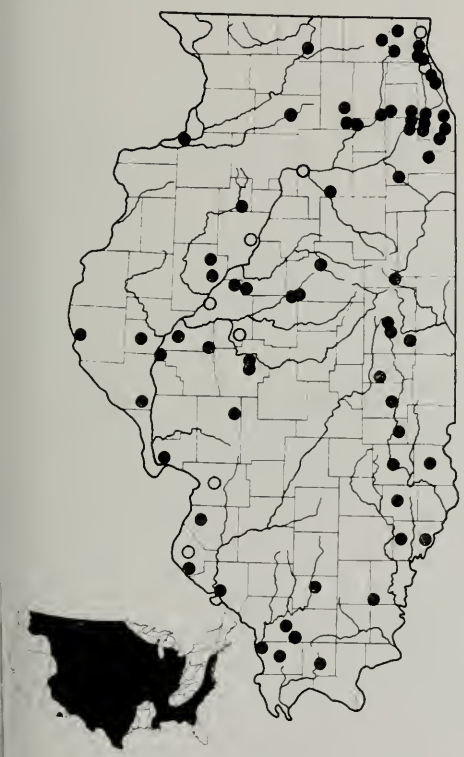


Fig. 29.—Distribution of *Ambystoma tigrinum*. The nominate subspecies occurs throughout the state. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Illinois Distribution.—This species is state-wide in distribution, fig. 29, but not abundant except in areas with numerous ponds. In most parts of the state, specimens are usually found quite incidentally in basements, deep-sided ditches, submerged meter boxes, or similar pits. Many permanent ponds, either prairie or woodland, harbor the species; small forest-edge ponds are probably preferred.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: COOK COUNTY: Glenview (Necker 1939*c*); Northfield (Yarrow 1882*a*); LAKE COUNTY: Waukegan (Necker 1939*c*); LA SALLE COUNTY: La Salle (Burt 1935); MADISON COUNTY: (Hurter 1893); MASON COUNTY: SE Havana (Vestal 1913); MENARD COUNTY: Athens (Dunn 1918); MONROE COUNTY: (Hurter 1893); PEORIA COUNTY: (H. Garman 1892).

SALAMANDRIDAE

This family includes two genera in the United States and Canada; *Notophthalmus* occurs east of the Great Plains and *Taricha* on the West Coast.

Notophthalmus Rafinesque

Three species of this eastern North American genus are found in the United States and Canada. The species occurring in Illinois consists of several subspecies, but only one of them is found within this state.

Notophthalmus viridescens louisianensis (Wolterstorff)
Central Newt

Diemyctylus viridescens louisianensis Wolterstorff 1914:383 (type locality: New Orleans, Louisiana).

Triturus viridescens louisianensis, Schmidt & Necker 1935:62.

Diemictylus viridescens louisianensis, Brown 1950:24.

Notophthalmus miniatus, Kennicott 1855:593.
Diemyctylus miniatus miniatus, Yarrow 1882*a*: 161.
Diemyctylus viridescens miniatus, Hay 1887*a*: 6.
Diemyctylus miniatus, H. Garman 1890:190.
Triton dorsalis nec Harlan, Brendel 1857:254.
Diemyctylus miniatus viridescens nec Rafinesque, Yarrow 1882*a*:161.
Diemyctylus viridescens, Hay 1887*b*:62.
Diemyctylus viridescens viridescens nec Rafinesque, Cope 1889:212–3.
Diemictylus viridescens, Shelford 1913:252.
Notophthalmus viridescens viridescens nec Rafinesque, Stejneger & Barbour 1917:8.
Triturus viridescens, Dunn 1918:451.
Triturus viridescens viridescens nec Rafinesque, Stejneger & Barbour 1923:4.

Diagnosis.—A small, stout, aquatic or terrestrial salamander (largest Illinois specimen 104 mm. in total length), fig. 30, without costal grooves; gular fold poorly developed; cranial crests present; vomeropalatine teeth in two longitudinal series; dorsum yellow-brown, olive-green, or red-brown and sharply cut off from yellow of venter and lower sides; scattered black specks above and below; one or two dorsolateral rows of small red dots, some of which are not margined with black or at least not completely encircled. The eft, a peculiar terrestrial stage found only in this salamander, differs from adults, which are aquatic, by the absence of fins on the tail, by the absence of secondary sexual characters, and by the presence of a granular or warty skin and darker groundcolor.

Variation.—Efts are difficult to sex, but the depth of the pits in the temporal region (hedonic glands) serves to identify at least some males. Adults in breeding ponds are easily sexed. The male possesses greatly enlarged hind legs with horny material on the inner sides, a swollen cloaca, and conspicuous dorsal tail crest during the breeding season, in addition to the deep hedonic pits at all times. The female in the breeding season has dark, converging, cornified ridges on the lips of the cloaca.

No data on ontogenetic variation are available for the Illinois populations.

Most of the specimens extant are efts. No variation trends within Illinois have been discerned. Ten specimens from northeastern Illinois vary as follows: snout-vent length 18.8 to 40.2 mm.; total length 39 to 81 mm.; lateral red spots enclosed by black, 0 to 8 per side (average 2.3); lateral head

Fig. 30.—Adult *Notophthalmus viridescens louisianensis,* eft stage, from Monroe County, Illinois. The groundcolor above is dark brown or olive-brown; below, yellow.

stripe prominent in four specimens, weak in five, absent in one. Fourteen specimens from the southern third of the state exhibit the following variation: snout-vent length 18.2 to 45.2 mm.; total length 35 to 104 mm.; lateral red spots ringed with black, 0 to 9 (average 4.4); lateral head stripe prominent in 1 specimen, weak in 13.

Habits.—*Notophthalmus viridescens* has a rather complicated life history, as adults have both a terrestrial and an aquatic stage. Presumably the subspecies *louisianensis* and *viridescens* have essentially the same life cycle, which in *N. v. viridescens* includes an underwater nuptial dance and deposition of spermatophores and eggs in winter or early spring. The eggs, which are attached individually to submerged vegetation, hatch in 2 or 3 weeks, and the larvae transform usually in 2 or 3 months. The transformed newt is rather dry and warty-skinned. It soon loses its gills and fins; it is then called an eft. Because the eft lives under bark, logs, or rocks in typical salamander habitats, this is the form most often encountered in Illinois. After 2 or 3 years, the eft is sexually mature and ready for an aquatic existence. It develops fins and skin changes that permit aquatic respiration. The number of tiny efts that have been found in southern Illinois suggests that the initial aquatic stage may be shorter in *louisianensis* than the 2 or 3 months of *viridescens*. Newts eat a variety of invertebrates, mollusks being a particularly important item.

Illinois Distribution.—The central newt probably once occurred throughout the state except in the extreme western part. All recent records are for either the northern or for the southern fifth of Illinois, fig. 31. Although records for the central part of the state are at least 35 years old, there is little reason to doubt them, inasmuch as the central newt is easily recognized. It is likely that its occurrence in the area between extreme northern and southern Illinois was sporadic even before cultivation. The destruction of much of the forest, the draining of ponds and marshes, and the lowering of the water table probably accelerated the disappearance of this salamander from central Illinois.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COLES COUNTY: Charleston (Hankinson 1917); HARDIN COUNTY: Cave in Rock (H. Garman 1892); JACKSON COUNTY: Grand Tower (H. Garman 1892); KANE COUNTY: Geneva (H. Garman 1892); MCLEAN COUNTY: Normal (Dunn 1918); PEORIA COUNTY: Peoria (H. Garman 1892); ST. CLAIR COUNTY: Bluff Lake (Hurter 1893); TAZEWELL COUNTY: Delavan (H. Garman 1892); UNION COUNTY: Anna (Cagle 1942*a*).

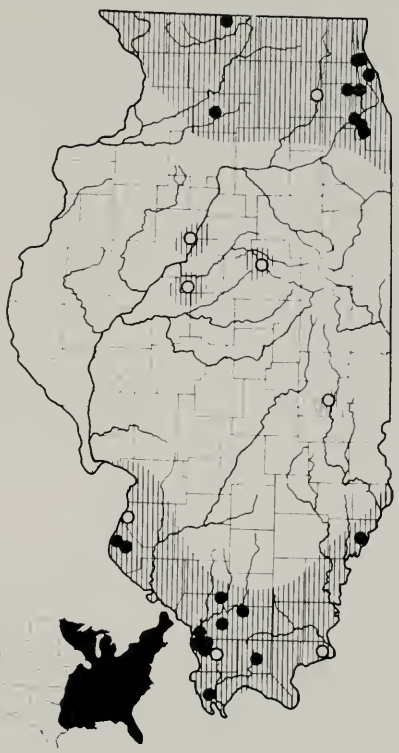


Fig. 31.—Distribution of *Notophthalmus viridescens*. Hatching indicates the presumed range of the subspecies *louisianensis* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

PLETHODONTIDAE

Four of the 17 plethodontid genera known from the United States and Canada are represented in Illinois. The family is primarily New World in distribution but it is represented in Europe by one genus.

Eurycea Rafinesque

The genus *Eurycea* includes eight species, most of which have several subspecies. Three species occur within Illinois.

Eurycea bislineata rivicola Mittleman
Midwest Two-Lined Salamander

Eurycea bislineata rivicola Mittleman 1949: 89–96 (type locality: Echo Canyon, McCormick's Creek State Park, Owen County, Indiana).
Eurycea bislineata bislineata nec Green, Dunn 1926:307.
Eurycea bislineata, Jordan 1929:218.
Spelerpes bilineatus, Davis & Rice 1883*a*:27.
?Desmognathus fusca nec Rafinesque, Hankinson 1915:293.
?Eurycea longicauda nec Green, Peters 1942: 182.

Diagnosis.—A small, slender, yellow or tan salamander (largest Illinois specimen 108 mm. in total length), fig. 32, with a lateral brown or black band of variable width extending from the eyes almost to the tail tip; 13 to 15 costal grooves; 1½ to 5 costal folds between the adpressed limbs; 6 to 22 vomerine teeth in two arched series behind and between the choanae; and usually either a median series of dark spots or irregularly spaced dark middorsal flecks.

Variation.—According to Bishop (1941), the male of this salamander differs from the female in its larger size, wider head, larger premaxillary teeth, and nasolabial tubercles. The teeth of the female at all times, and of the male from June to September, are said to be bicuspid.

Ontogenetic variation is not marked in the Illinois specimens available. The difference in ratio of tail length to total length, noted by Oliver & Bailey (1939) and Mittleman (1949), is apparent only when the figures are averaged. In 12 specimens 53 to 75 mm. in total length, the tail length ranges from 51.5 to 57.4 per cent (average 55.1) of the total length. In 12 specimens 85 to 108 mm. in total length, the tail length ranges

Fig. 32.—Adult *Eurycea bislineata rivicola* from Clark County, Illinois. The groundcolor is tan or yellow; the markings are dark brown.

Table 8.—Geographic variation in Illinois *Eurycea bislineata rivicola*. Figures in parentheses are numbers of specimens.

Characteristic	Pulaski County (12)		Pope-Gallatin Counties (16)		Clark-Edgar Counties (31)		Vermilion County (12)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	24–43	.....	28–41	.....	25–45	.....	32–45	.....
Total length (mm.)	78–99	.....	62–94	.....	53–108	.....	67–95	.....
Vomerine teeth	.....	.....	9–21	13.5	6–22	15.5	10–30	13.4
Costal folds between adpressed limbs	1–3	2.0	2–4½	2.9	1½–5	3.2	1½–3	2.4
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Costal grooves 15	0		12		4		0	
Costal grooves 14	67		44		48		75	
Costal grooves 13	33		44		48		25	
Stripes extending more than one-half tail length	100		100		85		75	
Unmarked dorsum	16		6		16		25	

from 53.6 to 61.0 per cent (average 57.0) of the total length.

The most apparent geographic variation among Illinois specimens is in color and pattern. The 16 specimens from Pope and Gallatin counties are the most strikingly marked, most of them having distinct spots middorsally on a clear yellow background. Viewed from the side they are sharply bicolored, and the light spots in the lateral dark stripes are conspicuous. Forty-seven specimens from east-central Illinois are less prominently marked, the middorsal flecks being less discrete and the groundcolor more often tan or dirty yellow. Variation in additional characters for four samples is shown in table 8.

Habits.—The two-lined salamander may be abundant in small, rocky streams and in springs and seeps in mesic forest. In the latter habitat specimens are found by raking wet leaves along stream banks or by digging in wet shale banks bordering brooks. This salamander is slippery, surprisingly agile, and difficult to hold. Captive individuals run with considerable speed and are able to jump some distance. If placed in a terrarium, they quickly climb the glass sides, their moist bodies providing sufficient adhesion for them to stick to the glass surface. Arthropods and small worms are their chief food items.

During the month of May, the comparatively large eggs of this salamander may be found under flat rocks, submerged branches, or leaves. They are closely packed in a single layer of 12 to 30 per clump. Hatching occurs in approximately a month, and the larval period requires something more than a year.

Illinois Distribution.—This typically eastern salamander is apparently confined in Illinois to the Indiana-Illinois border and eastern portion of the Shawnee Hills, fig. 33. The distribution pattern suggests that even small prairies or areas of farmlands may be barriers, and the woodlands of the Southern Division are probably unsuitable because of aridity in summer and fall. The apparent absence of the species from the western counties of the Shawnee Hills is difficult to explain, inasmuch as the area contains numerous rocky streams and springs.

Mittleman (1949) plotted a record for the Starved Rock area but did not cite the locality in his list of material. La Salle County is west of our records, but it has seemingly good habitat for the species.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: Coles County: Charleston (Hankinson 1915).

Fig. 33.—Distribution of *Eurycea bislineata*. Hatching indicates the presumed range of the subspecies *rivicola* in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

Eurycea longicauda (Green)

Four subspecies of this eastern, stream-inhabiting salamander have been described, but only three are recognized in the present study. Two well-marked subspecies occur within Illinois.

Eurycea longicauda longicauda (Green)
Long-Tailed Salamander

Salamandra longicauda Green 1818:351 (type locality: New Jersey; revised to vicinity of Princeton by Schmidt 1953).
Eurycea longicauda, Stejneger & Barbour 1917: 19.
Eurycea longicauda longicauda, Cagle 1941:5.
Spelerpes longicaudus, Davis & Rice 1883*a*:27.
Eurycea longicauda pernix Mittleman 1942: 101-5, pl. 20 (along Jimmie Strahl Creek, 2½ mi. SE Nashville, Brown County State Park, Indiana).

Diagnosis.—A moderate-sized, slender, long-tailed salamander (largest Illinois specimen 153 mm. in total length), fig. 34, with yellow or orange-yellow groundcolor and brown or black maculations that tend to coalesce on the sides to form lateral bands; sides of tail with vertical dark bars; 13 to 14 costal grooves; toes of adpressed limbs overlapping by 2 costal folds or separated by 2 folds; 12 to 39 vomerine teeth in all; venter immaculate yellow; middorsum plain or more often with numerous dark spots clustered along the midline.

Remarks.—The recently described *Eurycea longicauda pernix* (Mittleman 1942) of unglaciated Indiana is said to differ from *E. l. longicauda* by a higher vomerine tooth count, more intense pattern, and greater development of sexual dimorphism. The holotype and allotype of *pernix* have, respectively, 27 and 32 vomerine teeth. Only 8.6 per cent of the Illinois specimens, exclusive of *E. l. melanopleura* intergrades, have 27 or more vomerine teeth. Tooth counts for 11 specimens, which should be referable to *pernix* on the basis of range (Brown, Jennings, Morgan, and Owen counties, Indiana), vary from 11 to 26 (average 19.6); similar counts for 6 specimens of *E. l. longicauda* from glaciated Indiana (Parke and Montgomery counties, Indiana) vary from 18 to 28 (average 22.2). Accordingly, a high number of vomerine teeth does not appear to be diagnostic for the population in unglaciated Indiana and Illinois.

I can discern no differences in development of secondary sexual characters or pattern which will separate specimens of *E. longicauda* from glaciated Indiana from those of unglaciated areas. There is a tendency for the lower sides of specimens from Maryland and Pennsylvania to have zones of small, well-separated spots, whereas the lower sides of salamanders from the Great Smoky Mountains and transmontane regions are vermiculate. It seems best to refer the Illinois populations to *E. l. longicauda*, pending a restudy of the species.

Variation.—External sexual differences in this salamander are slight. Bishop (1943) reported that the male has more swollen nasolabial tubercles than the female, a slightly papillose vent, a shorter tail, and toes almost meeting when the limbs are

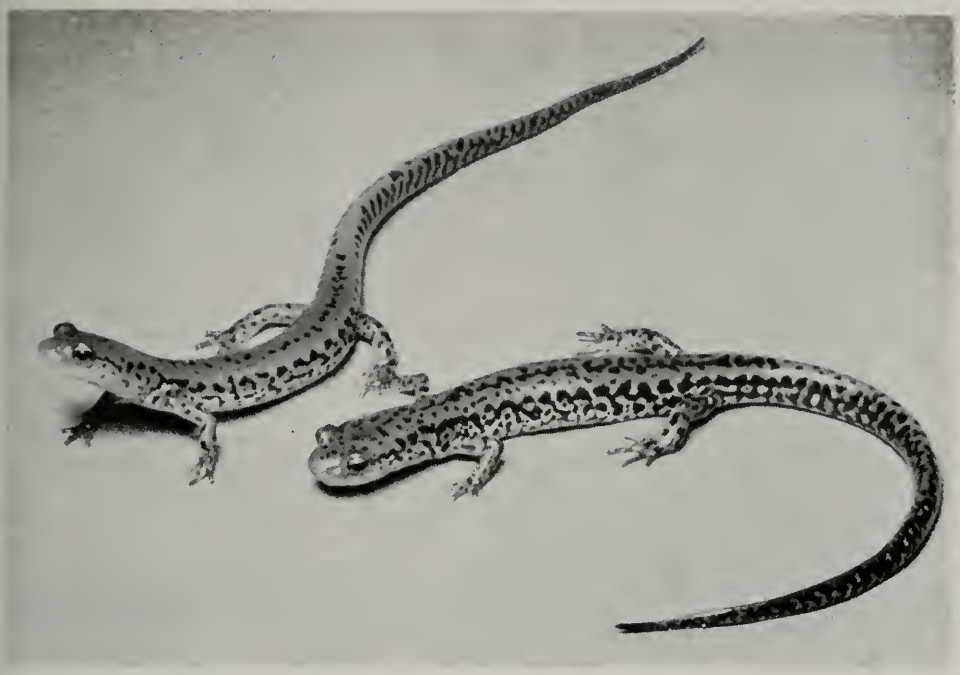


Fig. 34.—Adult *Eurycea longicauda longicauda* × *melanopleura* intergrades from Monroe County, Illinois. The specimen at the left is fairly typical of the nominate subspecies; the specimen at the right shows some *melanopleura* influence in the coalescence of the dark bars on the sides of the tail and the spotting on the dorsum. The groundcolor ranges from lemon yellow to almost orange; the markings are dark brown or black.

adpressed. In the female the toes of the adpressed limbs are separated by at least 1 costal fold.

Subadults are quite different from adults in general appearance, possessing a clear yellow groundcolor, smaller middorsal spots, shorter tails, and fewer vomerine teeth. They usually have prominent dark spots on the anterior part of the chins, whereas adults usually have dusky chins. The ontogenetic variation in proportionate tail length and number of vomerine teeth is summarized in table 9.

Geographic variation for this subspecies in Illinois is manifested by intergradation with the western race, *E. l. melanopleura*. Populations of typical *longicauda* occur in the Wabash Border counties and throughout the Shawnee Hills. A slight influence of *melanopleura* is seen in the tendency for the vertical tail bars to coalesce in occasional specimens from western Union and Jackson counties. Samples from other Lower Mississippi Border counties exhibit a gradual replacement, south to north, of *longicauda* characters by those of *melanopleura*. The

Table 9.—Ontogenetic variation in proportionate tail length and in vomerine tooth counts in Illinois *Eurycea longicauda*. Figures in parentheses are numbers of specimens.

Characteristic	Total Length (mm.)			
	54–84 (7)		133–155 (7)	
	Range	Mean	Range	Mean
Tail length as percentage of total length	51.9–61.0	57.3	60.8–64.7	63.0
Combined vomerine tooth counts	13–26	17.0	20–31	24.2

longicauda influence predominates as far north as St. Louis, but north of St. Louis specimens possess characters closer to those of *melanopleura*.

A single specimen (INHS), a juvenile, is known from the Wabash Border Division. This juvenile, 54 mm. in total length, has 14 costal grooves, a combined vomerine count of 16, 1 costal fold between toes of the adpressed limbs, a distinctly barred tail, or outcrops by searching these areas with a flashlight. On rainy days, individuals are sometimes abroad and may be seen on trunks of trees. Normally, however, they remain hidden under rocks or logs or within crevices in bluffs during the day. Their food consists predominantly of arthropods.

Details of the life history of this subspecies are lacking, but they are probably similar to those of *E. bislineata rivicola*. Larvae

Table. 10.—Geographic variation in Illinois *Eurycea longicauda*. Figures in parentheses are numbers of specimens.

Characteristic	Shawnee Hills (23)		Union and Jackson Counties (13)		Monroe and Randolph Counties (20)		Pike and Greene Counties (18)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	26.8–55.6	.....	31.2–55.0	.....	27.0–55.5	.....	33.8–48.0	.....
Vomerine teeth	13–31	20	12–39	22	12–30	21	12–24	18
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Costal grooves 13	100		100		90		7	
Costal grooves 14	0		0		10		93	
Tail bars present	100		100		85		22	
Middorsum plain or with median row of spots	100		77		50		6	
Middorsum with many scattered spots	0		23		50		94	
Venter plain	100		69		65		39	
Venter flecked	0		31		35		61	

and an unmarked middorsum. Geographic variation for a sample of *E. l. longicauda* from the Shawnee Hills and three samples of *E. l. longicauda* × *melanopleura* intergrades from the Upper and Lower Mississippi Border divisions is summarized in table 10.

Habits.—The long-tailed salamander occurs in abundance along rocky, swift streams in dissected, forested regions. It seems to be present in all of the areas in which this habitat occurs in the southern half of Illinois. *E. longicauda* does not occur in woodland seeps and springs without rock outcrops as does *E. bislineata*. Except for a more restricted habitat, *longicauda* is similar in habits and occurrence to *bislineata*. The species is nocturnal and can be found on boulders of various sizes may be found throughout the winter months, indicating that the larval period probably requires 2 years. Transforming larvae can be found throughout the warm months in southern Illinois.

Illinois Distribution.—This salamander is a characteristic species of the Shawnee Hills division and it occurs sporadically in the Wabash Border, fig. 36. Apparently it is limited to wooded regions with relatively large areas of rock outcrop. The distribution is continuous up the river bluffs in the Lower Mississippi Border.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: St. Clair County: Bluff Lake (Hurter 1893).

Eurycea longicauda melanopleura (Cope)
Dark-Sided Salamander

Spelerpes melanopleurus Cope 1893*b*:383 (type locality: Raley's Creek, White River, Missouri).
Eurycea longicauda pernix × *E. l. melanopleura,* Mittleman 1942:104.
Eurycea longicauda melanopleura, Grimmer & Langebartel 1948:224.

Diagnosis.—A medium-sized, long-tailed salamander (largest Illinois specimen 130 mm. in total length), fig. 35, related to the subspecies *longicauda* but differing in having a longitudinal dark band (rather than a series of vertical bars) on each side of the tail, numerous middorsal dark spots scattered or arranged in several irregular rows, numerous dark flecks on venter, yellow-green to yellow-brown groundcolor, and larger eyes.

Variation.—The males of the dark-sided salamander differ externally from the females in having more swollen snouts and larger nasolabial protuberances, but so many intermediate examples occur that dissection is often the only method by which the sex of an individual can be accurately determined.

In this subspecies subadults differ from older specimens less markedly than in *Eurycea longicauda longicauda* but in similar characters. Seven specimens, 88 to 114 mm. in total length, have tail lengths 48.0 to 65.5 (average 58.3) per cent of the total length, and six specimens, 115 to 130 mm. in total length, have tail lengths 58.5 to 65.2 (average 60.8) per cent. The groundcolor is usually more yellowish in small individuals,

Fig. 35.—An adult *Eurycea longicauda melanopleura* from Adams County, Illinois. The groundcolor ranges from greenish yellow to pure yellow; the markings are black or dark brown.

but the pattern is essentially the same. Some large specimens are suffused with fine flecks of darker pigment.

The Illinois population differs slightly from samples from more western localities in the smaller average number of vomerine teeth, in the poorly developed cirri, and in the usual irregularity of the rows of middorsal dark spots. Nevertheless, the samples from western Illinois are homogeneous, quite distinct from the eastern *E. l. longicauda*, and the differences noted are not due to intergradation with the eastern form.

Thirteen specimens from Adams County show the following variation: snout-vent length 32.8 to 54.0 mm.; total length 88 to 133 mm.; 13 costal grooves in 3 specimens, 14 in 10; toes of adpressed limbs overlapping by 1 costal fold to a separation of 2 folds; combined vomerine tooth counts 14 to 30 (average 20.5); cirri present in 1 specimen, nasolabial tubercles in 12; scattered ventral flecks in 11 specimens, immaculate venters in 2.

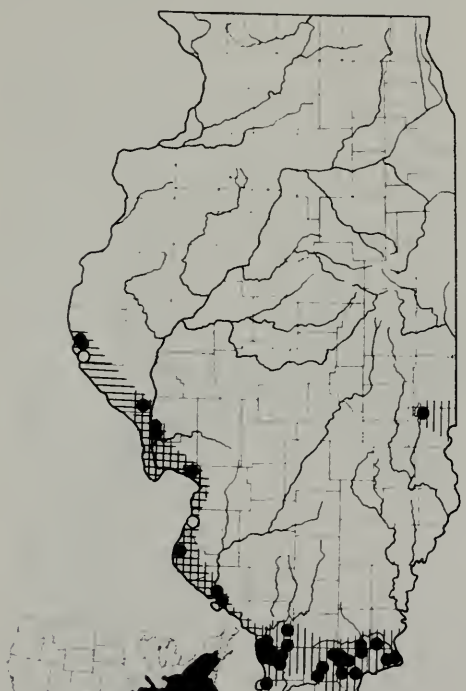


Fig. 36.—Distribution of *Eurycea longicauda*. Vertical hatching indicates the presumed range of *E. l. longicauda;* horizontal hatching, the presumed range of *E. l. melanopleura;* cross-hatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map shows the total range of the species in the United States.

Intergrades of *melanopleura* × *longicauda* have been discussed under the subspecies *longicauda*. Samples from Pike and Greene counties display some characters of *longicauda* but the *melanopleura* influence is so pronounced that these specimens would key out as *melanopleura*.

Habits.—This subspecies is similar to the eastern long-tailed salamander in habits. The only difference that seems worthy of notice is the more frequent occurrence of *melanopleura* within caves.

Illinois Distribution.—This salamander is common in rocky streams, caves, and springs of the Mississippi River bluffs and dissected wooded uplands in Adams and Pike counties, fig. 36. Intergrading populations occur south to Union County, but only those populations north of St. Louis have the general appearance of *melanopleura*. The apparent absence of this subspecies north of Adams County may be due to temperature intolerance, inasmuch as apparently suitable habitat extends well north of the known distribution. The upper Illinois River valley appears to afford suitable habitat, but none of the subspecies of *E. longicauda* has been able to ascend this valley, probably because the lower portion lacks the requisite rocky streams.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: ADAMS COUNTY: 11 mi. S Quincy (Grimmer & Langebartel 1948).

Eurycea lucifuga Rafinesque
Cave Salamander

Eurycea lucifuga Rafinesque 1822:3 (type locality: caves near Lexington, Kentucky); Stejneger & Barbour 1917:19.
?Spelerpes ruber nec Latreille, Hay 1887*a*:5.
Spelerpes ruber ruber nec Latreille, Yarrow 1882*a*:157.
Spelerpes maculicaudus, Hurter 1911:86.

Diagnosis.—A medium-sized, slender, red or red-orange salamander (largest Illinois

Fig. 37.—An adult *Eurycea lucifuga* from Union County, Illinois. The groundcolor is bright red-orange; the markings are jet black.

specimen 159 mm. in total length), fig. 37, with numerous black spots scattered irregularly over the back and sides; 13 to 14 costal grooves; toes of adpressed limbs separated by 1½ costal folds to an overlap of 2 folds; vomerine teeth usually in two J- or C-shaped series, the combined count ranging from 17 to 39.

Variation.—Males of this species can be distinguished from females by their more prominent nasolabial swellings, the presence of mental glands, the distinctly margined vents, and the slightly longer legs (an average of 1.08 costal folds between toes of adpressed limbs in 12 males and 0.47 costal fold in 18 females).

Newly transformed specimens are similar in general appearance to young *Eurycea longicauda*. The sides are dark gray, enclosing many light flecks, and the middorsal areas are yellow-gray, with scattered dark flecks. Slightly older specimens are yellow, with small black spots scattered over the backs and sides, differing from adults chiefly in the yellow ground color and the less conspicuous dorsal spots. Subadults differ in number of teeth and relative tail length. Seven subadults, 65 to 102 mm. in total length, vary in vomerine tooth counts from 18 to 28 (average 20.1) and the tail makes up 52.9 to 58.3 (average 55.0) per cent of the total length. Ten large specimens, 128 to 159 mm. in total length, have 20 to 39 vomerine teeth (average 26.2), and the tail ranges from 55.1 to 60.4 (average 58.1) per cent of the total length.

Several trends in variation are apparent in the Illinois series. Southeastern Illinois specimens are usually more heavily spotted above, are shorter-legged, have fewer vomerine teeth, and have less prominent secondary sexual characters than salamanders from the Lower Mississippi Border counties. These trends in three samples are summarized in table 11. Data for single specimens from localities geographically intermediate have not been included in the table.

Habits.—In Illinois, the cave salamander is not restricted to caves. In fact, the two localities where the species is most abundant are cypress swamps, one near Forman in Johnson County and one at Pine Hills in Union County. Both of these areas are bordered by rock bluffs, however, and both contain swamps that are spring fed. Adults and transforming larvae are common under logs and leaves within the swamp well away from the rock outcrops. Cave salamanders are nocturnal, spending the day concealed under objects along stream margins, in

Table 11.—Geographic variation in Illinois *Eurycea lucifuga*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southeastern Illinois (17)		Union County (15)		Monroe County (7)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	30–62	.....	37–57	.....	49–60	.....
Total length (mm.)	65–138	.....	79–141	.....	129–136	.....
Vomerine teeth	17–33	22.6	18–32	24.4	25–39	31.4
Toes of adpressed limbs	$-1\frac{1}{2}$ – $+1\frac{1}{2}$	.....	$-\frac{1}{2}$ – $+2$	.....	$-1\frac{1}{2}$ – $+2$	.....
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Costal grooves 12	6		0		0	
Costal grooves 13	76		80		86	
Costal grooves 14	18		20		14	
Males with cirri	0		26.6		57.7	

Fig. 38.—Distribution of *Eurycea lucifuga*. The hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

crevices in the rock outcrops, or in caves. At night a number of cave salamanders may be found on a single large boulder. They are quick and surprisingly difficult to pick up because of their slipperiness and alertness. *E. lucifuga* feeds chiefly upon arthropods.

Little is known of the life history of this salamander. Females with well-developed eggs have been taken in spring and in fall. The larvae, which are similar to other *Eurycea* larvae, overwinter one or more seasons. They transform throughout the warm months.

Illinois Distribution.—This species occurs in caves and springs throughout the Shawnee Hills division and in the Lower Mississippi Border counties north to at least Monroe County, fig. 38.

Hemidactylium Tschudi

The monotypic species of this predominantly northern genus is known only in extreme northeastern Illinois.

Hemidactylium scutatum (Schlegel) Four-Toed Salamander

Salamandra scutata Schlegel 1838:119 (type locality: Nashville, Tennessee).
Hemidactylum scutatum, Gebhard 1854:25.
Hemidactylium scutatum, Kennicott 1855:593.

Diagnosis.—A small, slender plethodontid salamander (largest Illinois specimen 95.5 mm. in total length), fig. 39; 4 toes on

Fig. 39.—An adult *Hemidactylium scutatum* from Ste. Genevieve County, Missouri. The groundcolor above is yellowish brown or reddish brown, below enamel white spotted with black.

each hind foot; tail with a basal constriction; a distinct median impressed line from base of tail to top of head, where it bifurcates; 12 to 14 costal grooves; groundcolor below white, with numerous black blotches.

Variation.—Bishop (1941) reported that males of this salamander are smaller and more slender and have slightly longer tails, more reddish brown above, and more prominently truncate snouts than females.

Blanchard & Blanchard (1931) have adequately described ontogenetic variation in this species and have prepared graphs to determine age groups. Young of the year are said to average 30 mm. long in females and 33 mm. in males by October. These juveniles differ from adults in the absence of basal tail constrictions and in their proportionately shorter tails. At the end of the second season, males average 50.6 mm. long and females 55.1 mm. The constriction at the base of the tail is then evident, and the tail is longer than the snout-vent length of the animal.

In the small series of Illinois specimens at hand, individuals range from 29.2 to 40.5 mm. in snout-vent length and 71.0 to 95.5 mm. in total length. Costal groove counts are 13 in seven specimens, 12 in four. Costal folds between the adpressed limbs range from 2½ to 5½. The dorsum is plain red-brown or yellow-brown, with indistinct darker spots. The venter varies from plain white to well spotted, with evenly distrib-

Fig. 40.—Distribution of *Hemidactylium scutatum*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States as currently known.

uted blotches. Most specimens are intermediate in ventral pattern, possessing black spots lateroventrally.

Habits.—The four-toed salamander is extremely rare in Illinois, and all the available specimens are quite old. The species is reportedly a bog animal, occurring under logs, bark, or sphagnum. Its food presumably consists of minute arthropods.

According to Bishop (1943) breeding occurs in late summer and fall, but oviposition does not take place until spring. Approximately 30 eggs in a cluster are laid near water in sphagnum or among roots of vegetation. The female remains with the eggs for the 1 to 2 months required for hatching. Metamorphosis occurs about 6 weeks after hatching.

Illinois Distribution.—The four-toed salamander is thus far known only in Lake and Cook counties, fig. 40, but may also occur in northwestern Illinois.

Plethodon Tschudi

This genus includes 15 species, most of which consist of two or more subspecies. Three species occur within Illinois.

Plethodon cinereus cinereus (Green) Red-Backed Salamander

Salamandra cinerea Green 1818:356 (type locality: New Jersey; revised to vicinity of Princeton by Schmidt 1953).

Plethodon erythronotus cinerea, H. Garman 1892:366–7.

Plethodon cinereus cinereus, Davis & Rice 1883*a*:26–7.

Plethodon cinereus, Shelford 1913:197, 243, 244, 256.

Plethodon cinereus erythronotus, Yarrow 1882*a*:154.

Plethodon erythronotus erythronota, H. Garman 1892:366–7.

Diagnosis.—A small, slender salamander (largest Illinois specimen 109 mm. in total length), fig. 41, with two color phases; lead-backed phase uniformly black or brown above; red-backed phase dark, with a middorsal, straight-edged red band extending from the occiput well onto the tail; limbs small and weak, the toes of the adpressed limbs separated by 4 to 9 costal folds, usually more than 6; costal grooves usually 18 or 19, sometimes 17 or 20; tail of adult slightly longer than snout-vent length; secondary sexual characters poorly developed; ventral interhumeral area (in life) without orange suffusion.

Variation.—Specimens of the red-backed salamander are difficult to sex accurately by external characters, although females tend to be slightly larger and to have more vomerine teeth than males. The males, when they are sexually active, have nasolabial swellings and each has a shelf on the tip of the lower jaw.

Juveniles differ from adults in having relatively shorter tails, relatively larger heads

Fig. 41.—Adult *Plethodon cinereus cinereus* from Clark County, Illinois. The specimen at the left is the dark, unicolor phase; the specimen at the right, a red-backed example.

Table 12.—Geographic variation in Illinois *Plethodon cinereus*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	VERMILION COUNTY (18)		CLARK COUNTY (18)		CRAWFORD COUNTY (27)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	25–47	.....	28–51	.....	28–51	.....
Tail length as percentage of total length	45.2–55.1	51.9	45.0–55.0	51.8	44.0–54.8	50.0
Costal grooves	18–20	19.1	17–19	18.6	18–20	19.5
Separation of toes of adpressed limbs	6.0–9.0	7.9	5.5–9.0	7.1	7.5–10.0	8.4
Vomerine teeth	7–15	10.7	9–18	13.0	9–16	12.4

and limbs, and lower average numbers of vomerine teeth. Bishop (1941) noted that the red middorsal stripe continues to the tip of the tail in a juvenile, whereas it terminates somewhere in the distal third of the tail in an adult.

The red-backed and lead-backed phases of this salamander occur together in all localities where the species is known in the state. The red-backed phase predominates in Illinois collections, averaging 66 per cent, except in a sample from Crawford County, where only 2 per cent are red-backed and the remainder are dark. This sample has a somewhat higher average costal groove count than other samples and a greater average number of folds between toes of the adpressed limbs. It possesses an extraordinary range of variation in ventral pigmentation, some specimens having a uniform blue-black venter, others having the stippling more or less typical of *Plethodon cinereus cinereus,* and still others having a dark venter with coarse patches of white pigment. Although the Crawford County sample is aberrant in these respects and shows some approach to *P. richmondi* of the Appalachian Plateaus region, its characters widely overlap those of *P. c. cinereus,* to which it is here assigned.

The geographic variation illustrated by the Crawford County sample and two other collections of *P. cinereus* is summarized in table 12.

A population of red-backed salamanders occurring on the Mississippi River bluffs from Jackson to Alexander counties has been referred to *P. cinereus* by various authors, but a recent study of the relationships of this population reveals that, although it shares with *cinereus* a straight-edged middorsal stripe, other characters indicate that it should be referred to *P. dorsalis.* It is accordingly discussed in more detail under that species.

Habits.—In the early spring, the small, slender red-backed salamanders are most frequently encountered under logs and rocks or within moist rotten stumps on hillsides. Later in the season, as the ground dries out, these salamanders retreat into the ground or move down the hillsides, where there is more moisture. When first uncovered they remain motionless, but when prodded they rush away to cover, each with looping movements of the tail and body. Captive specimens climb vertical surfaces with ease, as the moist body adheres firmly to almost any smooth surface. The food of the red-backed salamander consists of minute arthropods, annelids, and mollusks. Collembola are probably important dietary items.

Of this salamander, Bishop (1941) records that, in New York, spermatophores are deposited on leaves and sticks in late fall. The females receive the sperm packets, and after fertilization the eggs are laid in crevices, usually in rotten logs or under bark. Occasionally several females may be found within one rotten log, each guarding her suspended cluster of approximately half a dozen eggs. Hatching occurs in late summer. Each newly hatched larva is attached to the yolk of the egg for a period of a day or so, after which the gills disappear; the hatchling is a terrestrial salamander. The aquatic stage, characteristic of most amphibians, has been lost in species of *Plethodon,* and most of the brief larval period is spent within the egg.

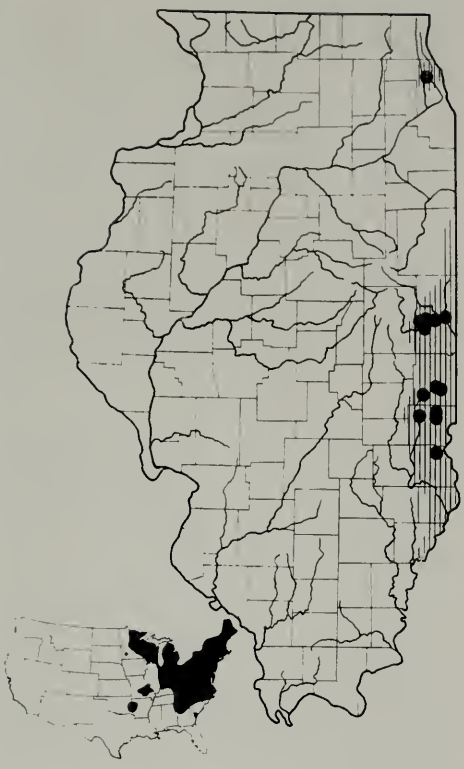


Fig. 42.—Distribution of *Plethodon cinereus*. Hatching indicates the presumed range of the subspecies *cinereus* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

Illinois Distribution.—The red-backed salamander is known in Illinois only from the extreme eastern part, fig. 42. In northeastern Illinois, it is inexplicably rare or perhaps extinct. It abounds in adjacent Indiana and in nearby Michigan.

Although undocumented by specimens, published records for the following localities are believed valid: COOK COUNTY: West Northfield (Yarrow 1882*a*); VERMILION COUNTY: Lake Vermilion (Peters 1946). (Records not plotted because of proximity to records based on museum specimens.)

Plethodon dorsalis Cope
Zigzag Salamander

Plethodon cinereus dorsalis Cope 1889:138 (type locality: Louisville, Kentucky); Bishop 1943:236.

Plethodon dorsalis, Stejneger & Barbour 1917: 15.

Plethodon cinereus nec Green, Cagle 1942*a*: 176.

Diagnosis.—A small, slender, red-backed or uniformly dark salamander (largest Illinois specimen 114 mm. in total length), fig. 43, allied to *Plethodon cinereus,* but differing over most of its range in having a strongly lobulated (zigzag rather than straight-edged) red or yellow middorsal band, or a straight-edged middorsal stripe with the following combination of characters: 16 to 18 costal grooves; 3.5 to 7.5 costal folds between toe tips of adpressed limbs; tail length of adult usually less than snout-vent length; shoulder and interhumeral region pigmented with orange or red (in life); mental gland prominent in male; and a stouter body, the statement in Bishop (1943) that *P. cinereus* is less slender than *dorsalis* notwithstanding.

Variation.—Bishop (1943) noted that well-marked sexual dimorphism is lacking in this species. The specimens in our series, on the contrary, display marked sexual characters, the male differing from the female in having a conspicuous mental gland, nasolabial swellings, and a pair of free lips at the posterior end of the vent. The vent of the female is a simple slit.

Ontogenetic variation in this species is similar to that found in *P. cinereus.* The number of vomerine teeth shows less correlation with body size, but the number of costal folds between toes of the adpressed limbs and the body size are more directly correlated.

Rather marked geographic variation is exhibited by this species in Illinois. A population in the extreme southwestern part of the state (the Mississippi River bluffs of Alexander, Union, and Jackson counties) is atypical, inasmuch as it consists entirely of the red-backed phase and consists almost invariably of salamanders with straight-edged middorsal stripes. These salamanders, because of their pattern features, bear a remarkable superficial resemblance to the allied *P. cinereus.* A population in southeastern Illinois is typical *P. dorsalis* in structural and pattern features, most obviously in the zigzag stripe of the red-backed phase. The salient features of variation exhibited by a sample of typical *dorsalis* and by a sample of the Mississippi River bluffs salamanders are summarized in table 13.

Two specimens from Vermilion County and a small series from a locality between Anna and Jonesboro, Union County, appear to be typical *dorsalis*.

Individual variation among specimens of the typical population is manifested primarily in the representation of the two color phases and by the distinctness of the mid-

Fig. 43.—An adult *Plethodon dorsalis* from Pope County, Illinois. The groundcolor is dark brown or black; the middorsal stripe, when present at all, is red or yellow.

Table 13.—Variation in two samples of Illinois *Plethodon dorsalis*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southeastern Illinois (65)		Mississippi River Bluffs (49)	
	Range	Mean	Range	Mean
Stripe width as percentage of body width	23–44	32.0	23–41	32.0
Costal grooves	16–19	17.4	16–18	17.0
Folds between adpressed limbs	3.5–8.0	5.5	2.0–7.0	5.4
Tail length as percentage of total length	42.5–51.5	46.8	42.5–51.5	47.6
	Per Cent of Specimens		Per Cent of Specimens	
Red-backed	69		96	
Red-backed with zigzag stripe	98		15	

dorsal stripe. Unlike *P. cinereus*, this species includes occasional specimens intermediate between the two color phases, and the zigzag stripe can be discerned in some intermediates only by careful examination. Among specimens with the red or yellow stripe, the lobulations extend posteriorly for the entire body length in approximately one-third of the material at hand, but for at least half of the body length in the majority of the specimens. A specimen from Hardin County is anomalous, with the middorsal band straight-edged on one side and strongly angulated on the other.

Habits.—In the early spring, zigzag salamanders are extremely abundant under flat rocks on wooded hillsides. In habits they are similar to red-backed salamanders but they are perhaps more rigidly restricted to a rock habitat. During the summer and fall they are rarely found; presumably they retreat into caves or rock crevices.

The life history of *P. dorsalis* is probably similar to that of the related *P. cinereus*, although *dorsalis* probably lays its eggs in crevices of rock outcrops rather than in logs.

Illinois Distribution.—This species has been confused with *P. cinereus* because of the difficulty of describing adequately the rather slight differences between the two species and because each species has a unicolorous phase. Most of the early references to *P. dorsalis* in Illinois were based on presumptions that this species would be found eventually in eastern Illinois or were obvious misidentifications of *P. cinereus*. Prior to 1948 the only published record for *dorsalis* was almost certainly in error, as the record, based on specimens AMNH 23297-3301 and labeled Urbana, Illinois, has not been substantiated by additional collections. Moreover, suitable habitat for this species is completely lacking in the vicinity of Urbana. During the first season of field work for the study reported here, *dorsalis* was found to be common in southeastern Illinois, as various authors had predicted, and the species is now known in much of the Shawnee Hills region, as well as in eastern Vermilion County, fig. 44.

It is now apparent that *P. dorsalis* has long been collected in southwestern Illinois but, until recently, has been invariably misidentified as *P. cinereus*. The status of the Mississippi River bluff population is still uncertain. There is some possibility that it is a colony of hybrid origin, inasmuch as the population combines certain characters of *dorsalis* and Ozarkian *cinereus* and there are good zoogeographic reasons for assuming that a segment of Ozark *cinereus* may have been isolated on the Illinois side of the Mississippi River. However, except for its minute geographic range, there is equal justification for describing the population in southwestern Illinois as new. The hiatus between its range and that of typical *dorsalis*, fig. 44, seems to be real, suggesting that the population has attained reproductive isolation. Until more definite evidence becomes available, however, it seems advisable to recognize it as an aberrant colony of *P. dorsalis*.

It is regarded by some current students as consanguineous with the Ozarkian *Plethodon cinereus angusticlavius*, but I consider it distinct.

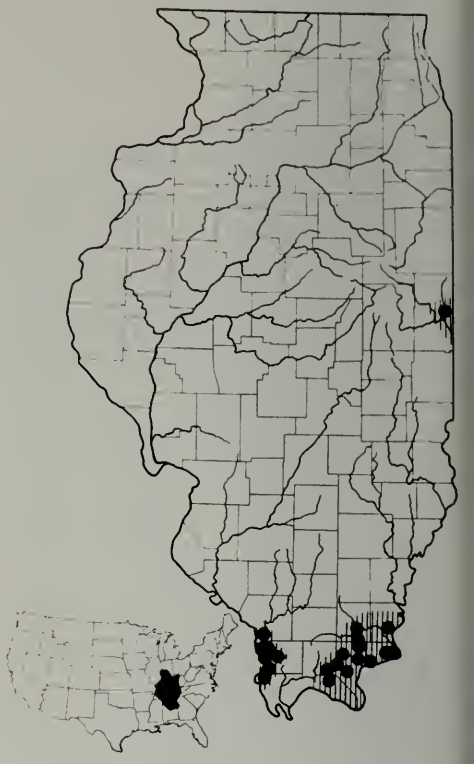


Fig. 44.—Distribution of *Plethodon dorsalis*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

Fig. 45.—An adult *Plethodon glutinosus glutinosus* from Richland County, Illinois. The groundcolor is black; the dots are milky white.

Plethodon glutinosus glutinosus (Green)
Slimy Salamander

Salamandra glutinosa Green 1818:357 (type locality: vicinity of Princeton, New Jersey).
Plethodon glutinosus, Yarrow 1882*a*:155.
Plethodon glutinosus glutinosus, Bishop 1943: 250.

Diagnosis.—A medium-sized terrestrial salamander (largest Illinois specimen 167 mm. in total length), fig. 45, black or blue-black above, with white flecks; usually frosted with white or silvery white on lower sides and uniformly black or black with occasional light flecks below; 14 to 15 costal grooves; usually 1 to 4 costal folds between toe tips of adpressed limbs; 12 to 22 vomerine teeth; tail of adult usually slightly longer than snout-vent length, and often lighter ventrally than belly.

Table 14.—Geographic variation in Illinois *Plethodon glutinosus glutinosus.* Figures in parentheses are numbers of specimens.

Characteristic	Wabash Border (15)		Southern Division (17)		Shawnee Hills (15)		Randolph and Monroe Counties (15)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	48.5–76.0	.....	49.0–68.2	.....	57.0–71.2	.....	44.8–72.0	.....
Total length (mm.)	107–167	.....	100–143	.....	114–163	.....	123–156	.....
Tail length as percentage of total length	49.9–58.5	54.2	51.0–55.2	53.4	49.6–56.2	53.3	50.5–55.8	53.3
Combined vomerine tooth count	14–23	16.8	11–20	15.7	15–22	18.0	12–22	17.0
Folds between toes of adpressed limbs	½–4½	2.5	1–3½	2.2	2–3½	2.7	1–3½	2.3
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Costal grooves 14	80		24		0		20	
Costal grooves 15	20		76		100		80	
Lateral blotches	67		47		60		93	
Small spots	33		53		40		7	

Variation.—In this salamander, the male differs from the female in having a noticeable mental gland or a circular light spot that indicates the position of the gland. Many males have in addition prominent nasolabial swellings.

Young specimens, less than 40 mm. in length, possess proportionately larger heads, more prominent eyes, and shorter tails than adults. Specimens less than 70 mm. in total length often have a brownish cast and the skin under magnification appears closely punctate with white. Superimposed on the small round dots are occasional larger light flecks that are most pronounced on the sides. In the smallest specimens at hand the venters are dull gray; in half-grown specimens the venters are dark, and the chins and undersides of the tails are light; and in adults the undersides of the tails and feet are lighter than the chins and bellies.

Geographic variation within the state is seen in the tendency toward a relatively low costal groove count, long tail, and large maximum size in individuals from the Wabash Border counties (Clark and Vermilion), table 14.

Habits.—Slimy salamanders are usually found under logs or rocks, but at night and on rainy days they may be seen wandering abroad. They are quick and so slimy that they are difficult to pick up. The slime is sticky and hard to remove from the hands. During early spring these salamanders are abundant on wooded hillsides, but later in the season, as the ground dries out, they retreat to moist situations, such as the interior of rotten logs. Their food consists of arthropods and annelids.

The life history of this common species is poorly known. The 10 to 20 eggs laid by the female are said to be suspended by a slender stalk within rock crevices or rotten logs. The female remains with the eggs. The entire larval period is spent within the egg; at hatching the young salamanders are ready for a terrestrial existence.

Illinois Distribution.—The slimy salamander occurs in forested areas throughout the southern half of the state, fig. 46; it is sporadic in occurrence at the northern edge of its range and on extensive floodplains. At the periphery of the range in Illinois, the occurrence of the species is correlated with relatively mesic forest and rock outcrops. Numerous forest areas, apparently suitable but without rock outcrops, in Coles County, for example, have been combed for this species without success, but wooded and rocky areas in adjacent Clark and Shelby counties have yielded slimy salamanders on almost every visit. Considerable field work in the lower Wabash River valley has not revealed this salamander there, even though the woods appear to be ideal plethodontid habitat. The absence of records for the Mississippi River counties north of St. Louis is inexplicable, inasmuch as no obvious break in habitat occurs in the St. Louis region.

The single published record for West Northfield, Cook County, in northern Illinois (Yarrow 1882*a*) has been justifiably deleted from the Cook County fauna by Schmidt & Necker (1935) on the basis of

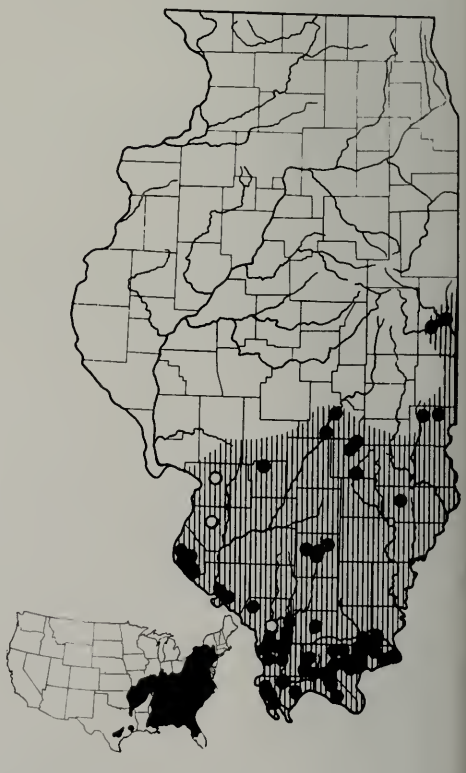


Fig. 46.—Distribution of *Plethodon glutinosus*. Hatching indicates the presumed range of the subspecies *glutinosus* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

its remoteness from the continuous range of the species and the absence of additional collections of the slimy salamander. Yarrow's record was probably based on a misidentified specimen of the superficially similar *Ambystoma laterale*.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: 5 mi. S Carbondale, near Murphysboro (Cagle 1942*a*); MADISON COUNTY: (Hurter 1911); ST. CLAIR COUNTY: (Hurter 1893).

Desmognathus Baird

This eastern genus includes nine species in the United States, some of which have several subspecies. One form occurs within Illinois.

Desmognathus fuscus conanti Rossman
Dusky Salamander

Desmognathus fuscus conanti Rossman 1958: 158 (type locality: 2.1 mi. S Smithland, Livingston County, Kentucky).
Desmognathus fuscus fuscus nec Rafinesque, Davis & Rice 1883*b*:14.

Fig. 47.—Adult *Desmognathus fuscus conanti* from Pulaski County, Illinois. The ground-color ranges from yellow or light red-brown to dark brown; the markings are usually some shade of brown.

Desmognathus fuscus, Schmidt & Necker 1935: 60.
Desmognathus fusca fusca nec Rafinesque, Yarrow 1882*a*:159.
Desmognathus fusca, Davis & Rice 1883*a*:27.
Desmognathus nigra, Yarrow 1882*a*:160.
Desmognathus fusca auriculata nec Holbrook, H. Garman 1892:358–9.

Diagnosis.—A moderately stout, tan or brown salamander (largest Illinois specimen 100 mm. in total length), fig. 47, with a distinct light line from the eye to the angle of the jaws; tail triangular in cross section; nasolabial grooves present; 13 or 14 costal grooves; toes of adpressed limbs separated by more than 3 costal folds.

Variation.—Bishop (1941) reported that males of *Desmognathus fuscus fuscus* differ from females by their larger size, broader and longer heads, longer hind legs, presence of villi rather than folds on the cloacal lips, presence of mental glands, enlarged premaxillary teeth, and the usual absence of vomerine teeth. Sexual variation in *D. f. conanti* is presumably similar to that reported for *D. f. fuscus.*

No definite ontogenetic variation has been discerned in the Illinois series of *D. f. conanti.*

Eighteen specimens from Pulaski County vary as follows: snout-vent length 37 to 54 mm.; total length 63 to 100 mm.; costal groove counts 14 in 15 specimens, 13 in 1 specimen; separation of toes of adpressed limbs 2 to 4½ (average 2.9) folds; vomerine teeth 0 to 1 in males, 9 to 16 (average 11.2) in females; groundcolor dark red-brown to light yellow. Some specimens are unicolorous; others have spotted, dashed, or vermiform markings.

A male and female from Union County display characters well within the range of variation of the Pulaski County series.

Habits.—Dusky salamanders occur in cold springs and are usually encountered by raking wet leaves or raising rocks at the margin of a spring or stream. These salamanders are alert, active, and extremely difficult to capture because of their quickness and slipperiness. Their food consists of arthropods, annelids, mollusks, and other salamanders.

Clusters of 10 to 20 eggs are deposited in nests near the water in both the spring and fall, according to Bishop (1941). The female remains with the eggs, which she sometimes devours. Hatching occurs in 1 or 2 months, the length of time probably depending on temperature. The larvae make their way to water by wriggling. Transformation occurs in less than a year.

Illinois Distribution.—Despite the numerous literature reports of *D. fuscus* in Illinois, it appears that this species is restricted to a very few colonies in the extreme southern tip of the state, fig. 48. Although it is abundant in most of the eastern United States, the nearest valid record outside of Illinois is for extreme western Kentucky rather than for Indiana, suggesting that the species entered southern Illinois via the Mississippi River valley.

One specimen (USNM 3823), which has been reported from Illinois as *D. nigra* and assumed to be *D. fuscus* by many authors, is actually a specimen of *D. quadramaculata*

Fig. 48.—Distribution of *Desmognathus fuscus.* Hatching indicates the presumed range of the subspecies *conanti* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

and obviously has incorrect locality data. The specimens MCZ 2054 and 2056, labeled as from Normal, Illinois, are *D. fuscus,* but undoubtedly they are from some other state. The record of Hankinson (1915) for Coles County was questioned by Dunn (1926); almost certainly Hankinson confused *Desmognathus* with larval *Eurycea.* Yarrow (1882*a*) and other authors reported dusky salamanders from Mount Carmel, Wabash County, probably on the basis of Robert Ridgway's recollection of these salamanders. A series of *Desmognathus,* supposedly collected at Olney, Richland County, by Ridgway, is extant in the HJVC collection; since this series also includes specimens of California newts, it cannot be given serious consideration. The Union County specimens collected by "Black and Twomey" in 1935 and reported by P. W. Smith (1948) may have incorrect locality data, since repeated attempts to find the species in the same spring have been unsuccessful.

AMPHIUMIDAE

The family Amphiumidae consists of a single genus, which occurs in southeastern United States.

Amphiuma Garden

This genus contains one species, which consists of two subspecies. One of these may eventually be found to occur in extreme southern Illinois.

Amphiuma means tridactylum Cuvier
Three-Toed Amphiuma

Amphiuma tridactylum Cuvier 1827:7, pl. 1, figs. 4–6, pl. 2 (type locality: New Orleans, Louisiana); Goodnight 1937:301; Cagle 1941:2; Baker 1947:12; Baker 1948: 131; Brown 1950:25.
Amphiuma means tridactylum, Schmidt 1953: 28.
Amphiuma means nec Garden, Weed 1923:50; Goodnight 1937:300, 301.

Diagnosis.—A large, eel-like, aquatic salamander without external gills and with 4 tiny legs, each leg bearing 3 toes.

Range.—This southern species has been found northward in the Mississippi River valley almost to Illinois. The authors cited above presumed that the species ranges into Illinois, but no specimens have been taken within the state despite efforts of a number of collectors. The species is known in western Kentucky, only 25 air-line miles south of Cairo, Illinois (S. A. Minton, personal communication), and it is accordingly a possibility for the Cairo region.

PROTEIDAE

One genus of this family occurs in eastern North America.

Necturus Rafinesque

The genus contains four species, one of which is polytypic and is widely distributed in eastern North America. The nominate subspecies of the polytypic species inhabits Illinois.

Necturus maculosus maculosus (Rafinesque)
Mud Puppy Waterdog

Sirena maculosa Rafinesque 1818:41 (type locality: Ohio River).
Necturus maculosus, Eycleshymer 1906:126.
Necturus maculosus maculosus, Schmidt & Necker 1935:62.
Necturus lateralis, Kennicott 1855:593.
Menobranchus lateralis, Milner 1874:36, 62–3.
Necturus maculatus, Cope 1889:23–7.

Diagnosis.—A large aquatic salamander (largest Illinois specimen 344 mm. in total length), fig. 49, with permanent bushy gills and only 4 toes on each foot; tail length less than 38 per cent of total length; head flattened, swollen laterally behind the eyes; snout truncate; groundcolor slate to brownish gray, with scattered black blotches on back; sometimes uniformly dark above, occasionally with numerous black dots.

Variation.—Bishop (1941) noted that the male mud puppy differs from the female in having a longer vent, which has oblique wrinkles at the margin, a pair of papillae directed backward, and a curved groove bordering the posterior margin. The vent of the female is a simple slit. Five males and six females from Vermilion County display slight differences in relative tail length; tails of the males average 32.4 per cent of the total length and those of the females 34.1 per cent.

Two juveniles from Illinois, 40 and 42 mm. in length, are dark brown, with a pair

Fig. 49.—A subadult *Necturus maculosus maculosus* from Vermilion County, Illinois. The groundcolor ranges from light gray to dark olive; the spots on the body are brown or black; the gills, dark red.

of yellow dorsolateral stripes extending from the gills onto the tail. Bishop (1941) found that in New York the yearling salamanders average 55 mm. in length and have a middorsal yellow-brown stripe, bordered on each side by dull yellow bands. He found that 2-year-old specimens averaged 83 mm. in length and had longitudinal stripes that were dimmed by the appearance of rounded dark spots over the back; 3-year-old salamanders averaged 113 mm. in length and had stripes that were dimmer; and 4-year-old specimens averaged 148 mm. in length and had essentially the pattern of adults.

No geographic variation has been noted in the Illinois specimens of *Necturus maculosus*. Individual variation, especially in color and pattern, is pronounced; in a fair-sized series, specimens may be present resembling many of the recognized species of the genus, at least in details of pattern. Despite the variability of pattern, the Illinois specimens almost certainly belong to a single population.

The largest Illinois series of *N. maculosus* available consists of six males and five females from Vermilion County. Total lengths range from 208 to 343 mm. and the tail length comprises 30.2 to 37.3 per cent of the total length. Vomeropalatine teeth vary in number from 24 to 35 (average 31.2). Costal grooves are 15 or 16, and the toes of the adpressed limbs are separated by 6.0 to 8.5 costal folds (average 7.4). All 11 specimens are distinctly spotted above. Three specimens have a narrow, midventral, light stripe; three have venters entirely light; and five have a sharply defined light stripe that is about half the width of the venter.

Seven specimens from western Champaign and Piatt counties are 235 to 344 mm. in length and vary as follows: tail length 31.3 to 35.6 (average 33.4) per cent of total length; costal grooves 15 to 17; toes of adpressed limbs separated by 6.0 to 9.5 (average 7.5) folds; vomeropalatine teeth 35 to 44 (average 40.1). Four of the seven are distinctly spotted above, and three are dark, two having the many black dots supposedly characteristic of the northern *N. m. stictus*. The venter color variation is similar to that in the Vermilion County series.

Single specimens at hand from localities in other parts of the state are, for the most part, well within the range of variation of the above series. A specimen (INHS 1002) from Rock Island County is almost identical with a Wisconsin specimen of *N. m. stictus*. A specimen (INHS 1003) from Massac County is much discolored but noteworthy because of its extremely squat body. An adult (INHS 8041) from 3 mi. NE Fairmount, Vermilion County, is an albino.

Habits.—Mud puppies or waterdogs occur in lakes, lagoons, rivers, and large creeks. They are frequently caught on hook and line by fishermen near ideal habitats, such as piles of driftwood that accumulate around bridge supports in moderate-sized rivers. Active throughout the year, they probably remain in deep water during the day. They are ugly, excessively slimy, and, although harmless, they are unpleasant creatures to handle. Their food consists of various fishes, arthropods, annelids, and mollusks.

Bishop (1941) records that pairing of males and females occurs in the fall but that oviposition does not take place until late spring. A gravid female lays approximately 100 eggs, usually on the underside of a submerged rock or log. Each egg is 5 to 6 mm. in diameter and suspended in a jelly-like sac. The eggs require about 2 months to hatch. The young are described briefly in the paragraph describing ontogenetic variation.

Illinois Distribution.—*Necturus* is statewide in distribution and probably abundant in suitable streams in every Illinois county, fig. 50, but it is difficult to collect by usual collecting methods. The accompanying map reflects the parts of Illinois where the most intensive collecting has been done, rather than the actual abundance of the species. Collections have recently been augmented by specimens obtained with the aid of electric shocking equipment that aquatic biologists are now using.

Fig. 50.—Distribution of *Necturus maculosus*. The subspecies *maculosus* occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: COLES COUNTY: Cooks Mill (Hankinson 1917); COOK COUNTY: Evanston (Milner 1874); Wilmette (Necker 1939*c*); JACKSON COUNTY: Big Muddy River (Cagle 1942*a*); KANE COUNTY: Carpentersville (Schmidt & Necker 1935); LEE COUNTY: Sublette (Pope 1944*b*); MADISON COUNTY: (Hurter 1893); MARSHALL COUNTY: Henry (H. Garman 1892); OGLE COUNTY: Oregon (H. Garman 1892); PEORIA COUNTY: Peoria (H. Garman 1892); ROCK ISLAND COUNTY: Moline (Howard 1951); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WILL COUNTY: Joliet (Howard 1951); WILLIAMSON COUNTY: Crab Orchard Creek (Cagle 1942*a*).

SIRENIDAE

This family includes two genera, both found in eastern North America.

Siren Linnaeus

The genus *Siren* contains one monotypic and one polytypic species. A western subspecies of the latter occurs in Illinois.

Siren intermedia nettingi Goin
Western Lesser Siren

Siren intermedia nettingi Goin 1942:211–7 (type locality: Imboden, Lawrence County, Arkansas).
Siren lacertina nec Linnaeus, Cope 1870:394.
Siren intermedia, Noble & Marshall 1932:2.

Diagnosis.—A large, eel-like salamander (largest Illinois specimen 457 mm. in total length), fig. 51, with 4 toes on each front foot, and no hind legs; 3 pairs of gills; body brown, black, dark olive, or bluish gray above, with or without small black spots; venter lighter than dorsum; margins of jaws with horny sheaths; 34 to 37 costal grooves, usually 34 or 35; venter and sides often marked with light flecks.

Variation.—Males of this species exceed females in size. I am unable to determine the sex of the specimens in our series by any external characters.

Fig. 51.—An adult *Siren intermedia nettingi* from Pope County, Illinois. The color ranges from very dark brown to blue-black.

In a series of eight specimens from Pine Hills, Union County, two are larvae. The smaller larva, 19 mm. from snout to vent and 24 mm. in total length, is boldly marked above with a light (red in life) band that extends from the gill tufts on one side around the snout to the gills on the other side of the head. This band is broadest on the edge of the truncate snout. A pair of interorbital dashes, a transverse band across the occiput, and a middorsal stripe that extends from the gill region to the tip of the tail also are red in life. The larger larva, 44 mm. from snout to vent and 58 mm. in

Table 15.—Geographic variation in Illinois *Siren intermedia nettingi*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southern Illinois (12)	Macoupin and St. Clair Counties (4)	Fulton and Mason Counties (2)	Crawford County (1)
	Range	Range	Range	Range
Snout-vent length (mm.)	69–254	109–290	133–312	268
Total length (mm.)	91–381	152–418	196–457	380
Tail length as percentage of total length	19.4–35.7	28.2–32.3	31.7	29.5
	Per Cent of Specimens	Per Cent of Specimens	Per Cent of Specimens	Per Cent of Specimens
Costal grooves 34	60	0	0	100
Costal grooves 35	40	100	100	0

total length, differs in lacking the interorbital and occipital bars. The dorsal fin extends well forward of the anus in both larvae, whereas in adults the fin originates just behind a point opposite the anus. The tail length of the larvae comprises, respectively, 20.8 and 24.2 per cent of the total length. Subadults less than 250 mm. in total length have nail-like cornifications on the toe tips. In large adults the toes have blunt, horny tips or no cornification at all.

No definite trends in geographic variation within Illinois have been discerned for the western lesser siren. A specimen from Mason County (INHS 6553) with a total length of 457 mm. appears to be the largest recorded for this salamander. There is considerable individual variation in the order of toe length, in color, and in distinctness of markings. Other variation for four small samples is to be found in table 15.

Habits.—The western lesser siren, which is permanently aquatic, frequents swamps, ditches, and sloughs. Captured individuals squirm violently and they are difficult to hold because of their slipperiness. Cagle & Smith (1939) found, in a culvert in southern Illinois, an aggregation of 138 individuals that appeared to be hibernating. There is evidence, however, that this salamander usually is active throughout the winter. Its food consists principally of arthropods, mollusks, and worms.

Bishop (1941) noted that the several hundred eggs, laid in early spring by the female of this salamander, are deposited in hollows in the mud bottom of a pond.

The eggs average about 3 mm. in diameter. Details are lacking regarding incubation time and larval development. A larva taken May 15 was less than 30 mm. in total length. This specimen was kept in a cattle watering trough until July 1. During this time it metamorphosed and attained a total length of 111 mm., having increased its length approximately fourfold in 6 weeks.

Illinois Distribution.—The exact range of *Siren* in Illinois can be only guessed. Probably the population has been reduced in historic times to narrow fingers of floodplain swamp that margin the medium-sized and large rivers of the state, fig. 52. In the Illinois River valley the species occurs north to Peoria County. The absence of records for counties in the upper Mississippi River valley is unaccountable, since the extensive river bottoms seem to offer ideal habitat. The statement that the species occurs in northern Illinois (Davis & Rice 1883*a*, 1883*b*) was based on a specimen in the Northwestern University collection. No specific locality was given, and the specimen has disappeared. The former occurrence of *Siren* in northeastern Illinois is possible, however, in view of records for Porter County, Indiana (Pope 1944*b*).

Fig. 52.—Distribution of *Siren intermedia*. Hatching indicates the presumed range of the subspecies *nettingi;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

This salamander is common in the southern fourth of Illinois, but it is difficult to collect by conventional techniques. If special effort is made, it can be taken in numbers. Many specimens can be secured in the Pine Hills swamp with a minnow seine. I have heard reports of animals fitting the description of *Siren* from Effingham, Fayette, and Jasper counties, in addition to the localities plotted on the map, fig. 52.

Published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CASS COUNTY: Beardstown (Weed 1923); MADISON COUNTY: Alton (Cope 1875); MONROE COUNTY: (Hurter 1911); PERRY COUNTY: 5 mi. E Du Quoin (Goin 1942); RANDOLPH COUNTY: (Hurter 1911); ST. CLAIR COUNTY: (Hurter 1911); UNION COUNTY: 5 mi. NE Jonesboro (Goin 1942); Union County State Forest (Cagle 1942*a*); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WILLIAMSON COUNTY: 1 mi. NE Herrin (Cagle & Smith 1939); Johnston City, Marion (Cockrum 1941).

Order SALIENTIA

Frogs and Toads

Twenty-one species and subspecies of frogs, treefrogs, and toads occur in Illinois.

Members of the order Salientia may be divided into three rather artificial groups: the true frogs, the toads, and the treefrogs. The true frogs, in general, are terrestrial, but they are forced to remain near water because of their rapid rate of dehydration. The toads are more resistant to desiccation and may occur far away from ponds and streams. The treefrogs also are fairly resistant to desiccation and they are usually

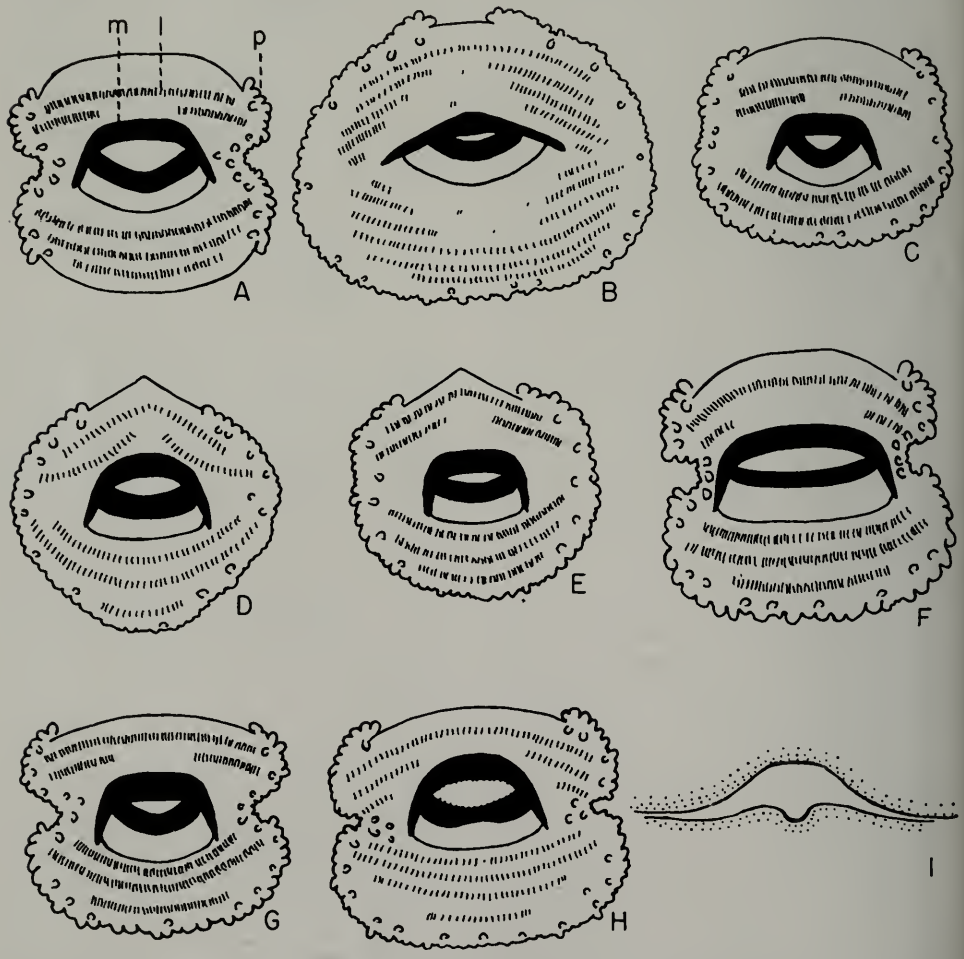


Fig. 53.—Mouthparts of some Illinois tadpoles (*A–I*): *A, Bufo americanus americanus; B, Scaphiopus holbrooki; C, Acris crepitans blanchardi; D, Pseudacris streckeri illinoensis; E, Hyla versicolor versicolor; F, Rana clamitans melanota; G, Rana pipiens sphenocephala; H, Rana sylvatica sylvatica; I, Gastrophryne carolinensis carolinensis; l,* labial teeth; *m,* mandible; *p,* papillary fringe.

arboreal in habits. Frogs and toads are primarily nocturnal, although they may be encountered occasionally during the day. In size they range from the inch-long cricket frog to the 8-inch bullfrog. All Illinois salientians are predatory and partially or exclusively insectivorous. Most frogs and toads are alert and quick in their movements. Their ability to leap, their habit of concealing themselves, and their protective coloration aid them in escaping predators.

Typically, the salientian life history begins anew each spring with migration to water. The males arrive first and utter their characteristic mating calls; the females follow in a day or so, and the clasping process or amplexus occurs. The males fertilize the eggs as they are laid by the females; after fertilization the eggs develop jelly-like envelopes. The eggs may be single, in strings, or in packets. They may be floating masses or they may be attached to objects on the bottom of a pond or stream. Hatching occurs in a few days, and the tadpoles or larvae begin feeding on algae almost immediately. The tadpole, which is limbless, has modified mouthparts consisting of a horny beak and rows of labial teeth. The arrangement of the mouthparts is distinctive for all genera and for some species, fig. 53. When the tadpole is a few weeks old, limb buds appear. The hind legs develop a few days earlier than the front legs. As the limbed tadpole grows, it spends more and more time at the edge of the water or at the surface. Gradually the tail is resorbed, and certain internal changes take place. The newly transformed froglet, recognizable by the temporary tail stub, has undergone important changes in the respiratory, circulatory, digestive, and skeletal systems, and by the end of summer the animal has acquired adult features, fig. 54.

Variations from the typical life cycle among the Illinois species consist of differences in length of time required for attaining adulthood, differences in breeding sites, and differences in breeding seasons. All of the Illinois species have an aquatic larval stage.

Five of the 21 species and subspecies known in Illinois have ranges centering to the south of the state. These are *Scaphiopus holbrooki, Hyla avivoca, H. cinerea, Rana pipiens sphenocephala,* and *Gastrophryne carolinensis.* The last species is of special interest, inasmuch as the Illinois population seems to be a relict rather than a peripheral colony. Farther south the species is both generally distributed and abundant.

Two Illinois frogs have ranges that center to the north of Illinois and that extend southward approximately to the central part of the state. These are *Rana pipiens pipiens* and *Rana sylvatica cantabrigensis.*

Six essentially eastern frogs enter Illinois from the east or southeast. These are *Pseudacris triseriata feriarum, Hyla crucifer crucifer, H. versicolor versicolor, Rana clamitans melanota, R. palustris,* and *R. sylvatica sylvatica.*

Four predominantly western frogs have ranges that extend into or beyond Illinois. These are *Bufo americanus charlesmithi, Pseudacris triseriata triseriata, P. streckeri illinoensis,* and *Rana areolata. Pseudacris s. illinoensis* is deserving of special note because the Illinois population is a relict with a hiatus of about 300 miles between it and the nearest population of *P. s. streckeri.*

Four species are wide-ranging and cannot be classified readily. These are *Bufo americanus americanus, B. woodhousei fowleri, Acris crepitans,* and *Rana catesbeiana.*

Key to the Order Salientia
(Frogs and Toads)

1. Horny cutting tubercles on heel of each foot, fig. 55 2
   No horny cutting tubercles on heel of each foot 5
2. One elongate, spadelike cutting tubercle on each heel, fig. 55; parotoid glands round and inconspicuous; eye pupils vertically elliptical (Pelobatidae) . . . . . *Scaphiopus holbrooki*
   Upper and lower horny tubercles on each heel, fig. 56; parotoid glands prominent and elongate; eye pupils horizontally elliptical (Bufonidae) 3
3. Venter plain or with a necklace of small spots across breast; maximum snout-vent length 75 mm. 4
   Venter completely spotted or mottled with dark; maximum snout-vent length 95 mm. . . . . *Bufo americanus americanus*
4. Dorsal dark spots on body small, each usually including a single tubercle; tibial warts distinctly larger than femoral warts . . . *Bufo americanus charlesmithi*
   Dorsal dark spots on body large, each usually including many tubercles; tibial warts no larger than femoral warts . . . . . *Bufo woodhousei fowleri*
5. Transverse fold of skin behind head; head less than one-fourth snout-vent length;

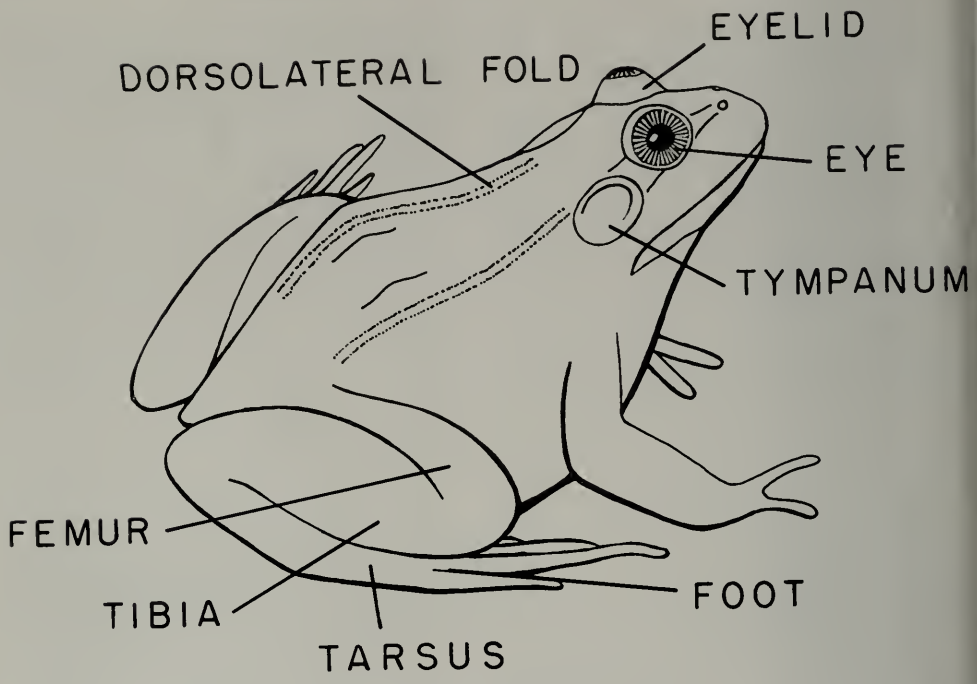


Fig. 54.—Lateral view of a frog.

tympanum absent (Microhylidae) .... ..*Gastrophryne carolinensis carolinensis*
No fold of skin behind head; head approximately one-third the snout-vent length; tympanum present 6

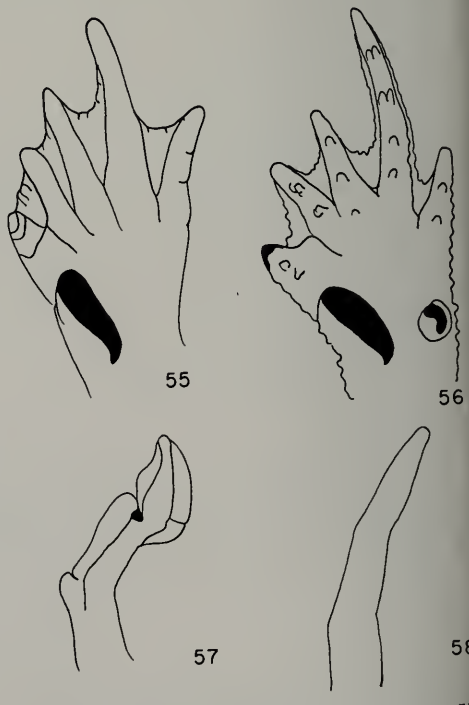
6. Terminal toe pads and intercalary cartilages present, fig. 57 (Hylidae) 7
Terminal toe pads and intercalary cartilages absent, fig. 58 (Ranidae).....14

7. Toe pads scarcely wider than penultimate joints; snout-vent length less than 35 mm. 8
Toe pads distinctly wider than penultimate joints; maximum snout-vent length 70 mm. 11

8. Toes fully webbed; back with numerous warts .....*Acris crepitans blanchardi*
Toes unwebbed, or web restricted to a flange on side of each digit; back smooth to granular 9

9. Lateral dark stripe arising on snout, passing through each eye to shoulder; suborbital dark spot; body short and squat .... *Pseudacris streckeri illinoensis*
Lateral dark stripe passing through each eye beyond shoulder; light, straight-edged maxillary stripe; no suborbital spot; body flattened and elongate...10

10. Tibia 47 per cent or more of snout-vent length; dorsal pattern weak; longitudinal stripes, if present, each usually less than one-half width of interspace..... .....*Pseudacris triseriata feriarum*
Tibia 46 per cent or less of snout-vent length; dorsal pattern usually of distinct longitudinal stripes, each stripe as wide



Figs. 55–58.—Characteristics of frogs: 55, foot of *Scaphiopus;* 56, foot of *Bufo;* 57, digit of *Hyla,* showing intercalary cartilage and terminal pad; 58, digit of *Rana.*

as the space between stripes ..... *Pseudacris triseriata triseriata*

11. Groundcolor tan or pink, with a distinct dark X-mark on the back; unders.de pink or yellow ..*Hyla crucifer crucifer*
No X-mark on back; dorsum unmarked or marked with blotches; venter gray or white 12
12. Rear of femora mottled; suborbital light spot present; back variable in color, usually with a star-shaped dark blotch 13
Rear of femora unmarked; no suborbital light spot; back green, without a star-shaped blotch..... *Hyla cinerea*
13. Rear of femora green, with dark reticulations; snout-vent length under 50 mm. .....*Hyla avivoca avivoca*
Rear of femora orange or yellow, with dark reticulations; maximum snout-vent length 60 mm..*Hyla versicolor versicolor*
14. A pair of dorsolateral folds extending down back, fig. 54; tympanic fold inconspicuous 15
Dorsolateral folds absent; tympanic fold well developed .....*Rana catesbeiana*
15. Dorsolateral folds terminating just beyond mid-back, fig. 54.....16
Dorsolateral folds extending length of back 17
16. Venter heavily reticulate with black; maximum snout-vent length 70 mm.; upper jaw of male olive, throat dusky ..*Rana clamitans clamitans* × *melanota*
Venter usually not heavily blotched or reticulate; maximum snout-vent length 95 mm.; upper jaw of male bright green, throat chrome yellow..... .....*Rana clamitans melanota*
17. No dark mask on side of head; dorsum with distinct spots 18
Dark mask passing through eye and tympanum; dorsal pattern plain or dashed, but without distinct spots . 21
18. Jaws mottled; dorsal spots closely crowded; groundcolor milky white and visible only as tracery around dorsal spots; maximum snout-vent length 110 mm. ..... *Rana arcolata circulosa*
Jaws without mottling; dorsal spots not closely crowded; maximum snout-vent length 100 mm. 19
19. Dorsal spots square or rectangular, regularly arranged in a double row between dorsolateral folds; concealed surfaces of legs and venter yellow *Rana palustris*
Dorsal spots irregular in size and arrangement; concealed surfaces of legs and venter white 20
20. Dorsal spots averaging larger than eye, usually distinctly light margined; snout usually with dark dorsal spot; breeding males with internal vocal sacs; groundcolor green, tan, or brown ..... *Rana pipiens pipiens*
Dorsal spots averaging smaller than eye, not distinctly light margined; snout usually without spot; breeding males with external vocal sacs; groundcolor tan, brown, or gray-green ..... *Rana pipiens sphenocephala*
21. Skin between dorsolateral folds usually smooth and unmarked; tibia usually more than 55 per cent of snout-vent length; maximum snout-vent length 60 mm. ..... *Rana sylvatica sylvatica*
Skin between dorsolateral folds often with secondary dorsal folds or with light or dark longitudinal markings; tibia usually less than 55 per cent of snout-vent length; maximum snout-vent length 50 mm. .....*Rana sylvatica cantabrigensis*

PELOBATIDAE

This family is regarded by some authors as having one genus in North America and by others as including two genera.

Scaphiopus Holbrook

Two or six species in the United States and Canada are included in the genus *Scaphiopus,* the number depending on the taxonomic viewpoints of various authors. One species, which belongs to typical *Scaphiopus,* is found in southern Illinois.

Scaphiopus holbrooki (Harlan)
Eastern Spadefoot

Rana holbrookii Harlan 1835:105 (type locality: South Carolina; revised to Charleston by Schmidt 1953).
Scaphiopus holbrookii holbrookii, Elder 1945: 122.
Scaphiopus holbrookii, P. W. Smith 1948:2.
Scaphiopus holbrooki, Burger, Smith, & Smith 1949:130.
Scaphiopus holbrooki holbrooki, Schmidt 1953: 58.

Diagnosis.—A medium-sized toad (largest Illinois specimen 59 mm. from snout to vent), fig. 59, lacking cranial crests and tubercles on the soles of the feet; vomerine teeth present; an elongate, dark-edged, horny spade on heel of each foot; vertically elliptical pupils; paired pectoral glands; yellow-gray and brown mottled groundcolor, with a pair of crescentic light bars extending from eyes to middle of back; tubercles on dorsum red tipped; chin and venter unspotted.

Variation.—In this species, the male differs from the female in having stouter fingers and black horny deposits on the upper surfaces of the first and second fingers. During the breeding season males have conspicuous subgular vocal pouches.

Fig. 59.—Adult *Scaphiopus holbrooki* from Alexander County, Illinois. The predominant color is dark brown; the crescentic dorsal markings are grayish yellow or bronzy; many of the warts are tipped with red spines.

Twenty specimens at hand fall into four size groups: 4 center about 26.5 mm.; 4 center about 30 mm.; 2 are about 45 mm.; and 10 range from 54 to 59 mm. from snout to vent. A female with a body length of 45 mm. contains eggs. The young toads differ from adults chiefly in their proportionately larger heads and greater wartiness. Specimens under 45 mm. have spines tipping almost all the body warts, whereas larger toads have spines that usually are restricted to warts on the head and interparotoid regions. Juveniles have poorly defined tympanums, and their dorsal tubercles are so arranged as to form two interparotoid ridges.

Head length in the 20 specimens comprises 33.9 to 38.5 per cent of the snout-vent length; head width 38.4 to 44.0 per cent; and tibia length 34.3 to 37.7 per cent. Adults vary in smoothness of skin, some large individuals being completely smooth in the midback region. The color varies from brown to black, with yellow-gray to dirty yellow markings.

Habits.—The spadefoot is subterranean and is usually found only in the breeding ponds. Most of our specimens have been obtained by following farmers' plows or raising logs. Toads of this species can quickly bury themselves, rear end first, by scooping away soil with the spades on their heels. Their food consists of arthropods and annelids.

Breeding of the spadefoot has been observed in May and August in southern Illinois. A specimen plowed up in June con-

Fig. 60.—Distribution of *Scaphiopus holbrooki*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle represents a published record believed to be valid. The lower map depicts the total range of the species in the United States.

tained well-developed eggs. Apparently breeding may occur any time between March and September, the time depending on the distribution of the heavy summer rains. Moderate rains do not provide sufficient stimulus for breeding. The mating call is a nasal grunt, uttered frenziedly, and can be heard almost half a mile away. Eggs are laid in short, irregular strings that are attached to vegetation in temporary pools or flooded fields. Hatching reportedly requires only 1 or 2 days, and the tadpoles may transform in 2 or 3 weeks. The broad, short-tailed tadpole has distinctive mouthparts, fig. 53.

Illinois Distribution.—The species is known in Illinois only in the southern tip of the state, fig. 60. Although this species occurs farther north on the Atlantic Coast, the nearest records outside Illinois are in Kentucky rather than Indiana, suggesting that the species entered southern Illinois via the Mississippi River valley.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: Jackson County: Makanda (P. W. Smith 1948).

BUFONIDAE

Only one genus of the family Bufonidae is represented in the United States and Canada.

Bufo Laurenti

This world-wide genus contains 15 species in the United States and Canada, most of which consist of several subspecies. Two species occur in Illinois.

Bufo americanus Holbrook

Many authors prefer to regard *Bufo americanus* and the southern toad, *B. terrestris,* as conspecific and to recognize four subspecies of *terrestris.* For the most part, the ranges of the two toads are widely separated; Neill (1949*b*) has shown that where they are in contact they maintain their specific identities. I am in accord with Neill in believing that the two are best considered distinct species. *B. americanus,* as here defined, consists of three subspecies, a well-marked Canadian race and two named races in the United States that are poorly defined morphologically and geographically.

Two populations of *B. americanus* occur in Illinois. A small, rather plain, woodland animal occurs sporadically in the southern half of the state; and a large, well-spotted, prairie form is abundant in the northern half. It is uncertain if either of the Illinois toads is the *B. americanus* of Holbrook, as a cursory examination of material from scattered localities in the eastern United States reveals that eastern toads are intermediate between the two Illinois forms in most characters.

The dwarf race in southern Illinois is provisionally referred to *B. a. charlesmithi,* because the paratypes I have examined are similar to the southern Illinois form, although appreciably smaller at sexual maturity. The large form of northern Illinois is provisionally, and reluctantly, referred to *B. a. americanus,* pending a complete reinvestigation of the *americanus* complex.

Bufo americanus americanus Holbrook
American Toad

Bufo americanus Holbrook 1836:75, pl. 2 (type locality: Maine through all the Atlantic States; revised to vicinity of Philadelphia, Pennsylvania, by Schmidt 1953); Kennicott 1855:592.
Bufo lentiginosus americanus, Yarrow 1882*a*: 166 (part).
Bufo americanus americanus, Schmidt & Necker 1935:64.
Bufo terrestris americanus, P. Smith 1947:30.
Bufo americana, Grassley 1923:130.
Bufo lentiginosus, Shelford 1913:187, 296.
Bufo fowleri nec Hinckley, Nichols 1937:18–9.
Bufo woodhousii fowleri nec Hinckley, Stille & Edgren 1948:197 (part).

Diagnosis.—A large toad (largest Illinois specimen 90 mm. from snout to vent), fig. 61, with conspicuous, elongate, parotoid glands and strongly developed cranial crests; venter dark spotted or mottled; tubercles on dorsal surface of tibia prominently enlarged; dark dorsal spots including more than one wart in about 50 per cent of individuals; head length usually less than 30 per cent of snout-vent length; parotoid gland length usually less than 21 per cent of snout-vent length.

Variation.—The male of the American toad differs from the female in being of smaller size and in having stouter first and

second fingers, horny deposits on these digits, and vocal pouches.

Juveniles differ from adults chiefly in having poorly developed cranial crests and inconspicuous tympanums. In details of pattern and proportions, no marked differences are apparent between subadults and adults. Newly transformed toads, however, are black and have light tubercles.

The most pronounced geographic variation is found in samples from Coles County and Adams and Hancock counties, near the southern edge of the range. Specimens in these samples are intermediate in size between the prairie form and the dwarf form. They approach the dwarf race in their proportionate head length, relative parotoid length, and reduced ventral patterns. Other samples from the northern half of Illinois are rather homogeneous. The variation is summarized in table 16.

Habits.—The original habitat of the American toad is problematical since the species is best known in gardens, orchards, and lawns. Individuals are encountered both in woods and in fields. The species has been presumed (P. W. Smith 1947) to be essentially a prairie animal, since in eastern Illinois the range terminates abruptly at the Shelbyville Moraine. On a spring night these toads can be heard singing in almost every flooded field north of the moraine.

Fig. 61.—Dorsal and ventral views of a subadult *Bufo americanus americanus* (left) from La Salle County, Illinois, and an adult *Bufo americanus charlesmithi* (right) from Pope County, Illinois. The dorsal groundcolor of both subspecies ranges from dark brownish black to olive and even to rusty red. The red color is particularly common among males of *B. a. charlesmithi*.

During the day American toads hide in hrubbery or bury themselves in the soil, oming forth at dusk to feed on insects and orms.

The peak of the breeding season is mid-April. The call is a sustained, high, musical rill and can be heard during the day as well

ern half of the state, *americanus* is quite general in its occurrence. In spring breeding aggregations are surprisingly large even in some areas where toads are seldom seen at other seasons.

Nichols' (1937) study of the larval mouthparts of *B. w. fowleri* undoubtedly refers to

Table 16.—Geographic variation in four samples of sexually mature Illinois *Bufo americanus americanus*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Northern Illinois (11)		Champaign-Sangamon Counties (17)		Coles County (12)		Adams-Hancock Counties (7)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
nout-vent length (mm.)	55.2–76.2		60.8–90.0		55.2–74.8		47.0–67.0	
Head length as percentage of body length	26.8–30.9	28.6	26.7–30.2	28.6	26.4–32.9	29.2	27.6–31.2	29.9
Parotoid length as percentage of body length	17.5–22.8	19.4	15.6–21.5	19.0	16.6–23.4	20.4	18.8–23.8	21.4
Ventral pattern*	3-5	3.9	3–5	4.1	2–5	3.0	2–4	3.2
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
One wart per dorsal spot	64		35		58		100	

*Ventral pattern indicated by index number. The index numbers have been assigned as follows: venter immaculate r with a single pectoral spot, 1; a few scattered spots on the breast region, 2; a zone of dark spots across the breast, ; entire venter spotted, 4; venter predominantly dark, 5.

s at night. The female lays several thou-and eggs in long strings, and these strands ıay extend for several feet along the bottom f a pond or ditch. Each jelly string com-ıonly contains double or sometimes triple ows of eggs, the individual eggs ranging rom 1.2 to 1.4 mm. in diameter. Hatching ccurs in approximately a week. The small lack tadpoles, easily recognized as toad arvae, fig. 53, are almost identical in all he Illinois species of *Bufo*. Metamorphosis ccurs in early June.

Heavy rain late in the season may stimu-ate singing by small, newly matured males.

Illinois Distribution.—With the excep-ion of the sand areas, where *Bufo woodhousei fowleri* predominates, *B. a. americanus* is the common toad of the northern alf of Illinois, fig. 62. In much of the black oil prairie it is the only toad. Although his form is less conspicuous in northern Illi-ois than *fowleri* appears to be in the south-

B. a. americanus, since both breeding dates and locality preclude the possibility of his specimens being *fowleri*.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Cook County: Calumet City (Schmidt & Necker 1935); Evanston, Morton Grove (Necker 1939*c*); West Pullman (Hubbs 1918); Wilmette (Necker 1939*c*); Winnetka (Hubbs 1918); Wolf Lake (Schmidt & Necker 1935); Du Page County: Downers Grove, Glen Ellyn, Naperville (Schmidt & Necker 1935); Kane County: Batavia, West Dundee (Stille & Edgren 1948); Lake County: Fox Lake, Half Day (Schmidt & Necker 1935); Waukegan (Hubbs 1918); Stephenson County: Freeport (H. Garman 1892); Will County: Joliet (Hubbs 1918); New Lenox (Schmidt & Necker 1935).

Bufo americanus charlesmithi Bragg
Dwarf American Toad

Bufo terrestris charlesmithi Bragg 1954:247 (type locality: 1.8 mi. S, 7 mi. E Norman, Cleveland County, Oklahoma).

Bufo lentiginosus americanus nec Holbrook, ?Yarrow 1882*a*:166 (part).

?Bufo americanus nec Holbrook, Burt & Burt 1929:2.

Bufo americanus americanus nec Holbrook, Cagle 1942*a*:179.

Diagnosis.—A small to medium-sized race of *Bufo americanus* (largest Illinois specimen 69 mm. from snout to vent but usually less than 60 mm. at sexual maturity), fig. 61, differing from *B. a. americanus* in the following characteristics: smaller size; plain or sparsely spotted venter; head length usually more than 30 per cent of snout-vent length (in 80 per cent of specimens); somewhat greater parotoid length; dorsal spots, if present, small and including a single wart (83 per cent of specimens).

Remarks.—Although the dwarf form (*B. a. charlesmithi*) and the large form (*B. a. americanus*) are difficult to distinguish because of the overlap in characters, there is little doubt that these two forms represent distinct biological entities in Illinois. Whatever its status, the dwarf race has a considerable range. Parker (1939) illustrated a specimen from Reelfoot Lake, Tennessee, where it is reportedly uncommon, and I have seen specimens in central Arkansas and southern Missouri.

Variation.—Like the large form, *B. a. charlesmithi* is characterized by sexual dimorphism. Also, there is some evidence that in *B. a. charlesmithi* the males tend to be unicolorous, whereas females have obscure, dorsolateral light bands on a reddish ground-color.

No information is available on ontogenetic variation. The few juvenile specimens available are small replicas of the adults.

Geographic variation for three samples is summarized in table 17. The number, length, and proportions are for sexually mature specimens. The variation in dorsal and ventral patterns, however, is for both adults and juveniles.

Habits.—The dwarf American toad, uncommon in Illinois, is apparently a forest animal. Otherwise, it is probably similar to the large form in habits. Breeding aggregations of the small form have been encountered on a few occasions in flooded fields and shallow ditches on the Mississippi River floodplain. Most specimens at hand, however, have been found in steep-sided excavations that were too deep for the toads to climb or jump from. The ecological relationships of this toad with Fowler's toad need study.

The peak of the breeding season appears to be the first half of April. The call is a prolonged, high trill that I cannot distinguish from the song of the large form. The eggs are laid in long strings, and there is a single row of eggs within each string. The individual eggs range from 1.5 to 2.0 mm. in diameter. Additional observations are

Table 17.—Geographic variation in Illinois *Bufo americanus charlesmithi*. Figures in parentheses are numbers of specimens.

Characteristic	Pope County		Union County		Monroe County	
	Range (5)	Mean	Range (9)	Mean	Range (5)	Mean
Snout-vent length (mm.)	52.8–68.0	.....	42.8–56.0	.....	48.0–69.5	.....
Head length as percentage of body length	29.8–33.9	31.8	28.6–34.2	31.6	28.8–31.8	31.1
Parotoid length as per cent of body length	21.8–22.8	22.4	18.4–23.4	21.3	19.4–24.2	21.3
	Range (8)	Mean	Range (13	Mean	Range (7)	Mean
Ventral pattern index*	1–5	2.5	1–4	2.7	1–5	3.0

*Ventral pattern indicated by index number. The index numbers have been assigned as follows: venter immaculate or with a single pectoral spot, 1; a few scattered spots on the breast region, 2; a zone of dark spots across the breast, 3; entire venter spotted, 4; venter predominantly dark, 5.

needed to confirm the apparent difference between the two forms in number of rows of eggs per strand. I have not seen tadpoles, but it is likely that transformation occurs in late May and early June.

Illinois Distribution.—The occurrence of *B. a. charlesmithi* is sporadic, fig. 62; this toad is subordinate in numbers to *B. woodhousei fowleri* even in the forested Shawnee Hills, where it is best known. Since adequate samples of *B. americanus* are not available from the Southern Division, the subspecific status of the toads from this area is uncertain. The rarity and the consistently small size of the few specimens known from this part of the state strongly suggest the dwarf race.

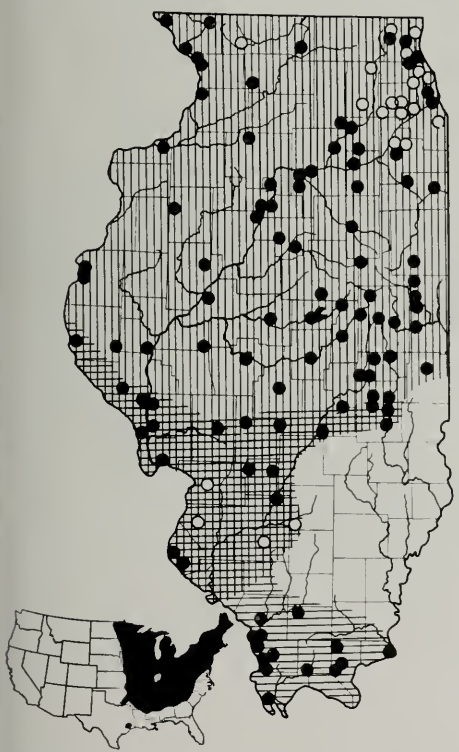


Fig. 62.—Distribution of *Bufo americanus*. Vertical hatching indicates the presumed range of *Bufo americanus americanus* in Illinois; horizontal hatching, the presumed range of *Bufo americanus charlesmithi;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

The Richland County records of Cope (1889) and Gaige (1914) have not been accepted here, because Cope's Olney material that is still extant contains only *B. w. fowleri.* Moreover, Mrs. Gaige in her paper failed to mention Fowler's toad, which is so abundant in Richland County that it is inconceivable it would have been overlooked. There is some doubt concerning the Marion County record of H. Garman (1892) and the Washington County record of Burt & Burt (1929), but since there are recent collections of *B. americanus* in Bond, Clinton, Macoupin, and Montgomery counties, Garman's and Burts' records may be valid. No records for either race of *americanus* are known for the Wabash Border division.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: MADISON COUNTY: (Hurter 1911); MARION COUNTY: Centralia (H. Garman 1892); ST. CLAIR COUNTY: (Hurter 1911); WASHINGTON COUNTY: Nashville (Burt & Burt 1929).

Bufo woodhousei fowleri Hinckley
Fowler's Toad

Bufo fowleri Hinckley 1882:310 (type locality: Milton, Massachusetts); Hubbs 1918:42–3.
Bufo woodhousii fowleri, Necker 1938:2.
Bufo woodhousei fowleri, Schmidt 1953:67.
Bufo lentiginosus americanus nec Holbrook, ?Yarrow 1882*a*:166.
Bufo lentiginosus lentiginosus, H. Garman 1890:189–90.
Bufo americanus nec Holbrook, ?Gaige 1914:4.

Diagnosis.—A medium-sized gray or greenish gray *Bufo* (largest Illinois specimen 69 mm. from snout to vent), fig. 63, typically with 2 or 3 pairs of large dark blotches between the parotoid region and anus, each blotch containing 3 or more warts; tibial warts never conspicuously enlarged; belly never spotted; breast usually with a single pectoral spot in specimens from southern Illinois, often with numerous dim spots in specimens from northern and central Illinois; cranial crests present but not strongly developed; throat of male black.

Variation.—In this toad, the male differs from the female in being smaller in size and in having a dark throat; also it has horny growths on the upper surfaces of the inner fingers.

Juveniles differ from adults chiefly in size. The newly transformed toadlet is clearly recognizable as Fowler's toad. The partially grown specimen lacks the clearly defined tympanum of the adult. The parotoid glands are proportionately larger. The parotoid length of seven specimens less than 40 mm. in body length averages 21.7 per cent of the snout-vent length, whereas the average parotoid length of seven adults over 58 mm. is 20.6 per cent.

The available series indicate an increasing frequency, from south to north, of individuals with spotted breasts. This variation is not strictly clinal in nature, but a general trend is discernible, as shown in table 18. It is noteworthy that all of the 23 specimens available from the Henderson-Mercer county sand area in northwestern Illinois are spotted beneath and would therefore key out as *B. americanus* by the most frequently employed character in anuran keys.

Fig. 63.—A subadult *Bufo woodhousei fowleri* from Tazewell County, Illinois. The ground-color is light gray, tan, or greenish gray; the spots are dark brownish black.

Table 18.—Geographic variation in ventral pattern of Illinois *Bufo woodhousei fowleri*. Figures in parentheses are numbers of specimens.

Characteristic	Southern Half of Illinois (133)	North-Central Illinois (47)	Extreme Northwestern Illinois (23)	Extreme Northeastern Illinois (14)
Breast spotted (per cent of specimens with).....	18.2	54.7	100.0	14.0
Pectoral spot only (per cent of specimens with).....	81.8	45.3	0.0	86.0

Habits.—Fowler's toad is one of the most conspicuous amphibians in the southern half of Illinois and it is abundant in almost all suitable habitats. It may be encountered day or night; during the hottest part of the summer it is found less frequently during the day than at night. This toad feeds on insects and probably on earthworms; captive individuals, however, are reluctant to eat worms.

Fig. 64.—Distribution of *Bufo woodhousei*. Hatching indicates the presumed range of the subspecies *fowleri* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Breeding occurs from late April until late June, the peak occurring in mid-May. The song is a prolonged nasal scream. The eggs are laid in long strings similar to those of *B. americanus charlesmithi*. Hatching occurs in approximately a week, and the tadpoles transform from late June through July.

Illinois Distribution.—Fowler's toad is extremely common in the southern half of Illinois, fig. 64. In west-central Illinois, it is abundant along the Mississippi and Illinois rivers, which provide sand areas or sandy floodplains. In the Mississippi River valley north of Mercer County, an area containing seemingly ideal habitat of sand prairie, records for Fowler's toad are lacking, despite considerable field work in northwestern Illinois and adjacent Iowa. In east-central Illinois, these toads are extremely sporadic in occurrence in the black soil north of the Shelbyville Moraine.

Where *B. woodhousei fowleri* and *B. a. americanus* occur together in northern Illinois, there is a tendency for *fowleri* to occupy sandy areas and stream or lake margins. Evidence that a combination of soil type and temperature is more important than competition with the American toad in determining the range of *B. w. fowleri* is given by (1) a close correlation of species abundance and soil type in eastern Illinois and (2) a northward extension of the *fowleri* range along the shores of the Great Lakes, which presumably moderate the climate.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JOHNSON COUNTY: 20 mi. N Metropolis (Blanchard 1924*b*); PULASKI COUNTY: Villa Ridge (H. Garman 1892).

HYLIDAE

This world-wide family contains four or five genera in the United States and Canada, the number depending on the viewpoints of various authors.

Acris Duméril & Bibron

Many authors regard the strictly North American genus *Acris* as monotypic and refer the several described, but poorly defined, subspecies to *Acris gryllus* Le Conte. The conspecificity of Coastal Plain *gryllus* and inland *crepitans* has not been demonstrated, however, and the race occurring in Illinois is accordingly considered a subspecies of *crepitans*. The cricket frogs in Illinois seem to belong to a single, rather homogenous population. Their characters are in essen-

tial agreement with those of the recently described *blanchardi* (Harper 1947). Accordingly, the Illinois frogs are provisionally assigned to *blanchardi*, even though this subspecies is doubtfully distinct from *A. crepitans crepitans*.

Acris crepitans blanchardi Harper
Blanchard's Cricket Frog

Acris gryllus blanchardi Harper 1947:39 (type locality: meadow near Smallen's Cave, Ozark, Christian County, Missouri).
Acris gryllus gryllus nec Le Conte, Yarrow 1882*a*:169.
Acris gryllus, S. Garman 1884:44.
Acris gryllus crepitans × *gryllus*, Cope 1889: 325, 331.
Acris gryllus crepitans nec Baird, Yarrow 1882*a*:169.
Acris crepitans, Schmidt & Necker 1935:64–5.

Diagnosis.—A small hylid frog (largest Illinois specimen 31.2 mm. from snout to vent), fig. 65, with digital discs scarcely wider than penultimate joints; extensively webbed feet; pointed head; tibia 58 per cent or more of body length; usually a few to many dorsal warts; light line from each eye to shoulder; dark postfemoral stripe on each leg; numerous vertical, light bars on snout.

Variation.—During the breeding season of Blanchard's cricket frog the male is easily distinguished from the female by the discolored throat and vocal pouch. Other dimorphism has not been noted in the Illinois series.

I have been unable to find ontogenetic variation other than size.

A study of adequate series reveals only minor geographic variation for this frog in Illinois. There is some indication that specimens in the southern fifth of the state are relatively small, the largest of a series of 37 specimens from this region being only 28 mm. from snout to vent. The largest specimens in series from other areas exceed this

Fig. 65.—An adult *Acris crepitans blanchardi* from McLean County, Illinois. The groundcolor may be gray, brown, black, olive, or tan; the markings, when present, are green, olive, or rusty red.

Table 19.—Geographic variation from north to south in tibia length to body length ratios of Illinois *Acris crepitans blanchardi*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	EXTREME NORTHERN ILLINOIS (34)		NORTH-CENTRAL ILLINOIS (19)		SOUTH-CENTRAL ILLINOIS (29)		EXTREME SOUTHERN ILLINOIS (44)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Tibia length as percentage of body length.....	55.6–69.6	59.6	55.3–70.0	60.9	55.0–69.9	61.2	55.9–67.8	61.4

length by 1 to 3 mm. Data for 157 specimens indicate that individuals from the northern half of Illinois tend to be more rugose than those from the southern half. The available data on color and pattern types indicate that individuals with green, or more rarely rust-colored, middorsal marks occur with greatest frequency in the Shawnee Hills division and with least frequency in the Mississippi Border counties.

A slight leg-length gradient is discernible from south to north, but no east-west cline is apparent. The leg-length variation is summarized in table 19.

Habits.—This cricket frog is the most common amphibian in Illinois, and almost any wet place affords suitable habitat. Although *Acris* is a hylid, it is like a true frog in habits. The digital pads are minute, and the species is aquatic and terrestrial but not arboreal. This frog is alert and capable of making leaps astounding for its small size. It is reluctant to hibernate and it has been found active as early as February and as late as December. Its food consists of minute arthropods.

Although the adult cricket frogs are able to tolerate near freezing temperatures without becoming inactive, the breeding season is late. Singing commences about the last of April in Illinois and continues throughout the summer. The males float on the surface or sit on masses of algae while uttering their metallic "gick, gick, gick." The small eggs are deposited as surface films of about a half dozen in each packet; one female may produce over 200 eggs. The tadpole is easily distinguished by its black-tipped tail. Metamorphosis apparently occurs from July through September, the time depending on when the eggs were laid.

Illinois Distribution.—The cricket frog is abundant in all parts of the state, fig. 66.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Deer Grove Park, Evanston, Wolf Lake (Necker 1939*c*); DU PAGE COUNTY: Glen Ellyn, Naperville (Schmidt

Fig. 66.—Distribution of *Acris crepitans*. The subspecies *blanchardi* occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

& Necker 1935); Henry County: Colona, Geneseo (H. Garman 1892); Jackson County: 2 mi. S Elkville (Burt & Burt 1929); Kane County: Dundee (Stille & Edgren 1948); Geneva (H. Garman 1892); Lake County: Highland Park (Schmidt & Necker 1935); Fox Lake (Necker 1939*c*); McHenry County: Richmond (Schmidt & Necker 1935); Macoupin County: Standard City (Owens 1941); Morgan County: Meredosia (Weed 1923); Ogle County: Grand Detour (Yarrow 1882*a*); Peoria County: Peoria (H. Garman 1892); Perry County: Tamaroa (Burt & Burt 1929); Tazewell County: Pekin (H. Garman 1892); Union County: 7 mi. S Anna (Burt & Burt 1929); Wabash County: Mount Carmel (Cope 1889); Will County: 3 mi. N Beecher (Burt 1935); Lockport, Marley (Necker 1939*c*); New Lenox, Wheatland Township (Schmidt & Necker 1935).

Pseudacris Fitzinger

This strictly North American genus of terrestrial hylids contains seven species, three of which consist of several subspecies. Two species are known in Illinois.

Pseudacris triseriata (Wied)

This species, as currently defined, includes three subspecies in the United States and Canada. Two of these occur in Illinois. For many years the three subspecies here assigned to *triseriata* and the southeastern chorus frogs, *nigrita* and *verrucosa*, were considered subspecies of *Pseudacris nigrita*. Schwartz (1957) demonstrated that the forms *nigrita* and *feriarum* behave as full species in the Coastal Plain of South Carolina and recommended the taxonomic arrangement here employed. *P. triseriata* and *P. nigrita* are actually intermediate between the specific and subspecific levels of differentiation; for, although they are specifically distinct in South Carolina, Georgia, and Florida, they are not so in southern Mississippi, where they behave as subspecies.

Pseudacris triseriata feriarum (Baird)
Upland Chorus Frog

Helocaetes feriarum Baird 1854*a*:60 (type locality: Carlisle, Cumberland County, Pennsylvania).

Chorophilus nigritus feriarum, Jordan 1888: 360.

Chorophilus feriarum, Cope 1889:341.

Pseudacris feriarum, Stejneger & Barbour 1917:30.

Pseudacris nigrita feriarum, Stejneger & Barbour 1933:32.

Chorophilus triseriatus nec Wied, H. Garman 1892:343–5 (part).

Pseudacris triseriatus nec Wied, Schmidt 1938*a*:380 (part).

Pseudacris nigrita triseriata nec Wied, Cagle 1941:6 (part).

Pseudacris nigrita nec Le Conte, P. W. Smith 1948:2.

Diagnosis.—A small hylid frog (largest Illinois specimen 32 mm. from snout to vent), fig. 67, without webbing between the toes; toes with slightly expanded discs; dorsum smooth to granular; venter granular or pustular; a light maxillary stripe; usually a triangular-shaped interorbital marking; distinct longitudinal lateral stripes; 3 longitudinal dorsal stripes or series of spots or flecks derived from 3 stripes; tibia 47 per cent or more of snout-vent length; head length 32 per cent or more of snout-vent length; and often with a tan or red-brown groundcolor.

Variation.—In this frog the male differs from the female in being smaller in size and in having slightly enlarged thumbs and longitudinal gular folds. During the breeding season, the throat of the male is discolored and the vocal pouch is evident because of its dark color.

Juveniles differ from adults chiefly in their proportionately larger heads and longer tibiae.

Individual variation in this frog is pronounced both in pattern and in habitus. Typically, the pattern consists of a distinct stripe along each side and 3 weak, and often interrupted, dorsal stripes. Occasional specimens are flecked with uniformly distributed dark markings above, and infrequent specimens are unicolorous above. Other individuals are broadly striped above, as in *Pseudacris triseriata triseriata*. The groundcolor ranges from gray-green to red-brown. Some specimens are slender, with conspicuously widened heads; others are squat, differing from *P. t. triseriata* only by their longer legs.

In a series of 42 specimens from the extreme southern tip of the state the tibia length is 43.6 to 58.4 (average 50.7) per cent of body length and the head length (for

23 specimens) 29.6 to 37.5 (average 34.5) per cent of body length.

In a series of 20 specimens from the Shawnee Hills, the tibia length is 44.9 to 52.0 (average 48.7) per cent of body length; head length (for 12 specimens), 30.9 to 34.1 (average 32.3) per cent of body length.

Geographic variation in *P. t. feriarum*

Fig. 67.—An adult *Pseudacris triseriata feriarum* from Saline County, Illinois. The ground-color is tan, gray, or light reddish brown; the weak dorsal stripes or spots are usually dark brown.

Table 20.—Geographic variation in tibia length to body length ratios of Illinois *Pseudacris triseriata feriarum* × *triseriata* intergrades. Figures in parentheses are numbers of specimens.

Characteristic	Jackson-Saline Counties (16)		Jefferson-Wabash Counties (16)		Richland County (48)		Clark-Crawford Counties (4)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Tibia length as percentage of body length.....	42.6-51.1	46.3	43.6-54.7	47.4	43.3-51.1	47.3	39.0-53.7	46.5

has been described elsewhere (Smith & Smith 1952). In Illinois the most pronounced variation is manifested by populations which intergrade with the northern, shorter-legged race, *triseriata*. Samples from the intergrading area do not exhibit the regular, accelerated cline from long legs to shorter legs, as might be expected. Instead, the characters of the two races are so intermingled that one sample may be referred to *feriarum* while one from an adjacent locality may be referred to *triseriata*. The erratic nature of the intergrade population is illustrated by four samples, table 20.

Habits.—*P. t. feriarum* is essentially a forest animal, occurring on floodplains and in mesic upland woods except during the breeding season, when it may be found around almost any type of temporary pool. In summer this frog is sometimes seen on the forest floor or perched on herbaceous plants in swampy places. It feeds on small arthropods.

Breeding occurs in temporary ditches or pools from late February until May, the peak occurring in mid-March. The male sings while perched at the edge of a pool or floating in the water; its call is similar to the noise made by rubbing a thumbnail over the teeth of a comb. The female deposits approximately 100 small eggs in elongate clusters that are attached to vegetation or sticks. Hatching occurs in a few days, and the tadpoles transform in May and June.

Illinois Distribution.—This subspecies occurs in the southern tip of Illinois, fig. 69, and intergrades with *P. t. triseriata* throughout the Wabash River valley from Saline to Clark counties.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: WABASH COUNTY: Mount Carmel (Cope 1889).

Pseudacris triseriata triseriata (Wied)
Western Chorus Frog

Hyla triseriata Wied 1839:249 (type locality: Rush Creek, approximately 4 mi. S New Harmony, Posey County, Indiana); Kennicott 1855:593.
Pseudacris nigrita triseriata, Hurter 1893:254.
Pseudacris triseriata, Weed 1923:49.
Helocaetes triseriatus, Baird 1854*a*:60.
Chorophilus triseriatus triseriatus, Yarrow 1882*a*:170.
Chorophilus triseriatus, Cope 1889:343, 347.
Pseudacris triseriatus, Schmidt 1929:10–1.
Chorophilus nigritus nec Le Conte, Shelford 1913:195, 206, 283, 296.
Pseudacris nigrita nec Le Conte, P. W. Smith 1948:2.

Fig. 68.—An adult *Pseudacris triseriata triseriata* from McLean County, Illinois. The groundcolor is tan, gray, or greenish gray; the dorsal stripes are dark olive or brownish black.

Pseudacris feriarum nec Baird, Pope 1919: 83–4.
?Acris gryllus nec Le Conte, Ridgway 1915: 94, 95.

Diagnosis.—A subspecies of *Pseudacris triseriata* (largest Illinois specimen 36 mm. from snout to vent), fig. 68, differing from *P. t. feriarum* in having shorter legs (tibia less than 47 per cent of snout-vent length in 95 per cent of specimens); proportionately wider body and smaller head (head length less than 32 per cent of snout-vent length in 80 per cent of specimens); usually a distinct triseriate dorsal pattern; and usually a gray, gray-green, or slate groundcolor.

Variation.—Sexual variation and ontogenetic variation are apparently identical in the two Illinois subspecies of *P. triseriata.* Individual variation involves occasional reduction of the striped pattern and differences in proportions, although specimens of this race are somewhat less variable than those of *feriarum.* No marked geographic variation, exclusive of the intergrading populations described under *P. t. feriarum,* has been discerned, but there is an indication that extreme northern Illinois specimens of *triseriata* may average a bit smaller than those from central Illinois. The absence of a leg-length gradient has been pointed out elsewhere (Smith & Smith 1952). Variation in pattern and proportionate head size is similarly nongeographic. The leg-length variation in four samples is given in table 21.

Habits.—The western chorus frog appears in temporary pools and ditches in great numbers early in the spring, and its voice is the most familiar frog sound in Illinois. After the breeding season, this species is seldom seen, and its habitat is not well known. Occasional specimens have been taken in summer and fall under rocks, grain shocks, or other objects. It is essentially a prairie animal, and it thrives in the most intensively cultivated regions of the state. Individuals encountered out of water progress by short, rapid hops and often try

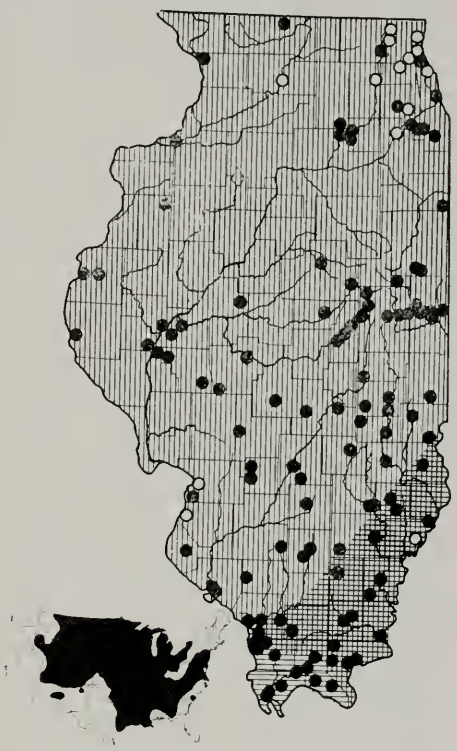


Fig. 69.—Distribution of *Pseudacris triseriata.* Vertical hatching indicates the presumed range of *Pseudacris triseriata triseriata* in Illinois; horizontal hatching, the presumed range of *Pseudacris triseriata feriarum;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Table 21.—Geographic variation in tibia length to body length ratios of Illinois *Pseudacris triseriata triseriata.* Figures in parentheses are numbers of specimens.

Characteristic	Jasper County (32)		Morgan-Brown Counties (20)		Champaign County (25)		Cook-Lake Counties (30)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Tibia length as percentage of body length.....	40.3–45.9	43.6	39.6–44.5	42.0	37.1–47.1	42.5	38.1–45.9	42.7

to secrete themselves under objects or in cracks in the ground. Its food consists of small arthropods.

Breeding occurs from early March into May, the peak occurring in late March. The song, egg-laying habits, and development are presumably similar to those of *P. t. feriarum,* although both hatching and transformation occur later in the season than in *feriarum.*

Illinois Distribution.—*P. t. triseriata* occurs commonly throughout Illinois except in the southern tip of the state, where it is replaced by *P. t. feriarum,* and in the Wabash River valley, where it is replaced by a *feriarum* × *triseriata* intergrade population, fig. 69.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Deer Grove (Necker 1939*c*); Palatine (Schmidt & Necker 1935); West Northfield (Yarrow 1882*a*); DU PAGE COUNTY: Downers Grove (Schmidt & Necker 1935); KANE COUNTY: Elgin (Schmidt & Necker 1935); LAKE COUNTY: Beach (Schmidt & Necker 1935); Fort Sheridan (Pope 1919); Fox Lake, Half Day, Highland Park (Schmidt & Necker 1935); Volo, Waukegan (Necker 1939*c*); MADISON COUNTY: Mitchell (Hurter 1893); OGLE COUNTY: Oregon (H. Garman 1892); ST. CLAIR COUNTY: Bluff Lake (Hurter 1893); WILL COUNTY: Lockport (Schmidt & Necker 1935).

Pseudacris streckeri illinoensis Smith
Illinois Chorus Frog

Pseudacris streckeri illinoensis, P. W. Smith 1951:190 (type locality: 3 mi. N Meredosia, Morgan County, Illinois).
Pseudacris streckeri illinoisensis, Schmidt 1953: 76.
Pseudacris feriarum brachyphonus nec Cope, Weed 1923:49.
Pseudacris sp., Walker 1932:382.

Diagnosis.—A medium-sized hylid frog (largest Illinois specimen 42 mm. from snout to vent), fig. 70, with a toadlike habitus; vestigial webs; intercalary cartilage; digital pad smaller than penultimate phalanx; lateral dark stripe from snout to shoulder; upper jaw light, with a prominent, dark suborbital spot; a dark interorbital V- or Y-shaped marking; and groin the same color as the dorsal groundcolor.

Variation.—In the Illinois chorus frog, the male differs from the female in having a vocal pouch and being smaller in size. During the breeding season the throat of the male is discolored.

Newly transformed individuals of this subspecies are dull gray, and their dorsal pattern is inconspicuous. The single known subadult differs slightly in proportions from

Fig. 70.—Adult *Pseudacris streckeri illinoensis* from Cass County, Illinois. The groundcolor is tan, flesh color, or light bronze; the markings are light brown to chestnut brown.

mature specimens. This subadult, 28 mm. from snout to vent, has a tibia length 46.4 per cent and a head length 36.1 per cent of the snout-vent length. Ten adults at hand have tibia lengths 39.7 to 42.4 (average 41.0) per cent and head lengths 29.8 to 32.4 (average 30.8) per cent of the snout-vent lengths.

The specimens obtained since the original description appeared (P. W. Smith 1951) have not appreciably altered the known range of individual variation. At the time of the original description, one of the supposedly diagnostic features of *Pseudacris streckeri illinoensis* was the reduced lateral stripe (82 per cent of specimens with dark stripe no larger than postorbital stripe). Examination of additional material reveals that this character is of questionable value. However, the diagnostic value of the groin color and groin pattern, the two principal characters utilized, has been substantiated by an examination of additional specimens of *P. s. illinoensis,* as well as of *P. s. streckeri.* In addition, the greenish groundcolor of the dorsum, which is of frequent occurrence in *P. s. streckeri,* apparently never occurs in *P. s. illinoensis.*

Approximately 75 per cent of the specimens available possess a dark, inverted Y-shaped marking on one or both shoulders, with the inner prong usually extending to the middle of the back. The dorsum bears a few dark bars and occasionally round, dark spots posteriorly.

Habits.—This frog is known only from specimens taken during the breeding season, and accordingly its habitat is unknown. It is abundant in the small area in which it is known; during the breeding season, choruses can be heard continuously along the highways in the area. *P. s. illinoensis* is terrestrial and probably similar to *P. triseriata triseriata* in behavior. On land it progresses by short, toadlike hops. Captives have eaten various insects that were obtained in a sweeping net such as is used for collecting insects.

Breeding in this subspecies occurs from the first to the last of March. The call of the male is a series of short, loud, birdlike whistles. The female lays approximately 400 eggs; the number in each mass and the shape of the mass are not known. Large tadpoles taken in mid-May transformed in the laboratory in late May and early June.

Illinois Distribution.—Since originally described, this frog has been found in an additional Illinois county and in a sand prairie in extreme southeastern Missouri. The total known range, fig. 71, occupies only four Illinois counties and one locality

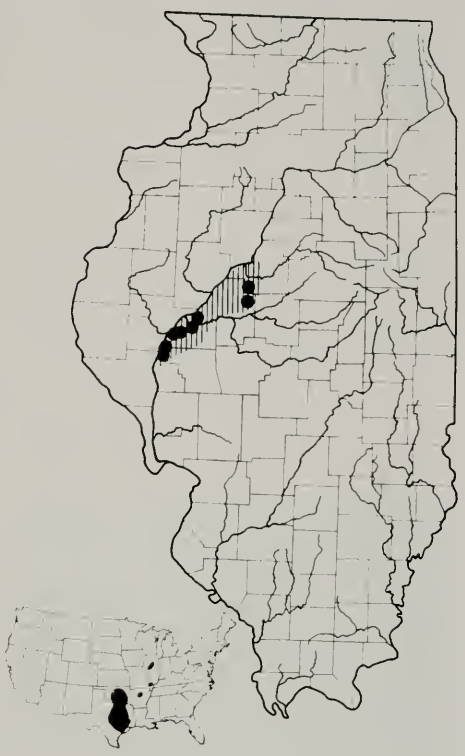


Fig. 71.—Distribution of *Pseudacris streckeri.* Hatching indicates the presumed range of the subspecies *illinoensis* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

in Missouri. To date, attempts to find the frog in other sand areas in the state have been unsuccessful, but there is some possibility that it occurs in the Oquawka sand prairie and perhaps also in the Iroquois-Kankakee sand area.

The relationships of this subspecies and its nearest relative, which occurs in central Oklahoma and Texas, have been discussed in the original description of *P. s. illinoensis.* The discovery of this animal in central Illinois is of some zoogeographic importance in that it provides additional evidence to support the Prairie Peninsula hypothesis and

the occurrence of a post-glacial xerothermic period.

Hyla Laurenti

The cosmopolitan genus *Hyla* contains 12 or 14 species in the United States and Canada, the number depending upon the taxonomic viewpoints of different authors. Many of the species consist of two or more subspecies. Four species occur in Illinois.

Hyla avivoca avivoca Viosca
Western Bird-Voiced Treefrog

Hyla avivoca Viosca 1928:89 (type locality: Mandeville, Louisiana); Harper 1933:230.
Hyla phaeocrypta, Viosca 1923:96–7 (part).
Hyla versicolor phaeocrypta, Wright & Wright 1933:134 (part).
Hyla phaeocrypta phaeocrypta, Schmidt 1953: 71–2.

Diagnosis.—A small, slender, smooth-skinned *Hyla* (largest Illinois specimen 36.5 mm. from snout to vent), fig. 72, with a gray

Fig. 72.—An adult *Hyla avivoca avivoca* from Union County, Illinois. The groundcolor varies from pale gray to light green to almost black; the markings are dark gray, brown, or black.

or green groundcolor and usually an asymmetrical, star-shaped, dark dorsal blotch; distinct suborbital light spot; wash of green color in groin and on rear of thighs in which black or brown reticulations or spots are present; relatively large eyes (33 to 44 per cent of head length); tympanum 43 to 59 per cent of eye diameter; and subarticular pustule on outer finger of hand usually divided.

Variation.—The male is considerably smaller than the female in this frog and it possesses either a discolored throat or longitudinal folds, which indicate the presence of a vocal sac.

No information on ontogenetic variation is available for Illinois populations of *Hyla avivoca avivoca.* Hellman (1953) noted that newly transformed frogs of the Florida population are about 13 mm. in snout-vent length, are pea-green above, and possess prominent suborbital light spots.

Individual variation in a series of 31 Union County specimens is as follows: snout-vent length 27.8 to 36.5 mm.; head length 28.3 to 31.6 (average 29.9) per cent of body length; tibia length 45.0 to 52.7 (average 48.5) per cent of body length; eye

Fig. 73.—Distribution of *Hyla avivoca.* Hatching indicates the presumed range of the subspecies *avivoca* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

33.0 to 43.5 (average 37.4) per cent of the head length; eye 28.6 to 35.3 (average 32.7) per cent of head width; tympanum 43.1 to 59.1 (average 49.1) per cent of eye diameter. The dorsal blotch is variable in size and shape. Metachrosis is well developed in *H. a. avivoca,* and living frogs may be light green, light enamel gray, or almost black.

Habits.—The western bird-voiced treefrog has been seldom collected except in breeding choruses, but its normal habitat is likely identical with the breeding site, which is cypress swamps. Breeding individuals are found above the water of the swamps, on vines, tree branches, or stems of *Cephalanthus.* Captives usually change from gray or black to light green when placed in dry, well-lighted containers.

Breeding in this treefrog occurs in southern Illinois from mid-May into August. The call of the male is a prolonged, quavering, birdlike note. Eggs have not been found in Illinois. Hellman (1953) found that Florida females contain 600 or more ovarian eggs, which are subsequently laid in submerged packets. Hatching occurs in 3 or 4 days, and the larval period requires about a month. The tadpole of both the Florida and Illinois populations is dark brown, with 3 to 7 red saddles and thin bronze-colored stripes on the head.

Illinois Distribution.—This species is known to extend into Illinois only as far as extreme southern Jackson County, fig. 73. It is abundant in the floodplain swamps of western Union and Alexander counties, but efforts to secure specimens in similar swamps of adjacent Massac, Johnson, and Pulaski counties have been unsuccessful.

Hyla cinerea (Schneider)
Green Treefrog

Calamita cinereus Schneider 1799:174 (type locality: Carolina; revised to Charleston, South Carolina, by Schmidt 1953).
Hyla cinerea, H. Garman 1890:189.
Hyla cinerea cinerea, H. Garman 1892:346–8.
Hyla lateralis, Brendel 1857:254.
Hyla cinerea semifasciata, H. Garman 1890: 189.
Hyla carolinensis, Hay 1892*a*:585.

Diagnosis.—A large, slender *Hyla* (largest Illinois specimen 56 mm. from snout to vent), fig. 74, bright green or olive-

Fig. 74.—A subadult *Hyla cinerea* from Union County, Illinois. The groundcolor is normally bright leaf-green, occasionally olive-green; the lateral stripe, white; the dorsal flecks are gold.

green above, without markings or with scattered, minute gold flecks; white lateral stripes extending onto shoulder region or beyond; smooth skin; and with a longitudinal light stripe along the dorsal surface of the tibiotarsus.

Variation.—The male of *H. cinerea* averages slightly smaller than the female and has a wrinkled throat indicating the vocal pouches.

Cagle (1942*a*) found that the newly transformed frog of this species is green only on the back of the head and that 12 days are required for the entire dorsum to become green. The subadult appears less elongate and the head length range is 31 to 36 per cent of the body length (in 10 juveniles under 35 mm.), whereas the head length range is from 30.0 to 31.5 per cent in the adult (six specimens over 40 mm.). The tympanum is evident in all of our material, but it is proportionately larger in mature specimens.

Eighteen specimens from Alexander and Union counties, ranging from 22.6 to 55.8 mm. in snout-vent length, exhibit the following variation: tibia length 48.4 to 55.0 (average 53.2) per cent of body length; lateral stripes present, extending no more than half the distance from tympanum to groin in 33 per cent, and more than half in 67 per cent. There are one to many small gold flecks, sometimes black-margined, over the back in each of our specimens.

Habits.—The green treefrog is one of the most colorful of Illinois amphibians. It is found in cypress swamps, along floodplain sloughs, and in cattail marshes. During the day it usually perches on a cattail blade, with its legs tucked underneath the body; because of its green color, it is difficult to see. Captives sometimes turn olive-green, particularly when cold, but most wild individuals are bright leaf-green.

Breeding in the green treefrog occurs from mid-May until August. The call of the male is a measured and monotonous "quonk, quonk, quonk." A chorus imparts a distinct metallic sound, and the song has been compared to the sound of cowbells. Wright & Wright (1949) report that eggs are laid in small packets or films among floating vegetation, that hatching presumably occurs in a few days, and that the larval period is approximately 2 months. Cagle (1942*a*) found newly transformed frogs the last of May, however, indicating that the eggs had been laid in late March or early April. Singing males have never been found earlier than May in southern Illinois. The life history of the species needs reinvestigation.

Illinois Distribution.—This species is known from the Mississippi and Ohio river floodplains in the extreme southern tip of Illinois, where it occurs in abundance, fig. 75. A Madison County record for *cinerea,* in which Hurter (1893) used the synonymous name *carolinensis,* is puzzling, for Hurter leaves little doubt that he was familiar with *cinerea,* inasmuch as the species with which it might be confused were reported in the same paper. Some doubt remains, however, since Hurter in a later paper (1911) failed to mention the

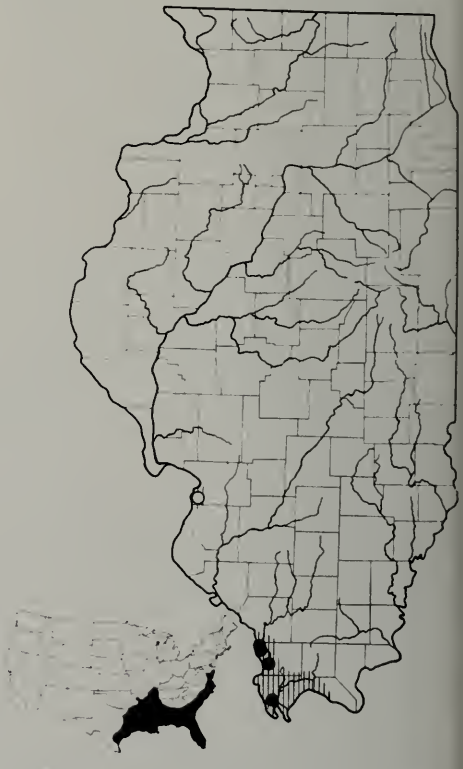


Fig. 75.—Distribution of *Hyla cinerea.* Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

Madison County locality, although he cited specimens from southeastern Missouri. I have not been able to find the species anywhere north of Union County.

Hyla crucifer crucifer Wied
Northern Spring Peeper

Hyla crucifer Wied 1839:275 (type locality: Leavenworth, Leavenworth County, Kansas); Schmidt 1929:10.
Hyla crucifer crucifer, Pope 1944*b*:95–100.
Hyla pickeringii, Kennicott 1855:593.
Hyla pickeringi, Davis & Rice 1883*a*:28.

Diagnosis.—A small *Hyla* (largest Illinois specimen 34 mm. from snout to vent), fig. 76, tan or brown, usually with a distinct pinkish cast; a prominent dark X-mark on the back and a dark mark between the eyes; toe pads distinctly wider than penultimate joints; snout projecting beyond mouth in lateral view; without suborbital light spot or light maxillary stripe.

Variation.—The male in this diminutive hylid is somewhat smaller than the female and possesses longitudinal gular folds, which permit expansion of the vocal pouch. During the breeding season, the throat of the male is discolored and saclike.

Juveniles tend to have a less well-defined dorsal pattern and the groundcolor is usually lighter.

Geographic variation is not pronounced in the Illinois series. Spring peepers from

Fig. 76.—An adult *Hyla crucifer crucifer* from Monroe County, Illinois. The groundcolor is pink or tan; the markings are brown.

Table 22.—Geographic variation in Illinois *Hyla crucifer crucifer*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	EXTREME SOUTHERN ILLINOIS (23)		SOUTHERN ILLINOIS NORTH OF SHAWNEE HILLS (40)		NORTH-CENTRAL ILLINOIS (9)		EXTREME NORTHERN ILLINOIS (4)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.), maximum	34.0	.....	31.6	.....	30.0	.....	22.1	.....
Head length as percentage of body length	27.9–34.7	31.7	28.2–34.7	30.7	28.9–31.3	30.2	29.3–33.4	31.1
Tibia length as percentage of body length	46.8–55.7	51.2	44.9–53.0	48.9	42.6–48.5	46.0	47.3–49.8	48.7
	PER CENT OF SPECIMENS		PER CENT OF SPECIMENS		PER CENT OF SPECIMENS		PER CENT OF SPECIMENS	
Without dark ventral flecks	43		28		3		5	

the northern part of the state, however, appear to be smaller in size and their venters are more often pigmented. The leg-length variation is irregular. Data for 76 specimens from four areas are summarized in table 22. The sample from extreme northern Illinois is actually from the northeastern corner of the state, and the strikingly shorter-legged frogs of this species from north-central Illinois are from the Illinois River sand area.

Habits.—The northern spring peeper occurs in mesic forest, living in trees or on herbaceous plants. It is normally abundant around woodland ponds early in the spring but difficult to find later in the season. Late in the fall, however, the male, whose gonads are again ripe, may begin singing from the woods. The peeper feeds on various small arthropods.

Breeding in this species occurs from early March to early June. The song is a soft, birdlike whistle and may be heard during the day or night at the peak of the breeding season. Diurnal singers usually are in trees or hidden under the leaves of the forest floor; at night peepers sing from the edge of the water or on vegetation over the water. The female deposits her several hundred eggs singly, and each egg is attached to a stick or other submerged object. Hatching occurs in a few days, and the larvae transform in May and June.

Illinois Distribution. — Apparently the northern spring peeper is state-wide in occurrence, fig. 77; abundance varies widely in different parts of Illinois. In the northern half of the state it probably does not occur in small islands of forest surrounded by prairie or cultivated fields, but it is known in the more extensive wooded areas along rivers. The absence of records from the Upper Mississippi Border counties probably reflects the small amount of field work in this region during the peeper breeding season; the species is known in adjacent Iowa and Missouri.

Where peepers occur, they are much in evidence in spring because of their abundance and the carrying power of their penetrating birdlike calls. In Illinois they are sporadic in distribution. In adjacent Indiana a person can hear a continuous chorus of peepers as he drives along the highways in spring.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Homewood, Palos Park (Schmidt & Necker 1935); LAKE COUNTY: Beach (Schmidt 1929); ST. CLAIR COUNTY: (Hurter 1893).

Fig. 77.—Distribution of *Hyla crucifer*. The subspecies *crucifer* occurs throughout Illinois mainly in extensive wooded areas. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Hyla versicolor versicolor Le Conte
Eastern Gray Treefrog

Hyla versicolor Le Conte 1825:281 (type locality: northern states; revised to vicinity of New York City by Schmidt 1953); Kennicott 1855:592.
Hyla versicolor versicolor, Blanchard 1924*b*: 534.
Hyla versicolor phaeocrypta Cope 1889:375 (type locality: Mount Carmel, Illinois).
Hyla phaeocrypta, Viosca 1923:96–7 (part).
Hyla phaerocrypta, Burt 1928:630.

Diagnosis.—A large *Hyla* (largest Illinois specimen 57 mm. from snout to vent), fig. 78, with a suborbital light spot on each side of head; usually a star-shaped or irregular dark blotch on the back; dorsum tubercular or pustular; digital pads distinctly widened; posterior surfaces of thighs with orange-yellow spots enclosed by a dark matrix or a loose reticulation of yellow and brown or black; a simple subarticular pustule on outer finger of hand usually present (70 per cent of specimens); tympanum usually 52 per cent or more of the diameter of eye.

Remarks.—Two Illinois populations are evident. In one, in the southern half of the state, the dark color on the rear of the femora encloses round yellow spots and the dorsal blotch is star shaped. In the other, in the northern half, the thighs are reticulated brown and yellow or uniformly yellow and the dorsal blotch is nondescript.

Fig. 78.—An adult *Hyla versicolor versicolor* from Union County, Illinois. The groundcolor varies from pale gray to light green to almost black; the markings are dark gray, brown, or black.

Series intermediate between these pattern types are available from the Illinois River valley (the north-central Illinois sample in table 23).

There is a great deal of individual variation in specimens from any one locality, and the differences mentioned above are rather slight, particularly in preserved frogs. Accordingly, all the Illinois series are provisionally referred to *H. versicolor versicolor,* pending a detailed investigation of geographic variation in the species. There is some possibility that the population in the southern half of Illinois is assignable to *H. v. chrysocelis,* inasmuch as the frogs there appear to be identical with comparative material from Arkansas. If *chrysocelis* is valid, its range requires redefinition.

Variation.—In this treefrog the male is somewhat smaller than the female and, during the breeding season, is readily distinguished from the female by the presence of the discolored vocal pouch. In the male a process of the pad at the base of the thumb extends onto the upper surface of the thumb, whereas in the female this pad is restricted to the ventral and inner side of the thumb.

Newly transformed frogs of this species are green or gray-green. The characteristic suborbital light spot and the postfemoral reticulation are not evident, but both appear in frogs of about 25 mm. from snout to vent. Proportionate head size and leg length are much the same in adult and juvenile. The proportionate size of the tympanum increases with larger body size. Thus, in 10 specimens under 28 mm. the tympanum averages 52.5 per cent of the diameter of the eye; in 22 specimens 28 to 36 mm. the tympanum is 58.2 per cent; in 27 specimens 36 to 45 mm. it is 60.1 per cent; and in 10 specimens over 45 mm. it is 62.4 per cent.

In addition to the differences in postfemoral patterns mentioned under "Remarks," both proportionate head length and proportionate leg length decrease toward the north, although the gradients are not steep. These trends are illustrated in table 23.

Habits.—The eastern gray treefrog inhabits forested areas. Although a tree animal, it is seen on the ground when it is migrating to breeding ponds. In the summer, particularly during dry weather, this treefrog lives in hollows of dead trees or under the bark of stumps or of moist, rotten logs. On three occasions individuals have been found in pump spouts of abandoned wells. Metachrosis in this treefrog is well developed, as

Table 23.—Geographic variation in Illinois *Hyla versicolor*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southern Illinois (28)		Southern Illinois North of Shawnee Hills (29)		North-Central Illinois (36)		Extreme Northern Illinois (22)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	21.6–57.0	.....	23.0–49.3	.....	22.9–51.9	.....	31.2–43.8	.....
Head length as percentage of body length	28.8–33.8	31.5	28.0–34.6	30.7	27.9–34.8	30.4	28.1–30.9	29.7
Tibia length as percentage of body length	45.5–52.8	48.2	43.0–52.6	46.9	42.0–52.5	46.9	44.5–50.2	46.5
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
With postfemoral pattern of *H. v. chrysocelis*	75.0		69.0		34.5		0	

the species name implies, and individuals often blend so well with tree bark that they are difficult to discern. Captives vary from almost black (usually when cold and wet) to enamel gray or light green (under optimum conditions). Individuals found in shaded floodplains in the summer and fall may be quite conspicuous in color. In such habitats they often perch at the tips of dead branches, and their almost white coloration is in sharp contrast to the black tree limbs. The food of the gray treefrog consists of various arthropods.

Breeding in this treefrog occurs from late April into August, the peak occurring in late May. The season varies with latitude, and males may occasionally sing late in the fall, when their gonads have again ripened.

Fig. 79.—Distribution of *Hyla versicolor*. The subspecies *versicolor* occurs throughout Illinois wherever there are wooded areas. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

The call of the male is a loud, guttural trill. Singing males may be in trees or bushes, on the ground, or in the water. The breeding sites are extremely variable, ranging from water-filled automobile tracks to creeks or lakes. The packets of two or three dozen eggs are loosely attached to vegetation at the surface of the water. Hatching occurs in a few days, and the larvae transform from May to August. The tail of the tadpole is boldly marked with red and black.

Illinois Distribution.—The eastern gray treefrog commonly occurs in forested areas over all of Illinois, fig. 79. It may be absent from small islands of forest surrounded by prairie, but it occurs in narrow strips of forest along streams, even in areas predominantly prairie.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: Cook County: Aux Plaines (Yarrow 1882*a*); Chicago (Schmidt 1929); Willow Springs (Schmidt & Necker 1935); Jackson County: Murphysboro (Cagle 1942*a*); Kankakee County: Hopkins Park, Pembroke Township (Necker 1939*c*); Kendall County: Yorkville (H. Garman 1892); Knox County: Galesburg (H. Garman 1892); Lake County: Fox Lake (Necker 1939*c*); Half Day (Schmidt & Necker 1935); Highland Park (Schmidt 1929); McHenry County: McHenry (Stille & Edgren 1948); Rock Island County: Rock Island (H. Garman 1892); Union County: Anna (H. Garman 1892); Will County: Custer Park (Stille & Edgren 1948).

RANIDAE

This family, which includes the typical frogs, occurs on all of the continents and ranges in latitudinal distribution from the Arctic Circle (North America) southward to Queensland (Australia). In the New World this large family contains only one genus.

Rana Linnaeus

This world-wide genus is represented in the United States and Canada by about 15 species, most of which consist of two or more subspecies each. Eight species and subspecies of *Rana* have been found in Illinois.

Fig. 80.—Adult *Rana areolata circulosa* from Marion County, Illinois. The groundcolor is milky white; the closely crowded spots are brown or black.

Rana areolata circulosa Rice & Davis
Northern Crayfish Frog Gopher Frog

Rana circulosa Rice & Davis 1878:355 (type locality: Benton County, Indiana; revised incorrectly to northern Illinois by Stejneger & Barbour 1943; corrected by Mittleman 1947; revised incorrectly to Richland County, Illinois, by Schmidt 1953).
Rana areolata circulosa, Davis & Rice 1883*a*: 28.
Rana aerolata circulosa, Peters 1942:182.
Rana areolata capito nec Le Conte, Yarrow 1882*a*:178.
Rana capito nec Le Conte, S. Garman 1884:41.
Rana areolata, H. Garman 1892:319–20.

Diagnosis.—A large *Rana* (largest Illinois specimen 109.8 mm. from snout to vent), fig. 80, with dorsolateral folds; conspicuously mottled upper jaws; prominent hump at the middle of the back; tympanum always smaller than eye; large head; conical snout; and milky white groundcolor visible at the margins of the many closely crowded, round, black spots.

Variation.—The female gopher frog averages larger than the male and possesses heavy glandular ridges under the tympanums. The male has a pair of saclike vocal pouches on the sides of the head and enlarged thumbs.

Ten newly transformed specimens, ranging from 22.5 to 24.5 mm. in snout-vent length, differ from sexually mature adults by their proportionately larger heads, shorter legs, more distinctly spotted dorsums, and less distinctly barred legs. Head length in 10 juveniles ranges from 39.6 to 41.0, averaging 40.2, per cent of the body length, whereas in 50 frogs over 57 mm. in snout-vent length it ranges from 30.0 to 37.1, averaging 33.3, per cent. Tibia length for the 10 juveniles ranges from 42.5 to 47.5, averaging 45.1, per cent of the body length, whereas in the 50 adult specimens it ranges from 34.9 to 53.9, averaging 48.8, per cent.

Data provided by three samples of adults suggest a slight reduction in proportional

Table 24.—Geographic variation in proportionate leg length in three Illinois samples of *Rana areolata.* Figures in parentheses are numbers of specimens.

Characteristic	Edgar-Coles-Cumberland Counties (20)		Lawrence to Bond Counties (11)		Williamson County (21)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	65.9–109.8	.....	74.0–101.3	.....	57.2–106.3	.....
Head length as percentage of body length	30.0–35.5	33.5	31.0–37.5	33.1	31.0–37.1	33.2
Femur length as percentage of body length	39.6–49.8	44.3	43.9–47.3	45.4	35.3–43.6	38.3
Tibia length as percentage of body length	46.7–53.9	50.7	48.2–52.0	50.3	34.9–49.9	46.2

leg length toward the south, table 24. Other trends in geographic variation are not evident.

Habits.—Except for a brief period in spring when it is mating, the gopher frog remains hidden in abandoned crayfish holes and is seldom encountered above ground. The distribution of this species is apparently correlated with the hardpan, clay soils that are extensive in southern Illinois. Outlier prairies, wet pastures, and golf courses are particularly favorable habitats. During summer and fall an adult can sometimes be found by investigating a large-bore crayfish hole that has a bare platform to one side of the entrance. The frog usually may be seen an inch or so below the surface, but when disturbed it backs down to the bottom of the burrow, where it wedges its body against the sides of the hole. The bottom of the burrow usually contains fecal matter, including crayfish remains. The depth of the hole averages a little less than a yard.

Fig. 81.—Distribution of *Rana areolata*. Hatching indicates the presumed range of the subspecies *circulosa* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

The breeding season of this frog varies somewhat with temperature and the distribution of spring rains; choruses have been heard from early March to mid-April. The call of the male is a prolonged bass snore with remarkable carrying power. The preferred breeding sites are flooded fields, farm ponds, and small lakes in pastures or on golf courses; at the peak of the season several hundred adults may occupy a single pond. Approximately 5,000 eggs are deposited by each female in shallow water as large, submerged masses. Hatching probably requires several days. The larvae transform in Illinois in late June and early July.

Illinois Distribution.—The gopher frog, or northern crayfish frog, is a characteristic animal of the outlier prairies of the southern half of Illinois, fig. 81, and it is much more abundant than the map indicates. In Illinois the range of the species terminates abruptly at the southern edge of the Shelbyville Moraine; records for adjacent Indiana and Iowa extend slightly farther north.

Rana catesbeiana Shaw
Bullfrog

Rana catesbeiana Shaw 1802:30 (type locality: South Carolina; revised to vicinity of Charleston by Schmidt 1953); Shelford 1913:171.
Rana catesbiana, Yarrow 1882*a*:184.
Rana catesbeana, Hankinson 1915:294.
Rana pipiens nec Schreber, Brendel 1857:254.
?Rana clamitans nec Latreille, Hankinson 1910: 25.

Diagnosis.—A large *Rana* (largest Illinois specimen 154 mm. from snout to vent), fig. 82, lacking dorsolateral folds but possessing well-developed tympanic folds; webbing extending to toe tips; olive, green, or brown dorsum, with dots or obscure blotches but not with discrete dark spots; median gular vocal pouch in the male; and tympanum larger than eye in adults of both sexes.

Variation.—The male bullfrog differs from the female in being smaller in size and in having greatly enlarged tympanums, swollen thumbs, yellow throat, and two openings inside the mouth which lead to the vocal pouch.

Virtually all juveniles less than 60 mm. in snout-vent length are olive, with small,

black, evenly distributed dots over the dorsum. The dots are retained in occasional adults but they are usually brown rather than black. In most large subadults the dark dots are lost and the pattern, if present at all, consists of mottling or light, obscure blotches on a darker groundcolor. Sexual dimorphism is not evident in juveniles.

The range of individual variation in pattern and proportions in a single sample usually exceeds any geographic variation discernible. The mean tibia length in samples of 12 to 20 specimens from Shawnee Hills, south-central Illinois, and north-central Illinois varies from 48.5 to 49.3 per cent of the body length, exhibiting a difference of less than 1.0 per cent. A series of 20 specimens from western Illinois differs only slightly, averaging 47.5 per cent. The lower mean, which is of doubtful significance, is due to nine specimens, from Adams and Hancock counties, that are somewhat shorter-legged. Half of the specimens available are reticulated or spotted ventrally; the highest frequency of such frogs occurs in western Illinois and the lowest frequency in eastern Illinois. This character is probably of little significance.

Fig. 82.—An adult *Rana catesbeiana* from Coles County, Illinois. The color range is usually olive or brown over the body, with some green on the upper jaw.

Habits.—The bullfrog inhabits almost any type of permanent water, such as lake, pond, river, and creek. Adults are rather solitary, each frog occupying part of the stream or pond to the exclusion of other adults. They are wary and are difficult to approach during the day but rather easy to catch at night. When disturbed they retreat to deeper water with a series of long leaps and considerable splashing. The bullfrog is of some importance as food for man. However, in parts of Illinois the gopher frog is eaten by more people. The bullfrog is voracious, eating almost any animal it can swallow. Although a great many kinds of animals have been found in bullfrog stomachs,

crustaceans and insects probably make up the bulk of the diet.

Breeding in the bullfrog occurs from late April until August. The call of the male is a deep bass, consisting of two slurred syllables. The song, which has great carrying power, has been characterized as "jug-o'-rum" and "br-wum." Each female lays several thousand eggs in a huge surface mass, often a yard across. Hatching occurs in less than a week. Although tadpoles grow rapidly, they presumably overwinter, developing legs the following spring, and metamorphose in July and August of their second season. The larvae may attain a length of more than 6 inches.

Illinois Distribution.—The bullfrog is common in all parts of Illinois, fig. 83.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: COOK COUNTY: Evanston (Schmidt & Necker 1935); Willow Springs (Schmidt 1929); DU PAGE COUNTY: Naperville (Necker 1939*c*); JACKSON COUNTY: Carbondale (Cagle 1942*a*); 2 mi. S Elkville (Burt & Burt 1929); LAKE COUNTY: Waukegan (Schmidt 1929); MCHENRY COUNTY: McHenry (Necker 1939*c*); MACOUPIN COUNTY: Standard City (Owens 1941); MADISON COUNTY: opposite St. Louis (Hurter 1893); MORGAN COUNTY: Meredosia (Weed 1923); PEORIA COUNTY: Peoria (H. Garman 1892); UNION COUNTY: Anna (H. Garman 1892); 7 mi. S Anna (Burt & Burt 1929); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WASHINGTON COUNTY: 7 mi. SE Beaucoup, Nashville (Burt & Burt 1929).

Fig. 83.—Distribution of *Rana catesbeiana*. The species occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Rana clamitans melanota (Rafinesque)
Green Frog

Ranaria melanota Rafinesque 1820:5 (type locality: Lake Champlain, New York).
Rana clamitans melanota, Mecham 1954:1, 4, 5, 9.
Rana clamata, Kennicott 1855:593.
Rana clamitans, Yarrow 1882*a*:183.

Diagnosis.—A medium-sized to large *Rana* (largest Illinois specimen 95 mm. from snout to vent), fig. 84, with prominent dorsolateral folds that extend only to the middle of the back; webbing extending almost to the toe tips; back olive, brown, or green; dorsum plain, or with obscure dark spots which are not light margined; dark spots or reticulations usually on chin, breast, and undersides of legs; sexual dimorphism (in color and size of tympanum) pronounced.

Variation.—In *Rana clamitans melanota* the male differs from the female in having a larger tympanum, swollen thumbs, and stouter forelegs. In most of Illinois, it has a bright green upper jaw and yellow throat; the population in extreme southern Illinois is exceptional in that color dimorphism is less pronounced. The female is said to be larger than the male; this size difference is not obvious in the series at hand, although the largest specimen known is a female.

Ontogenetic variation is not striking, but the ventral markings are somewhat bolder in subadults than in large frogs.

In most of Illinois geographic variation in the green frog is rather slight. A weak

Fig. 84.—An adult *Rana clamitans melanota* from Vermilion County, Illinois. The ground-color is green, olive, or brown. Males usually have green upper jaws and yellow throats.

Table 25.—Geographic variation in Illinois *Rana clamitans*. Figures in parentheses are numbers of specimens.

Characteristic	Northern Illinois (39)		Western Illinois (13)		Eastern Illinois (11)		Extreme Southern Illinois (18)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Femur length as percentage of body length	43.2–53.9	48.3	44.2–51.2	48.3	45.2–54.2	49.9	46.1–53.3	48.5
Tibia length as percentage of body length	45.3–54.5	50.2	46.6–54.5	50.4	47.0–54.3	52.1	46.3–54.1	51.2
Snout-vent length (mm.), maximum	95.0	.....	77.0	.....	84.0	.....	79.0	.....
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
With belly unmarked	69.0		84.5		82.0		33.5	

trend toward greater average size and better-developed dorsal spotting in the northern samples is apparent. In the samples from the southwestern tip of the state the individuals are of smaller average size; frequent specimens are without dorsal spotting; and many have dark markings on the belly, some being boldly marbled with black. The males tend to have dusky upper jaws and throats rather than the green and yellow of more northern males. The southwestern samples are assumed to represent an intergrade population, *R. c. melanota* × *clamitans*. The variation is illustrated by four samples, table 25.

Habits.—In northern Illinois the green frog occurs in a variety of aquatic habitats, but in the central and southern counties it appears to be restricted to clear streams in the vicinity of rock outcrops. It is often seen on a bank above water and when disturbed it can reach the safety of deep water with a single leap. A startled green frog sometimes emits a high-pitched squawk at the instant it jumps. Like the bullfrog, this species is somewhat solitary in habits, but the presumed home range of one individual is smaller in area than that of the bullfrog. The green frog probably eats almost any invertebrate and small vertebrate animal on occasion, but the chief items in its diet are arthropods, mollusks, and annelids.

In Illinois breeding of the green frog apparently occurs throughout the summer, as singing may be heard from May until September. The call of the male consists of two or three well-spaced, explosive notes, each of which closely resembles the plucking of the bass string on a banjo. The female deposits several thousand eggs in shallow surface masses that are similar to those of the bullfrog, but each mass is less in diameter. Hatching occurs in a few days. The tadpoles, which resemble the bullfrog larvae, overwinter and transform throughout the summer of the second season.

Illinois Distribution.—The Illinois distribution, fig. 85, of the green frog, which is abundant in most of eastern North America, is puzzling. The species is common in ponds, lakes, and streams throughout the northern fourth of the state, but it becomes increasingly sporadic in occurrence to the south. In central and southern Illinois it is absent from the Grand Prairie and the Southern Division, but it occurs along both the extreme eastern and western edges of the state in the immediate vicinity of rock outcrops. In the Shawnee Hills of southern Illinois it is common in rocky, clear streams. The record for Charleston (Hankinson 1910) is almost certainly based on a misidentified specimen of the bullfrog.

Intergradation of *R. c. melanota* with *R. c. clamitans* occurs along the Mississippi River floodplain of Jackson, Union, Alexander, and possibly Johnson counties. The swampy habitat of the intergrade population is quite different from the preferred habitat of the northern *R. c. melanota* and resembles that of *R. c. clamitans*.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on

Fig. 85.—Distribution of *Rana clamitans*. Vertical hatching indicates the presumed range of the subspecies *melanota* in Illinois; crosshatching, the presumed range of the *melanota* × *clamitans* intergrades; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

the distribution map by hollow symbols: CHAMPAIGN COUNTY: Champaign (H. Garman 1892); COOK COUNTY: Chicago (Schmidt & Necker 1935); DU PAGE COUNTY: Naperville (Schmidt & Necker 1935); JACKSON COUNTY: 4 mi. S Carbondale (Burt & Burt 1929); KANE COUNTY: Batavia, West Dundee (Stille & Edgren 1948); LAKE COUNTY: Fox Lake (Schmidt & Necker 1935); MCHENRY COUNTY: McHenry, Richmond (Schmidt & Necker 1935); UNION COUNTY: 7 mi. S Anna (Burt & Burt 1929); WILL COUNTY: Hickory Creek (Necker 1939*c*); Marley, New Lenox (Schmidt & Necker 1935); Romeoville (Necker 1939*c*).

Rana palustris Le Conte
Pickerel Frog

Rana palustris Le Conte 1825:282 (type locality: not given; suggested as vicinity of Philadelphia, Pennsylvania, by Schmidt 1953); Brendel 1857:254.

Diagnosis.—A small to medium-sized *Rana* (largest Illinois specimen 69.2 mm. from snout to vent), fig. 86, with distinct, square or rectangular, brown or black blotches arranged in two more or less regular series between the dorsolateral folds; dorsolateral folds yellow, extending to the hip region, and approximately half the width of the dorsal blotches; groundcolor gray or tan; concealed surfaces of hind legs and often the belly with a wash of bright yellow.

Variation.—The male pickerel frog has enlarged thumbs, each of which bears a small pad on its inner surface. According to Pope (1944*b*), the male is usually darker, larger, and more fully webbed between the toes than the female. In our series, however, the female averages larger, and Walker (1946) noted that females are larger in Ohio specimens.

No small specimens are available for study. Young frogs observed in the field, however, seemed to differ from adults in their proportionately larger heads and smaller legs.

Two races of the pickerel frog, differing in pattern details and proportions, are present in Illinois: an unnamed race, which oc-

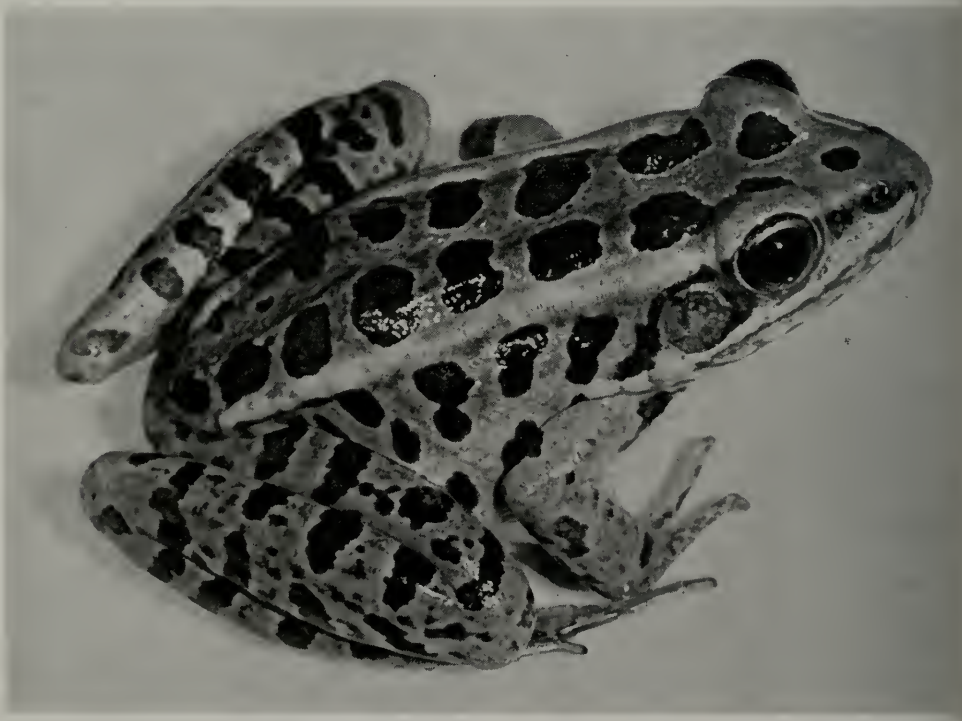


Fig. 86.—An adult *Rana palustris* from Monroe County, Illinois. The groundcolor is yellow, tan, or light gray; the square or quadrangular blotches are chestnut or dark brown.

Table 26.—Geographic variation in Illinois *Rana palustris*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	ALEXANDER-UNION COUNTIES (8)		MONROE COUNTY (17)		PIKE, ADAMS, AND GREENE COUNTIES (23)		NORTHERN ILLINOIS (11)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Snout-vent length	28.2–57.0	.....	33.0–64.8	.....	34.5–69.2	.....	34.5–56.0	.....
Head length as percentage of body length	35.6–41.2	38.0	33.9–38.8	36.8	32.1–38.6	36.1	33.0–38.4	36.0
Tibia length as percentage of body length	51.0–55.3	53.5	50.2–62.5	56.9	54.2–62.9	57.6	55.6–63.5	58.7
Blotches between dermal folds	6–15	9.9	11–17	13.8	9–21	15.1	6–17	12.7
	PER CENT OF SPECIMENS		PER CENT OF SPECIMENS		PER CENT OF SPECIMENS		PER CENT OF SPECIMENS	
With snout spot	12.0		77.0		84.3		82.0	
With mottled chin	88.0		70.6		21.9		9.0	
With mottling on underside of legs	100.0		53.0		17.3		0	

curs in Alexander and Union counties and occupies an unexpected habitat for the species, and the typical race, which occurs sporadically along the rock bluffs of the Mississippi River northward to the northern fifth of the state, where it is rather general in occurrence. The two races differ slightly in proportions and markedly in pattern, table 26.

Habits.—Throughout most of its range this frog is limited in distribution by its intolerance of bodies of water that are both warm and sluggish. In northern Illinois, for example, the species occurs around ponds, creeks, and marshes, and in central Illinois it is found only in cold springs or rocky, fast-running streams. In western Illinois the species exhibits a fondness for caves in which there are permanent streams. However, in southern Illinois a race of the pickerel frog occurs in the relatively warm waters of floodplain swamps. Pickerel frogs are alert and powerful jumpers and accordingly difficult to collect in marsh or stream-edge vegetation. The pickerel frog is reputed to have a skin secretion that is toxic or at least distasteful to many other animals, but experimental evidence is needed to substantiate the report. Its food consists probably of arthropods and mollusks.

The pickerel frog presumably spawns in the clear, quiet water of bogs, lakes, and ox-bows. The song of the male is a short, low-pitched snore with little carrying power. The female lays 1,000 to 2,000 eggs in compact globular masses. The eggs hatch in about 2 weeks. I have not seen tadpoles in Illinois. Newly transformed adults are found the last of June.

Illinois Distribution.—The peculiar distributional pattern of this species, fig. 87, has been noted above. The range to some extent parallels that of *R. clamitans*, but the pickerel frog seems even less tolerant of conditions in the central prairie region. Although records are available from west-central Indiana, the Illinois range of the species is probably little more extensive than the localities on the map indicate. There is some possibility, however, that it may be found in the dissected canyons of La Salle County and in the rocky streams of extreme eastern Clark and Vermilion counties.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: KANE COUNTY: Batavia (Stille & Edgren 1948); ST. CLAIR COUNTY: Bluff Lake (Hurter 1893).

Fig. 87.—Distribution of *Rana palustris.* Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Rana pipiens Schreber
Leopard Frog

Opinion is about equally divided among current herpetologists as to whether *Rana pipiens* consists of subspecies distinct enough to warrant taxonomic recognition. Inasmuch as this is one of the most famous problems in herpetological taxonomy, a solution satisfactory to everyone will appear only when series of specimens from over all of North America are studied in monographic fashion. In spite of the difficulty in recognizing races in some parts of the continent, there are certain geographical areas in which the distinctness of subspecies is unavoidable. Such is the case in Illinois and adjacent states, and it is as difficult to lump the two Illinois populations of the leopard frog as it seems to be for eastern and southwestern investigators to recognize more than one form of this frog. Variation data for the Illinois populations are presented in the hope that they may contribute to a final understanding of the *pipiens* problem.

Unfortunately, the question of names for the population adds still more confusion, and usage of *pipiens* and *sphenocephala* as subspecific names for the two Illinois populations is accordingly tentative. The names involved in eastern North America are *pipiens* (1782, type locality: New York), *brachycephala* (1889, type locality; Yellowstone River), *sphenocephala* (1886, type locality: St. John's River, Florida), and *berlandieri* (1854, type locality: South Texas). Provisional assignment of the subspecific name *pipiens* to the northern Illinois frogs and the subspecific name *sphenocephala* to the southern Illinois frogs assumes that the populations *berlandieri* and *sphenocephala* are distinct taxonomically. Otherwise, the earlier name, *berlandieri,* would supersede *sphenocephala* for the southern population. Assignment of the name *pipiens* to the northern population also assumes that the names *pipiens* and *brachycephala* refer to the same population, or that *pipiens* Schreber is an intergrade between the northern, large spotted frog that Cope described as *brachycephala* and the southern, small spotted frog that the same author described as *sphenocephala.* This assumption (that *pipiens* is an intergrade between the northern and southern races) is a strong possibility, although Schreber's colored plate represents a fairly typical specimen of the northern frog; and, if correct, the name *pipiens,* which has priority over both *sphenocephala* and *brachycephala,* could be assigned to either of these races. Obviously, it would be preferable to restrict *pipiens* to the northern form, in view of the long usage of the name in experimental biology for frogs from the northern population.

In brief, the history of the *pipiens* investigations is as follows. Cope (1889) assigned *sphenocephala, brachycephala,* and *virescens* to *R. virescens* (equals *pipiens*) as subspecies. Dickerson (1906) and the Wrights (1933 to date) recognized *pipiens* and *sphenocephala* as races of *R. pipiens,* but they did not accept *brachycephala.* Boulenger (1920) regarded *R. pipiens* as a monotypic species. Kauffeld (1936) resurrected

brachycephala and regarded it, as well as *pipiens* and *sphenocephala,* as full species. Mittleman & Gier (1942) resurrected *berlandieri* for the southwestern leopard frogs, but evaded the question of the validity of other races. Moore (1944), who studied the problem most intensively, concluded that no subspecies were recognizable.

Cope (1889) and Kauffeld (1936) both utilized proportionate head length as a criterion for separating the three races which they recognized, and Dickerson (1906) and the Wrights (1933) used the same character for distinguishing *pipiens* from *sphenocephala.* Trapido & Clausen (1938) and Grant (1941) criticized the use of this character because Quebec specimens under study by them failed to agree with the proportions Kauffeld (1936) recorded for *brachycephala* (the population presumably occurring in Quebec). Moore (1944) tested this character with large series and reported no significant differences in head proportions. These seemingly diametrically opposite views are easily explained if samples of similar-sized specimens are compared. The amount of ontogenetic variation in proportionate head length in one population exceeds the amount of variation displayed by adults of the two different populations. The difference in means between samples of similar-sized individuals from the two populations is slight. The northern population, *brachycephala* of Kauffeld or *pipiens* as here understood, attains a larger maximum and average size, however, and, if small samples of fully adult specimens of northern and southern frogs are compared, the difference between the means is magnified simply because the northern form is a larger frog. It is likely that Cope and Kauffeld believed the head-length character was diagnostic for this reason. Actually, it has only limited diagnostic value, but it is discernible. The ratios displayed by 64 specimens of *R. p. pipiens* from northern Illinois and 60 specimens of *R. p. sphenocephala* from southern Illinois are shown by the graph, fig. 88.

Length of snout, as well as proportionate head length, has been used as a subspecific character by those authors who recognize subspecies in *R. pipiens.* In the Illinois series the southern frogs appear to have longer, more acuminate snouts, but I am unable to find any mensurable difference. It appears that the position of the eyes and the more prominent dark vitta of southern specimens creates the illusion of longer snouts.

Leg length has similarly been used as a subspecific character and it is usually expressed as the point reached by the heels when the legs are carried alongside the body. Because of the difficulty of manipulating limbs of preserved specimens, tibia/body ratios have been computed in lieu of the leg-body relationship. Moore (1944) investi-

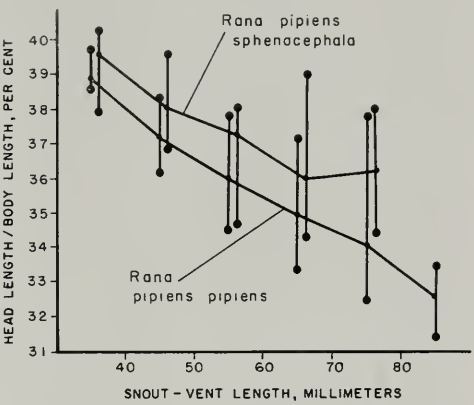


Fig. 88.—Head/body length ratios for 60 specimens of *Rana pipiens sphenocephala* and 64 specimens of *Rana pipiens pipiens.* The diagonal lines connect means of each size class; the vertical lines represent variational ranges exhibited by each size class.

gated both ratios and found only a slight tendency toward longer legs in those frogs from southeastern United States. Tibia/body ratios for 270 Illinois specimens reveal no indication of clinal variation in this character. In combined samples of *R. p. sphenocephala* the tibia averages 56.8 per cent of the body length, and in combined samples of *R. p. pipiens* it averages 56.9 per cent.

The degree of webbing, amount of dark mottling on the rear of the thighs, nature of the tibial bars, width of the dorsolateral folds, and presence of secondary dorsal ridges are of limited value, although none is constant enough to be a good diagnostic character.

The presence of a light tympanic spot, a character frequently stated to be diagnostic of *R. p. sphenocephala,* does not coincide geographically with the other subspecific characters of *R. p. sphenocephala* in Illinois. Instead, it occurs in all Illinois populations except those in the northern third of the state.

The remaining characters used by various authors (nature of vocal sacs in breeding males, size of spots and prominence of light margins, and groundcolor) and the presence of a dark snout spot are reliable; they indicate that two subspecies are valid.

Rana pipiens pipiens Schreber
Northern Leopard Frog

Rana pipiens Schreber 1782:185, pl. 4 (type locality: New York; revised to White Plains, New York, by Schmidt 1953); H. Garman 1890:188–9 (part).
Rana pipiens pipiens, Pope 1944*b*:132–42.
Rana halecina, Kennicott 1855:593.
Rana halecina halecina, Davis & Rice 1883*a*: 28 (part).
Rana halecina berlandieri nec Baird, ?Yarrow 1882*a*:181.
Rana virescens, H. Garman 1889:134.
Rana virescens virescens, Cope 1889:403 (part).
Rana virescens brachycephala Cope 1889: 403–6 (type locality: Yellowstone River).
Rana pipiens brachycephala, Wright & Wright 1949:511.
Rana utricularia, H. Garman 1892:321–2 (part).
Rana pipiens burnsi, Wright & Wright 1933: 178–9.
Rana pipiens sphenocephala nec Cope, Wright & Wright 1949:496–7 (part).

Diagnosis.—A medium to large *Rana* (largest Illinois specimen 96.2 mm. from snout to vent), fig. 89, with large subround or elongate dark spots on a green, tan, or brown background; venter white or off-white; a pair of prominently widened dorsolateral folds extending the length of the back; secondary ridges often present between dorsolateral folds; the breeding male with a pair of lateral vocal pouches that do not project posteriorly; a large dark spot on top of snout (in 87 per cent of specimens); dorsal spots distinctly margined with light and averaging larger than eye (in 78 per cent of specimens); no discrete light spot in center of tympanum; postfemoral reticulum heavy; tibia boldly barred with dark.

Variation.—The male leopard frog is smaller than the female and differs also in having enlarged thumbs and stouter fore legs. During the breeding season, the skin is loose between the angle of the jaws and the shoulder region, indicating the position of the internal vocal sacs of the male frog.

Juveniles have proportionately longer, narrower heads than adults and weaker bars across the legs. The head-length relationship is graphed in fig. 88.

Several trends of unknown importance can be discerned by comparing series of specimens from northeastern Illinois with those from northwestern Illinois. Specimens from the northeast tend to possess a darker groundcolor, more conspicuous light margins around spots, larger spots, and more prominent secondary dermal ridges between the dorsolateral folds.

In Illinois, the most striking geographic variation in *R. pipiens pipiens* occurs from north to south, inasmuch as *pipiens* intergrades with *R. p. sphenocephala* in the central part of the state. Two intergrade samples, one from Coles County and the other from Mason and Morgan counties, differ from northern Illinois leopard frogs in the smaller frequency of individuals with snout spots, the smaller average size of the dorsal spots, the occasional presence of males with external vocal sacs, and the usual presence of a light tympanic spot. These characteristics for four typical *pipiens* samples and two intergrade samples are shown in table 27.

Habits.—The leopard frog occurs in abundance in the vicinity of streams, ponds, or lakes and it is frequently encountered in fields well away from permanent water. It is an excellent jumper and is so alert that it is difficult to capture unless it is stalked at night with a flashlight. The captured frog often squawks and usually emits a copious quantity of urine. When seized by a predator, such as a snake, the leopard frog may scream. Juveniles of this species sometimes inhabit puddles—water-filled automobile tracks—in little-used dirt roads. The heads of several young frogs may be seen protruding from the water by any person approaching such a puddle. As soon as the young frogs sense danger, they quickly leave the water for the greater protection of surrounding vegetation.

Breeding in the northern leopard frog occurs from mid-March to May. The breeding sites are ponds, lakes, sloughs, or semipermanently flooded fields. The call of the male has been characterized as "coaxing" and can be simulated by rubbing a thumb over an inflated balloon. Each female deposits 3,000 to 5,000 eggs in compact, slightly flattened, submerged spheres, which are usually 3 to 6 inches across. Hatching presumably requires approximately a week, and

Fig. 89.—An adult *Rana pipiens pipiens* from Porter County, Indiana. The groundcolor may be green, gray, or tan; the spots are usually brown. Note spot on snout. (Photo by Isabelle Hunt Conant.)

Table 27.—Geographic variation in Illinois *Rana pipiens pipiens* and *R. p. pipiens* × *sphenocephala* intergrades. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	NORTH-EASTERN ILLINOIS (18)	NORTH-WESTERN ILLINOIS (23)	HENDERSON-WARREN COUNTIES (14)	CHAMPAIGN-VERMILION COUNTIES (9)	COLES COUNTY (20)	MASON-MORGAN COUNTIES (24)
With snout spot (per cent of specimens)	89.0	78.0	72.0	84.0	45.0	33.0
With average dorsal spot smaller than eye (per cent of specimens)	0	0	0	22.0	40.0	71.0
With external vocal sac (per cent of males)	0	0	0	0	28.5	36.0
Snout-vent length (mm.), maximum	77.8	88.9	72.0	84.0	96.2	84.0

transformation occurs from June until August.

Illinois Distribution.—*R. p. pipiens* is common around almost all types of water throughout the northern half of Illinois, fig. 90. Intergradation with *R. p. sphenocephala* occurs across the central part of the state. The intergrading area is relatively narrow in eastern Illinois, wider along the Mississippi River, and also wider in the Illinois River valley, where intermediates are known from Jersey to Mason County.

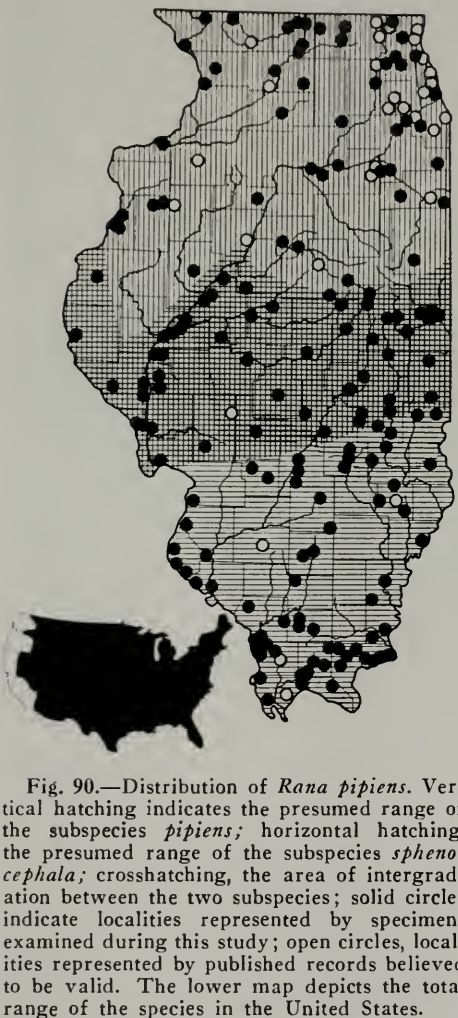


Fig. 90.—Distribution of *Rana pipiens*. Vertical hatching indicates the presumed range of the subspecies *pipiens;* horizontal hatching, the presumed range of the subspecies *sphenocephala;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Carle Woods (Necker 1939*c*); Chicago Ridge (Schmidt & Necker 1935); Deer Grove, Evanston (Necker 1939*c*); Homewood, Lambert, Wolf Lake (Schmidt & Necker 1935); DU PAGE COUNTY: Downers Grove, Glen Ellyn, Lisle, Naperville (Schmidt & Necker 1935); GRUNDY COUNTY: Coal City, Pequot (Necker 1939*c*); HENRY COUNTY: (H. Garman 1892); KANE COUNTY: West Dundee (Stille & Edgren 1948); KANKAKEE COUNTY: Aroma Township, Pembroke Township (Schmidt & Necker 1935); KNOX COUNTY: 2½ mi. E Galesburg (Adcock 1922); LAKE COUNTY: Beach, Fox Lake, Highland Park (Schmidt & Necker 1935); Waukegan (Necker 1939*c*); MCHENRY COUNTY: McHenry, Richmond (Schmidt & Necker 1935); MCLEAN COUNTY: Normal (H. Garman 1892); OGLE COUNTY: Grand Detour (Yarrow 1882*a*); PEORIA COUNTY: Peoria (H. Garman 1892); STEPHENSON COUNTY: Freeport (H. Garman 1892).

Rana pipiens sphenocephala Cope
Southern Leopard Frog

Rana halecina sphenocephala Cope 1886:517 (type locality: near St. John's River, Florida).
Rana sphenocephala, Blanchard 1924*b*:535.
Rana pipiens sphenocephala, Wright & Wright 1949:496–7 (part).
Rana halecina halecina, Yarrow 1882*a*:179–80.
Rana halecina, Boulenger 1920:433–45 (part).
Rana virescens virescens, Cope 1889:403 (part).
Rana virescens brachycephala nec Cope, Cope 1889:405–6 (part).
Rana pipiens, H. Garman 1890:188–9 (part).
Rana pipiens pipiens nec Schreber, P. W. Smith 1947:32.
Rana utricularia, H. Garman 1892:321–2 (?part).

Diagnosis.—A subspecies of *Rana pipiens* (largest Illinois specimen 79.4 mm. from snout to vent), fig. 91, differing from *R. p. pipiens* in being smaller, in lacking a dark snout spot, and in having the following additional characters: a pair of external vocal sacs which project posteriorly in the breeding male; dorsal spots averaging smaller than eye diameter (in 76 per cent of specimens); dorsal spots not distinctly margined with light; groundcolor light tan, gray-green, or light brown; usually a discrete light spot in center of tympanum; tibial bars frequently interrupted; less distinct postfemoral re-

Fig. 91.—An adult *Rana pipiens sphenocephala* from Union County, Illinois. The ground-color is usually gray or tan, rarely green; the spots are brown.

ticulum; narrower and lighter colored dorsolateral folds; narrower and lighter colored maxillary ridge; and sharper-appearing snout.

Variation.—Sexual variation in *R. p. sphenocephala* is similar to that in *R. p. pipiens*, although more pronounced because of the pouchlike vocal vesicles, the statement by Liu (1935) that all *pipiens* subspecies have internal sacs notwithstanding.

Ontogenetic variation in the southern leopard frog is similar to that in the northern

Table 28.—Geographic variation in Illinois *Rana pipiens sphenocephala*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southern Illinois (20)		Shawnee Hills (20)		South-Central Illinois (20)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.), maximum	79.4		78.2		66.0	
Spots between dorsolateral folds	5–20	12.8	8–30	17.3	7–23	14.5
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
With snout spot	5		15		10	
With tympanic spot	80		85		95	

subspecies. The head-length/body-length relationships are summarized in fig. 88.

Individual variation in a series of *R. p. sphenocephala* from one locality exceeds geographic variation (the difference between series) displayed within Illinois. The only trend discerned in this subspecies is a tendency for individuals from the Mississippi and Ohio River floodplains at the southern tip of Illinois to have fewer dorsal spots. These frogs are usually brassy in appearance, and a few individuals have been seen that had no dorsal spots. Such individuals are remarkably similar to wood frogs. Variation in the more salient features of three samples of *R. p. sphenocephala* is summarized in table 28.

Habits.—The southern leopard frog is similar to the northern race in habits and habitat, and most of the remarks concerning behavior of *R. p. pipiens* apply as well to this form. The breeding season for *sphenocephala* is known to be earlier, and singing begins in early March and extends into April. There is some likelihood that development is faster in *sphenocephala;* transforming frogs can be found in June and early July.

Illinois Distribution.—The southern leopard frog is abundant throughout the southern half of Illinois, fig. 90. Intergradation with *R. p. pipiens* occurs in a rather narrow zone in eastern Illinois at about the Shelbyville Moraine. The intergrading area widens in western Illinois, but it usually does not exceed a hundred miles in width.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: MACOUPIN COUNTY: Standard City (Owens 1941); PULASKI COUNTY: Villa Ridge (H. Garman 1892); RICHLAND COUNTY: Olney (Cope 1889); UNION COUNTY: Anna (H. Garman 1892); 2 mi. N Anna (Burt & Burt 1929); WASHINGTON COUNTY: (Yarrow 1882*a*).

Rana sylvatica Le Conte

The wood frog is transcontinental in northern North America. Several allied populations of northern Europe and Asia belong to the same complex but are currently considered to be specifically distinct. The North American wood frog has been generally regarded as consisting of three subspecies; the distributional limits and the diagnostic characters, until quite recently, have been vaguely defined in the herpetological literature. The species has, however, just received an intensive and thorough revision by Martof & Humphries (1959), who suggest that the named subspecies be dropped. Their analysis of geographic variation in the species is excellent and objective; their taxonomic recommendation, in my opinion, is prompted by their personal attitude toward subspecies. Inasmuch as their data can be interpreted as suggesting that races are recognizable, subspecific names are provisionally retained for the two types of wood frogs represented in Illinois.

Rana sylvatica sylvatica Le Conte
Eastern Wood Frog

Rana sylvatica Le Conte 1825:282 (type locality: not stated; designated as New York City by Schmidt 1953); Shelford 1913:195, 206, 243, 244, 256.
Rana sylvatica sylvatica, Cagle 1941:9 (part).
Rana silvatica, Brendel 1857:254.
Rana temporaria silvatica, Yarrow 1882*a*:185 (part).
Rana cantabrigensis nec Baird, Hay 1892*a*:586.
Rana cantabrigensis cantabrigensis nec Baird, Cope 1889:437.
Rana sylvatica cantabrigensis nec Baird, Schmidt 1938*a*:379 (part).

Diagnosis.—A medium-sized *Rana* (largest Illinois specimen 54.5 mm. from snout to vent), fig. 92, with prominent dorsolateral folds; tympanum smaller than eye; two or three joints of fourth toe free of webbing; tan or rich red-brown groundcolor above, with a conspicuous chestnut or black mark on each side of head; dark dash on shoulder; tibia 55 per cent or more of snout-vent length; head 33 per cent or more of snout-vent length; breast plain white (64 per cent of specimens); dorsum immaculate or occasionally with scattered small black dots but without longitudinal light or dark stripes between dorsolateral folds; secondary ridges between dorsolateral folds seldom present.

Variation.—No average size difference in the sexes is evident in the Illinois series of eastern wood frogs. The male possesses swollen thumbs, each of which bears a small pad on the inner surface, and somewhat stouter front legs; and the webbing between the toes of the hind feet is convex rather

Fig. 92.—An adult *Rana sylvatica sylvatica* from Clark County, Illinois. The groundcolor is tan or light red-brown; the mask through the face and dorsal flecks are chestnut or dark brown.

than incised. In the breeding ponds the female may be rich red-brown while the male may be almost black. Outside the breeding ponds individuals of both sexes are ordinarily light in color, but the female is usually the more brightly colored.

Table 29.—Geographic variation in Illinois *Rana sylvatica sylvatica* and *R. s. sylvatica* × *cantabrigensis* intergrades. Figures in parentheses are numbers of specimens.

Characteristic	Southwestern Illinois (6)		East-Central Illinois (30)		Northeastern Illinois (17)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	36.0–50.8	.....	34.8–54.5	.....	30.0–49.3	.....
Head length as percentage of body length	33.5–38.4	36.0	31.3–37.2	33.9	29.9–36.7	32.6
Tibia length as percentage of body length	58.3–63.0	61.1	51.4–61.8	58.6	49.8–59.5	54.0
Femur length as percentage of body length	47.3–56.9	51.4	48.8–56.6	52.9	44.2–54.3	50.5
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
With breast unmarked	100.0		78.0		12.0	
With dark interorbital bar	83.0		0		24.0	

Young specimens are slightly shorter legged, larger headed, and less brightly colored than adults.

In Illinois the most noticeable trends in geographic variation are the proportionately greater head size and longer legs in samples from north to south. The limited data at hand thus conform in general with the findings of Schmidt (1938*a*) that there is a north-south cline in leg length in the wood frog. Although north-south clines are evident in the Illinois wood frogs, the data do not preclude the possibility that a northern and southern race are involved. Suzuki (1951) did not find a regular cline in tibial length in Wisconsin samples, and specimens at hand from Arkansas are no longer legged than specimens from southwestern Illinois. The population in northeastern Illinois is regarded as being composed of *R. s. sylvatica* × *cantabrigensis* intergrades. The sample from this part of Illinois displays *cantabrigensis* characters in proportionate head length, tibial length, size, and ventral pattern but *sylvatica* characters in dorsal pattern and dorsal skin texture. This variation is summarized in table 29.

Habits.—The wood frog, which is usually solitary in habits, is restricted to relatively mesic forests in which there are permanent or semipermanent pools. It is usually not abundant even in optimum habitat and is often overlooked because its colors blend so well with fallen leaves. Individuals are most often seen when they call attention to themselves by making a long, low leap. In spring and fall the wood frog may be aquatic, but it spends most of the summer well away from water. Its food consists of arthropods and mollusks.

The short breeding season of the wood frog occurs in March. A pond may be suddenly full of breeding individuals and a week or two later they may have completely disappeared. The call of the male consists of a series of five or six explosive clucking notes that have little carrying power. Each female lays 2,000 to 3,000 eggs, which soon become a submerged globular mass. Hatching requires only a few days, and the larvae grow rapidly. The tadpole is distinctive because of the labial formula of ¾, fig. 53. Transformation takes place in May and June.

Illinois Distribution.—The eastern wood frog is exceedingly sporadic in occurrence even in forested parts of the state, fig. 93. It is moderately common in Coles County, but attempts to find the species in some adjacent counties, which have seemingly suitable habitats, have been unsuccessful. Once a locality is found in which the species occurs, it is usually possible to collect specimens on each subsequent visit. It is difficult to ascertain if the number of wood frog populations has been appreciably reduced by drainage and destruction of forest or if this frog was sporadic in occurrence in Illinois even before such practices were begun. *R. sylvatica* is regarded as one of the animal indicators of the beech-maple forest, although most of the Illinois localities in

Fig. 93.—Distribution of *Rana sylvatica*. Vertical hatching indicates the presumed range of the subspecies *sylvatica* in Illinois; horizontal hatching, the presumed range of the subspecies *cantabrigensis;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

which the species is known are west of this ecological zone.

The wood frog populations throughout southern and most of eastern Illinois are regarded as typical *R. s. sylvatica,* the population in northeastern Illinois as *sylvatica* × *cantabrigensis* intergrades. The central prairie region is apparently uninhabited by the species.

Rana sylvatica cantabrigensis Baird
Northern Wood Frog

Rana cantabrigensis Baird 1854*a*:62 (type locality: Cambridge, Massachusetts, in error; revised to Moose Jaw, Saskatchewan, by Schmidt 1953); Dickerson 1906:212.
Rana cantabrigensis cantabrigensis, Howe 1899:372.
Rana sylvatica cantabrigensis, Schmidt 1938*a*: 379 (part).
Rana temporaria silvatica nec Le Conte, Yarrow 1882*a*:185 (part).
Rana silvatica nec Le Conte, H. Garman 1892: 330.
Rana sylvatica sylvatica nec Le Conte, Cagle 1941:9 (part).

Diagnosis.—A subspecies of *Rana sylvatica* (largest Illinois specimen 48.8 mm. from snout to vent), smaller than *R. s. sylvatica* and differing from it in having shorter legs (tibia less than 55 per cent of body length); proportionately shorter head (usually less than 33 per cent of the snout-vent length); usually spotted breast; frequently a dorsal pattern of dark, light, or both dark and light longitudinal stripes between the dorsolateral folds; and often raised ridges between the dorsolateral folds.

Variation.—Sexual dimorphism exhibited by *R. s. cantabrigensis* is the same as in *R. s. sylvatica.*

Suzuki (1951) mentions that the tibiae of immature Wisconsin wood frogs are proportionately shorter than those of adults. Juveniles are larger headed and less richly colored.

Five specimens from extreme northwestern Illinois vary as follows: snout-vent length 38.8 to 48.8 mm.; head length 30.5 to 35.6 (average 32.1) per cent of body length; tibia 52.4 to 55.8 (average 53.6) per cent of body length; femur 48.7 to 53.1 (average 50.2) per cent of body length; 80 per cent with spotted breasts; and 80 per cent with dark interorbital markings.

Habits.—The northern wood frog is similar to the eastern subspecies in habits, although it shows somewhat greater ecological tolerance, inasmuch as it is sometimes found in open areas and along grassy stream borders (Pope 1944*b*). Its breeding season is somewhat later because of its more northern distribution.

Illinois Distribution.—*R. s. cantabrigensis* is known in Illinois by only five specimens, fig. 93. Very little field work has been done in northwestern Illinois early enough in the spring to encounter breeding wood frogs, but habitats that appear to be suitable for the species are fairly extensive. When more early spring collecting is done, this race may prove to be more general in occurrence. The specimens from Jo Daviess County deserve special comment. The collector reported that they were taken in a woodland pond near Galena, Illinois, but their general appearance strongly suggests a more northern provenance.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: PEORIA COUNTY: Peoria (H. Garman 1892).

MICROHYLIDAE

This large family contains two genera in the United States and numerous genera in the New World and Old World tropics.

Gastrophryne Fitzinger

Some authors believe that in the United States this genus contains a single polytypic species; others regard it as comprising two species, one consisting of several subspecies. One form enters southwestern Illinois.

Gastrophryne carolinensis carolinensis (Holbrook)
Eastern Narrow-Mouthed Toad

Engystoma carolinense Holbrook 1836:83, pl. 11 (type locality: Charleston, South Carolina); Davis & Rice 1883*a*:27.
Gastrophryne carolinensis, Jordan 1929:226.
Microhyla carolinensis carolinensis, Hecht & Matalas 1946:5.
Microhyla carolinensis, P. W. Smith 1948:2.

Diagnosis.—A small, squat-bodied frog (largest Illinois specimen 33 mm. from snout to vent), fig. 94, without webbing between the toes and without a visible tym-

Fig. 94.—An adult *Gastrophryne carolinensis carolinensis* from Randolph County, Illinois. The groundcolor is olive, dark gray, rusty red-brown, or almost black.

panum; with a transverse fold of skin or a groove behind the head; head pointed, its width half or less than half the greatest body width, its length less than one-fourth the body length; dorsum red-brown, gray, or almost black, plain or irregularly blotched, with a tendency toward a median dark band that gradually widens posteriorly.

Variation.—During the breeding season of this toad the male differs from the female in having loose, discolored skin on the throat, but at other times specimens are extremely difficult to sex by external characters. The chin spinules noted on the male by Mittleman (1950) are not present on any of the Illinois frogs, although they are evident on a series of males from the Gulf Coast.

The immature frog differs from the adult in its proportionately wider head. The sides of the body in the juvenile are nearly parallel, whereas in the adult they diverge rapidly.

Two specimens from adjacent Missouri (Wayne County) are 37.2 and 37.6 mm. in snout-vent length, thus exceeding the previously known maximum size (36.0 mm.) for this species. Fifteen Illinois specimens from Monroe and Randolph counties vary as follows: head width 25.6 to 32.8 (average 29.2) per cent of the snout-vent length; tibia 36.4 to 42.9 (average 39.0) per cent of snout-vent length; all are mottled ventrally, and almost half of them have lateroventral light markings between the front and hind legs. The dorsal pattern is variable, but all Illinois individuals have vague dorsolateral light bands.

Habits.—The eastern narrow-mouthed toad is a small frog, usually found in rotten stumps, or under flat rocks, bark, or other objects on the ground. Upon being uncovered, this frog appears dazed by light, but after an instant it darts away in a series of short, rapid hops. Occasionally two or three individuals may be found under one rock.

In the South the narrow-mouthed toad breeds throughout the summer. I have not found eggs or larvae of this toad in Illinois, but I have heard the low, nasal buzz of the

male near Valmeyer on two occasions, both in June. According to Wright & Wright (1949), each female produces approximately 850 eggs as small surface films, one layer deep, each layer composed of 10 to 90 eggs. The egg of this species is unique among Illinois amphibians in that it has a flat surface rather than being perfectly spherical. Hatching occurs in a few days, and transformation is said to occur in 20 to 70 days. The tadpole is unique inasmuch as it has a sucking disc rather than labial teeth, mandibles, and oral papillae.

Illinois Distribution.—The eastern narrow-mouthed toad has been assumed to occur in Illinois since Davis & Rice (1883*a*) published the first check list of Illinois amphibians and reptiles, but no specimens were secured until 1948. Since a number of collectors had attempted unsuccessfully to find the species in the southern tip of the state, it was with some surprise that I discovered a colony of narrow-mouthed toads within 35 miles of St. Louis, fig. 95. Systematic collecting, aimed at extending the known range of the species, has shown it to be common along the Mississippi River bluffs of Monroe and Randolph counties but has revealed no greater range than this. Its range in adjacent Missouri is poorly known.

Fig. 95.—Distribution of *Gastrophryne carolinensis*. Hatching indicates the presumed range of the subspecies *carolinensis* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

Shortly after the discovery of *Gastrophryne* in Illinois, a specimen was recorded from southeastern Iowa (Klimstra 1950). The apparently disjunct range of the species suggests that this frog was formerly widespread in occurrence and that some adverse environmental conditions, presumably lower temperatures, have reduced the range to relict colonies in the Mississippi River valley. It appears unlikely that the species has simply been overlooked in the intervening areas, since it is ordinarily easily collected and could scarcely have been missed in such well-known areas as Reelfoot Lake, Tennessee, and extreme southern Illinois.

Class REPTILIA

Turtles, Lizards, and Snakes

It is believed that reptiles were derived from Labyrinthodontia amphibians in the Pennsylvanian age. Although the primitive reptiles shared many similarities with certain extinct amphibian groups, reptiles as a class apparently appeared in an explosive evolutionary burst, flourished in great variety throughout the Mesozoic Age, and diminished with the appearance in the Cenozoic Age of the birds and the mammals, both of which were better adapted for a way of life on land. There are relatively few present-day reptiles. The fossil record reveals three extinct subclasses and 11 extinct orders in addition to the three subclasses and four orders represented by surviving forms.

The relationship of the subclasses, orders, suborders, and families represented in Illinois may be summarized in the following synopsis.

Subclass Anapsida.—Temporal region of skull encased in bone, fossae lacking.

Order Testudines.—Body enclosed in a shell, consisting of an upper carapace and a lower plastron; jaws toothless.

Suborder Cryptodira.—Toes present;

4 or 5 claws on each front foot; shell with horny plates.

Family Chelydridae.—Bridge narrow; plastron cruciform, consisting of 9 or 10 plates.

Family Kinosternidae.—Bridge broad; plastron consisting of 11 plates.

Family Testudinidae.—Plastron large, consisting of 12 plates.

Suborder Trionychoidea.—Three claws on each foot.

Family Trionychidae.—Shell depressed, leathery; snout proboscis-like.

Subclass Lepidosauria.—Skull a modified diapsid type.

Order Squamata.—Body completely scaled.

Suborder Sauria.—External ears usually present; movable eyelids usually present; limbs usually present.

Family Iguanidae.—Pineal eye present; subdigital carinae present; venter scaled; femoral pores present.

Family Scincidae.—Pineal eye absent; usually smooth, overlapping scales on dorsum and venter; femoral pores absent.

Family Anguidae.—Longitudinal groove along each side of body (in North American species); femoral pores absent; the only representative in Illinois limbless.

Family Teiidae.—Granular dorsal scales; venter with transverse plates; femoral pores present.

Suborder Serpentes.—External ears absent; movable eyelids absent; limbs always absent.

Family Colubridae.—Hollow, movable fangs and venom glands absent, no loreal pit between eye and nostril on side of head.

Family Crotalidae.—Hollow, movable fangs and venom glands present, loreal pit between eye and nostril.

For ease in identification, the Illinois species of Reptilia are diagnosed in three large keys, the turtles (order Testudines) in one, the lizards (suborder Sauria) in the second, and the snakes (suborder Serpentes) in the third. Illinois representatives of these three groups may be identified with the aid of the following key.

1. Body enclosed in a shell; jaws without teeth ..... Order Testudines, p. 114
   Body not enclosed in a shell; jaws with teeth 2
2. Body having four legs ..... Suborder Sauria, p. 159
   Body having no legs 3
3. External ear openings present; movable eyelids present; venter scaled or plated, without transverse scutes; mandibles of lower jaw fused anteriorly ..... The anguid genus *Ophisaurus* in the suborder Sauria, p. 163
   External ear openings absent; movable eyelids absent; venter with transverse scutes; mandibles of lower jaw separate and free anteriorly ..... Suborder Serpentes, p. 172

Order TESTUDINES
Turtles

Seventeen species and subspecies of turtles occur in Illinois. Four species have Illinois populations of one subspecies each and an adjacent intergrade population or an Illinois population that is entirely intergrade between two subspecies. The intergrade populations, although included in the key for identification, have not been regarded as entities.

Most of our turtles are aquatic, although a few species are terrestrial in habit. Some aquatic species are predominantly stream animals; some are pond or lake animals; others occupy either still or running water. One terrestrial species inhabits forest; the other, prairie. They range in size from the 4-inch musk turtle to the 24-inch alligator snapper. Some species are carnivorous, some omnivorous, and some do a certain amount of scavenging. Turtles are of economic importance because several kinds are prized as food for man, the principal food species being the snapping turtle and two species of soft-shelled turtles. Along the major rivers of Illinois, several of the large aquatic testudinids also are utilized for food. Some turtles, particularly the snappers and soft-shells, are accused of being important predators of fish, but the current opinion of fishery biologists is that turtle predation is insignificant insofar as fish populations are concerned.

Most turtles have a courtship preceding mating, and in some species this is an elaborate performance. Turtle eggs are round or elongate, hard-shelled or membranous-shelled, the shape and type of shell depending on the species. Typically, eggs are deposited in early summer in loamy soil several yards from water. The nest excavation and concealing activities are often complicated processes, including the discharging of cloacal water to moisten the nest site. The hatchling turtles emerge from the ground in early fall or, in some instances, the following spring.

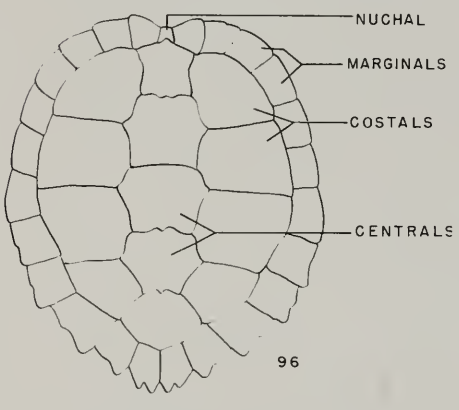
The hatchling turtle is recognizable by its small, usually rounded shell, prominent umbilical scar, and sometimes by the retention of the "egg tooth." Growth is relatively slow; the length of time necessary for sexual maturity varies widely with the different species. The longevity of some turtles is apparently similar to that of man. Some species shed their shell laminae at intervals; others do not. In the latter group concentric growth rings are present which may provide an indication of the age of the turtle.

Turtles, particularly young specimens, are popular pets. Because many of them escape or are deliberately released outside their natural range, distributional records must be evaluated with caution.

The 17 species and subspecies of Illinois turtles are divisible into five groups. One group includes six species that are either poorly known (*Kinosternon subrubrum* and *Graptemys pseudogeographica*) or have ranges in which Illinois is approximately centered (*Chelydra serpentina, Sternothaerus odoratus, Graptemys geographica,* and *Trionyx muticus*). Another group (including *Macroclemys temmincki, Pseudemys scripta elegans,* and the *Pseudemys concinna* × *floridana* hybrid population) is essentially southern in distribution, with northward extensions into Illinois in the Mississippi River valley. A group of four species (*Clemmys guttata, Terrapene carolina carolina, Chrysemys picta marginata,* and *Trionyx spinifer spinifer*) is predominantly eastern, and Illinois lies at the western edge of the range of each. The fourth group includes three Great Plains species (*Kinosternon flavescens, Chrysemys picta belli,* and *Terrapene ornata*), which reach Illinois from the West. One species (*Emydoidea blandingi*) is northern, extending southward into Illinois for approximately half the length of the state.

Key to the Order Testudines
(Turtles)

1. Carapace leathery and covered with skin, without plates; front foot with 3 claws (Trionychidae) 2
   Carapace plated with horny shields, fig. 96; front foot with 4 or more claws... 4



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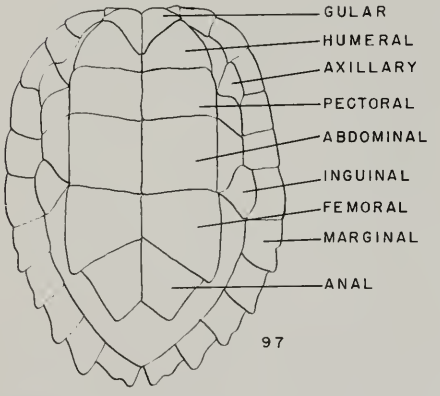

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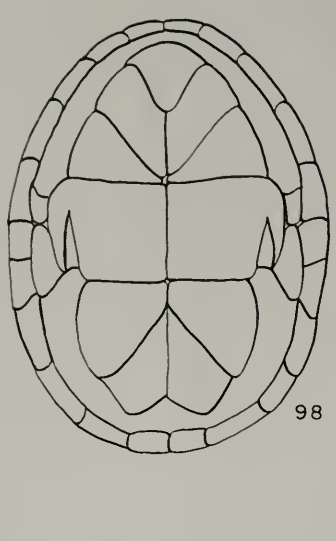
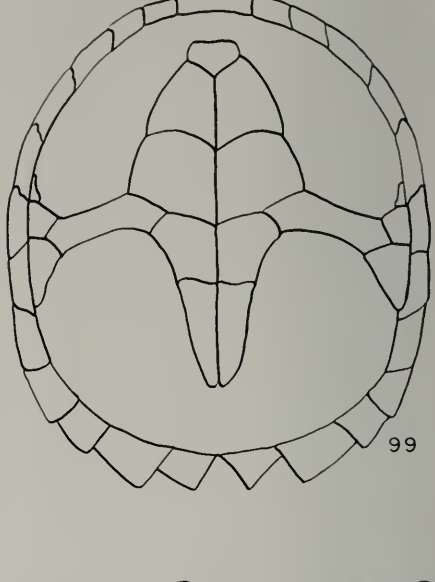
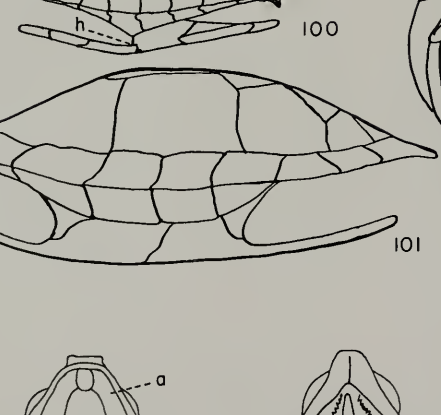
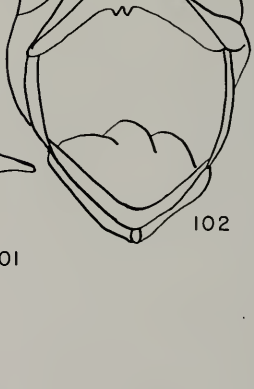
Figs. 96–97.—Dorsal and ventral views of the shell of a turtle, *Graptemys pseudogeographica.*

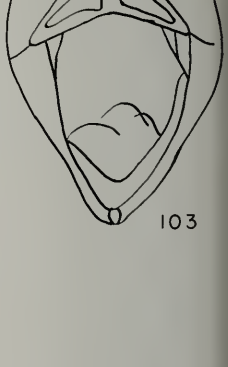
2. Anterior edge of carapace with spiny protuberances; incomplete nasal septa present; 2 lateral head stripes per side... 3
   Anterior edge of carapace smooth; nasal septa absent; 1 light head stripe on each side ..... *Trionyx muticus muticus*
3. Black ocelli on carapace sharply decreasing in size peripherally ..... *Trionyx spinifer spinifer*
   Central and peripheral ocelli subequal... *Trionyx spinifer spinifer* × *hartwegi*
4. Plastron with 12 plates, fig. 97 (Testudinidae) 9
   Plastron with 11 or fewer plates, fig. 98 5

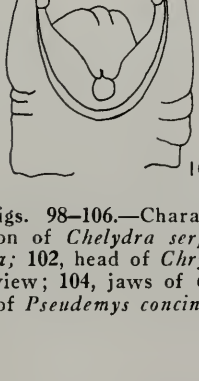


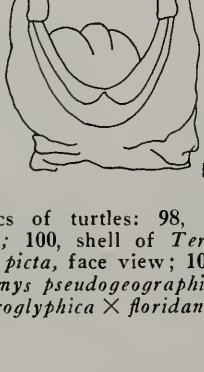


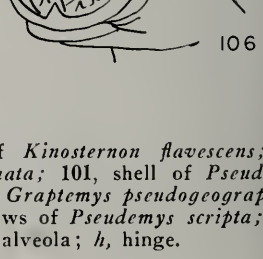












Figs. 98–106.—Characteristics of turtles: 98, plastron of *Kinosternon flavescens;* 99, plastron of *Chelydra serpentina;* 100, shell of *Terrapene ornata;* 101, shell of *Pseudemys scripta;* 102, head of *Chrysemys picta,* face view; 103, head of *Graptemys pseudogeographica,* face view; 104, jaws of *Graptemys pseudogeographica;* 105, jaws of *Pseudemys scripta;* 106, jaws of *Pseudemys concinna hieroglyphica* × *floridana hoyi; a,* alveola; *h,* hinge.

5. Plastron with 11 plates; posterior margin of carapace not serrate, fig. 98 (Kinosternidae) 6
Plastron with fewer than 11 plates, fig. 99; posterior margin of carapace serrate (Chelydridae) 8
6. Plastron incompletely cornified; head usually with yellow stripes along sides; carapace arched ..... *Sternothaerus odoratus*
Plastron completely cornified; head without yellow stripes; carapace depressed 7
7. Ninth marginal plate triangular and much higher than eighth; head slate color, without spots ..... *Kinosternon flavescens spooneri*
Ninth marginal plate no higher than eighth; top of head with light and dark spots ..... *Kinosternon subrubrum subrubrum* × *hippocrepis*
8. Top of head with enlarged plates; carapace with some marginals separated from costals by 3 to 5 supramarginals ..... *Macroclemys temminckii*
Top of head without enlarged plates; carapace with supramarginals absent ..... *Chelydra serpentina serpentina*
9. Carapace highly domed, the height more than 44 per cent of length, fig. 100; plastron with well-developed hinge, permitting shell to be tightly closed; toes with vestiges of webs only; jaws beaked 10
Carapace not highly domed, greatest height less than 43 per cent of length, fig. 101; plastron with bridge or with limited movement that does not permit shell to be entirely closed; toes webbed; jaws not beaked 12
10. Carapace with middorsal keel; apex of upper jaw without notch; axillary element absent 11
Carapace without trace of median keel; apex of upper jaw notched; axillary element present ..... *Terrapene ornata ornata*
11. Hind foot with 3 claws; carapace pattern dim or absent ..... *Terrapene carolina triunguis* × *carolina*
Hind foot with 4 claws; carapace boldly marked with yellow or orange ..... *Terrapene carolina carolina*
12. Carapace globular; black, with scattered yellow spots 13
Carapace depressed or angular in cross section; shell not black with scattered yellow spots 14
13. Underside of chin and neck immaculate yellow; many yellow flecks in each carapace shield, each smaller than orbit ..... *Emydoidea blandingi*
Underside of chin and neck predominantly dark; a few yellow spots in each carapace shield, some as large as orbit ..... *Clemmys guttata*
14. Marginals marked with red; apical notch in upper jaw flanked by toothlike projections, fig. 102 15
Marginals marked with yellow or with greenish white; apical notch in upper jaw, if present, without adjacent "teeth," fig. 103 17
15. Plastron immaculate yellow or red; middorsal red stripe half the width of orbit *Chrysemys picta dorsalis* × *marginata*
Plastron with a dark figure; middorsal red stripe appearing as a thin line, if visible at all 16
16. Dark plastral figure occupying 60 per cent or more of plastron, containing light vermiform markings and sending processes peripherally along the seams; carapace with irregular yellow lines at least on costals *Chrysemys picta belli*
Dark plastral figure an elongate central blotch occupying less than 60 per cent of plastron; figure dark, without processes extending along seams; carapace without yellow lines ..... *Chrysemys picta marginata*
17. Alveolar surfaces of upper jaw smooth; apex of lower jaw rounded, fig. 104 18
Alveolar surfaces of upper jaw with median ridge or toothlike projections; apex of lower jaw pointed, fig. 105 19
18. A pair of small, isolated yellow spots on occiput, each separated from eye by 2 or more thin, diagonal yellow lines ..... *Graptemys geographica*
A pair of boomerang-shaped yellow markings on occiput, each separated from eye by no more than 1 diagonal line ..... *Graptemys pseudogeographica*
19. Alveolar surfaces of upper jaw with unequal, toothlike projections, fig. 106; most prominent head markings consisting of a pair of yellow stripes arising on snout and passing between the eyes onto the neck ..... *Pseudemys concinna hieroglyphica* × *floridana hoyi*
Alveolar surfaces of upper jaw with median, smooth or finely serrate ridges, fig. 105; most prominent head markings consisting of a pair of red or brown postorbital bands 20
20. Head with pair of conspicuous, red postorbital stripes; each costal plate with a median, light transverse bar bordered by parallel, thinner dark and light lines ..... *Pseudemys scripta elegans*
Head uniformly dark or mottled; postorbital bands, if present, not red; each costal plate olive or brown, without definite pattern except for dusky margins of carapace seams ..... melanistic *Pseudemys scripta elegans*

CHELYDRIDAE

Two New World genera are placed in the family Chelydridae. A third genus, reported to be restricted to New Guinea, has been shown recently to have been based on an erroneously labeled and misidentified specimen of the common snapping turtle,

Chelydra serpentina. Some authors prefer to include the family Kinosternidae in the Chelydridae.

Chelydra Schweigger

The genus contains only two species, one restricted to Central America and one occurring from southern Canada to Ecuador. The wide-ranging species contains two subspecies, one of which, the nominate subspecies, occurs throughout Illinois.

Chelydra serpentina serpentina (Linnaeus)
Common Snapping Turtle

Testudo serpentina Linnaeus 1758:199 (type locality: "warmer regions"; revised to vicinity of New York City by Schmidt 1953).
Chelonura serpentina, Kennicott 1855:591.
Chelydra serpentina, Davis & Rice 1883*a*:32.
Chelydra serpentina serpentina, Pope 1939:72–83.
Chelydra sp., Cagle 1944*a*:105.
Chelydra, Cagle & Chaney 1950:388.

Diagnosis.—A large aquatic turtle (largest Illinois specimen approximately 300 mm. from anterior to posterior end of carapace), fig. 107, with an enormous head, thick, powerful legs, and a relatively long tail; carapace in young with 3 longitudinal keels, in adults with keels worn off but rough and usually coated with algal growth; posterior edge of carapace serrate; plastron cruciform and inadequate to conceal legs, neck, and tail; head pointed, covered with tuberculate skin; jaws strong; small, paired gular barbels; eyes dorsolateral in position; underside of tail plated with large scales; in young, groundcolor black, with some olive or gray mottling and spotting on sides of head, plastron, and underside of soft parts; subadults and adults dirty olive, gray, or brownish black above, with some evidence of radiating rows of dark flecks on each carapace plate, or carapace almost patternless; soft parts gray or light olive; beak with numerous dark dashes.

Variation.—The basal portion of the tail is on the average longer in the male than in the female of the snapping turtle, and the vent is posterior to the rear edge of the carapace. In the female the anus is usually about even with the posterior edge of the carapace. Although several proportional ratios have been tested in an attempt to find a method for sexing this turtle by external characters, none has proved reliable. Part of the difficulty in sexing these turtles is due to a remarkable change in proportionate tail length as the turtle becomes larger.

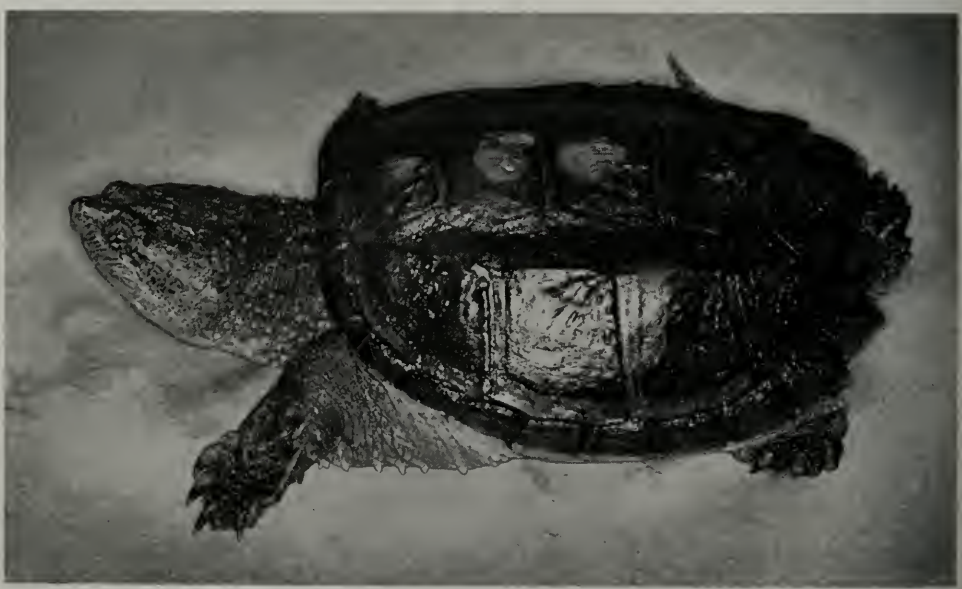


Fig. 107.—An adult *Chelydra serpentina serpentina* from Vermilion County, Illinois. Young specimens are predominantly black; older individuals are dirty olive or brownish black. Most large specimens have growths of algae on the carapace.

The hatchling is almost round and strongly keeled; the tail is considerably longer than the carapace length. The shell is black above and below, with some light spots on the underside. As the animal grows, the keels become less conspicuous, the tail relatively shorter, and the carapace length increases faster than its width. These changes are summarized in table 30. The black color above fades to dark gray or brown, and the light spots on the underside increase until eventually the venter is uniformly light olive-gray. The adult loses all trace of the keels, and the highest part of each carapace plate may be worn smooth.

Table 30.—Ontogenetic variation in Illinois *Chelydra serpentina serpentina*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)									
	Under 30(7)		30–50(14)		50–100(6)		100–200(10)		Over 200(3)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Tail length as percentage of carapace length	113–172	130	86–127	107	74–94	82	65–85	72	64–72	67
Carapace width as percentage of carapace length	98–106	100	92–105	97	82–95	89	81–90	86	86–87	86
Third central width as percentage of length of all 5 centrals.....	38.4–44.8	42.4	33.1–48.2	38.5	32.2–39.3	35.4	29.1–34.6	31.8	31.0–31.4	31.2

The relationship of the width of the third central plate to the length of all five centrals is of some interest, inasmuch as this ratio is one of the three characters used to separate *Chelydra serpentina serpentina* from the peninsular Florida subspecies, *C. s. osceola*. The northern race is said to have a third central width less than one-third the length of the five centrals. It is evident in table 30 that this ratio is useful only for adults, since specimens under 100 mm. in carapace length would be referable to *osceola* because of the wide third central. The Illinois sample is typical of *C. s. serpentina* in the position of the knobs of the dorsal keels and in the presence of lateral caudal tubercles subordinate in size to the dorsal caudal series.

No geographic variation within Illinois has been found for this turtle. There is individual variation in the number of bridge elements, size of the gular shield, proportions, and color, but these features do not vary clinally. On some turtles the gular is single, in others divided or partially divided.

Habits.—Although the common snapping turtle is aquatic, it may migrate overland from one pond or stream to another. Individuals are often seen on roads, and many are killed by cars. They are slow moving and awkward, both on land and in water. When unmolested these turtles probably spend much of their life lying in wait at the bottom of a stream, lake, or pool for prey to come within striking distance of their jaws. They do some stalking. Cahn (1937) describes the gregarious hibernating habits of the species and the harvesting of aggregations by turtle fishermen. I have seen individuals active in late December and early February, although activity in winter may be atypical. Turtles of this species do well as captives, and young ones become tame rather quickly. Newly captured individuals are fearless, and their powerful jaws are formidable.

Captive specimens eat almost any kind of food offered. In nature the diet is probably almost equally variable. Feeding habits include some scavenging.

Egg laying by the snapping turtle occurs early in the mornings during June. The nest

is in soil and may be many yards from the nearest water. The spherical eggs are sufficiently resilient to bounce when dropped. Cahn (1937) believed a normal-sized clutch consists of 20 to 30 eggs, each measuring about 33 mm. in diameter. Hatchlings are abroad in September and October. Some are found on highways at this time, presumably making their way from nest site to water.

Illinois Distribution.—The common snapper occurs in almost every pond and stream within the state, fig. 108. Individuals may be found in a great variety of aquatic habitats from small dredge ditches to major rivers and from temporary rain pools to large lakes.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CLAY COUNTY: Louisville (Cahn 1937); CLINTON COUNTY: Carlyle (Cahn 1937); COOK COUNTY: Chicago, Riverview Park (Necker 1939*c*); DE WITT COUNTY: Clinton (Cahn 1937); DU PAGE COUNTY: Downers Grove, Glen Ellyn (Schmidt & Necker 1935); HANCOCK COUNTY: Carthage (Cahn 1937); HENRY COUNTY: Geneseo (H. Garman 1892); Kewanee (Cahn 1937); JACKSON COUNTY: Elkville (Cagle 1942*b*); Grimsby (Cagle 1942*a*); KANE COUNTY: Elgin (Schmidt & Necker 1935); KANKAKEE COUNTY: Kankakee (Cahn 1937); LAKE COUNTY: Beach, Fox Lake, Highland Park (Schmidt & Necker 1935); Lake Zurich, Waukegan Flats (Necker 1939*c*); LA SALLE COUNTY: Ottawa (Cahn 1937); LIVINGSTON COUNTY: Pontiac (Cahn 1937); MCHENRY COUNTY: Cary (Necker 1939*c*); MACOUPIN COUNTY: Carlinville (Cahn 1937); Standard City (Owens 1941); MADISON COUNTY: Cahokia (Baker 1930); MASON COUNTY: Havana (H. Garman 1892); PEORIA COUNTY: Peoria (H. Garman 1892); 11 mi. S Peoria (Burt & Hoyle (1934); POPE COUNTY: Lake Glendale (Cagle 1948); ROCK ISLAND COUNTY: Rock Island (Cahn 1937); ST. CLAIR COUNTY: (Cahn 1937); SALINE COUNTY: Harrisburg (Cagle 1944*c*); SHELBY COUNTY: Shelbyville (Cahn 1937); WHITE COUNTY: Carmi (Cahn 1937); WILL COUNTY: Hickory Creek (Necker 1939*c*); WILLIAMSON COUNTY: Marion (Cagle 1942*a*).

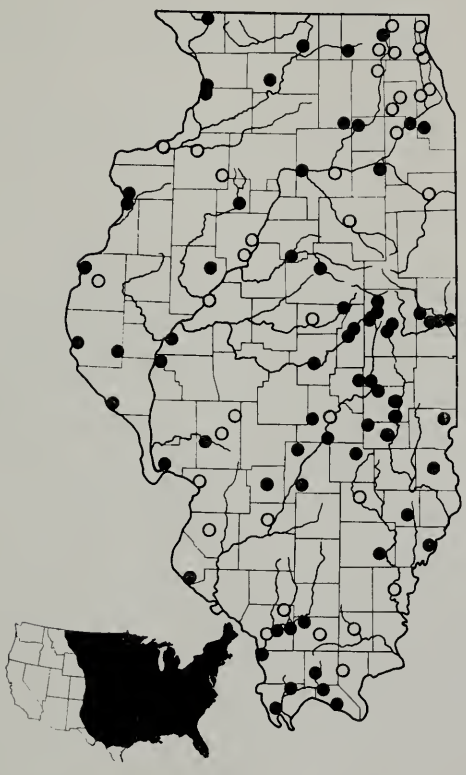


Fig. 108.—Distribution of *Chelydra serpentina*. The subspecies *serpentina* occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Macroclemys Gray

The single species in this genus is restricted to southeastern United States; it occurs northward in the Mississippi River valley into Illinois. For many years the generic name *Macrochelys* was applied to this turtle.

Macroclemys temminckii (Troost) Alligator Snapping Turtle

Chelonura temminckii Troost 1835:158, footnote (type locality: tributary stream of the Mississippi above Memphis, in western Tennessee).
Macroclemys temminckii, Hay 1892*a*:560.
Macrochelys temminckii, Cahn 1937:24–34.
Macrohelys temmincki, Parmalee 1954:453–4.
Macrochelys lacertina, Jordan 1878:167.
Macroclemys lacertina, H. Garman 1892:243.

Fig. 109.—A subadult *Macroclemys temmincki* from Jackson County, Illinois. Young specimens are predominantly black; older individuals are dirty olive or brownish black.

Diagnosis.—A large aquatic turtle (largest Illinois specimen with a carapace length of 610 mm.),* fig. 109, similar to *Chelydra* but differing as follows: larger maximum size, carapace of adults as well as juveniles with 3 continuous longitudinal keels; 3 to 5 supramarginal plates separating costals from lateral marginals; eyes lateral in position and not visible from above; top of head covered with large plates; snout, anterior to eyes, long, relatively narrow, and strongly beaked; underside of tail with numerous small scales.

Variation.—The sexes in this turtle presumably differ slightly in the relative position of the anus on the underside of the tail, but the reliability of this character for sexing individuals has not been tested.

The young resemble adults except that they are darker in color and have more rounded and more highly sculptured shells and more conspicuous skin ornamentations.

Almost no data are available for geographic or even individual variation in this turtle within Illinois. Carapace width for four Illinois specimens in the UIMNH collections ranges from 75.5 to 86.5, averaging 78.3, per cent of the carapace length; tail length ranges from 48.6 to 54.6, averaging 52.0, per cent of the carapace length.

Habits.—On land this huge turtle is slow moving and awkward. In water it apparently lies in wait for prey that is attracted to the pink "lure" within the gaping jaws. The dull coloration and algal growth on the carapace make the turtle blend with its surroundings, and the "lure" is the most conspicuous feature of the animal as it rests on the muddy bottom of a stream or swamp. Captive specimens have been found to vary in temperament. A 17-pound specimen displayed the pugnacious behavior implied by the name of the species, but a 60-pound specimen from Tennessee appeared dull witted and reluctant to bite, although it often opened its jaws in threatening display.

Table 31.—Illinois records of *Macroclemys temmincki*.

County	Source of Data	Weight in Pounds
Adams	H. Garman 1889	?
Alexander	H. Garman 1892	?
Calhoun	Parmalee 1954	108
Jackson	Cahn 1937	96
Jackson	UIMNH 24962	17
Jackson	Jess Grammer	160±
Jersey	John F. Wanamaker	?
Mason	Lewistown Community High School biology department.	40±
Massac	Cahn 1937	103
Rock Island	Schroder 1957	54
Randolph	Cahn 1937	33
Union	H. Garman 1892	?
Union	E. C. Galbreath	?
Wabash	Hay 1887*a*	?
White	H. Garman 1892	?

*Since this account was written, two more specimens have been taken: a record-sized turtle (Jess Grammer, personal communication) and a female ready for oviposition (E. C. Galbreath, personal communication), table 31.

Cahn (1937) reported that the food of the alligator snapper consists primarily of fish, and he presumed that almost any small animal coming within striking distance of the jaws might be eaten.

Almost nothing is known of the life history of this rare turtle within Illinois. The eggs are spherical and presumably much larger than those of any other Illinois species. In the South the number of eggs varies from 15 to 50, presumably the size of the female governing the number deposited.

Illinois Distribution. — The alligator snapper occurs in the Mississippi, lower Illinois, Ohio, and Wabash rivers and their associated tributaries and may occur in swamps and streams throughout the southern fifth of the state. It is extremely rare. In 15 years of collecting and of visiting commercial fishermen, I have never encountered a specimen in the state, except for a 90-pound individual found dead near Carlyle; subsequently I learned that it had been brought from Tennessee to the local State Fish Hatchery and then discarded. Nevertheless, occasional specimens are taken by Illinois commercial fishermen, and, if they come to the attention of biologists, are reported in the literature, table 31 and fig. 110.

Fig. 110.—Distribution of *Macroclemys temmincki*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

KINOSTERNIDAE

Two genera of this family occur in the United States and Canada. Both are in Illinois. Some authors regard the Kinosternidae as a subfamily of Chelydridae.

Sternothaerus Gray

Four species of *Sternothaerus,* one of which consists of several subspecies, occur in the United States and Canada. The range of one monotypic species covers all Illinois.

Sternothaerus odoratus (Latreille)
Stinkpot Musk Turtle

Testudo odorata Latreille 1801:122 (type locality: Carolina; revised to vicinity of Charleston, South Carolina, by Schmidt 1953).
Aromochelys odorata, Hay 1887*a*:16.
Aromochelys odoratus, Davis & Rice 1883*a*:32.
Sternotherus odoratus, Blanchard 1924*b*:540.
Kinosternon odoratum, Evermann & Clark 1916:479.
Aromochelys carinatus nec Gray, Davis & Rice 1883*a*:32.
Aromochelys carinata nec Gray, Hay 1892:593.
Sternotherus sp., Cagle 1944*a*:105.
Sternotherus, Cagle & Chaney 1950:388.

Diagnosis.—A rather small aquatic turtle (largest Illinois specimen having a carapace length of 128 mm.), fig. 111, with an oval-shaped, usually high-domed shell; 11 poorly ossified plates; pectoral scutes broadly in contact, the suture between at least equal to the interhumeral suture; pectoral scutes never triangular in shape; anterior portion of the plastron much shorter than posterior part; tenth and eleventh marginal plates much higher than anterior marginals; plastron usually with a considerable amount of cartilaginous material bordering the sutures; head large; nose projecting well beyond mouth; a pair of barbels on chin; usually a pair of yellow stripes on each side of head; carapace black, olive, or mottled

Fig. 111.—An adult *Sternothaerus odoratus* from Tazewell County, Illinois. The shell and soft parts are olive, brownish, or black. On most specimens a pair of yellow stripes extends along each side of the head.

brownish black and olive, occasionally with radiating dark lines or series of dashes.

Variation.—The stinkpot male differs from the female in its much larger tail, the prominent claw on the tip of the tail, and the presence of two small horny patches on the inner side of each hind leg. The male tends to have a less ossified and proportionately shorter plastron. In 16 males the plastron length ranges from 67.0 to 78.7 (average 73.3) per cent of the carapace length; in 21 females the range is from 75.0 to 90.3 (average 79.7) per cent.

The hatchlings, which range from 21.5 to 27.2 mm. in carapace length, have black carapaces and soft parts; usually some light marks are present on most of the marginal scutes. The plastron is marbled with black and yellowish white or gray. The carapace has a prominent middorsal keel and a secondary lateral keel on either side of the middorsal.

Subadults are dark olive or brown and have radiating dark lines or a series of spots on each carapace shield. The venter is predominantly light; the head pattern is similar to that of hatchlings. The middorsal keel is less prominent than in young, and in most individuals the lateral keels have been lost.

In adults the carapace is usually dark above, with some mottling, although it is sometimes almost a uniform olive. It is smooth and exhibits a tendency to become somewhat flattened on top. The head stripes

Table 32.—Ontogenetic variation in carapace proportions of Illinois *Sternothaerus odoratus*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)							
	Under 30(20)		30–70(2)		70–100(21)		Over 100(15)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length.....	75.2–85.8	82.0	77.0–83.5	80.2	67.5–82.0	72.9	64.5–74.3	68.8
Height as percentage of length.....	52.7–75.5	57.3	46.3–48.6	47.4	37.2–53.2	43.2	37.2–46.2	41.6

may be lost on some very old individuals. The head and neck often have a dimly mottled pattern.

As a stinkpot grows, it becomes progressively more elongate, and the shell becomes somewhat depressed. These ontogenetic changes are summarized in table 32.

No definite geographic variation in this species within Illinois has been noted, although a small series from extreme northern Illinois suggests that the head stripes may be narrower and may be lost at a smaller size in the northern turtles than in turtles from farther south.

Habits.—The stinkpot is aquatic and is not often seen away from water. It is a good swimmer, but its normal behavior consists of crawling over the mud bottom of ponds, searching aquatic vegetation for food. This elongate turtle is notoriously ill-tempered; even a baby turtle not yet free of the egg will snap at objects that annoy it. In addition to its powerful jaws, the stinkpot possesses four scent glands situated on the sides of the body. The musk is extremely unpleasant; many individuals are apparently reluctant to emit the scent.

Sternothaerus odoratus is carnivorous, feeding on aquatic arthropods, fish, annelids, and mollusks. Captives take almost any kind of meat offered.

Egg laying occurs in the late afternoons in June. The nest site is several yards from a pond. Cahn (1937) records the clutch size as 3 to 5. The elliptical, hard-shelled eggs, which average about 27.5 × 15 mm., hatch in early fall.

Illinois Distribution.—The stinkpot undoubtedly occurs in every Illinois county, fig. 112. Although this species is found in rivers and even small streams, it is probably most abundant in permanent ponds and relatively shallow lakes. Usually special efforts must be made to find this turtle in the mud of bodies of water, and for this reason the accompanying map does not reflect the actual abundance of *Sternothaerus* in Illinois.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Cook County: Homewood, Wolf Lake (Schmidt & Necker 1935); Du Page County: Hinsdale (Necker 1939*c*); Fayette County: Vandalia (Cahn 1937);

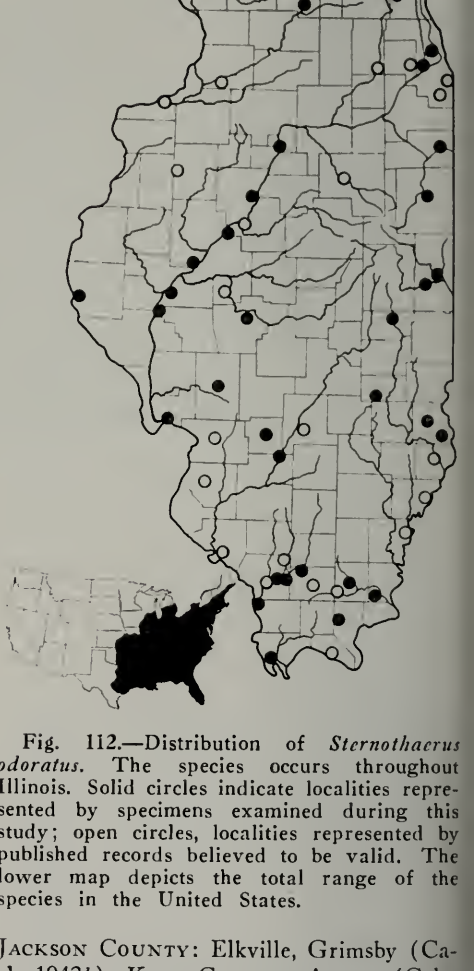


Fig. 112.—Distribution of *Sternothaerus odoratus*. The species occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Jackson County: Elkville, Grimsby (Cagle 1942*b*); Kane County: Aurora (Cahn 1937); Kankakee County: Momence (Cahn 1937); Knox County: 2½ mi. E Galesburg (Adcock 1922); Lake County: Deep Lake (H. Garman 1892); Fox Lake, Nippersink Lake, Round Lake (Schmidt & Necker 1935); Lawrence County: Lawrenceville (Cahn 1937); Livingston County: Pontiac (Cahn 1937); McHenry County: McHenry (Necker 1939*c*); Madison County: (Hurter 1911); Massac County: Metropolis (Cahn 1937); Menard County: Petersburg (Cahn 1937); Randolph County: Chester (Cahn 1937); Rock Island County: Rock Island (Cahn 1937); St. Clair County: (Hurter 1911); Saline County: 3 mi. W Carriers Mills (Blanchard 1924*b*); Tazewell County: Pekin (H. Garman 1892); Wabash Coun-

TY: Mount Carmel (Hay 1887*a*); WHITE COUNTY: Phillipstown (H. Garman 1892); WHITESIDE COUNTY: Prophetstown (H. Garman 1892); WILLIAMSON COUNTY: Marion (Cagle 1942*b*).

Kinosternon Spix

Five species of this New World genus, most of them polytypic, occur in the United States and Canada, two in Illinois.

Kinosternon flavescens spooneri Smith
Illinois Mud Turtle

Kinosternon flavescens spooneri P. W. Smith 1951:195 (type locality: Henderson County State Forest, 7 mi. N Oquawka, Illinois).
Kinosternon flavescens, Cahn 1931:120–3.
Kinosternon flavescens flavescens nec Agassiz, Pope 1939:52–5.

Diagnosis.—A medium-sized aquatic turtle (largest Illinois specimen with a carapace length of 145.5 mm.), fig. 113, with an obtusely oval, much-depressed shell; plastron large and consisting of 11 plates; pectoral scutes triangular in shape and narrowly in contact; length of interpectoral suture less than one-fourth length of interhumeral suture; ninth marginal more than twice height of eighth marginal; anterior and posterior parts of plastron approximately equal in length; head of medium size; nose not noticeably projecting beyond mouth; paired barbels on chin and neck conspicuous; head a uniform dark above, lighter beneath, with some yellow in patches; carapace black, brownish black, or dark olive, patternless or with black margins along the sutures.

Variation.—Sexual variation in the Illinois mud turtle is similar to that found in the musk turtle. Males possess larger tails, more prominent horny tips on the tail, and two patches of horny skin on the inside of

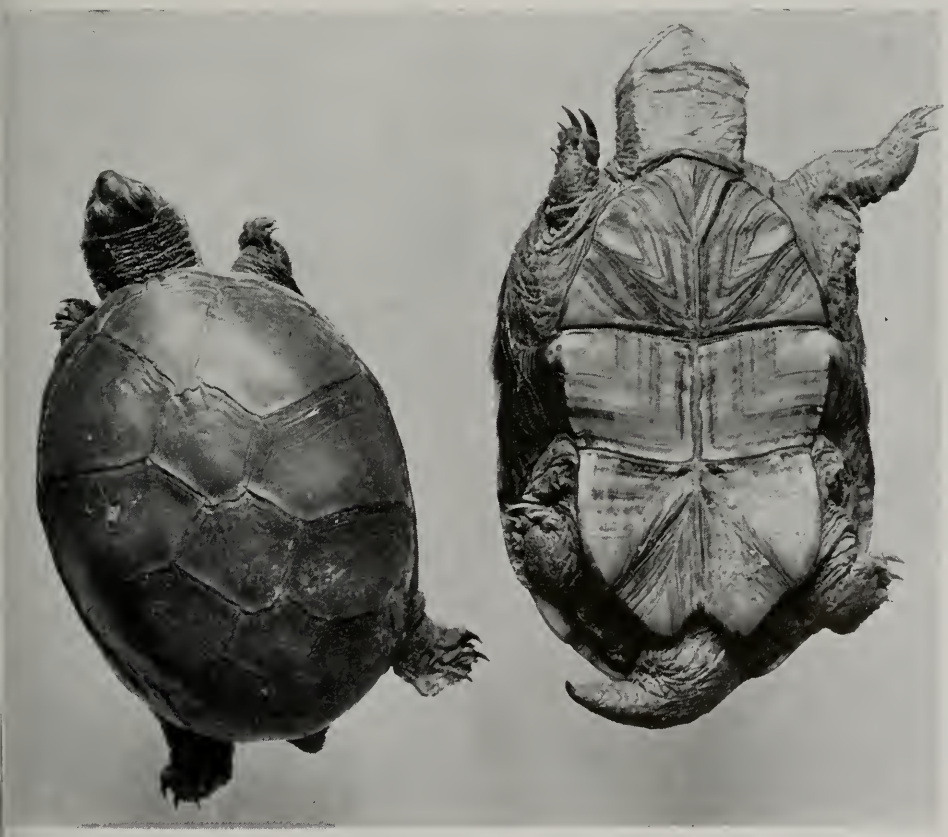


Fig. 113.—Adult *Kinosternon flavescens spooneri* from Mason County, Illinois. Young specimens are nearly black; older individuals, dark olive or brownish black.

each hind leg. Cahn (1937) noted that males tended to be larger and to have heavier upper beaks. The sexual dimorphism in proportionate plastron length is more pronounced in this turtle than in *Sternothaerus odoratus*. In nine adult males at hand the plastron length ranges from 84.5 to 87.5 trace of pattern. The beak on old individuals is often flecked with numerous dark dashes.

The carapace of the mud turtle becomes more elongate as this turtle attains adulthood; in old specimens it is even flatter than in juveniles, although the proportionate shell

Table 33.—Ontogenetic variation in carapace proportions of Illinois *Kinosternon flavescens spooneri*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)					
	Under 100(4)		100–130(7)		Over 130(7)	
	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length	78.5–87.0	83.4	72.3–82.0	76.9	68.0–71.5	68.9
Height as percentage of length	35.3–43.0	39.6	34.0–43.5	39.4	32.1–36.2	33.9

(average 85.4) per cent of the carapace length; in six adult females at hand the range is from 95.0 to 98.5 (average 96.9) per cent.

Data on ontogenetic changes in this species are fragmentary and are at variance with published information. Cahn (1937) described the young as being similar to the adults except that hatchlings are more circular in form and lack the elevated ninth and tenth marginals. Cahn's remarks were based on an examination of Oklahoma juvenile *Kinosternon flavescens flavescens,* however, and it is almost certain that these characters do not apply for *spooneri,* which has a distinctively patterned subadult.

No hatchlings of this species are available from Illinois, but the variation in the adults and subadults extant suggests an ontogenetic change in color and pattern. This change provides an additional character for separating *spooneri* from the subspecies *flavescens*. The smallest specimens at hand are 61 and 70 mm. in carapace length. These subadults are distinctly different from any *K. f. flavescens* and from the largest specimens of *spooneri* in the very dark color of the shell and soft parts and in the irregular but discrete small light markings on the chin. Specimens up to 100 mm. in carapace length retain some trace of the head pattern and in each the underside of the head and neck is dark gray, with yellow restricted to the lower mandible and barbels. Adult specimens are lighter in shell color, and the chin and neck are dark yellow-gray, without a height does not decrease as regularly as in the musk turtle. The ontogenetic changes in shell proportions are summarized in table 33.

Illinois mud turtles occur in three apparently isolated populations in this state but the samples available are rather homogeneous. Since the original description was published, a few additional specimens have become available to supplement those from which the ratios of plastral elements to each other were derived; the additional data do not appreciably alter the means given in the original description. The gular length ranges from 80 to 140 (average 108) per cent of the interhumeral suture length and from 44.7 to 55.5 (average 50.2) per cent of the length of the anterior lobe of the plastron.

Habits.—The mud turtle is rather slow and awkward on land. In captivity it is adept at digging, even in dry soil. It is a strong swimmer; when undisturbed, it forages in the silty bottoms of ponds and sloughs, plowing a furrow similar to that made by a large mussel. It is timid, preferring to withdraw into its shell rather than try to bite. Newly captured mud turtles emit an extremely nauseating musk; the disagreeable odor of this secretion persists for hours.

The Illinois mud turtle is a scavenger as well as a carnivore. Captives take many kinds of food.

Of two captive females, one laid three eggs and the other four eggs in the latter

half of July. The elliptical, hard-shelled eggs averaged 28.5 × 16.5 mm. No hatchlings have been collected in Illinois.

Illinois Distribution.—The Illinois mud turtle is known to occur in the sand area along the Illinois River from Morgan to Peoria counties and in Whiteside and Henderson counties, fig. 114. The species may occur also in sand prairie ponds and sloughs of the upper Mississippi River. The preferred habitats are probably backwater sloughs of the major rivers and ponds in the sand prairies.

K. f. spooneri is one of the striking examples of a relict xerothermic period animal. The closest relative occupies the Great Plains from eastern Kansas westward. As a result of the climatic changes occurring in the Prairie Peninsula, the race *spooneri* has evidently been reduced to a few small remnant colonies.

Fig. 114.—Distribution of *Kinosternon flavescens*. Hatching indicates the presumed range of the subspecies *spooneri* in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: PEORIA COUNTY: Peoria (Cahn 1937).

Kinosternon subrubrum (Lacépède)

Three subspecies of *Kinosternon subrubrum* are currently recognized. One is restricted to peninsular Florida, one occurs from the Atlantic Ocean to Alabama and Indiana, and one occurs from Missouri and Mississippi westward into Texas and Oklahoma. The few Illinois specimens available are intermediate between the eastern and western subspecies and are provisionally referred to *K. s. subrubrum* × *hippocrepis*; the *subrubrum* influence seems to predominate.

Kinosternon subrubrum subrubrum (Lacépède) × hippocrepis Gray
Mud Turtle

Testudo subrubra Lacépède 1788:618, 619 (type locality: Pennsylvania; revised to vicinity of Philadelphia by Schmidt 1953).
Kinosternon subrubrum subrubrum, Stejneger & Barbour 1917:112.
Kinosternon subrubrum, Pratt 1923:238.
Kinosternon subrubrum ssp., Cagle 1946:691.
Cinosternum pennsylvanicum, Hay 1887*a*:16.
Kinosternon pennsylvanicum, Hurter 1897:501.

Diagnosis.—An intergrade population of rather small aquatic turtles (largest Illinois specimen with a carapace length of 120 mm.), fig. 115, each of which is similar to *Kinosternon flavescens* but differs as follows: tenth marginal plate distinctly higher than preceding marginals; chin reticulated or mottled; sides of head with discrete light spots; carapace brownish black, olive-brown, or yellow-brown, usually with black margins along the sutures of the carapace.

Variation.—Sexual variation in *K. subrubrum* is apparently similar to that found in *K. flavescens*. The male possesses a larger tail than the female, a more conspicuous nail on the tip of the tail, patches of horny skin on the hind legs, and a proportionately shorter plastron. In an adult male at hand, 94 mm. in carapace length, the plastron length is 90.5 per cent of the carapace length; in an adult female, 120 mm. in carapace

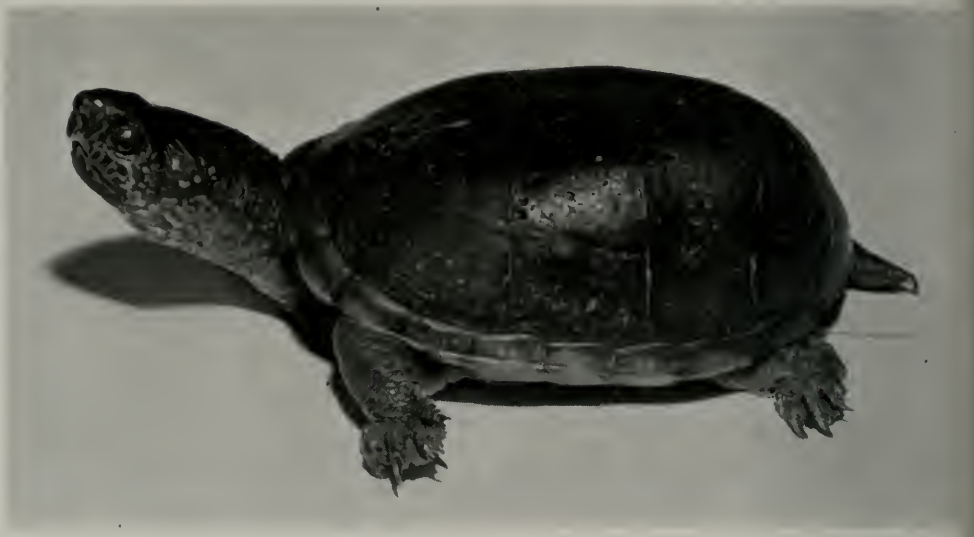


Fig. 115.—An adult *Kinosternon subrubrum subrubrum* from Sussex County, Delaware. The shell and soft parts are olive or brownish black. Specimens from Illinois usually have irregular yellow spots on the head. (Photo by Isabelle Hunt Conant.)

length, the plastron length is 96.7 per cent of the carapace length.

The only Illinois hatchling of this turtle available for study has a carapace 22 mm. long; the width of its carapace is 87.3 per cent of the length (73.5 and 74.5 per cent in two adults), and the height is 49.2 per cent of the length (41.6 and 42.5 per cent in two adults). The carapace of the hatchling, which has a median keel and roughened plates, is thus more rounded and proportionately higher than that of adults. The tenth and eleventh marginal plates are no higher than the anterior marginals. The soft parts, including the head, and the carapace are black; small light marks are present on the edges of the marginals. The plastron is black centrally, light (probably orange in life) peripherally.

The Illinois specimens examined are intermediate in head pattern between the parental subspecies. None has head stripes, but adults have a variable number of discrete light spots on the sides of the head. The sample is too small to provide sufficient data for a study of individual variation.

Habits.—This rare turtle is probably similar in habits to the stinkpot and the Illinois mud turtle, although the impression is given by collectors that *K. subrubrum* is more often found on land than other kinosternids. Captive specimens are rather shy and usually are not prone to bite. The musk of this turtle is said to be less disagreeable than that of *K. flavescens*. Feeding, nesting, and other habits are probably similar to those of *flavescens*. No life history information is available for this rare species in Illinois.

Illinois Distribution.—The mud turtle is inexplicably rare in Illinois, fig. 116. Southern Illinois habitats that appear to be identical with southern United States habitats, where the species is common, have been searched with little success.

The Illinois range of this turtle is unknown. The Peoria record of H. Garman (1892) and the Mount Carmel record of Hay (1887*b*) would be dismissed as probably referring to misidentified turtles of related species, if it were not that a recently collected specimen from Calhoun County is available, and a colony of *K. subrubrum* is well known in northern Indiana. Most of the recent Illinois records are from the southern tip of the state.

Although undocumented by specimens, published records for the following additional localities are believed valid and are also indicated on the distribution map by hollow symbols: ALEXANDER COUNTY: N Cairo (Cahn 1937); JACKSON COUNTY: NE part of county (Cagle 1942*a*); POPE COUNTY: Dixon Springs (Cagle 1946).

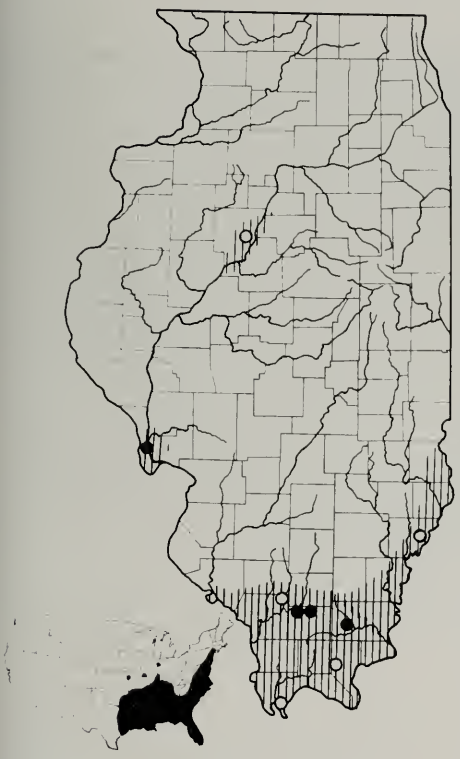


Fig. 116.—Distribution of *Kinosternon subrubrum.* Hatching indicates the presumed range of *subrubrum* × *hippocrepis* intergrades in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

TESTUDINIDAE

Eight genera in this family are found in the United States and Canada. Six are represented by species occurring in Illinois.

Clemmys Ritgen

Four species of this nearly cosmopolitan genus occur in the United States and Canada. One of these barely enters northeastern Illinois.

Clemmys guttata (Schneider)
Spotted Turtle

Testudo guttata Schneider 1792:264 (type locality: not stated; suggested as vicinity of Philadelphia, Pennsylvania, by Schmidt 1953).

Clemmys guttata, Necker 1933:8.
Chelopus guttatus, H. Garman 1892:215.

Diagnosis.—A small aquatic turtle (largest Illinois specimen 118.8 mm. in carapace length), fig. 117, with an oval, smooth, rather depressed carapace; posterior marginals flaring outward; plastron large, immovable, consisting of 12 plates; carapace black, each shield with 1 to 10 prominent, round, yellow spots, each of which is almost as large as eye; plastron predominantly black in very old individuals, light groundcolor with prominent black blotches on subadults, and black groundcolor with light central portion in most adults; head rather small and dark, with scattered yellow spots above; neck dark above and below, sometimes spotted with yellow; limbs usually somewhat bicolored, dark above and orange-yellow beneath.

Variation.—Grant (1935) found that the male spotted turtle differs from the female in having a more posteriorly situated anus, a slightly concave plastron (flat or convex in the female), less prominent postmandibular stripes, brown eyes (orange eyes in the female), and, on the average, fewer yellow crown spots.

Hatchlings, according to Carr (1952), are about 28 mm. in carapace length, almost circular in outline, and have one spot per carapace plate. The young are said to have feeble keels, proportionately longer tails than adults, and plastrons that are light but with a dark central blotch in each.

The three available specimens from Illinois are not sufficient to indicate the extent of variation of the species within the state. Cahn (1937) cites two specimens from near Wolf Lake, Cook County, and he gives measurements for both turtles. My measurements of one of these specimens (the only one now extant) do not correspond to those given by Cahn for either, and this discrepancy precludes use of his data. Two adult females have carapace lengths of 118.8 mm. and 103.6 mm., carapace widths of 81.2 and 75.0 mm., plastron lengths of 109.0 and 96.5 mm., and plastron widths of 61.0 and 59.5 mm. A male has measurements for these characters as follows: 94.2 mm., 71.2 mm., 83.0 mm., and 51.2 mm. The carapace height in the three Illinois specimens available averages about 39 per cent of the length.

Fig. 117.—An adult *Clemmys guttata* from Cook County, Illinois. The groundcolor is black; the spots are yellow.

Habits.—Almost nothing is known of the habits of the spotted turtle in Illinois. In northern Indiana this species is thoroughly aquatic, inhabiting bogs. Carr (1952), summarizing published information on eastern specimens of the spotted turtle, noted that the female lays one to four elliptical eggs in June. The eggs, averaging 30 × 17.5 mm., hatch in late September. In nature the species is probably carnivorous, but it takes plant material on occasion.

Illinois Distribution.—This eastern turtle was suspected by H. Garman (1892) of occurring in Illinois, but the first specimen was not discovered in the state until 1927. In addition to records examined and plotted, fig. 118, is a published record for Romeoville, Will County (Necker 1939*c*), inadvertently omitted from the map. The only area in the state where this rare species occurs is rapidly becoming entirely urban.

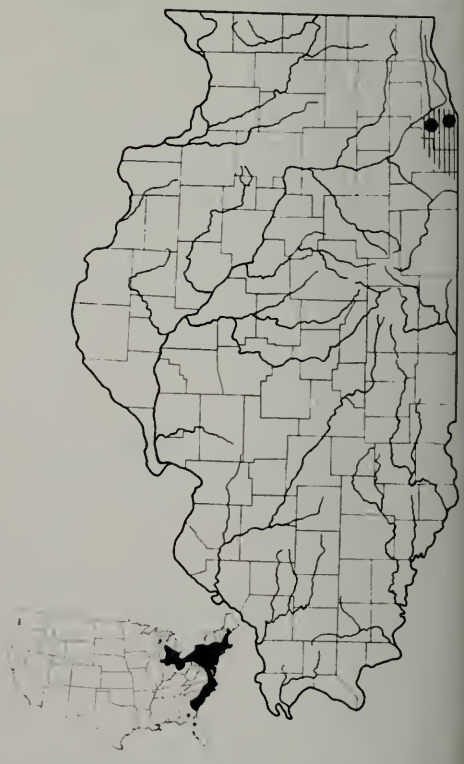


Fig. 118.—Distribution of *Clemmys guttata*. Hatching indicates presumed range in Illinois; circles indicate places represented by specimens examined during this study. The lower map depicts range in the United States.

Emydoidea Gray

One monotypic species of *Emydoidea* occurs in the New World. For many years the North American species was placed in the Holarctic genus *Emys*.

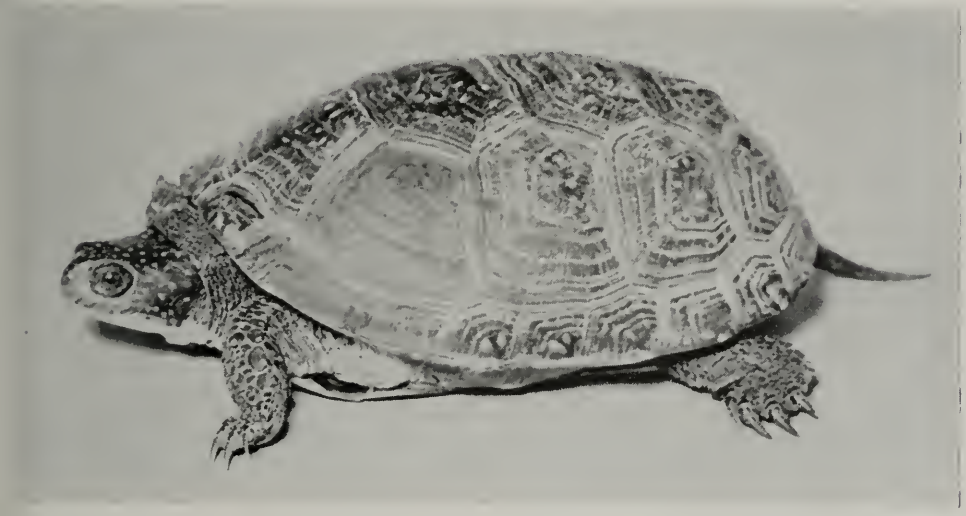


Fig. 119.—An adult *Emydoidea blandingi* from Whiteside County, Illinois. The ground-color is black or dark brown; the spots and flecks are yellow.

Emydoidea blandingi (Holbrook)

Blanding's Turtle

Cistuda blandingii Holbrook 1838:35, pl. 5 (type locality: Fox River, Illinois).
Cistudo blandingii, Müller 1855:89.
Emydoidea blandingii, Hay 1892*a*:579.
Emys blandingii, Ditmars 1907:56.
Emys blandingi, Schmidt 1953:93.
Emys meleagris, Yarrow 1882*a*:37.

Diagnosis.—A medium-sized aquatic and terrestrial turtle (largest Illinois specimen with a carapace length of 240 mm., according to Cahn 1937), fig. 119, with an oblong, somewhat depressed carapace; large plastron consisting of 12 plates, hinged with anterior and posterior lobes movable; head and legs of moderate size; a deep terminal notch in upper jaw; carapace of adult black or dark brown, each plate usually containing numerous small yellow spots and dashes which tend to form radiating series; marginals often reticulate, with equal amounts of brown and pale yellow; plastron of adult yellow, usually with a heavy black blotch on the distal portion of each plastral plate (occasionally old examples are predominantly black below); top of head black or dark brown, often with scattered, small yellow spots; chin and underside of neck chrome yellow. Young specimens usually have some evidence of the radiating series of spots or dashes on each carapace shield, the adult plastral pattern, and the deeply notched upper jaw. Hatchlings of this species may be patternless, but the deeply notched jaw and longer tail distinguish them from hatchling box turtles.

Variation.—The position of the anus on the tail of Blanding's turtle is posterior to the hind edge of the carapace in the male, anterior in the female. The male has a concave plastron (flat in the female) that is proportionately smaller. In four adult males the plastron length ranges from 89.3 to 93.0 per cent of the carapace length, averaging 90.8 per cent; in seven adult females the range is from 95.5 to 100.0, averaging 97.8 per cent.

In hatchlings, the carapace length ranges from 29.5 to 35.2 mm. The shell is more nearly circular in form and has a heavy but low central keel. The tail length is 65 to 70 per cent of the carapace length. The upper shell is uniformly black or is black except for a poorly defined light spot within each carapace shield. The plastron has a large, black central blotch. The top of the head, neck, and soft parts are black, and the chin has light markings. Lateral light lines are rather prominent on the tail. The lateral edges of the pectoral and abdominal scutes are obtusely angular in juveniles; the edges of these scutes are not inflected in adults.

In older juveniles, radiating yellow-brown dashes are evident around the edges

Table 34.—Ontogenetic variation in carapace proportions of Illinois *Emydoidea blandingi*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)							
	Under 40(6)		40–100(3)		100–200(8)		Over 200(3)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length.....	83.0–93.0	87.8	79.5–89.5	84.1	66.5–72.3	69.3	62.0–70.5	66.4
Height as percentage of length.....	39.8–44.0	42.4	40.0–43.2	41.8	32.8–43.0	37.6	33.8–40.7	36.7

of each carapace shield, and the entire chin is light. The chin color encroaches onto the ventral side of the neck in the form of vermiform markings. The keel is less evident than in hatchlings, and the tail is relatively shorter. Ontogenetic changes in shell proportions are given in table 34.

No geographic variation has been discerned for this turtle in Illinois. Individual variation, particularly in the size and distinctness of the light spots on the carapace, is pronounced. In general, older specimens are more distinctly spotted than young; some young adults are shiny black, except for the light spots, which are reduced in number as well as in intensity. Occasional large examples are almost entirely black beneath. The top of the head in some individuals is dark, except for small or large yellow spots, or it may be yellow-brown, reticulated with black.

Habits.—Blanding's turtle is reportedly terrestrial as well as aquatic. In Illinois it appears to be largely aquatic; most of the individuals found on land have been migrating from one body of water to another. This turtle is shy and it shows no inclination to bite when handled. It is a swift swimmer. It takes both plant and animal food.

Copulation in the turtle has been observed on October 15 and on November 17. Cahn (1937) found that the number of eggs laid by a single female ranged from 6 to 10 and that the leathery-shelled eggs averaged 36.5 × 25.0 mm. The time of oviposition is unknown. Females taken in late June had not yet deposited eggs. A number of baby Blanding's turtles were found dead and desiccated on August 26 in sand hills in Whiteside County. These young turtles were presumably hatchlings that had been killed by the hot sun before they could find their way across several hundred feet of sand to water.

Illinois Distribution.—Blanding's turtle occurs in the northern half of Illinois in areas originally prairie, fig. 120. It now oc-

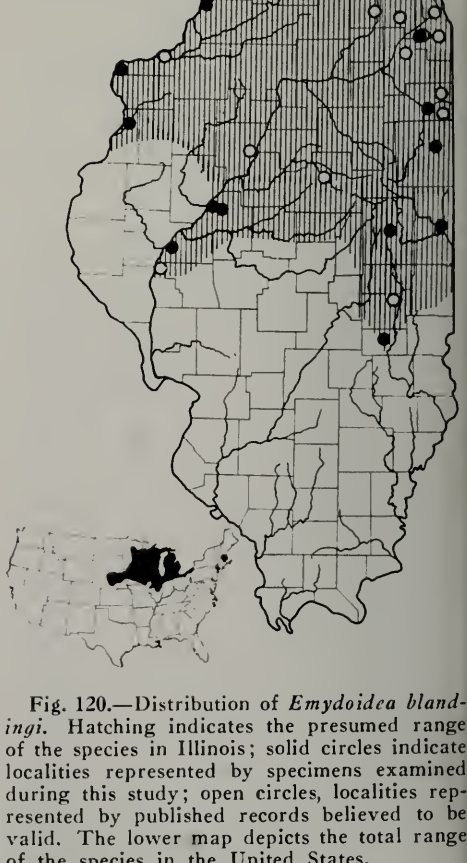


Fig. 120.—Distribution of *Emydoidea blandingi*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

curs only as scattered colonies, although it was probably abundant on the central prairies before the extensive marshes were drained. In a few areas this species is still common, but its distribution is probably discontinuous, except for the floodplain sloughs that margin the large rivers.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COLES COUNTY: 4 mi. N Charleston (Hankinson 1917); COOK COUNTY: Chicago (Yarrow 1882*a*); Homewood (Necker 1939*c*); Orland Park (Schmidt & Necker 1935); DU PAGE COUNTY: Lisle (Schmidt & Necker 1935); KANE COUNTY: Batavia, Dundee (Stille & Edgren 1948); KANKAKEE COUNTY: Momence (Schmidt & Necker 1935); Pembroke Township (Necker 1939*c*); LAKE COUNTY: Lake Forest (Cahn 1937); Pistakee Lake (Schmidt & Necker 1935); Sayer Bog (Necker 1939*c*); Waukegan (Cahn 1937); MCHENRY COUNTY: Woodstock (Schmidt & Necker 1935); MCLEAN COUNTY: Normal (H. Garman 1892); MORGAN COUNTY: Meredosia (Cahn 1937); PEORIA COUNTY: Peoria (Cahn 1937); ROCK ISLAND COUNTY: Rock Island (Cahn 1937); WILL COUNTY: Wheatland Township (Necker 1939*c*).

Terrapene Merrem

Two polytypic species of *Terrapene* occur in the United States. Both species are found in Illinois.

Terrapene carolina carolina (Linnaeus) Eastern Box Turtle

Testudo carolina Linnaeus 1758:198 (type locality: Carolina; revised to vicinity of Charleston, South Carolina, by Schmidt 1953); Schneck 1886:897.
Cistudo carolina, Yarrow 1882*a*:37.
Cistuda carolina, Hay 1892*a*:581.
Cistudo carolina carolina, H. Garman 1892: 219–20.
Terrapene carolina, Cope 1895*b*:757.
Terrapene carolina carolina, Stejneger & Barbour 1917:115.
Cistuda clausa, Brendel 1857:254.
Cistudo clausa, Davis & Rice 1883*a*:32.
Cistudo carolina triunguis nec Agassiz, H. Garman 1892:219–20.
Cistuda carolina triunguis nec Agassiz, Hurter 1893:261.
Terrapene triunguis nec Agassiz, Taylor 1895: 584.
Terrapene carolina triunguis nec Agassiz, Schmidt 1953:95.

Diagnosis.—A medium-sized, terrestrial turtle (largest Illinois specimen with a carapace length of 151 mm.), fig. 121, with an obtusely oval, high, globular carapace that

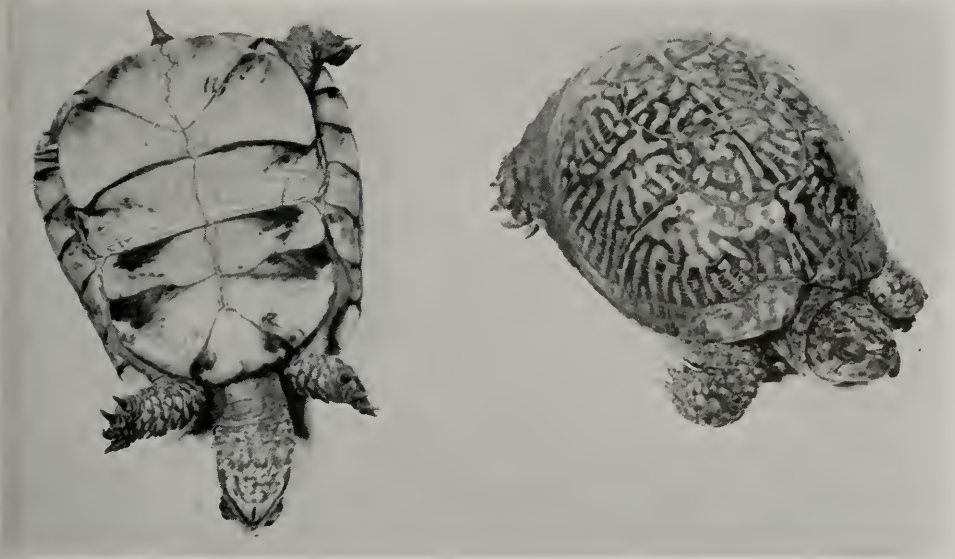


Fig. 121.—Adult *Terrapene carolina carolina* from Johnson County, Illinois. The groundcolor is brown or black; the extremely variable markings are yellow or orange.

has a steep rear margin and a slight median keel; plastron completely filling aperture of carapace and bilobed, each lobe attached to a transverse hinge, freely movable and capable of effectively sealing the shell; axillary element absent or rudimentary; bridge absent; beak strongly hooked, not notched at tip; toes with slight web; tail short; carapace brown or black, with extremely variable pattern of yellow or orange markings within each shield; pattern never consisting entirely of straight, narrow yellow lines arranged medially; plastron dark or light, mottled or streaked, but not containing discrete, straight yellow lines; head and legs variable in color and markings.

Variation.—In the eastern box turtle, the male differs from the female in having a more posteriorly situated anus; longer tail; heavier, more curved claws on the hind feet; stouter hind legs; presence of a concavity in the plastron (flat in female); usually red or orange eyes (brown in female); more flaring posterior marginals; and proportionately greater shell height and width. In eight adult males the width of the carapace ranges from 73.6 to 84.8 (average 79.3) per cent of the length and the height from 40.6 to 47.2 (average 44.1) per cent of the length. In 12 adult females corresponding figures are as follows: 76.0 to 87.5 (average 80.5) and 43.0 to 55.0 (average 50.1).

Although hatchlings are remarkably uniform in color and size, the eastern box turtle shows considerable ontogenetic variation. Shell proportions of three size groups are given in table 35. The smallest specimen available has a carapace length of 27.2 mm. Its shell is almost circular and has the appearance of being depressed, despite the presence of a strong central keel. The carapace of hatchlings is dull brown, except for an indistinct yellow-brown spot in each costal and vertebral shield; the edges of all the marginals are tipped with the same light color. The plastron, which is not obviously hinged at this age, has a black blotch almost filling it, the basic yellowish white color being visible only around its edge. The head and limbs are dull brown; the lower mandible is yellow.

Older juveniles have a more globular carapace, but the central keel is still strongly developed. The plastron is proportionately larger and has an obvious hinge. The juvenile light spots are still evident on the carapace, but there are in addition yellow-brown dashes and spots at the periphery of each vertebral and costal plate. The central black blotch of the plastron usually shows evidence of light markings, and the head and legs are light spotted.

Large juveniles are similar to adults in carapace shape, although the central keel is more prominent. The pattern of the carapace, plastron, and soft parts is exceedingly variable. Old individuals have more widely flaring marginals and only a faint trace of the median keel. In many old turtles a median furrow in the carapace is apparently the result of the costals growing at a faster rate than the vertebral plates.

Individual variation completely defies any attempt to classify pattern types or color. Even in large series it is almost impossible to find a pattern type duplicated. The groundcolor is brown or black, and the markings are yellow-brown, yellow, or orange. In different individuals the plastron may be light or dark, plain, or marked in almost every conceivable manner.

Inasmuch as the Mississippi River has been presumed to be the barrier separating

Table 35.—Ontogenetic variation in carapace proportions of Illinois *Terrapene carolina carolina*. Figures in parentheses are numbers of specimens.

Characteristic	Juveniles(9)		Subadults(20)		Adults (20)	
	Range	Mean	Range	Mean	Range	Mean
Carapace width as percentage of carapace length	87.2–98.0	94.3	78.0–93.0	83.3	73.6–87.5	85.0
Carapace height as percentage of carapace length	37.8–51.2	46.1	46.1–53.7	49.2	40.6–55.0	48.7
Plastron length as percentage of carapace length	85.5–95.3	90.6	90.5–99.5	95.6	92.2–102.2	95.7

this race from the western three-toed race, *Terrapene carolina triunguis*, in this region, box turtles from the counties bordering the Mississippi have been scrutinized for possible *triunguis* influence. During the course of this survey many specimens have been examined, all of which had 4 toes and distinct markings, until April, 1954, when an adult male was found at Golden Eagle, Calhoun County. This specimen is unquestionably *triunguis*; it has 3 toes, an obscure pattern, and the typical yellow groundcolor. It was found with seven typical individuals of *T. c. carolina* at a presumed breeding site within a few yards of the Mississippi River. This single example may be a waif, or possibly the population between the Mississippi and nearby Illinois rivers consists of intergrades, in which the characters of *triunguis* are recessive to those of *carolina*. In either case, the Illinois turtles must be assigned to *T. c. carolina* in the absence of evidence that a pure *triunguis* population occurs in the state.

Six specimens at hand are presumably *T. o. ornata* × *T. c. carolina* hybrids. These specimens, all subadults, have been described and figured elsewhere (P. W. Smith 1955). They are worthy of special note inasmuch as they are from prairie outliers which interdigitate in complex manner with a forest habitat in south-central Illinois. All six specimens are referable to *T. ornata* on the basis of shell conformation, absence of keels, presence of both bridges and axillaries, notched upper jaws, and plastral patterns, but the *ornata* pattern is so obviously superimposed on the subadult *carolina* pattern that it is more difficult to conceive this extent of variation in either species than it is to assume hybridization. Three INHS specimens (3494, Marion County; 5956, Richland County; and 3320, Washington County) are intermediate in patterns. Three INHS specimens (3066, Clay County; 3069, Washington County; and 3067, Wayne County) suggest backcrosses, as the *carolina* influence is strongly subordinate to that of *ornata*.

Habits.—In spring and fall the eastern box turtle is conspicuous in the southern half of Illinois. Frequently it is seen crossing roads or is encountered in wooded areas where it appears to be wandering in search of food. In the heat of midsummer, individuals may congregate in mudholes and burrow into the mud. More than 40 turtles have been taken from one marshy area on a single visit in summer. When in the wild, the box turtle withdraws its head and closes its shell tightly to protect itself from its enemies. As a captive of only a few weeks, it becomes so tame that it cannot be induced to withdraw its head into its shell even if teased. As the time for hibernation approaches, the box turtle digs into the soil a short distance each day. By the time of the first freeze, it is sufficiently deep to be protected.

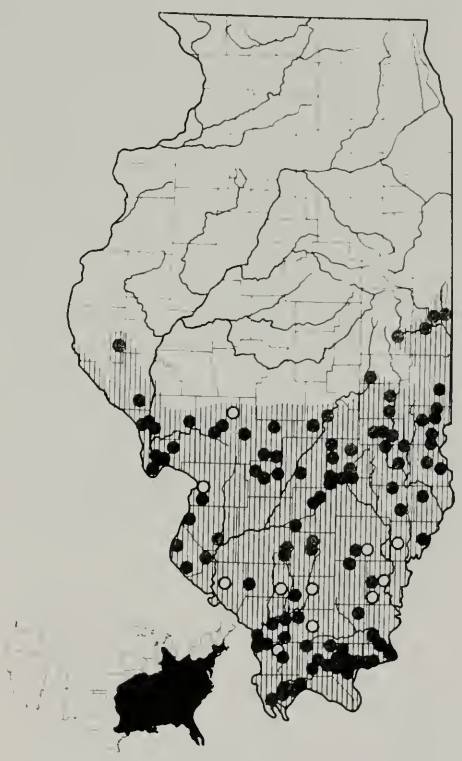


Fig. 122.—Distribution of *Terrapene carolina*. Hatching indicates the presumed range of the subspecies *carolina* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

The eastern box turtle feeds on a variety of plant and animal matter. It seems to relish fungi, fruit, berries, and melons and apparently will consume many kinds of invertebrate animals.

There is some evidence that box turtles may congregate for mating. On several

occasions mating pairs have been found close together on a particular floodplain in the spring. Fall mating also may occur. Cahn (1937) records the clutch size as three to eight eggs, each egg measuring about 33 × 19.5 mm. The leathery-shelled eggs are laid in June and July, often at the edge of woodlands. Hatchlings, although difficult to find, have been taken in September.

Illinois Distribution.—The eastern box turtle is abundant throughout the southern half of Illinois, fig. 122. A few scattered colonies evidently occur in forest islands on the black-soil prairie, but these colonies are only a short distance north of the Shelbyville Moraine. Records from these areas are open to some doubt, inasmuch as picnickers, scouts, and other people often transport turtles to new areas, where they are subsequently released or permitted to escape. An illustration of the difficulty in evaluating these possible waifs is provided by seven specimens taken at Urbana, Illinois. Inasmuch as six of the seven were found within the city, they were probably escaped pets. Nevertheless, the natural range of the species approaches Urbana so closely that some uncertainty remains.

In eastern Illinois, the eastern box turtle occurs north to Vermilion County and is apparently limited in northward dispersal by the tongue of prairie that occupies most of Iroquois and Kankakee counties. In western Illinois apparently suitable habitat extends much farther north than the known range of the turtle. Apparently the box turtle has not yet reoccupied forests in the predominantly prairie areas. In Indiana it is state-wide in occurrence, and it extends well into Michigan.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: EDWARDS COUNTY: Albion (Schneck 1886); FRANKLIN COUNTY: Benton (Cahn 1937); MACOUPIN COUNTY: Standard City (Owens 1941); MADISON COUNTY: Cantine (Hurter 1893); PERRY COUNTY: Du Quoin (H. Garman 1892); RANDOLPH COUNTY: (Hurter 1911); UNION COUNTY: Anna, Cobden (H. Garman 1892); WAYNE COUNTY: Fairfield (Yarrow 1882*a*); WHITE COUNTY: Carmi, Norris City (Cahn 1937); WILLIAMSON COUNTY: Marion (Cahn 1937).

Terrapene ornata ornata (Agassiz)
Ornate Box Turtle

Cistudo ornata Agassiz 1857:445 (type locality: the upper Missouri River and Iowa; revised to junction of the Platte and Missouri rivers by Schmidt 1953); Yarrow 1882*a*:37.
Cistuda ornata, Hay 1892*a*:595.
Terrapene ornata, Taylor 1895:582.
Terrapene ornata ornata, Schmidt 1953:95.
Terrapene carolina nec Linnaeus, Hart & Gleason 1907:257.

Diagnosis.—A medium-sized terrestrial turtle (largest Illinois specimen with a carapace length of 128 mm.), fig. 123, differing from the eastern box turtle as follows: size smaller; carapace flatter and never keeled; gular elements longer; axillary element present; upper jaw notched at tip; plastron of subadult and adult always marked with numerous subequal yellow lines on a brown background; carapace brown or black, with narrow, straight yellow lines arranged radially on each shield and a middorsal series of long yellow dashes.

Variation.—Usually the adult male of the ornate box turtle can be readily separated from the adult female by the more posteriorly located anus and the sharply recurved first claw of the hind foot. In some populations males have greenish or bluish heads. Subadults and juveniles, however, lack obvious secondary sexual characters; and even some adults, unlike those of *Terrapene carolina*, are difficult to sex.

Ontogenetic variation is much less pronounced in *T. ornata* than in *T. carolina*. Marr (1944) recorded western juveniles, 30–37 mm. in carapace length, as being rounder, relatively flatter, and having a dorsal ridge, a dark carapace bearing faint yellow spots, and a light-margined dark plastron. The smallest Illinois specimens available are 59.5 and 67.0 mm. in carapace length. These and other subadults have shell proportions almost identical to those of adults. Their color pattern differs from that of adults only in the wider light margin and less distinct yellow lines on the plastron. Measurements of 61 Illinois specimens reveal no progressive ontogenetic changes in shell ratios, although very old adults tend to have more widely flaring marginals.

In Illinois a slight variation in head color of males suggests a geographic correlation, but the correlation is weak and may be fortuitous. Color notes for 14 specimens from

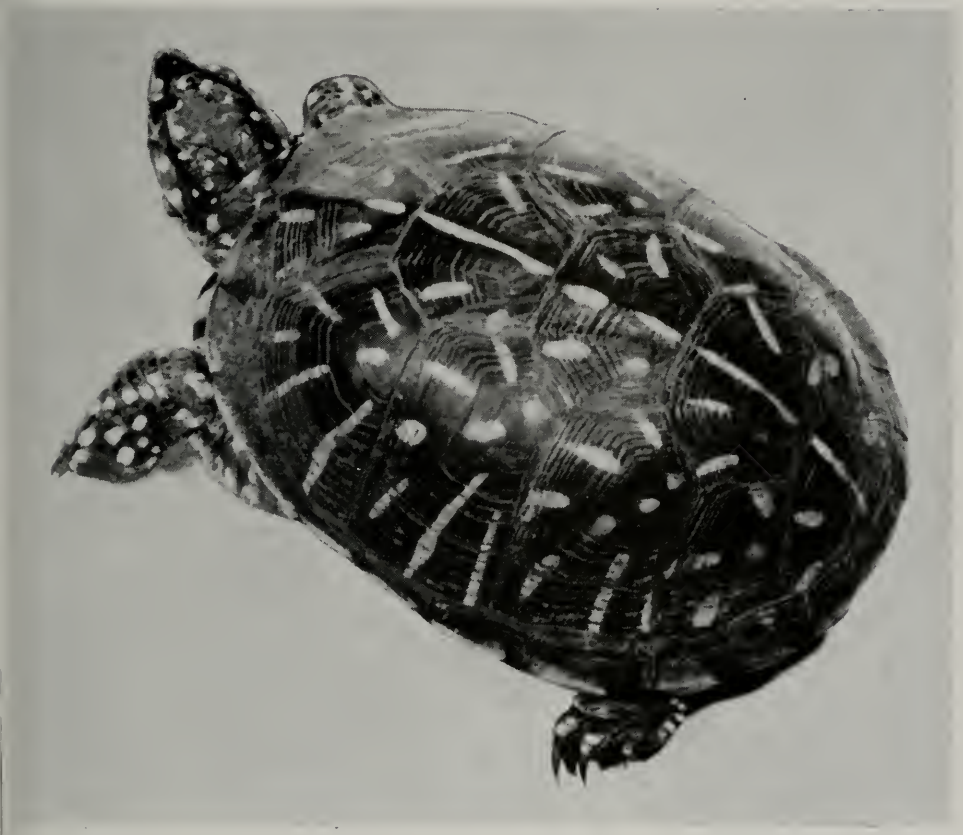


Fig. 123.—A subadult *Terrapene ornata ornata* from Marion County, Illinois. The ground-color is brown or black; the linear markings are yellow.

the sand prairies of central and northern Illinois indicate that approximately 30 per cent of the turtles from these areas have peculiar, uniformly green or blue heads. These strangely colored individuals impart the impression of being stunted or at least unhealthy. About half of the remaining 70 per cent have dark heads without light spots; the other half have dark heads with light spots scattered over the top and sides.

The bizarre head coloring of males is evident on less than 5 per cent of the 44 specimens from the clay soil outlier prairies of western and southern Illinois. Of the 95 per cent with presumably normally colored heads, the majority have distinct light spots.

Individual variation in *T. o. ornata* is less pronounced than in *T. c. carolina,* and probably finds its greatest expression in head color as described above. In 60 specimens shell width ranges from 75.4 to 95.8 (average 85.0) per cent, the carapace height from 45.7 to 56.0 (average 50.0) per cent, and the plastron length from 94 to 105 (average 99) per cent of carapace length. The number and particularly the width of the radiating yellow lines on the carapace are variable, but the raylike arrangement is always present. The plastral pattern is rather constant. One specimen among 60 at hand has 3 toes per hind foot; the others have 4.

Six specimens, which are presumably *T. o. ornata* × *T. c. carolina* hybrids, have been discussed in the account of variation of *T. c. carolina.*

Habits.—The ornate box turtle is the prairie counterpart of the eastern box turtle. In addition to its fondness for fields, it differs from the eastern box turtle by its more rapid locomotion and quickness to bite when handled. Captive individuals display feeding habits similar to those of *T. c. carolina,* taking both plant and animal foods readily.

Although the species is common in many parts of Illinois, I have never found its eggs except some that had been destroyed by skunks. Nesting habits and development are probably similar to those of the eastern box turtle.

Illinois Distribution.—The range of *T. o. ornata* exhibits one of the most peculiar distributional patterns of all Illinois reptiles, fig. 124. The turtle occurs in isolated relict colonies in all of the central and northern Illinois sand areas, but it is absent from adjacent forested regions and from the black-soil muck prairies. Its range in central and southern Illinois consists of a triangular-shaped tongue with its tip east of Lawrenceville (eastern record is Daviess County in Indiana). This tongue is bounded on the north by the Shelbyville Moraine and on the south by a line connecting Jackson and Wabash counties. Within this area, prairie outliers and forest interdigitate; *T. o. ornata* is probably restricted to the prairie outliers. In many areas the prairie outliers are narrow, and it is possible to collect forest-loving *T. carolina* and prairie-loving *T. ornata* almost side by side.

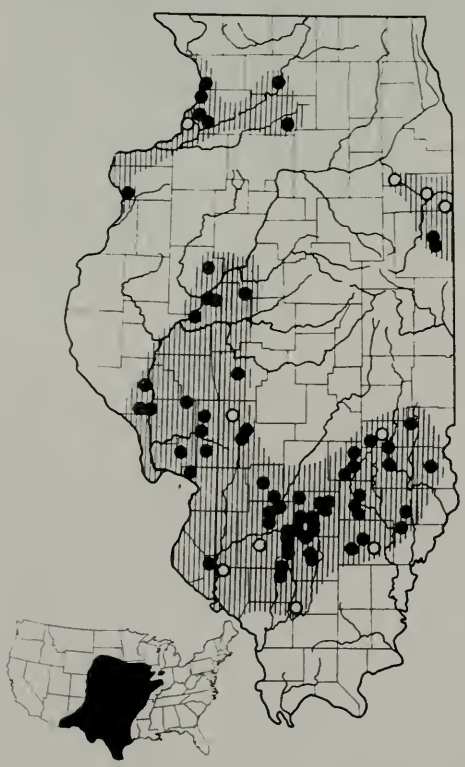


Fig. 124.—Distribution of *Terrapene ornata*. Hatching indicates the presumed range of the subspecies *ornata* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

The enigmatical distribution can be readily explained with the evidence furnished by paleoecology. It can be inferred that the present isolated colonies are remnants of a formerly widespread distribution in the Prairie Peninsula, and that encroaching forest and the increasing mesic nature of this region have reduced the *ornata* habitat to sand prairies in the north and to the savanna-like prairies in the south.

One specimen from Macomb, McDonough County, has not been plotted since its discovery on a sidewalk in the center of the city suggests that it may have been transported there. The literature record (Peters 1942) for Toledo, Cumberland County, may be correct, although numerous visits to this area have revealed only *T. c. carolina*, and the habitat does not appear to be that of *T. o. ornata*.

Although undocumented by specimens, published records for the following additional localities are believed valid and are indicated on the map, fig. 124, by hollow symbols: FRANKLIN COUNTY: Royalton (Cagle 1942*a*); KANKAKEE COUNTY: Aroma Township (Necker 1939*c*); Pembroke Township (Schmidt & Necker 1935); MACOUPIN COUNTY: Standard City (Owens 1941); RANDOLPH COUNTY: Baldwin (Hurter 1911); ROCK ISLAND COUNTY: 6 mi. W Cordova (Schroder 1950); WASHINGTON COUNTY: Addieville (Hurter 1893); WAYNE COUNTY: Fairfield (Yarrow 1882*a*); WILL COUNTY: Bonfield (Necker 1939*c*).

Chrysemys Gray

One species of *Chrysemys*, with four subspecies, occurs in the eastern United States and Canada.

Chrysemys picta (Schneider)

Three subspecies of *Chrysemys picta* meet and intergrade in Illinois. A western race that apparently is genetically pure occurs in the upper Mississippi River and tributaries

and intergrades throughout most of the state with a genetically pure eastern race that occurs in southeastern Illinois. A Gulf Coastal subspecies occurs in the Mississippi River as far north as the southern tip of the state, and, although the Gulf Coastal race is not genetically pure in Illinois, its influence is discernible in the intergrade population occupying Alexander County.

Chrysemys picta marginata Agassiz
Midland Painted Turtle

Chrysemys marginata Agassiz 1857:439, pl. 1, fig. 6; pl. 5, figs. 1–4 (type locality: Wisconsin, Iowa, Michigan, and Indiana; revised to northern Indiana by Schmidt 1953); Yarrow 1882*a*:35.
Chrysemys picta marginata, Bishop & Schmidt 1931:123, 131–7.
Chrysemys marginata marginata × *bellii,* Necker 1933:8.
Chrysemys picta marginata × *bellii,* Schmidt 1938*b*:403.
Chrysemys picta bellii × *marginata,* Necker 1940:62.
Chrysemys picta dorsalis × *marginata* × *bellii,* Cagle 1942*a*:199.
Chrysemys belli nec Gray, Hurter 1893:260.
Chrysemys bellii bellii nec Gray, Ditmars 1936:417–8.
Emys picta, Kennicott 1855:591.
Chrysemys picta, Yarrow 1882*a*:34.
Chrysemys picta ssp., Cagle 1942*a*:199.
Chrysemys sp., Hankinson 1917:328.
Chrysemys marginata treleasei, Weed 1923:48.
Chrysemys cinerea, Baker 1930:55.
Chrysemys picta dorsalis nec Agassiz, Cahn 1937:145–52.
Chrysemys, Cagle & Chaney 1950:388.

Diagnosis.—A medium-sized aquatic turtle (largest Illinois specimen with a carapace length of 166 mm.), fig. 125, with an obtusely oval, depressed carapace; no central keel; posterior margin of carapace smooth, not notched; large, solid plastron, consisting of 12 plates; hind legs somewhat broadened; toes webbed; alveolar surfaces of upper jaw not ridged; terminal notch in upper jaw flanked on either side by a toothlike projection; carapace black to slate-gray, with a thin middorsal red stripe, its sutures sometimes margined with yellow; upper side of marginals with red markings; underside of marginals marbled with red and black; limbs striped with red; head with narrow greenish yellow stripes that become red on the neck; plastron yellow or red, usually with an elongate dark central blotch.

Variation.—In the midland painted turtle the male has conspicuously elongated claws on the front feet. The tail is longer and the anus located more posteriorly in the male than in the female.

The shells of juveniles are more nearly round and proportionately wider than in adults. The thin middorsal stripe is more pronounced and the entire venter is washed with bright red. Larger individuals retain the bright red on the marginals and legs, but the plastron is predominantly yellow. Ontogenetic changes in shell ratios are illustrated by five size classes in table 36.

Geographic variation in *Chrysemys picta marginata* is well marked. In southern Al-

Fig. 125.—A subadult *Chrysemys picta marginata* × *belli* intergrade from Tazewell County, Illinois. The groundcolor is black; the markings on the shell margin are red; and the head stripes are yellow.

Table 36.—Ontogenetic variation in carapace ratios of Illinois *Chrysemys picta*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)									
	Under 30(8)		30–60 (12)		60–100 (17)		100–150 (28)		Over 150 (14)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length..	93.2–99.5	96.0	85.0–97.0	92.0	76.5–92.3	83.6	72.0–79.2	75.5	70.5–80.0	74.5
Height as percentage of length.....	42.3–49.7	45.5	36.6–48.3	41.5	34.0–43.0	38.3	29.8–40.2	35.1	30.9–38.2	34.3

exander and Massac counties, occasional specimens display a widened, middorsal red stripe and a reduced, dark plastral blotch. In a few specimens the plastral blotch may be absent. These individuals are identical with the more southern *C. p. dorsalis*. The majority of painted turtles from these counties, however, have a narrow middorsal red stripe and a well-defined plastral blotch. The population therefore may be referred to *C. p. marginata* × *dorsalis*; since the *marginata* influence predominates in all samples, *C. p. dorsalis* must be excluded from the list of Illinois turtles.

In central and northern Illinois an east-west cline in size and shape of the plastral blotch is evident in the midland painted turtle. In extreme eastern Illinois most specimens have a central blotch without processes, but occasional individuals display dark processes extending peripherally along the plastral sutures. Toward the west the average size of the plastral blotch and the extent of the dark processes rapidly increase. As the plastral blotch increases in size, light markings appear within. The carapace of many central Illinois specimens has yellow lines or dashes, usually one to each costal plate. The carapace of eastern Illinois specimens rarely has yellow markings on the costals.

In western Illinois *C. p. marginata* is replaced by *C. p. belli*. The east-west cline in the nature of the plastral blotch is the result of intergradation of the two races. In eastern Illinois the populations are referable to *C. p. marginata* × *belli*, although the *marginata* influence predominates. In most of the Sangamon and Illinois river tributaries, the populations are almost exactly intermediate.

Arbitrary numbers, 1 to 6, have been assigned for the relative size and degree of complexity of the plastral blotch as indicated in fig. 126. Numbers 1 and 2 are considered within the normal range of variation of *C. p. marginata;* numbers 5 and 6 are within the range of variation of typical *C. p. belli*. The correlation of blotch size and geography is illustrated in table 37.

Necker (1940) described and illustrated a kyphotic specimen from Fox Lake, Illinois. In pattern this hump-backed anomaly was intermediate between *marginata* and *belli*.

Habits.—Although primarily aquatic, the midland painted turtle is frequently found on land, sometimes well away from permanent water. The species is abundant. In summer, numbers of painted turtles may be seen congregated on floating logs to bask in the sun. Individuals of this species are rather wary in the wild.

The painted turtle is omnivorous and to some degree a scavenger. The stomachs of 25 specimens, collected in July, contained only plants. Cahn (1937) found insects, mollusks, crustaceans, amphibians, fish, and abundant vegetable material in the alimentary tracts of specimens he examined.

This species has an involved courtship in which the male strokes the head of the female with the attenuated claws on the front feet.

Cahn (1937) recorded that the nest sites of the painted turtle are in soil within a few yards of a pond or stream. He reported that 4 to 10, usually 6 or 7, elliptical eggs, averaging about 30 × 17.5 mm., are deposited at midday. The shells become rather brittle after drying. Hatchlings can be found in September; they may be more in evidence the following spring.

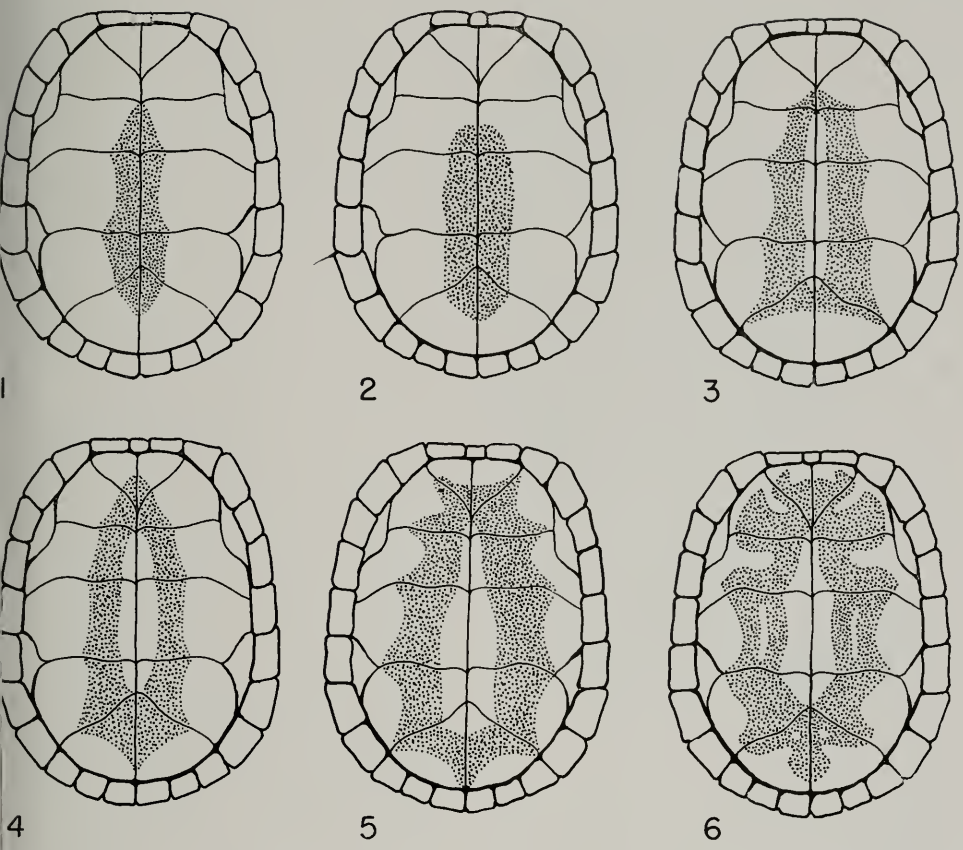


Fig. 126.—Plastral patterns of Illinois *Chrysemys picta.* Numbers 1 and 2 represent typical patterns of *Chrysemys picta marginata;* 5 and 6, patterns within the normal range of variation of *Chrysemys picta belli;* 3 and 4, intermediate patterns frequently exhibited by intergrades.

Table 37.—Geographic variation in plastral pattern of Illinois *Chrysemys picta marginata* × *belli*. Figures in parentheses are numbers of specimens.

Region	Index Number*	
	Range	Mean
Northeastern Illinois (3)	1–3	2.0
East-central Illinois (22)	1–5	2.5
Southeastern Illinois (12)	1–2	1.5
North-central Illinois (4)	2–5	3.7
Central Illinois (13)	1–6	3.2
Southwestern Illinois (12)	1–6	3.2

*Index numbers are as shown in fig. 126.

Illinois Distribution.—Painted turtles referable to *C. p. marginata* occur only in south-central and southeastern Illinois. *C. picta marginata* × *belli* intergrades occur throughout the rest of the state except in the Mississippi River counties north of the confluence of the Illinois and Mississippi rivers, where typical *C. p. belli* replaces the intergrade population, fig. 127. Painted turtles are abundant in almost any aquatic situation, although they are more common in ponds, lakes, and river sloughs than in fast-running streams.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Clay County: Louisville (Cahn 1937); Cook County: Arlington Heights (Cahn 1937); Carle Woods, Evanston, Jackson Park (Necker 1939*c*); Lemont, Palos Park, West Pullman (Schmidt & Necker 1935); River Forest (Necker 1939*c*); Wolf Lake (Schmidt & Necker 1935); Crawford County: Robinson (Cahn 1937); De Witt County: Clinton (Cahn 1937); Du Page

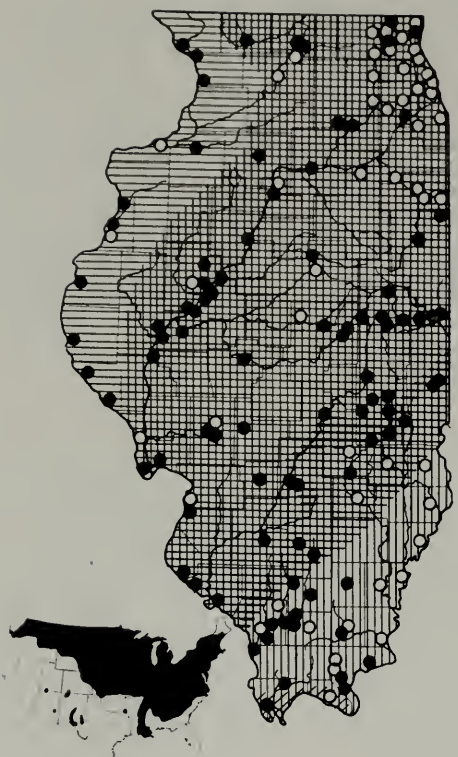


Fig. 127.—Distribution of *Chrysemys picta.* Vertical hatching indicates the presumed range of the subspecies *marginata* in Illinois; horizontal lines, that of the subspecies *belli;* crosshatching in the extreme southern tip of the state, the area of intergradation between *marginata* and *dorsalis;* crosshatching in the northern three-fourths of the state, the area of intergradation between *marginata* and *belli;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

COUNTY: Lombard, Naperville (Schmidt & Necker 1935); EFFINGHAM COUNTY: Effingham (Cahn 1937); FULTON COUNTY: Lewistown (Cahn 1937); GALLATIN COUNTY: Shawneetown (Cahn 1937); GRUNDY COUNTY: (Necker 1939*c*); JACKSON COUNTY: Elkville, Grimsby (Cagle 1942*a*); JASPER COUNTY: Newton (Cahn 1937); KANE COUNTY: Batavia, Dundee (Stille & Edgren 1948); KANKAKEE COUNTY: Aroma Township (Schmidt & Necker 1935); Kankakee (Cahn 1937); Pembroke Township (Necker 1939*c*); LAKE COUNTY: Beach, Burton Ridge, Fox Lake, Grass Lake, Highland Park (Schmidt & Necker 1935); Dead River (Necker 1939*c*); Nippersink, Wauconda (Schmidt & Necker 1935); Waukegan (Necker 1939*c*); LAWRENCE COUNTY: Lawrenceville (Cahn 1937); MCHENRY COUNTY: Cary (Schmidt & Necker 1935); McHenry (Necker 1939*c*); MCLEAN COUNTY: Normal (H. Garman 1892); MACOUPIN COUNTY: Carlinville (Cahn 1937); MADISON COUNTY: Cahokia (Baker 1930); MASSAC COUNTY: Metropolis (Cahn 1937); OGLE COUNTY: Oregon (H. Garman 1892); POPE COUNTY: Dixon Springs (Cagle 1946); Glendale (Cagle 1948); PUTNAM COUNTY: Lake Senachwine (Cahn 1937); SALINE COUNTY: Harrisburg (Cahn 1937); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WHITE COUNTY: Carmi (Cahn 1937); Phillipstown (H. Garman 1892); WILL COUNTY: between Wilmington and Kankakee (Necker 1939*c*); WILLIAMSON COUNTY: Marion (Cagle 1942*b*); WINNEBAGO COUNTY: 7 mi. S Rockford (Fritsch 1940).

Chrysemys picta belli (Gray)
Western Painted Turtle

Emys bellii Gray 1831:31 (type locality: not stated; designated as Puget Sound, Washington, by Schmidt 1953).
Chrysemys bellii, Agassiz 1857:439–40.
Chrysemys bellii bellii, Ditmars 1936:417–8.
Chrysemys picta bellii, Cahn 1937:138–45.
Chrysemys belli, S. Garman 1884:9.
Chrysemys picta belli, Schmidt 1953:100.
Chrysemys picta marginata × *belli,* Necker 1933:8.
Chrysemys picta belli × *marginata,* Necker 1940:62.
Emys picta, Brendel 1857:254 (part).
Chrysemys treleasei Hurter 1911:235–6, pl. 24 (type locality: Madison, St. Clair, and Monroe counties, Illinois).
Chrysemys picta treleasei, Stejneger & Barbour 1917:118.
Chrysemys cinerea, Baker 1930:55.

Diagnosis.—A medium-sized aquatic turtle (largest Illinois specimen with a carapace length of 177 mm.) differing from *Chrysemys picta marginata* by its larger, more complex plastral pattern and by the usual presence of narrow yellow lines on the carapace. The plastral blotch typically occupies most of the plastron and consists of dark processes extending along most of the plastral sutures. Various light mottling and streaking occur within the blotch. The yellow lines on the carapace typically are ar-

ranged one to each costal shield. This line may be straight or forked and usually traverses the middle of each costal.

Variation.—Sexual and ontogenetic variation in *C. p. belli* are presumably identical with those features in *C. p. marginata*.

Geographic variation in the form of intergradation with adjacent *C. p. marginata* has been described in the discussion of that race, table 37 and fig. 126.

Habits.—The behavior of the western painted turtle is presumably similar to that of *C. p. marginata*. Since *C. p. belli* attains a greater size, as might be expected the eggs are larger. Cahn (1937) cited the average dimensions as 35 × 18 mm.

Illinois Distribution.—Typical *C. p. belli* is abundant in the Mississippi River and its lesser tributaries from Jersey to Jo Daviess counties, fig. 127. The painted turtles that occur in the Illinois River and in most of the northern three-fourths of the state are intergrades.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CALHOUN COUNTY: Hardin (Cahn 1937); HENDERSON COUNTY: opposite Burlington [Iowa] (Cahn 1937); ROCK ISLAND COUNTY: Rock Island (Cahn 1937).

Pseudemys Gray

Six species, most of which consist of several subspecies, of this New World genus occur in the United States. Two populations inhabit Illinois, one of which is of hybrid origin.

Pseudemys scripta elegans (Wied)
Red-Eared Turtle Slider

Emys elegans Wied 1839:213 (type locality: Fox River at New Harmony, Indiana).
Trachemys elegans, Agassiz 1857:435.
Pseudemys elegans, Jordan 1878:165.
Chrysemys scripta elegans, Boulenger 1889:79.
Chrysemys elegans, Hay 1892*a*:570.
Pseudemys troostii elegans, Stejneger & Barbour 1939:167.
Pseudemys scripta elegans, Cagle 1941:27–8.
Trachemys troostii nec Holbrook, Agassiz 1857: 435.
Pseudemys troostii nec Holbrook, Cope 1875:53.
Chrysemys troostii nec Holbrook, Boulenger 1889:76.
Pseudemys scripta troostii nec Holbrook, Pope 1939:224–33.
Pseudemys troosti nec Holbrook, Yarrow 1882*a*:187.
Chrysemys troosti nec Holbrook, Ditmars 1907: 30, 36.

Diagnosis.—A large aquatic turtle (largest Illinois specimen with a carapace length of 229 mm.), fig. 128, with an obtusely oval, depressed carapace; central keel present in juvenile, absent in subadult and adult; posterior margin of carapace notched (except in juvenile); plastron large, solid, consisting of 12 plates; hind legs broadened, adapted for swimming; toes webbed; alveolar surfaces of upper jaw with a smooth or finely serrate median ridge; terminal notch in upper jaw, not flanked by toothlike projections; carapace brown or olive, usually with a conspicuous yellow, transverse bar through the middle of each costal; secondary dark and light stripes paralleling yellow bar; plastron and underside of marginals yellow; a dark spot surrounded by concentric dark rings on most of marginal sutures as seen from below; plastron of juvenile with about 6 pairs of ocelli, each ocellus consisting of 2 or more concentric dark lines; subadult and adult usually with 6 pairs of dark smudges on the plastron; legs and tail with prominent yellow stripes of unequal size; head dark, with several greenish yellow stripes and a conspicuous, broad red temporal stripe on each side of head; red stripes extending from eye onto neck; occasional melanistic male with dusky mottling over entire shell, which obscures typical pattern, and with plastral and carapace sutures usually heavily margined with black.

Variation.—The male of the red-eared turtle differs from the female in having a longer tail, more posteriorly located anus, elongated claws on the front feet, and in the tendency for old males to become melanistic. In old males the color may be brown or olive, with the only pattern consisting of heavy black margins along the sutures of the carapace and plastron. In the adult male the feet are usually black; the head retains some trace of the red postorbital stripe, but fine reticulations replace the other head stripes. In very large females the color may approach that of melanistic males in the development of pigment along the plastral sutures, but the typical pattern of the carapace and soft parts is always evident. The plastron is relatively longer in the female, although this characteristic may be apparent

Fig. 128.—An adult *Pseudemys scripta elegans* from Tazewell County, Illinois. The groundcolor is green in young specimens, olive or brown in adults; the shell markings are yellowish gray; the head stripes, greenish yellow, except for the wide red stripe behind each eye.

only when measurements are averaged. In 22 males the plastron length ranges from 88.0 to 94.0 (average 91.3) per cent of the carapace length; in 18 females the range is 89.3 to 98.5 (average 94.0) per cent.

The hatchling of this species is green, with greenish yellow markings on the carapace and soft parts. The head has the characteristic red postorbital stripes. The plastron is clear yellow, with paired ocelli, each of which is composed of concentric dark rings. The shell of the juvenile is almost round and has a central keel, which in the hatchling tends to have protuberances. As the juvenile becomes larger, it loses the green groundcolor of the carapace, and paired dark smudges partially obscure the plastral ocelli. The shell of the subadult is relatively longer and flatter than that of the juvenile, although the central keel may still be found in some specimens as long as 100 mm. The ontogenetic changes in shell proportions are illustrated by the ratios in table 38.

No geographic variation in the red-eared turtle has been discerned within Illinois, but there is considerable individual variation in any one sample. This variation is manifested chiefly in color, in the prominence of

Table 38.—Ontogenetic variation in carapace ratios of Illinois *Pseudemys scripta elegans*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)									
	Under 60 (7)		60–100 (10)		100–150 (16)		150–200 (14)		Over 200 (8)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length	85.6–104.0	94.0	83.0–92.0	86.6	76.3–84.3	80.2	74.0–87.8	78.0	73.2–78.1	75.5
Height as percentage of length	36.9–53.6	44.7	39.4–42.4	40.8	32.3–39.7	35.9	33.3–41.4	35.6	33.8–38.4	36.2

the secondary light lines on the carapace, in the size of the plastral dark smudges, and in the size of the red postorbital stripes. The extremes in carapace pattern variation range from examples in which the transverse yellow bar is parallel to a larger black bar to other examples in which the secondary light lines are nearly as prominent as the primary light bar, thus obliterating the dark groundcolor. The extremes in plastral patterns range from those of occasional individuals in which the ocelli or dark smudges are small to those of individuals in which dark color predominates on the plastron. The postorbital stripes vary in width; in some turtles the stripes may continue onto the neck; in others each stripe may be in the form of a horizontal exclamation mark.

Habits.—Cagle has made detailed studies of this aquatic species in southern Illinois, determining its temperature tolerances, growth rate, and life history. This turtle is active from late April until October. It is a good swimmer, not particularly wary, and enjoys basking on stranded logs, many individuals often congregating for this purpose. It is seldom found on land except when females are seeking nest sites. Cagle (1950) found that males may attain sexual maturity in less than two growing seasons, females in three.

Twenty specimens collected in July contained approximately equal amounts of plant and fish fragments. Cahn (1937) noted that amphibians, crustaceans, mollusks, insects, fish, and plants occurred most often in the stomachs.

The courtship in the red-eared turtle is elaborate and is similar to that exhibited by the painted turtle. Females are often encountered on land in June and July, when they leave the water to lay their eggs. Cagle (1944*b*) recorded the number of eggs laid by a female as 5 to 22; medium-sized turtles usually deposit about 10. The dimensions of the elliptical, granular-shelled eggs average 36 × 21.5 mm. Hatchlings have been found in the fall, but they are perhaps more often found in the spring.

Illinois Distribution.—*Pseudemys scripta elegans* apparently occurs throughout Illinois, except possibly in the northernmost counties, fig. 129. Eastern Illinois records are available as far north as Kankakee and southern Cook counties, but the species is probably uncommon in both areas. In western Illinois the northern limits of the range are unknown; I have not been able to find specimens north of Henderson County. Robert Schroder (personal communication) of Rock Island reported that sliders occur near Moline in Rock Island County. Cahn (1937) plotted records for Rock Island and

Fig. 129.—Distribution of *Pseudemys scripta*. Hatching indicates the presumed range of the subspecies *elegans* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Winnebago counties on his map, although, curiously enough, he failed to cite these records in his list of localities. The species is unknown from Wisconsin and occurs in Iowa only in the southeastern corner. The northern records of Cahn have not been plotted on the accompanying map, inasmuch as the occurrence of the species in extreme northwestern Illinois needs substantiation.

In the southern half of Illinois, red-eared turtles are abundant. Fast-running streams do not usually harbor these turtles, but

many slow streams, lakes, river sloughs, and ponds contain concentrations of them.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CALHOUN COUNTY: Hardin (Cahn 1937); CLAY COUNTY: Clay City, Louisville (Cahn 1937); COOK COUNTY: Orland Park (Necker 1939*c*); FAYETTE COUNTY: Vandalia (Cahn 1937); FULTON COUNTY: Liverpool (Cahn 1937); GALLATIN COUNTY: New Haven, Shawneetown (Cahn 1937); JACKSON COUNTY: De Soto (Cahn 1937); Elkville (Cagle 1942*b*); Grimsby (Cagle 1942*a*); KANKAKEE COUNTY: Altorf Mills (Necker 1939*c*); Aroma Township (Cahn 1937); LAWRENCE COUNTY: Lawrenceville (Cahn 1937); MACOUPIN COUNTY: Carlinville (Cahn 1937); MADISON COUNTY: (Hurter 1893); MARION COUNTY: Centralia (Cahn 1937); MASSAC COUNTY: Metropolis (Cahn 1937); MENARD COUNTY: Petersburg (Cahn 1937); MONROE COUNTY: Maeys (Cahn 1937); PEORIA COUNTY: Peoria (H. Garman 1892); POPE COUNTY: Dixon Springs (Cagle 1946); ST. CLAIR COUNTY: New Athens (Cahn 1937); SALINE COUNTY: Harrisburg (Cahn 1937); SANGAMON COUNTY: Springfield (Cagle 1946); SCHUYLER COUNTY: Camden (Cahn 1937); TAZEWELL COUNTY: Pekin (H. Garman 1889); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WHITE COUNTY: Carmi (Cahn 1937); WHITESIDE COUNTY: Sterling (Cahn 1937); WILLIAMSON COUNTY: Herrin, Marion (Cagle 1942*a*).

Pseudemys concinna hieroglyphica (Holbrook) × floridana hoyi (Agassiz)

Slider Hieroglyphic Turtle

Emys hieroglyphica Holbrook 1836:47, pl. 2 (type locality: Cumberland River, Tennessee) × *Ptychemys hoyi* Agassiz 1857:433 (type locality: southwestern Missouri; revised to vicinity of Springfield, Missouri, by Schmidt 1953).

Pseudemys hieroglyphica, Davis & Rice 1883*a*: 32.

Chrysemys hieroglyphica, Hay 1892*a*:566.

Pseudemys floridana hieroglyphica, Carr 1938: 108.

Pseudemys concinna hieroglyphica, Stejneger & Barbour 1939:164.

Pseudemys concinna, H. Garman 1890:185–6.

Chrysemys concinna, Hay 1892*a*:568.

Pseudemys labyrinthica, Baur 1893:222, 225.

Diagnosis.—A large aquatic turtle (largest Illinois specimen with a carapace length of 314 mm.), fig. 130, with an obtusely oval, rather flattened carapace, usually with flaring posterior marginals in the adult; central

Fig. 130.—A hatchling *Pseudemys floridana hoyi* × *concinna hieroglyphica* from Alexander County, Illinois. The groundcolor is brown; the markings are yellowish gray; the head stripes, yellow.

keel absent except in young; posterior portion of carapace with shallow notches; plastron large, solid, consisting of 12 plates; hind legs broadened, adapted for swimming; toes webbed; alveolar surfaces of both jaws with several subequal spikelike "teeth"; upper jaw without a terminal notch; carapace brown or olive, with a complicated network of light lines, many of which enclose concentric dark rings; each marginal split with an I-shaped light marking; marginal seams dividing concentric light figures; top of head with 6 to 8 narrow, subequal, longitudinal yellow lines and a pair of prominent yellow supratemporal stripes which widen posteriorly; side of head usually with 5 narrow and 3 wider yellow stripes; chin dark, usually with a broad, median, inverted Y-shaped greenish yellow marking, on either side of which are two prominent but subequal yellow lines.

Table 39.—Data for five specimens of *Pseudemys concinna hieroglyphica* × *floridana hoyi* from Illinois. Measurements are in millimeters.

LOCATION OF SPECIMEN	CARAPACE LENGTH	CARAPACE WIDTH	CARAPACE HEIGHT	PLASTRON LENGTH	CARAPACE MARKINGS
INHS	314.0	233.0	.....	305.0	Narrow
INHS	300.0	208.0	105.0	284.0	Broad
INHS	168.0	138.0	57.0	156.0	Broad
UIMNH	76.0	62.5	32.0	71.0	Narrow
INHS	39.0	39.0	21.2	36.0	Broad

Remarks.—The large slider of the major rivers and associated oxbow lakes of extreme southern Illinois is easily distinguished from *Pseudemys scripta elegans,* but its identity is uncertain. Dr. John W. Crenshaw, Jr., who studied the group very intensively while at the University of Florida, advises me in correspondence that introgression of *P. floridana* genes into the *P. concinna* populations of the lower Mississippi valley has produced an intermediate form. He recommends that the southern Illinois sliders be regarded as hybrids.

P. concinna differs from *P. floridana,* the other parental species, as follows: second costal plate with a light-colored C-shaped marking versus an I- or inverted Y-shaped marking; plastral pattern well developed versus weakly developed; bridge markings contacting adjacent submarginal blotches versus markings separate from blotches; submarginal blotches numerous versus few; and carapace flattened versus more or less globular. *P. floridana* is principally a lake species, *P. concinna* a river species.

Only five Illinois specimens of this large slider have been examined. These are a hatchling, a juvenile, an adult female, and the shells of two adults of undetermined sex. Too few data are available to measure the degree of intermediacy; but, in the five specimens at hand, the characters of *P. c. hieroglyphica* seem to predominate.

Variation.—Carr (1952) noted that the male slider is smaller and flatter than the female; the carapace width averages more than one-third its length in the male, less than one-third in the female. As in *P. s. elegans,* the claws of the front feet of the male are enlarged, and the anus is located posterior to the rear edge of the carapace.

The hatchling mentioned above is almost round and it has a weak central keel, although anterior protuberances are evident. The shell pattern is similar to that of the adults at hand. The chin pattern is apparently atypical, consisting of a broad, oblong yellow patch, bounded by a pair of narrow dark lines.

Measurements of the five specimens known from Illinois are given in table 39.

Habits.—The slider, or hieroglyphic turtle, is an extremely wary species which probably leaves the water only to bask on logs or cypress knees or to lay eggs. It is a strong swimmer. It is timid and inoffensive.

Cahn (1937) recorded that this turtle eats plant material, crustaceans, amphibians, fish, mollusks, and insects. He also noted that it scavenges a certain amount.

The same author reported that in western Tennessee egg laying occurs in June. The nests are in soil not far from the water. One female was reported to contain nine elliptical, hard-shelled eggs, each measuring approximately 37.5 × 26 mm.

Illinois Distribution.—The hybrid described here is evidently very rare in Illinois, and it probably is restricted to the large rivers and adjacent lakes in the extreme southern counties, fig. 131. The northernmost records are Mount Carmel, on the Wabash River, and Elsah, on the Mississippi River. Cahn (1937) believed the species was exterminated in Horseshoe Lake, Alexander County, one of the seemingly ideal habitats in Illinois, when this lake went dry in 1930. The most recently collected specimen of this species, however, is a juvenile found in a slough adjacent to Horseshoe Lake, and it appears that this turtle has rehabilitated itself in the lake.

A series of hatchlings present in the University of Illinois Museum of Natural History labeled "Meredosia, Morgan County, Illinois, A. R. Cahn," is almost certainly in error. Several of the Cahn specimens, many of which were probably from Reelfoot Lake,

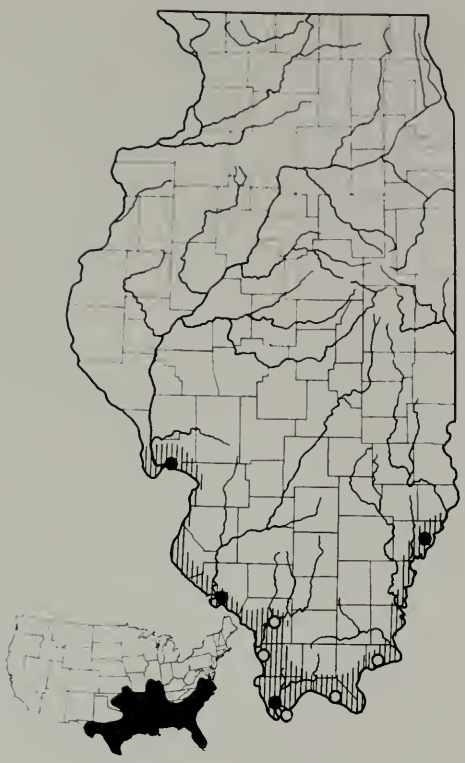


Fig. 131.—Distribution of *Pseudemys concinna* × *floridana*. Hatching indicates the presumed range of the species hybrid in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the combined total ranges of the parental species in the United States.

Tennessee, have been assigned to Illinois localities, and this unfortunate situation has made it necessary to be extremely critical of Cahn's records.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: ALEXANDER COUNTY: Cairo (Cahn 1937); HARDIN COUNTY: Elizabethtown (Cahn 1937); JACKSON COUNTY: Murphysboro (Cahn 1937); MASSAC COUNTY: Metropolis (Cahn 1937); UNION COUNTY: (Cahn 1937).

Graptemys Agassiz

Seven North American species, one of which has several subspecies, are included in this New World genus.

Graptemys pseudogeographica (Gray)

Five subspecies are currently referred to this species. The species and subspecies constituting the *Graptemys pseudogeographica* group are too poorly understood, however, for the Illinois turtles to be assigned names with certainty. In most characters all the Illinois members of the group appear to belong to a single population. In head pattern, a character presumably diagnostic in the genus, as many as four of the nominal species seem to be present at one Illinois locality. Collections from other Illinois localities commonly include turtles that key out to two different forms. Accordingly, the small series of specimens available are discussed as *ouachitensis* type, *kohni* type, *pseudogeographica* type, and *versa* type, but referred to *G. pseudogeographica* subspecies, pending the completion of a monographic study of the genus by F. R. Cagle. Additional collections are needed from the upper Mississippi River.

Graptemys pseudogeographica (Gray) False Map Turtle

Emys pseudogeographica Gray 1831:31 (type locality: Wabash River at New Harmony, Indiana).
Graptemys pseudogeographica pseudogeographica, Weed 1923:48.
Graptemys pseudogeographica, Breckenridge 1944:178.
Malacoclemmys pseudo-geographicus, Davis & Rice 1883*a*:32.
Malaclemys pseudo-geographica, Hurter 1893: 260.
Malacoclemmys lesueuri, Yarrow 1882*a*:34.
Malaclemys lesueuri, Hurter 1911:243.
Graptemys pseudogeographica kohnii × *versa,* Carr 1949:10 (map).
Graptemys pseudogeographica kohnii, Carr 1952:202, 207.
Graptemys pseudogeographica ouachitensis, Cagle 1954:185.
?Graptemys, Cagle 1944*c*:5–34.

Diagnosis.—A large aquatic turtle (largest Illinois specimen having a carapace length of 235 mm.), fig. 132, with an obtusely oval carapace that is serrate on posterior edge and has a strong central keel with spikes at least on second and third vertebrals; plastron large, solid, consisting of 12 plates; hind legs broadened, adapted for swimming; toes webbed; alveolar surfaces of upper jaw relatively wide, lacking ridges or "teeth"; head very small in the male, medium-sized in the female. Carapace brown, olive, or

Fig. 132.—A subadult *Graptemys pseudogeographica* from White County, Illinois. The shell is light olive, dull tan, or light brown with dark smudges; the head is conspicuously striped with yellow.

green, with variable pattern of narrow yellow lines and large dark smudges; legs and head dark, with narrow yellow lines; a pair of boomerang-shaped yellow markings or large yellow blotches just behind eyes on top of head; postorbital marking separated from eye, sometimes by a diagonal yellow line, sometimes only by dark groundcolor.

Variation.—If more than one form of false map turtle is involved in our material, sexual dimorphism and ontogenetic variation are very similar in all. The male differs from the female in its smaller size, decidedly smaller head, more elliptical carapace, long claws on the front feet, longer tail, and more posteriorly situated anus. The plastron is proportionately larger in the female. In nine males the plastron length is 85.1 to 91.2 (average 88.6) per cent of the carapace length, and in 19 females the plastron length is 83.8 to 94.8 (average 91.1) per cent of the carapace length. Other differences in carapace ratios are noted below under ontogenetic variation and in table 40.

Table 40.—Ontogenetic variation in carapace proportions of Illinois *Graptemys pseudogeographica*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)							
	Under 100, Juveniles (8)		100–150				Over 150, Females (11)	
			Males (9)		Females (6)			
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length	84.5–102.0	89.0	70.0–79.2	74.7	76.0–83.4	79.4	74.2–83.2	79.2
Height as percentage of length	38.8–47.5	42.1	33.8–40.2	36.7	35.1–40.9	38.7	36.3–42.8	39.2

In juveniles of this turtle the carapace is more nearly circular in shape and relatively higher than in adults because of the prominence of the central keel and spikes. The posterior edge of the carapace is sharply serrate, and some marginals are doubly serrate. The carapace is greenish, with concentric dark figures. The plastron has a large, variable, central dark blotch. The markings on the soft parts are more vivid in young turtles than in adults; configuration of the markings is probably the same at all ages. The ontogenetic decrease in proportionate carapace width and height is rapid in males, more gradual in females, table 40.

Aside from head patterns the only discernible trend in geographic variation for the false map turtle is a slight indication that

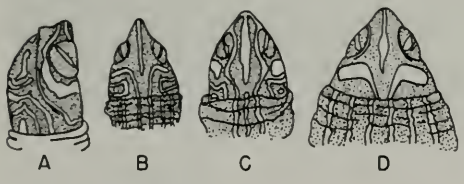


Fig. 133.—Head patterns of *Graptemys pseudogeographica,* all from Morgan County, Illinois *(A–D): A, kohni* type; *B, pseudogeographica* type; *C, versa* type; *D, ouachitensis* type.

heads of males may be proportionately smaller in turtles from western Illinois than in those from other parts of the state. The various head patterns, fig. 133, represented are as follows:

The *ouachitensis* Type.—The most frequent head pattern in Illinois, illustrated in fig. 133*D*, consists of a pair of prominent, rectangular postorbital markings that are lateral extensions of the narrow, paravertebral light lines. This type also has a large suborbital yellow spot and 3 large yellow spots on the chin, 1 apical and 1 on either side of the lower mandible just anterior to the angle of the jaws. Three to 6 thin yellow lines enter the eye, passing between the postorbital and suborbital yellow markings. This type differs from *Graptemys pseudogeographica ouachitensis* from more southern areas principally in the greater number of yellow lines entering the eye.

The distribution of this type makes little sense geographically. The pattern occurs in specimens from Calhoun, De Kalb, Jackson, Mason, Morgan, and Shelby counties, Illinois. It also occurs in a specimen from the Mississippi River in Muscatine County, Iowa, and it is the predominant pattern in a series of topotypic *pseudogeographica,* occurring in 7 of the 10 available specimens from Posey County, Indiana.

The *pseudogeographica* Type.—The second most common pattern, fig. 133*B*, differs from the above in that the postorbital markings are very narrow rather than rectangular and the suborbital and chin spots are reduced or wanting. Five to 7 light lines enter the posterior border of the eye. This type is the *G. p. pseudogeographica* of most recent authors.

It occurs in specimens from Adams, Alexander, Mason, Morgan, Massac, Hardin, Randolph, and Williamson counties, Illinois, and in two topotypic specimens of *pseudogeographica* (Wabash River at New Harmony, Indiana). It occurs in four of the five Mississippi River specimens from Muscatine County, Iowa, suggesting that this pattern may predominate in northern specimens. The occurrence of the same pattern in single specimens from the four southernmost Illinois localities is contradictory.

Two Morgan County, Illinois, specimens and one Posey County, Indiana, specimen could be regarded as intermediate between the *ouachitensis* and *pseudogeographica* pattern types.

The *kohni* Type.—A few specimens have a modification of the postorbital bar, fig. 133*A*. Three specimens, two from Morgan County and one from Cumberland County, Illinois, key out readily as *G. kohni.* In lateral view, the head pattern consists of a prominent, rectangular postorbital marking that continues as an anterior process underneath the eye. The anterior process eliminates the possibility of any light-colored lines entering the orbit. The chin spots are large, as in the *ouachitensis* type. The head of the male is very small. The shell pattern in the *kohni* type is essentially the same as in the other types.

Despite their resemblance in head pattern to *kohni,* the three specimens at hand are referred to *G. pseudogeographica* rather than to *kohni,* inasmuch as *kohni* is presumably a distinctive animal, differing from other forms by its larger head, osteology, and behavior, as well as in head pattern (Cagle, personal communication).

The *versa* Type.—The least common pattern, fig. 133*C*, can be regarded as a modified *kohni* type. Three specimens, two from Morgan County, Illinois, and one from Posey County, Indiana, differ from the *ouachitensis, pseudogeographica,* and *kohni* types in that each has a pair of large square or rectangular postorbital blotches that are isolated and surrounded by incomplete concentric light rings. The chin spots and suborbital spots are large. One to 6 light lines enter the posterior border of the eye. The chin shows a tendency toward transverse, although broken, yellow stripes. The head of the male is extremely small for the body size of the animal. These specimens are in essential agreement with descriptions of *versa.*

The current arrangement of the forms of this complex seems to be to recognize *kohni* and *versa* as full species and *pseudogeographica* and *ouachitensis* as subspecies of *pseudogeographica* that intergrade in a wide belt including Illinois and Indiana. If the head patterns are reliably diagnostic, we must assume that three species occur together and may even be taken at the same time in the same net. That three closely related species occur together seems very unlikely. An alternate possibility is that all the pattern types may occur as occasional variants in turtles of a single population. The similarity of all characters except head patterns lends credence to this possibility. A study of substantial series of these turtles from the Illinois and Mississippi rivers might resolve the problem involved; this is one of the most urgent problems in the herpetological taxonomy of eastern United States.

Fig. 134.—Distribution of *Graptemys pseudogeographica.* This rather uncommon species apparently occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the combined total ranges of the species *pseudogeographica* and *kohni* in the United States.

Habits.—The false map turtle, sawback, or hackle-back, is strictly aquatic and so wary that capture is difficult. It is taken in numbers in fishermen's nets, and occasional individuals are caught by hook and line. The species is gregarious, at least in basking habits; frequently stranded logs may be seen lined with these turtles. Captives are timid and apparently will not bite.

G. pseudogeographica is probably omnivorous. Cahn (1937) found that young specimens fed on vegetable matter, mollusks, and occasional insects. Adults, however, showed evidence of being strict vegetarians, their stomachs yielding only stems of aquatic grasses and sedge bulbs.

Illinois Distribution.—The false map turtle apparently occurs throughout Illinois; and, although it is not abundant, it probably is more common than the available records indicate, fig. 134. It is characteristic of swift rivers but may occur in large lakes. Also, it may be found in bays of large rivers, but it prefers rivers with moderate current and clean bottoms.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: ALEXANDER COUNTY: Cairo (H. Garman 1892); Horseshoe Lake (Cahn 1937); CLINTON COUNTY: Carlyle (Cahn 1937); HARDIN COUNTY: Elizabethtown (Cahn 1937); JACKSON COUNTY: Murphysboro (Cahn 1937); MCHENRY COUNTY: McHenry (Cahn 1937); MADISON COUNTY: (Hurter 1911); MONROE COUNTY: Maeys (Cahn

1937); ST. CLAIR COUNTY: (Hurter 1911); UNION COUNTY: Muddy River (Minton & Minton 1948); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WASHINGTON COUNTY: Okawville (Cahn 1937); WHITE COUNTY: Carmi (Cahn 1937).

Graptemys geographica (Le Sueur) Map Turtle

Testudo geographica Le Sueur 1817:86, pl. 5 (type locality: marsh on border of Lake Erie); Say 1823:32.
Graptemys geographica, Agassiz 1857:436.
Malaclemys geographica, Hurter 1893:261.
Malacoclemmys geographicus, Yarrow 1882*a*: 33.
Malaclemmys geographicus, McLain 1899:1.
Graptemys geographicus, Shelford 1913:130, 135, 156.
Graptemys, ?Cagle 1944*c*:5–34.

Diagnosis.—A large aquatic turtle (largest Illinois specimen with a carapace length of 239 mm.), fig. 135, with an obtusely oval carapace; posterior edge of carapace serrate; central keel spiked in juveniles; plastron large, solid, consisting of 12 plates; hind legs broadened, adapted for swimming; toes webbed; alveolar surfaces of upper jaw wide, lacking ridges or "teeth"; no distinct terminal notch in upper jaw; head medium-sized to large; carapace brown, olive, or green, with a vague pattern of dim light lines and dark smudges on some or all of carapace shields; plastron plain or with variable plastral markings; legs and head dark, with narrow yellow lines; a small, isolated, dorsal yellow spot back of each eye; postorbital spot separated from eye by 2 or 3 diagonal yellow lines.

Variation.—The male in this species differs from the female in being of smaller size and in having a narrower head, longer tail, more posteriorly located anus, and slightly smaller plastron. There is a tendency for the carapace of the male to be more oval than that of the female. In five males at hand the plastron length ranges from 85.6 to 92.3 (average 87.4) per cent of the carapace length; in 13 females corresponding figures are 84.5 to 92.0 (average 89.3) per cent.

In hatchlings the carapace is strongly keeled with conspicuous spikes, and its width is relatively greater than in adults, table 41. The carapace pattern consists of numerous rounded, concentric figures on a green groundcolor. In older juveniles the keels have less prominent spikes, and the groundcolor is olive or brown, with irregular dark smudges on most of the shields as well as a complex pattern of thin yellow lines. The plastron of juveniles contains a large cen-

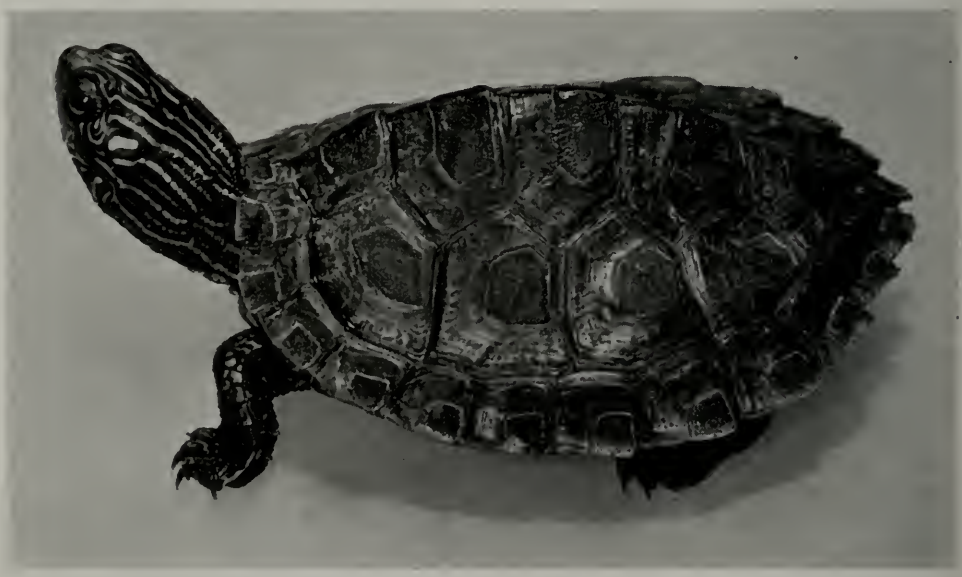


Fig. 135.—A subadult *Graptemys geographica* from Vermilion County, Illinois. The shell is light olive, dull tan, or light brown with dark smudges; the head markings are pale yellow or light greenish yellow.

Table 41.—Ontogenetic variation in carapace ratios of Illinois *Graptemys geographica*. Figures in parentheses are numbers of specimens.

Characteristic	Carapace Length (mm.)					
	Under 100 (13)		100–150 (14)		Over 150 (3)	
	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length	76.3–91.5	86.4	74.2–86.7	77.1	73.0–79.2	76.7
Height as percentage of length	35.2–54.6	40.7	29.7–37.0	33.6	31.7–36.4	34.0

tral dark blotch or 6 to 8 transverse dark markings along the seams.

No geographic variation has been discerned in the limited series of Illinois specimens available. Individual variation is most pronounced in pattern of carapace and plastron and the shape of the postorbital spots. The variability of the pattern features is due to degree of retention of the juvenile pattern in adults. The postorbital spots may be round, triangular, or, in occasional specimens, shaped like an elongate teardrop. Shell pattern varies much as in *pseudogeographica*.

Habits.—The thoroughly aquatic map turtle is difficult to capture because of its wariness and its speed in swimming. It is fond of basking on stranded logs but will dive at the least disturbance and secrete itself among aquatic vegetation. It is found on land only when it is seeking a nest site. This species has been taken in fishermen's nets well into November, showing an apparent reluctance to go into hibernation. Captive turtles are timid, usually refuse food, and show no inclination to bite.

The principal food of the map turtle is mollusks, which are broken by the broad crushing surfaces of this turtle's jaw. Cahn (1937) found insect remains in some individuals.

Cahn (1937) described the egg-laying process as occurring in early morning from late May through June. The nests, in soil some distance from water, contain 10 to 16, usually 12 or 14, elliptical, leathery-shelled eggs, which average about 32 × 21 mm. Hatchlings can be found as early as mid-July, according to Cahn.

Illinois Distribution.—The map turtle occurs throughout Illinois, although it is apparently not abundant, fig. 136. This species shows preference for large rivers, backwater sloughs, and large lakes.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Alexander County: Cairo (H. Garman 1892); Horseshoe Lake (Cahn 1937); Bureau County: Bureau (Cahn 1937); Cass

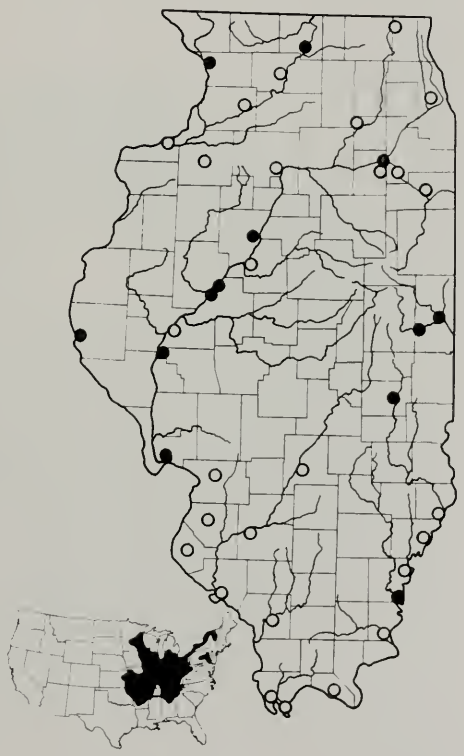


Fig. 136.—Distribution of *Graptemys geographica*. This species occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

COUNTY: Beardstown (Cahn 1937); COOK COUNTY: Chicago (Cahn 1937); FAYETTE COUNTY: Vandalia (Cahn 1937); GALLATIN COUNTY: Shawneetown (Say 1823); GRUNDY COUNTY: Diamond (Stille & Edgren 1948); HENRY COUNTY: (H. Garman 1892); JACKSON COUNTY: Murphysboro (Cahn 1937); KANKAKEE COUNTY: Kankakee (Cahn 1937); KENDALL COUNTY: Plano (McLain 1899); LAKE COUNTY: Fox Lake (Cahn 1937); Nippersink Lake (H. Garman 1892); LAWRENCE COUNTY: St. Francisville (Cahn 1937); MADISON COUNTY: (Hurter 1911); MASSAC COUNTY: Metropolis (Cahn 1937); MONROE COUNTY: (Hurter 1911); OGLE COUNTY: (H. Garman 1892); RANDOLPH COUNTY: Chester (Cahn 1937); ROCK ISLAND COUNTY: Rock Island (Cahn 1937); ST. CLAIR COUNTY: (Hurter 1911); TAZEWELL COUNTY: Pekin (H. Garman 1892); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WASHINGTON COUNTY: Okawville (Cahn 1937); WHITE COUNTY: Grand Chain [Indiana] (H. Garman 1892); WHITESIDE COUNTY: Sterling (Cahn 1937); WILL COUNTY: Kankakee River (Stille & Edgren 1948).

TRIONYCHIDAE

Only one of the seven genera included in this family occurs in the New World; the remaining genera inhabit only Asia and Africa.

Trionyx Geoffroy St. Hilaire

One monotypic and two polytypic species are recognized in this North American and Asiatic genus. Two species occur in Illinois. These turtles, which for many years were placed in the genus *Amyda*, are among the reptiles that are most highly specialized for life in fresh-water habitats.

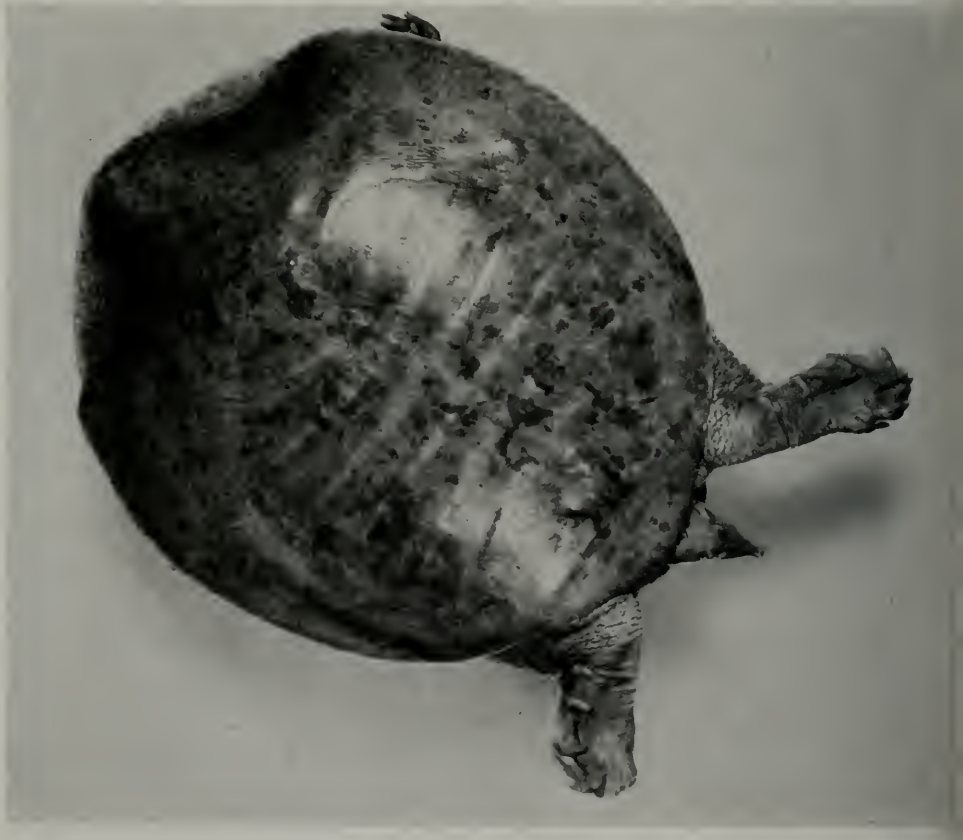


Fig. 137.—An adult *Trionyx muticus muticus* from Wabash County, Illinois. The shell and body are tan above, white below.

Trionyx muticus muticus Le Sueur
Smooth Softshell

Trionyx muticus Le Sueur 1827:263, pl. 7 (type locality: Wabash River at New Harmony, Posey County, Indiana); Hay 1892*a*: 552.
Amyda mutica, Yarrow 1882*a*:28.
Trionyx mutica, Cagle 1941:23.
Trionyx, Brendel 1857:255 (part).

Diagnosis.—A large aquatic turtle (largest Illinois specimen with a carapace length of 233 mm.), fig. 137, with an almost round, much-depressed carapace; edges of carapace leathery and flexible; carapace and plastron without plates; nostrils without septa; anterior edge of carapace without tubercles; shell pattern of juvenile and subadult consisting of numerous dots and bacilliform dashes on a tan, olive, or light brown groundcolor; plastron white; sides of head brown, with a single light stripe extending from the eye to the throat on each side of head; chin light; carapace of large adult irregularly mottled or blotched with dark and light.

Variation.—The male of this species differs from the female in being of smaller size and in having a longer tail and a more posteriorly located vent. The anus is posterior to the rear edge of the carapace in the male, anterior in the female.

The young turtle differs from the adult in having a distinct pattern of dark dashes and a more prominent light margin around the posterior and lateral edges of the carapace. The head stripes are better defined on young specimens. In six juveniles the carapace width ranges from 84.2 to 89.2 (average 87.4) per cent and the carapace height from 20.8 to 27.5 (average 24.5) per cent of carapace length. In 11 adults the carapace width ranges from 83.5 to 94.6 (average 88.4) per cent and carapace height from 18.6 to 23.0 (average 20.3) per cent of carapace length.

No geographic variation in this species has been discerned within Illinois. Individual variation is not pronounced. Among juveniles there is a slight range in the number of bacilliform lines and dots. Among adults the distinctness of the carapace pattern and prominence of the light head stripes are variable. The plastron is usually immaculate white; in occasional turtles a small amount of dusky mottling is present on the anterior portion of the plastron and on the underside of carapace margins. One specimen (INHS 2148 from Morgan County) is kyphotic, the hump projecting so high that the carapace height is almost one-third its length.

Habits.—The smooth soft shell is similar to *Trionyx spinifer* in many respects, but it differs markedly in habitat and temperament. It often lies buried at the edge of water but only in clean sand; it avoids mud- and rock-bottomed streams. Captives withdraw their heads completely into the shell, and I have never encountered an individual that showed a willingness to bite. This species presumably has hibernating habits similar to those of *T. spinifer*, although no information on this subject is available. In summer, large numbers of *muticus* may be seen basking on sandbars in certain areas.

T. m. muticus is primarily a carnivorous animal. Cahn (1937) found that stomachs usually contained crustaceans, fish, amphibians, insects, and mollusks. Plant feeding and scavenging are probably uncommon if they occur at all.

The eggs of this turtle are laid in sandbanks quite near the edges of rivers. Cahn (1937) noted that young females lay five or six eggs, large females as many as 31. The spherical eggs average about 22.6 mm. in diameter. Nesting occurs in June and early July; eggs almost ready to hatch have been found in early September.

Illinois Distribution.—The smooth softshell is evidently restricted to rivers with relatively clean, sandy bottoms and with frequent sand bars. The species is known throughout the southern half of Illinois and along the sandy stretches of the Illinois and Mississippi rivers, fig. 138. Although records are lacking for the Chicago area, the species may be present there; it has possibly been overlooked in the sand-bottomed rivers of Kankakee and Iroquois counties. These streams appear to afford ideal habitat. The sluggishly moving and mud-bottomed streams of much of the Grand Prairie of northern and central Illinois do not seem to provide suitable habitat.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: ADAMS COUNTY: Quincy (H. Garman 1892); ALEXANDER COUNTY: Cairo (H. Garman 1892); Horseshoe Lake (Cahn 1937); CAR-

Fig. 138.—Distribution of *Trionyx muticus*. Hatching indicates the presumed range of the subspecies *muticus* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed valid. The lower map depicts the total range of the species in the United States.

ROLL COUNTY: 5 mi. S Savanna (Stejneger 1944); CLAY COUNTY: Louisville (Cahn 1937); CLINTON COUNTY: Carlyle (Cahn 1937); CRAWFORD COUNTY: Robinson (Cahn 1937); FAYETTE COUNTY: Vandalia (Cahn 1937); GALLATIN COUNTY: Shawneetown (Cahn 1937); HANCOCK COUNTY: between Warsaw and Hamilton (Stejneger 1944); JACKSON COUNTY: Murphysboro (Cahn 1937); MARION COUNTY: Centralia (Cahn 1937); POPE COUNTY: Golconda (Cahn 1937); RANDOLPH COUNTY: Chester (Cahn 1937); RICHLAND COUNTY: Olney (Stejneger 1944); ROCK ISLAND COUNTY: Rock Island (Cahn 1937); ST. CLAIR COUNTY: Mississippi River at St. Louis (Hurter 1893); WHITE COUNTY: Carmi (Cahn 1937); WHITESIDE COUNTY: Sterling (Cahn 1937); WOODFORD COUNTY: (H. Garman 1892).

Trionyx spinifer Le Sueur

Five subspecies of *Trionyx spinifer* have been described. The nominate race occurs throughout Illinois. A slight genetic influence of another western subspecies is discernible in the population inhabiting the upper part of the Mississippi River.

Trionyx spinifer spinifer Le Sueur
Eastern Spiny Softshell

Trionyx spiniferus Le Sueur 1827:258, pl. 6 (type locality: Wabash River at New Harmony, Posey County, Indiana); Hurter 1893: 260.
Aspidonectes spinifer, Agassiz 1857:404–5.
Trionyx spinifer, Ditmars 1907:77.
Amyda spinifera, Hurter 1911:252.
Platypeltis spinifera, Hankinson 1917:328.
Trionyx spinifera, Schmidt 1938*b*:21–3.
Amyda spinifera spinifera, Necker 1939*d*:3.
Trionyx spinifera spinifera, Cagle 1941:23.
Amyda spinifera hartwegi × *spinifera*, Conant & Goin 1948:10–1.
Amyda ferox spinifera, Carr 1952:428.
Trionyx ferox nec Say, Kennicott 1855:591.
Aspidonectes ferox nec Say, H. Garman 1892: 215.
Amyda ferox nec Say, Schmidt & Necker 1935: 60.
Amyda ferox hartwegi, Carr 1952:433–5(1).
Trionyx, Brendel 1857:255 (part).
Amyda, Baker 1936:243, 245.

Diagnosis.—A large aquatic turtle (largest Illinois specimen with a carapace length of 282 mm.), fig. 139, similar to *Trionyx muticus*, but differing as follows: nostrils with incomplete septa; anterior edge of carapace lined with tubercles; each side of head dark, a postorbital light stripe and a light line passing posteriorly from the angle of the jaws; neck and legs olive, mottled with dark; carapace in juveniles and in some adults tan, olive, or dull brown, with scattered, round dark circles or ocelli rather than bacilliform dashes; carapace in large adults sometimes with ocelli but usually irregularly mottled.

Variation.—In *T. spinifer spinifer*, the male is smaller and has a longer tail than the female; its anus is posterior to the rear edge of the carapace. The male usually has a carapace with sandpaper-like texture, whereas the female tends to have fewer and larger shell tubercles, particularly in the middorsal region. The adult female loses the pattern of dark ocelli and usually is mottled.

Fig. 139.—A subadult *Trionyx spinifer spinifer* from Tazewell County, Illinois. The shell and body are tan or brown above, white below.

The juvenile is paler than the adult, and the carapace markings and the mottling of soft parts are more prominent. Both proportionate width and height of the shell decrease as the turtle becomes adult. Since the male is intermediate in size between the juvenile and the adult female, changes in shell ratios can be illustrated by comparing the means of carapace width to length and carapace height to length ratios of juveniles, males, and females, table 42.

Geographic variation in the eastern spiny softshell within Illinois is manifested by an east-to-west reduction in the size of the central ocelli of the carapace. This clinal variation represents intergradation of eastern *spinifer* with *hartwegi*, which occurs west of the Mississippi River. In eastern Illinois the ocelli of *spinifer* are typically large in the center of the carapace; they decrease in size toward the periphery of the shell. In western Illinois occasional specimens have enlarged central ocelli, but the majority tend to have less difference in size between central and peripheral ocelli. These characters are difficult to measure and, since no north-to-south variation has been discerned, the patterns of the available material have been assigned to "*hartwegi*-like," "intermediate," or "*spinifer*-like" groups and divided into a western Illinois sample and an eastern Illinois sample, table 43.

The data shown in table 43 are essentially in agreement with the findings of Conant & Goin (1948), who described *hartwegi*, except that our samples suggest that

Table 42.—Ontogenetic variation in carapace ratios of Illinois *Trionyx spinifer*. Figures in parentheses are numbers of specimens.

Characteristic	Juveniles (10)		Adults			
			Males (15)		Females (15)	
	Range	Mean	Range	Mean	Range	Mean
Width as percentage of length	85.7–93.7	89.5	83.2–92.4	86.5	82.4–88.7	85.0
Height as percentage of length	22.2–28.6	26.8	19.4–27.7	23.4	20.4–27.8	25.2

the area of intergradation is somewhat larger in Illinois (and also probably in Missouri) than that indicated by these authors.

Individual variation in the eastern spiny softshell is manifested in groundcolor, size and number of ocelli on the shell, amount of dark spotting or mottling on the underside of the carapace, and distinctness of dark mottling of the soft parts. On some individuals the postocular and lower lateral light head stripes unite on the sides of the neck. One specimen in the sample of 50 at hand lacks the characteristic tubercles on the leading edge of the carapace.

Table 43.—Geographic variation in patterns of Illinois *Trionyx spinifer*. Figures in parentheses are numbers of specimens.

Pattern	Per Cent of Eastern Illinois Specimens (21)	Per Cent of Western Illinois Specimens (36)
T. s. spinifer-like....	67	22
Intermediate.....	19	50
T. s. hartwegi-like..	14	28

A dried shell of a kyphotic specimen in the University of Illinois Museum of Natural History is presumably from Illinois. Another humpbacked specimen, from 3½ miles south of Batavia, Kane County, is in the collection of the Chicago Academy of Sciences.

Habits.—The spiny softshell and the smooth softshell are the most highly adapted of all Illinois reptiles for an aquatic existence. Nevertheless, both species enjoy basking, and at times a particularly favorable sand bar may be lined with these animals. It is almost impossible to stalk these alert turtles successfully and, once they are alarmed, it is difficult to overtake them. They run with great speed and appear to swim even faster. Both species of softshells have a habit of burying themselves in sand at the very margin of a stream. Inconspicuous craters mark the site where a turtle is buried, and occasionally the animal, when it needs air, may be seen to push its snout above sand and water. Anal and pharyngeal respiration enable softshells to remain submerged for long periods. Captured individuals are agile and extremely vicious.

In late November I have seen these turtles swimming in central Illinois. My observations are probably exceptional, inasmuch as Cahn (1937) reported that individuals buried themselves in mud or sand in late October to remain until May.

The spiny softshell is carnivorous, capturing and eating various aquatic animals.

Egg laying in this turtle, according to Cahn (1937), is slow and deliberate; the female is always alert for danger. The eggs are laid in sand or other soil, which the female may moisten with discharges of cloacal water. The eggs are carefully covered and concealed in the manner of other turtles. Nine to 25, averaging 18, spherical, hard-shelled eggs are laid in June. The eggs are 28 to 29 mm. in diameter. Hatchlings are in evidence by late August.

Illinois Distribution.—The spiny softshell occurs commonly throughout Illinois, fig. 140; records are not numerous, because this turtle is difficult to collect unless a special effort is made. *T. s. spinifer* has a much greater ecological tolerance than *T. m. muticus,* as it can be found in lakes, sloughs, and mud-bottomed streams as well as in sand-bottomed rivers. The spiny softshell is apparently most abundant in the last type of habitat.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols. Boone County: Belvidere (Cahn 1937); Bureau County: Bureau (Cahn 1937); Cass County: Chandlerville (Cahn 1937); Clay County: Louisville (Cahn 1937); Cook County: Chicago (Schmidt & Necker 1935); Evanston (Necker 1939*c*); Fayette County: Vandalia (Cahn 1937); Grundy County: Morris (Stille & Edgren 1948); Hancock County: Hamilton, between Hamilton and Warsaw (Stejneger 1944); Jackson County: Carbondale (Cagle 1942*a*); Elkville (Conant & Goin 1948); Kane County: Aurora (Stille & Edgren 1948); Kankakee County: Altorf Mills (Necker 1939*c*); Aroma Township, Momence (Schmidt & Necker 1935); Lake County: Fox Lake (Cahn 1937); La Salle County: Streator (Cahn 1937); McHenry County: McHenry (Stille & Edgren 1948); Macon County: Decatur (Cahn 1937); Madison County: (Stejneger 1944); Ogle County: Oregon (H.

Fig. 140.—Distribution of *Trionyx spinifer*. Vertical hatching indicates the presumed range of the subspecies *spinifer* in Illinois; cross-hatching, the area of intergradation between the subspecies *spinifer* and *hartwegi;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Garman 1892); RANDOLPH COUNTY: Chester (Cahn 1937); ROCK ISLAND COUNTY: Barstow, Hillsdale, Rock Island (Cahn 1937); STEPHENSON COUNTY: Freeport (Cahn 1937); UNION COUNTY: Bluff Lake (H. Garman 1892); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WHITESIDE COUNTY: Sterling (Cahn 1937); WINNEBAGO COUNTY: Rockton (Cahn 1937).

Order SQUAMATA
Suborder SAURIA
Lizards

Six species of lizards are known to inhabit Illinois. Four additional species are included in the key, inasmuch as they may eventually be found in extreme western Illinois.

The Illinois lizards are essentially diurnal animals. Some are strictly terrestrial; others are arboreal as well as terrestrial. They range in size from the 3-inch ground skink to the yard-long joint snake. All are predatory and partially or exclusively insectivorous.

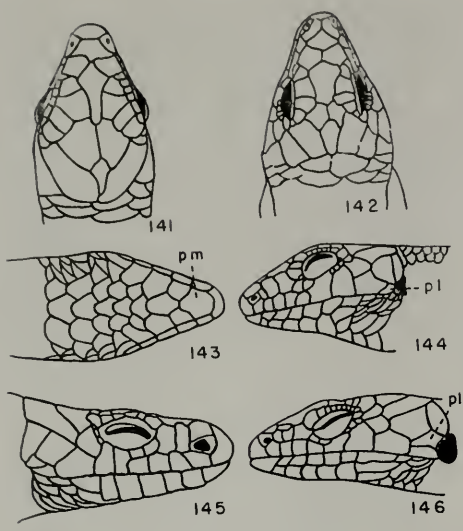
The tail, in all of the Illinois species of lizards, is readily broken off when this appendage is seized by a predator. This protective mechanism is best developed in the joint snake, whose tail comprises approximately two-thirds of its entire length. It is probably least developed in the racerunner, whose speed provides its best protection. The tail twitches violently for a time after it has been detached from the lizard, and in many cases the lizard escapes while the tail occupies the attention of the predator. The tail is eventually regenerated. The broken-off part is never reattached by the lizard, as is sometimes supposed.

Most lizards have a rather simple courtship before mating. Typically, the elongate, membranous-shelled eggs are deposited in early summer under objects or within logs where desiccation is unlikely. In some species the female remains with the clutch and may even attempt to protect the eggs. The young hatch in late summer. The attainment of sexual maturity requires at least 2 years. The longevity of the Illinois species is unknown.

Three of the six Illinois species occur principally in southern United States and have ranges extending northward for varying distances into or beyond Illinois. Another species, *Ophisaurus attenuatus,* also principally southern in distribution, has a subspecies, clearly a western element, extending into Illinois and northern Indiana via the Prairie Peninsula. One species, *Eumeces fasciatus,* is essentially a lizard of eastern North America; one, *Cnemidophorus sexlineatus,* is not readily assignable.

Key to Suborder Sauria
(Lizards)

1. Legs absent; a lateral groove on each side of body extending from neck to anus (Anguidae) 2
   Legs present; no lateral grooves 3
2. White markings in middle of scales; usually a distinct middorsal stripe; scale



Figs. 141–146.—Characteristics of lizards: 141, head of *Scincella laterale;* 142, head of *Eumeces;* 143, chin of *Eumeces anthracinus,* showing single postmental (pm) scale; 144, head of *Eumeces laticeps,* showing single postlabial (pl) scale; 145, head of *Eumeces septentrionalis;* 146, head of *Eumeces fasciatus,* showing two subequal postlabial scales.

rows 1 and 2 of venter usually with thin, longitudinal dark stripes..... .....*Ophisaurus attenuatus attenuatus*
White markings on posterior corner of scales; no distinct middorsal stripe; no dark stripes on venter .... *Ophisaurus ventralis*

3. Scales strongly keeled (Iguanidae)..... .....*Sceloporus undulatus hyacinthinus*
Scales not keeled 4
4. Scales above granular.....5
Scales above large, smooth, and imbricate (Scincidae) 6
5. Venter with large transverse plates; dorsum with six light longitudinal stripes (Teiidae) ..... *Cnemidophorus sexlineatus sexlineatus*
Venter without large transverse plates; a distinct black collar on the neck (Iguanidae) .....*Crotaphytus collaris collaris*
6. Frontonasals contacting rostral, fig. 141; maximum snout-vent length 1½ inches .... *Scincella laterale*
Frontonasals separated from rostral by a pair of supranasals, fig. 142; maximum snout-vent length 5 inches. 7
7. One large postmental, fig. 143; pronounced, lateral dark stripe 2 scale rows wide... *Eumeces anthracinus pluvialis*
Two postmentals; lateral dark stripe, if present, poorly defined.....8
8. Postnasal scale present, fig. 144; dorsolateral light stripe, if present, no more pronounced than middorsal light stripe 9
No postnasal scale, fig. 145; conspicuous dorsolateral light stripe..... ..... .*Eumeces septentrionalis septentrionalis*
9. One or no postlabials, fig. 144; usually 8 supralabials on each side..... ..... *Eumeces laticeps*
Two subequal postlabials, fig. 146; usually 7 supralabials on each side ....*Eumeces fasciatus*

IGUANIDAE

Twelve genera of this family occur in the United States and Canada. Although this family is essentially New World in distribution, a few genera are known on Madagascar and on certain islands in the Pacific. One genus, *Sceloporus,* is represented in Illinois; a second genus, *Crotaphytus,* may eventually be found in the state.

Sceloporus Wiegmann

Fourteen species, most of which consist of several subspecies, of this North American genus occur in the United States. One form enters Illinois.

Sceloporus undulatus hyacinthinus (Green)

Northern Fence Lizard Swift

Lacerta hyacinthina Green 1818:349 (type locality: probably Princeton, New Jersey).
Sceloporus undulatus hyacinthinus, P. W. Smith 1947:32.
Sceloporus undulatus undulatus nec Latreille, Yarrow 1882*a*:59–60.
Sceloporus undulatus, S. Garman 1883:xiv.
Sceloporus undulatus fasciatus, McCauley 1945: 31.

Diagnosis.—A moderately stout lizard (largest Illinois specimen 190 mm. in total length), fig. 147, with rough, overlapping scales, each of which has a backwardly projecting spine; 40 to 50 scales around middle of body; 36 to 44 scale rows between occiput and point above hind legs; ventral scales similar to dorsals but smaller; femoral pores 12 to 16 on each side; usually 5 to 8 undulating, transverse brown or black bands on a gray or light brown groundcolor.

Variation.—The adult male in this species differs from the female in having a stouter tail proximally, more prominent femoral pores, and conspicuous gular and lateroventral blue patches.

The subadult is proportionately shorter tailed and, like the adult female, usually lacks the blue gular and lateroventral belly patches. The femoral pores are inconspicuous in the juvenile.

No important trends in geographic variation have been discerned for this species within the state. A slightly higher frequency of males with gular spots fused is suggested for lizards from the extreme southern tip of the state. Other trends in geographic variation are summarized in table 44.

Habits.—The northern fence lizard, or swift, is ordinarily a conspicuous reptile in

Fig. 147.—An adult *Sceloporus undulatus hyacinthinus* from Jackson County, Illinois. The groundcolor is gray, tan, or light brown; the markings are dark brown or almost black.

Table 44.—Geographic variation in Illinois *Sceloporus undulatus*. Figures in parentheses are numbers of specimens.

Characteristic	Shawnee Hills (20)		Lower Mississippi Border (12)		Southern Division (20)	
	Range	Mean	Range	Mean	Range	Mean
Snout-vent length (mm.)	38–73	.....	36–76	.....	51–82	.....
Total length (mm.), maximum	173	.....	174	.....	190	.....
Dorsal scale rows	36–44	40	36–43	40.5	36–42	39.4
Scale rows at mid-body	40–48	43.3	40–50	44.8	40–49	43.8
Femoral pores on both sides	24–32	28.5	24–30	25.2	25–31	28.4
Transverse body bands	5–9	6.3	5–8	6.9	6–8	6.6

open, dry, wooded areas, such as rocky hillsides or wood lots. This lizard frequently is found in the vicinity of fallen trees, stumps, and rail fences, and often it is heard scampering over bark before it is seen. It climbs readily and is usually alert, managing to be on the side of a limb or tree trunk opposite the pursuer. When undisturbed, this lizard may be seen flattened against a limb or rock and basking in the sun. During cold or rainy weather, it seeks shelter under bark, logs, or rocks. While hunting food, the northern fence lizard has a rather jerky locomotion and stops at intervals to do "push-ups" with its front legs. Its food consists of insects and other arthropods, ants being especially relished (Cagle 1945).

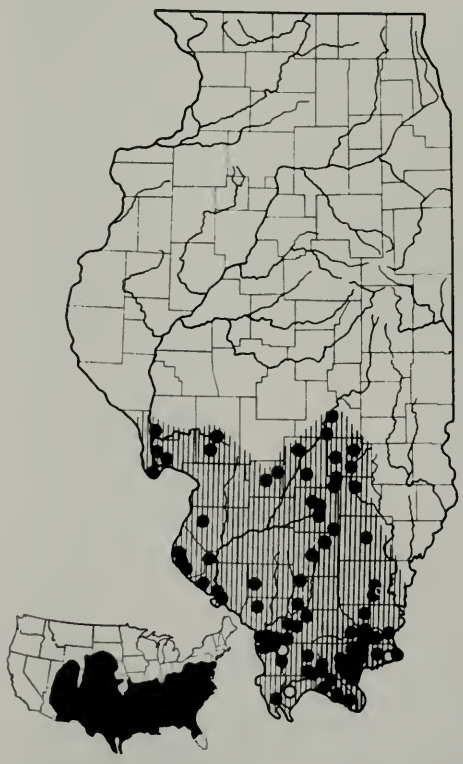


Fig. 148.—Distribution of *Sceloporus undulatus*. Hatching indicates the presumed range of the subspecies *hyacinthinus* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Copulation in the northern fence lizard occurs in late April and early May. Gravid females deposit elongate, soft-shelled eggs within rotten stumps or under the bark of decaying logs. Cagle (1942*a*) found that 8 eggs laid the first of August by a female in southern Illinois averaged 7.5 × 13.5 mm. Hatchlings are generally abundant by the last of August.

Illinois Distribution.—Fence lizards occur throughout the southern part of Illinois except for the Wabash Border division, fig. 148. Their occurrence becomes increasingly local toward the northern edge of the range, suggesting that temperature may be one of the important limiting factors. Where they occur, they are abundant; their avoidance of Wabash River counties in Illinois and Indiana is not readily explained.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: Hardin County: Cave in Rock (H. Garman 1892); Pulaski County: Villa Ridge (H. Garman 1892); Union County: Cobden (H. Garman 1892).

Crotaphytus Holbrook

This strictly North American genus contains four species, according to some authors, five, according to others. Two or three, the number depending on the point of view of the specialist, species occur in the United States, and one of these is known from the Mississippi River bluffs in Missouri but is not known in Illinois.

Crotaphytus collaris collaris (Say)
Eastern Collared Lizard

Agama collaris Say 1823:252 (type locality: Verdigris River near its union with the Arkansas River, Oklahoma).

Diagnosis.—A large iguanid lizard with a broad head distinctly set off from the body by a narrow neck; tail approximately twice as long as snout-vent length; granular scales above, slightly larger scales below; femoral pores present; a distinct black nuchal collar, which is interrupted medially.

Distribution.—A colony of eastern collared lizards at Pevely, Missouri, which is on the Mississippi River bluffs opposite Valmeyer, Monroe County, Illinois, was known to Hurter (1897). This population still exists. I have thus far been unable to find the species on the Illinois side of the river, but there is a slight possibility that a small colony may occur somewhere in the Monroe County bluffs.

ANGUIDAE

Opinion is divided among American herpetologists on the number of anguid genera in the United States, some authors recognizing two and others four. The family is predominantly New World in distribution, but a few genera occur in Eurasia and Africa.

Ophisaurus Daudin

Three species of *Ophisaurus,* one with two subspecies, occur in the United States. Other species are found in the Old World. The nominate race of the polytypic species occurs over most of Illinois. One other species may be found in the state, although it is as yet unrecorded here.

Ophisaurus attenuatus attenuatus Cope
Western Slender Glass Lizard Joint Snake

Opheosaurus ventralis attenuatus Cope 1880: 18 (type locality: Dallas, Texas).
Ophisaurus attenuatus attenuatus, Schmidt 1953:138.
Ophiosaurus lineatus, Kennicott 1855:591.
Opheosaurus ventralis nec Linnaeus, Yarrow 1882*a*:46.
Ophisaurus ventralis nec Linnaeus, Hay 1887*a*: 14.
Ophisaurus ventralis ventralis nec Linnaeus, Cope 1900:500.
Ophiosaurus ventralis nec Linnaeus, Gaige 1914:4.

Remarks.—Although most authors, since the species' rediscovery, and a check list (Schmidt 1953) credit the name *attenuatus* to Baird rather than to Cope, it is clear that Cope validated the name and is actually the author. Dallas, Texas, automatically becomes the type locality.

Diagnosis.—A limbless lizard (largest Illinois specimen 726 mm. in total length), fig. 149, with a distinct, dark middorsal stripe; white markings primarily in the mid-

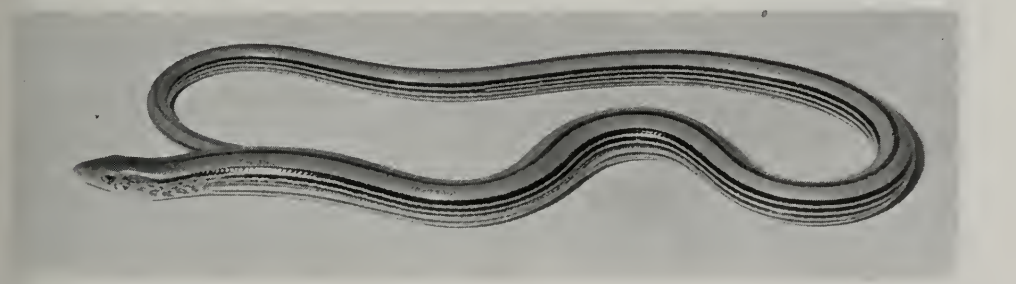


Fig. 149.—An adult *Ophisaurus attenuatus attenuatus* from Harris County, Texas. The groundcolor is greenish gray, tan, or light brown; the stripes are brown or dark gray. (Photo by Isabelle Hunt Conant). Some adults from Illinois have numerous dark and light flecks on the dorsum and are less distinctly striped than the lizard pictured here.

dle of the scales, often forming longitudinal light stripes; 1 or 2 dark stripes or rows of dark spots below the lateral line on each side of body; and length of the unregenerated tail of the adult less than 2.4 times the snout-vent length.

Variation.—The male of the western slender glass lizard presumably possesses a thicker tail proximally than the female, but external characters are not reliable for distinguishing the sexes. The juvenile apparently differs from the adult only in size.

No geographic variation has been discerned in the meager sample available. Nine specimens yield the following individual variation: snout-vent length 164 to 304 mm.; body length 30 to 33 per cent of total length; ventral scales 127 to 138 (average 130.7); supralabials 9 + 9 to 11 + 12, usually 10 or 11; infralabials 8 + 8 to 11 + 10, usually 9 + 9. Eighty-eight per cent of the specimens have distinct, dark middorsal stripes; 22 per cent possess weak middorsal bands. The two largest specimens possess prominent light markings on the posterior edges of the dorsolateral scales, as well as confluent light lines through the middle of the scales; the remaining seven specimens exhibit only the light lines. One specimen, from Perry County, lacks the ventral rows of spots, two specimens have a single row on each side, four have a double row, and two have three rows. A specimen from Champaign County has a double tail.

Habits.—The snakelike ophisaur is terrestrial and somewhat fossorial. Little is known of its habits in Illinois, aside from the generally known fragility of its long tail. Captives are nervous; those I have kept refused all food offered. A captive specimen of the related *Ophisaurus ventralis* ate other lizards, small snakes, and crickets, and it is likely that food habits are similar in the two species. Captured individuals do not usually bite, but they must be held gently or the brittle tail will fragment.

No information is available for eggs or hatchlings of this lizard in Illinois.

Illinois Distribution.—This lizard is inexplicably rare in Illinois, fig. 150. It is interesting to note that Garman (1892) believed the species was rapidly being exterminated within the state. Today, almost 70 years later, the same observation might be made; nevertheless, specimens are still found in Champaign County, one of the most intensively cultivated regions in Illinois.

Several specimens have been collected in narrow strips of prairie bordering railroads. Judged from reports, the western slender

Fig. 150.—Distribution of *Ophisaurus attenuatus*. The subspecies *attenuatus* apparently occurs throughout the state, although it is rare in all sections. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

glass lizard is more common in the dissected hills of Calhoun and Pike counties than elsewhere in the state. In Illinois *Ophisaurus* does not seem to be more common in the sand prairies than on other soil types, as it is in Indiana.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: COOK COUNTY: Evanston, Palos Park (Schmidt & Necker 1935); GRUNDY COUNTY: Pequot (Stille & Edgren 1948); JERSEY COUNTY: Pere Marquette State Park (Link 1939);

Knox County: Abingdon (McLain 1899); McLean County: Normal (H. Garman 1892); Peoria County: Peoria (H. Garman 1892); Wabash County: Mount Carmel (Yarrow 1882*a*).

Ophisaurus ventralis (Linnaeus)
Eastern Glass Lizard

Anguis ventralis Linnaeus 1766:391 (type locality: Carolina; revised to vicinity of Charleston, South Carolina, by Neill 1949*c*).
Ophisaurus ventralis, McConkey, 1952:2.

Diagnosis.—A limbless lizard, differing from *Ophisaurus attenuatus* in the following characters: white marking occurring on posterior corner of each scale rather than in middle of scale; no distinct middorsal dark stripe; ventral region without dark stripes or rows of dark spots.

Distribution.—*O. ventralis* is a southeastern species, said to occur northward to southern Illinois (McConkey 1952). No Illinois specimens are extant, but there is an authentic record for it in adjacent St. Louis County, Missouri.

TEIIDAE

The center of distribution of this family is South America. It is represented in North America by one widely distributed genus.

Cnemidophorus Wagler

Ten species of *Cnemidophorus*, several of which consist of two or more subspecies, occur in the United States, but only one inhabits Illinois.

Cnemidophorus sexlineatus sexlineatus (Linnaeus)
Six-Lined Racerunner Whiptail Lizard

Lacerta sexlineata Linnaeus 1766:364 (type locality: Carolina; revised to Charleston, South Carolina, by Schmidt 1953).
Cnemidophorus sexlineatus, Jordan 1878:171.
Cnemidophorus sexlineatus sexlineatus, Burt 1931:76–97.
Cnemidophorus sex-lineatus, Hay 1887*a*:14.

Diagnosis.—A medium-sized, slender lizard (largest Illinois specimen 240 mm. in total length), fig. 151, having granular scales above and 32 to 36 rows of enlarged rectangular scutes below; 2 gular folds; olive, gray, brown, or gray-green groundcolor with 6 longitudinal, narrow light stripes extending onto the base of the tail.

Variation.—In this species the male differs from the female in having more conspicuous femoral pores, a heavier tail proximally, less distinct, lateral light stripes, and the frequent presence of a pale blue wash ventrally.

Juveniles are shorter tailed than adults. In five young specimens less than 45 mm. from snout to vent, the snout-vent length comprises 32.1 to 38.5 (average 35.8) per cent of the total length, whereas in eight adult females the range is 30.6 to 35.7 (average 32.4) and in eight adult males 30.3 to 34.2 (average 31.9).

Six-lined racerunners appear to attain their maximum size in extreme southeastern

Fig. 151.—An adult *Cnemidophorus sexlineatus sexlineatus* from Tazewell County, Illinois. The groundcolor ranges from olive-gray to brown, often with green on the fore part of the body; the dark stripes are dark gray, brown, or almost black; the light stripes are green, gray, or dirty yellow.

Illinois. In a series from Brookport, Massac County, four adults range from 70 to 79 mm. in snout-vent length. Elsewhere in the state the largest specimens seldom exceed 70 mm. in snout-vent length.

No other geographic variation trends are evident. Scutellation data for 26 specimens are as follows: femoral pores 14 to 19, usually 17, per side; transverse rows of ventral plates between second gular fold and anal plates 30 to 36, average 33.8; lamellae under fourth toe 21 to 29, average 25.2.

Habits.—These strictly terrestrial lizards are sun-loving, and on hot, sunny days they are quite conspicuous. On dull or cool days they seek shelter in holes or beneath objects. Whiptails are alert and fast, and shooting is the most profitable collecting technique. The food consists of arthropods.

Fig. 152.—Distribution of *Cnemidophorus sexlineatus*. Hatching indicates the presumed range of the subspecies *sexlineatus* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Eggs of this lizard have been found in late June. The eggs, 3 to 5 to a clutch, were in scooped-out hollows in moist sand beneath railroad ties. Hatchlings are in evidence by late July.

Illinois Distribution.—The racerunner, or whiptail lizard, occurs on hill prairies, in all the major sand areas, and also in the extreme southeastern part of Illinois, fig. 152. It is possible that it may be found also in some of the minor sand areas and in all the counties bordering the Mississippi River.

Along the Mississippi River bluffs this species appears to be restricted to the dry hill prairies and is seldom found at the bases of the bluffs. It is most abundant in sand prairies and it shuns woods, wet soil, and soil rich in humus.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Forest Preserves (Pearsall 1940); HARDIN COUNTY: Cave in Rock (H. Garman 1892); LA SALLE COUNTY: Ottawa (H. Garman 1892); MASON COUNTY: 10 mi. N Havana (Hart & Gleason 1907); Topeka (Burt 1931); ST. CLAIR COUNTY: Bluff Lake (Hurter 1893).

SCINCIDAE

Three genera of this world-wide family of lizards occur in the United States and Canada. Two are represented in Illinois.

Scincella Mittleman

One monotypic species occurs in eastern United States. Currently most authors regard *Scincella* as a subgenus of the widely distributed *Lygosoma*.

Scincella laterale (Say)
Ground Skink

Scincus lateralis Say 1823:324 (type locality: banks of the Mississippi River below Cape Girardeau, Missouri).
Oligosoma lateralis, S. Garman 1884:14.
Oligosoma laterale, Jordan 1878:171.
Lygosoma laterale, Moore 1896:752.
Liolopisma laterale, Cope 1900:624.
Leiolopisma laterale, Surface 1907:251.
Leiolepisma laterale, Schmidt & Necker 1935: 60.
Leiolopisma unicolor, Stejneger & Barbour 1939:86.
Leiolepisma unicolor, Brimley 1941:14.

Diagnosis.—A small, slender, lizard (largest Illinois specimen 131 mm. in total length), fig. 153, with 24 to 30 rows of smooth scales around the middle of the body; 59 to 74 dorsal scales in a line between the parietal and a point above the hind legs; frontal scale V-shaped; a window in the lower eyelid; a dorsal groundcolor of tan, light brown, or copper, with distinct, dark chestnut dorsolateral bands; supranasals absent.

Variation.—In the ground skink, the sexes presumably differ in the heavier tail of the male, but external characters are not reliable for sexing specimens.

Newly hatched lizards appear propor-

Fig. 153.—An adult *Scincella laterale* from Jefferson County, Missouri. The groundcolor is tan or light brown; the lateral bands and dorsal flecks are dark brown. Some specimens, particularly subadults, are distinctly copper colored above.

tionately shorter tailed and longer legged than adults. In nine juveniles less than 40 mm. from snout to vent, the legs, when adpressed, overlap or are separated by as much as 8 scale lengths (average 3.1). In nine adults, the toes of the adpressed limbs are separated by 13 to 24 scale lengths (average 15.5). However, the proportionately shorter tail of the young is not evident in subadults, inasmuch as the tail comprises approximately 60 per cent of the total length of all the available specimens 25 mm. or more in snout-vent length.

No geographic variation in this species has been discerned within the state. Twenty specimens at hand vary as follows: snout-vent length 24 to 49 mm.; total length 61 to 131 mm.; scale rows at mid-body 24 to 29 (average 26.3); dorsal scales between parietal and point above the hind legs 59 to 74 (average 67); supralabials 5 + 6 to 7 + 7 (7 + 7 in 90 per cent of specimens); infralabials 6 + 6 to 7 + 7 (6 + 6 in 60 per cent of specimens); lamellae under fourth toe 14 to 17 (average 15.3). Thirty-seven per cent of the specimens are plain brown above, 47 per cent have a tendency toward having 2 longitudinal rows of dark spots, and 16 per cent are variously flecked with dark markings.

H. Smith (1956) gives the range of dorsal scales as 77 to 80. The source of his counts is presumed to be Kansas specimens.

Habits.—This small, terrestrial lizard is inconspicuous in appearance. On numerous occasions, specimens would have been missed if they had not rustled leaves on the ground as they ran. Their movements are quick and jerky. When pursued ground skinks burrow into the leaf mold. They have been encountered at night several times. An active individual was once found in February. The food of the ground skink consists of small, soft-bodied arthropods.

A captive specimen laid 5 eggs on June 21–22. At the time the eggs were laid, their dimensions averaged 8.6 × 5.1 mm. In a few days the average size was 8.6 × 6 mm., but the eggs spoiled soon thereafter. Eggs in natural nests have been found in rotten logs in July. Hatchlings are abundant by late August.

Illinois Distribution.—The ground skink is abundant in wooded regions of the Shawnee Hills and Lower Mississippi Border counties, fig. 154. Widely scattered colonies are known as far north as Calhoun and Cumberland counties; numerous areas between, which appear to be suitable, are seemingly uninhabited. The northern colonies are in dry, wooded habitat; rocks are not requisite for the occurrence of *Scincella*.

Fig. 154.—Distribution of *Scincella laterale*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: WABASH COUNTY: Mount Carmel (Cope 1900).

Eumeces Wiegmann

Fourteen species of this genus, a few consisting of several subspecies, occur in the United States and Canada. The genus is almost world-wide in distribution. Two species are known to inhabit Illinois and two others may eventually be found in the extreme western part of the state.

Fig. 155.—An adult female *Eumeces fasciatus* from Monroe County, Illinois. Young specimens are black with narrow yellowish white lines and brilliant blue tails; subadult males and adult females are dark brown with light gray stripes. Adult males are bronzy brown with little trace of the striped pattern and have conspicuously reddened jowls.

Eumeces fasciatus (Linnaeus)
Five-Lined Skink

Lacerta fasciata Linnaeus 1758:209 (type locality: Carolina; revised to Charleston, South Carolina, by Schmidt 1953).
Plestiodon fasciatum, Kennicott 1855:591.
Eumeces fasciatus, Schneck 1880*b*:55.
Plestiodon quinquelineatum, Kennicott 1855: 591.
Eumeces quinquelineatus, Cope 1900:639–40 (?part).
Eumeces sp., Mertens 1951:15.

Diagnosis.—A small to medium-sized lizard (largest Illinois specimen 190 mm. in total length), fig. 155, with 26 to 30 smooth, subequal scales around the mid-body; 50 to 54 dorsal scales between the occiput and a point above the hind legs; frontal scale rectangular; pattern of 5 longitudinal light stripes on dark background, except in sexually mature males, which are tan, gray, or bronze, with red jowls; juveniles and subadults with blue tails; two postmental scales and a postnasal scale on each side of head; usually 7 + 7 supralabials; 2 subequal postlabials, fig. 146. Key characters of this species and a similar species, *Eumeces laticeps,* are graphed in fig. 156.

Variation.—The adult male in this species is almost unicolorous above, with red or coppery color on the swollen jowls; the adult female retains the striped juvenile pattern, although the lines are often dim. The base of the tail and the temporal region are conspicuously larger in the male.

Newly hatched skinks are shiny black, with distinct light stripes and a brilliant blue tail, which is proportionately shorter than in adults. The subadult loses the blue color of the tail and much of the contrast between stripes and groundcolor.

Individual variation within a series from one locality at least equals any geographic variation in Illinois. Scutellation data for two samples are summarized in table 45.

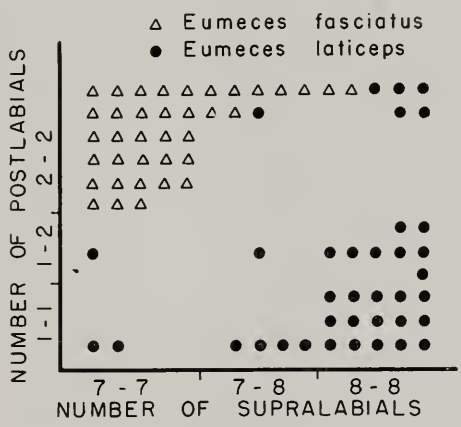


Fig. 156.—Scattergram showing number of supralabials plotted against number of postlabials in *Eumeces fasciatus* (hollow symbol) and *Eumeces laticeps* (solid symbol).

Habits.—The five-lined skink is often seen on sunny days around abandoned buildings, rotten logs, dead trees, and rock outcrops, but it can be collected in numbers only by raising rocks or logs, or ripping apart rotten stumps. The species is much less conspicuous than the northern fence lizard. The two species are equally abundant in the southern half of Illinois. Both open and dense wooded areas appear to provide ideal habitat for five-lined skinks. These

Table 45.—Geographic variation in Illinois *Eumeces fasciatus*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	EXTREME SOUTHERN ILLINOIS (20)		SOUTHERN ILLINOIS NORTH OF SHAWNEE HILLS (20)	
	Range	Mean	Range	Mean
Scale rows at mid-body	25–30	28.9	26–30	28.4
Dorsal scale rows	50–55	52.9	52–55	53.0
Subdigital lamellae on fourth toe	15–19	16.8	15–18	16.6
Snout-vent length (mm.)	34.0–82.8	.....	35.5–82.0	.....
Total length (mm.), maximum	195	.....	187	.....

skinks are quick and difficult to capture, but usually they are not so alert as fence lizards. Captured specimens try to bite, and often their tails are broken off unless the animals are handled carefully. The food of these skinks consists primarily of arthropods, although instances of predation on annelids, mollusks, and vertebrates have been reported.

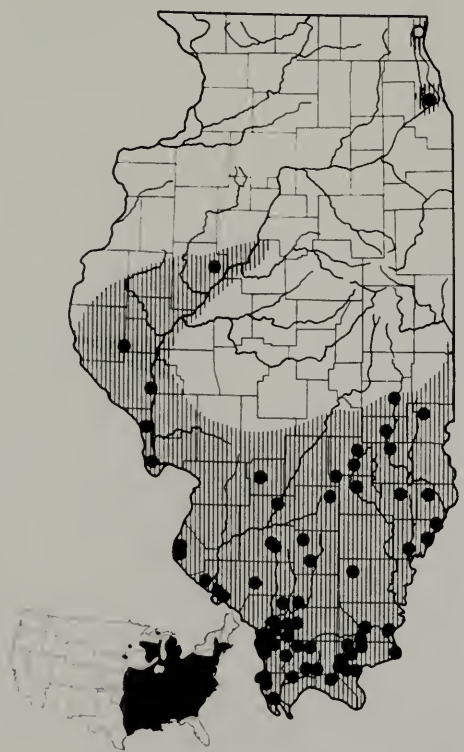


Fig. 157.—Distribution of *Eumeces fasciatus*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States. The species avoids prairie areas.

Egg clutches of the five-lined skink, attended by the female, are to be found in rotten logs or stumps in July. Eggs laid by a captive specimen averaged 13 × 7.8 mm.; the eggs increase in size as they develop, and those found in natural nests average 13.5 × 10 mm. The clutch size in southern Illinois ranges from 6 to 15, averaging about 9 per nest (Cagle 1940). Oviposition occurs in late June, and hatchlings are to be found by late July.

Illinois Distribution.—The five-lined skink occurs throughout the southern half of Illinois, fig. 157. It is known in the Northeastern Mesic Forest, and scattered colonies may occur along the Mississippi and Illinois rivers. North of the Shelbyville Moraine this species is very rare and probably does not occur at all throughout the Grand Prairie region.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: LAKE COUNTY: Waukegan (Cope 1900).

Eumeces laticeps (Schneider)
Broad-Headed Skink

Scincus laticeps Schneider 1801:189 (type locality: not stated; designated as Charleston, South Carolina, by Schmidt 1953).
Eumeces laticeps, Taylor 1935:212–24.
Plestiodon quinquelineatum, Kennicott 1855: 591 (?part).
Eumeces quinquelineatus, Cope 1900:639–40 (?part).

Eumeces fasciatus nec Linnaeus, Yarrow 1882*a*:42 (?part).
Eumeces obsoletus nec Baird & Girard, Davis & Rice 1883*a*:31.
Scincus erythrocephalus, H. Garman 1892: 257–9 (?part).
Eumeces sp., Mertens 1951:15.

Diagnosis.—A large skink (largest Illinois specimen 260 mm. in total length), fig. 158, differing from the five-lined skink in the usual presence of 8 + 8 supralabials (usually 5 preceding subocular), 1 + 1 postlabials, fig. 144, slightly higher average number of scale rows at mid-body, and its larger size.

Variation.—Sexual and ontogenetic variation in *Eumeces laticeps* parallels that in *E. fasciatus*. Scutellation data for three samples are summarized in table 46.

Habits.—This large Illinois skink is similar in habits to *E. fasciatus*. It is reportedly more arboreal, however, and the Illinois observations bear out the report. It is occasionally seen high in trees, particularly in dead trees with numerous woodpecker holes. On the ground it is agile and quick. Captives are quick to bite, and their jaws are strong enough to inflict an uncomfortable pinch. Specimens have been observed at the edges of wood lots, where they were feeding on grasshoppers. These lizards probably feed on almost any animal they can overpower.

Fig. 158.—An adult male *Eumeces laticeps* from Coles County, Illinois. Young specimens are black with yellowish white lines and blue tails; subadult males and adult females, dark brown with light gray stripes; adult males are bronzy brown with little trace of the striped pattern and have conspicuously reddened jowls.

Table 46.—Geographic variation in Illinois *Eumeces laticeps*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southern Illinois (12)		Southern Illinois North of Shawnee Hills (21)		Rock Island County(1)
	Range	Mean	Range	Mean	
Scale rows at mid-body	27–32	29.5	27–33	29.5	30
Dorsal scale rows	50–56	53.1	51–55	52.4	56
Subdigital lamellae on fourth toe	16–18	17.1	15–18	16.6	17
Snout-vent length (mm.)	40.5–97.8	.....	33.0–116.8	.....	64
Total length (mm.), maximum	225	.....	260	.....	.....

Almost nothing is known of the nesting habits of the species in Illinois. A female was found coiled around her eggs in a stump on July 4; the eggs were not measured.

Illinois Distribution.—The broad-headed skink, like *E. fasciatus*, is common throughout the southern half of Illinois, fig. 159,

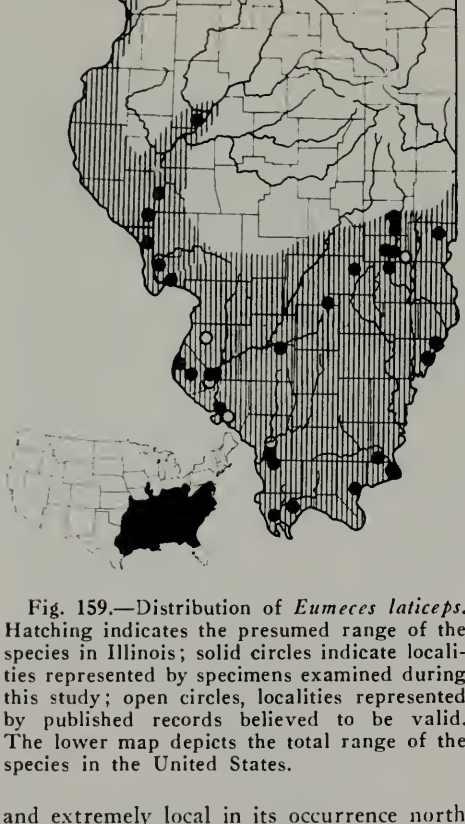


Fig. 159.—Distribution of *Eumeces laticeps*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

and extremely local in its occurrence north of the Shelbyville Moraine.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CUMBERLAND COUNTY: SE corner of county (Peters 1942); JACKSON COUNTY: Murphysboro (Taylor 1935); RANDOLPH COUNTY: Chester (Taylor 1935); Red Bud (Taylor 1935); ST. CLAIR COUNTY: Belleville (Taylor 1935).

Eumeces anthracinus pluvialis Cope
Southern Coal Skink

Eumeces pluvialis Cope 1880:19, footnote (type locality: near Mobile, Alabama).
Eumeces anthracinus pluvialis, Smith & Smith 1952:690.

Diagnosis.—A medium-sized skink with a single postmental scale, fig. 143; 23 to 30 rows of smooth scales at mid-body; usually 7 + 7 supralabials; supranasal scales present but no postnasal scales; a distinct black or chestnut dorsolateral stripe on each side of body.

Range.—The southern coal skink is known in Missouri adjacent to Monroe County, Illinois, but efforts to secure specimens on the Illinois side of the Mississippi have thus far been unsuccessful. There is a possibility that a local population in the Illinois bluffs may eventually be found.

Eumeces septentrionalis septentrionalis (Baird)
Northern Prairie Skink

Plestiodon septentrionalis Baird 1858:256 (type locality: Minnesota and Nebraska; revised to Fort Ripley, Minnesota, by Schmidt 1953).

Diagnosis.—A medium-sized skink with supranasal but no postnasal scales, fig. 145; two postmental scales; 26 to 28 rows of smooth scales at mid-body; conspicuous, light, dorsolateral stripe on each side of body bordered above and below by prominent, slightly wider dark bands; dim or prominent light middorsal line that does not fork.

Range.—The northern prairie skink is known from nearby Iowa and Wisconsin, and there is some possibility that populations occur in the northwestern corner of Illinois, in which little work has been done.

Suborder SERPENTES
Snakes

Forty-six species and subspecies of snakes are known to occur in Illinois. Four of the species are represented not only by a population typical for a particular subspecies but by an adjacent intergrade population as well. Although these intergrade populations are not regarded as distinct entities they are included in the key.

Snakes are extremely variable in habits and structure. In general, the crotalids

(*Crotalus, Sistrurus,* and *Agkistrodon*) and natricines (*Natrix, Thamnophis, Storeria, Virginia,* and *Tropidoclonion*) are active day or night, and the colubrines (the remaining genera) tend to be diurnal. The majority of our genera are terrestrial; some are fossorial; a few are aquatic; still fewer are arboreal. In size, they range from the 10-inch *Tantilla gracilis* to the 7-foot *Pituophis melanoleucus*. Snakes are rather specialized in feeding habits, some taking only one or two specific types of prey. All of them are predatory. Some species swallow living prey; some swallow their prey after killing it by constriction and some (those that possess fangs) after using poison for procuring it.

One or more species of venomous snakes occur in all herpetofaunal divisions of Illinois, but there are many smaller areas of the state from which the poisonous snakes have been entirely eliminated. The dangerous species rank, according to the decreasing seriousness of their bites, as follows: timber rattler, cottonmouth, copperhead, and massasauga. Although bites of all four species have come to my attention in the course of this survey, I know of no deaths from snake bite in Illinois during this time. The copperhead is probably responsible for the greatest number of snake bites requiring medical attention.

Snakes usually mate in the spring of the year, although exceptions are known. Approximately half of the Illinois species lay elongate, membranous-shelled eggs; the other half retain their eggs within the body and give birth to active young. The former are called oviparous; the latter ovoviviparous. Typically, snake eggs are deposited under rocks or in wood rot. The hatching of the eggs of the oviparous species and the birth of young of the ovoviviparous species take place in late summer and early fall. The young snakes grow fairly rapidly and are probably sexually mature at an average age of 2 years. The young and adults shed their skins two to six times annually, the number of times depending on the rate of growth and state of health of the individual snake.

Most of the species and subspecies found in the state have the centers of their ranges outside of Illinois. Seventeen have distributions centering to the west and southwest, the ranges of some (for example, *Tantilla gracilis*) being slight eastern extensions of ranges in the Ozarks of Missouri and Arkansas. Others (for example, *Heterodon nasicus*) are Great Plains animals with small relict populations in our sand prairies. Eleven forms have essentially southern ranges with northward extensions in the Mississippi River valley. Eight have ranges centering to the east of Illinois and one to the north; eight cannot be readily assigned to any of the above groups.

Key to the Suborder Serpentes
(Snakes)

1. No pit between eye and nostril, figs. 160, 161 (Colubridae) 7
   Pit between eye and nostril on each side of head, fig. 163 (Crotalidae) 2
2. Rattle on end of tail 3
   No rattle on tail 5
3. Top of head with large plates ..... *Sistrurus catenatus catenatus*
   Top of head with various-sized unsymmetrical scales 4
4. Dorsal scales usually in 23 rows; few or no elongated black dashes between body bands ..... *Crotalus horridus horridus*
   Dorsal scale rows usually 25; many elongated black dashes between body bands ..... *Crotalus horridus horridus* × *atricaudatus*
5. Scale rows 23, fig. 162; suboculars present; postorbital dark stripe absent 6
   Scale rows 25; suboculars absent; postorbital dark stripe present ..... *Agkistrodon piscivorus leucostomus*
6. Dorsal pattern constrictions averaging 3 scale lengths in width or less; ventral spots pale ..... *Agkistrodon contortrix contortrix* × *mokeson*
   Dorsal constrictions averaging 4 or 5 scale lengths in width; ventral spots in marked contrast to groundcolor ..... *Agkistrodon contortrix mokeson*
7. Some or all dorsal scales keeled 8
   All scales smooth 38
8. Anal plate divided, fig. 164 9
   Anal plate entire, fig. 165 31
9. Rostral scale upturned and keeled, figs. 166, 167 10
   Rostral scale normal, fig. 160 12
10. Prefrontals in contact, fig. 166; posterior supralabials slightly higher than wide ..... *Heterodon platyrhinos*
    Prefrontals separated by small scales, fig. 167; posterior supralabials about twice as high as wide 11
11. Dorsal body blotches usually more than 35 in males, more than 40 in females ..... *Heterodon nasicus nasicus*
    Dorsal body blotches usually less than 35 in males, less than 40 in females ..... *Heterodon nasicus nasicus* × *gloydi*
12. Loreal present, fig. 168 14
    Loreal lacking, fig. 169 13

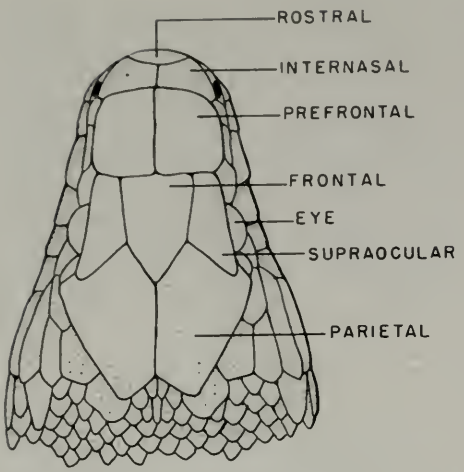


Fig. 160.—Dorsal view of the head of a snake, *Elaphe obsoleta.*

20. Ventrals less than 220; dorsum tan or yellow, with brown blotches; venter yellow.....*Elaphe vulpina vulpina*
Ventrals more than 220; dorsal groundcolor not yellow or tan; venter not yellow 21
21. Dorsal scale rows 25–27; pattern in adults of evident black blotches on gray groundcolor...*Elaphe obsoleta spiloides*
Dorsal scale rows 25; pattern in adults solid black, or the groundcolor visible as tracery around blotches or as white patches between spots middorsally on the posterior portion of body.....
.....*Elaphe obsoleta obsoleta*
22. Scale rows 19.....23
Scale rows more than 19.....25
23. Infralabials 7; preoculars 1 on each side of head .....*Natrix kirtlandi*
Infralabials 9 or more; preoculars 2 on each side of head..... 24
24. Venter immaculate yellow or with 1 thin median stripe.....*Natrix grahami*
Venter entirely dark brown or with two median stripes .. *Natrix septemvittata*

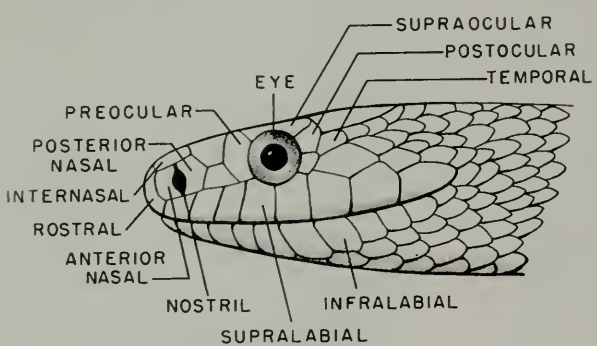


Fig. 161.—Lateral view of the head of a snake, *Elaphe obsoleta.*

13. Scale rows 15; light spots on rear of head; venter orange or red.....*Storeria occipitomaculata occipitomaculata*
Scale rows 17; no occipital light spots; venter pink or white.....
..... *Storeria dekayi wrightorum*
14. Internasals 2, fig. 170.....17
Internasals 1, fig. 171.....15
15. Supralabials 6 or fewer on each side of head 16
Supralabials 7 or more on each side of head.....*Farancia abacura reinwardti*
16. Supralabials 6, postoculars 2 on each side of head.....*Virginia valeriae elegans*
Supralabials 5, postoculars 1 on each side of head.....*Virginia striatula*
17. Scale rows 17; dorsal color green .....
.....*Opheodrys aestivus*
Scale rows more than 17; dorsal color not green 18
18. Scale rows strongly keeled; 2 or 3 postoculars (if 2, less than 25 scale rows) .22
Scale rows weakly keeled; 2 postoculars; 25–33 scale rows.....19
19. Neck bands traversing parietals and uniting on frontals .*Elaphe guttata emoryi*
Neck bands, if present, not as above....20

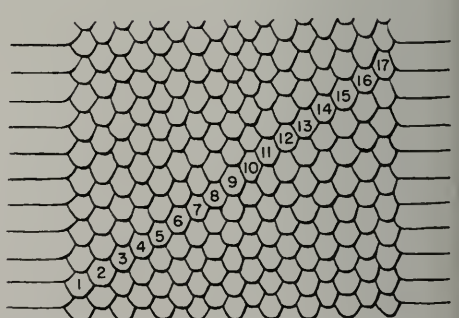
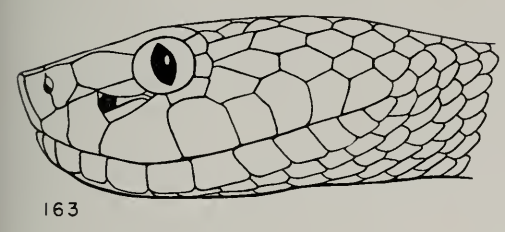
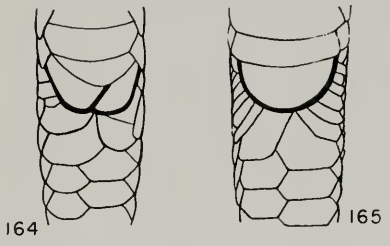


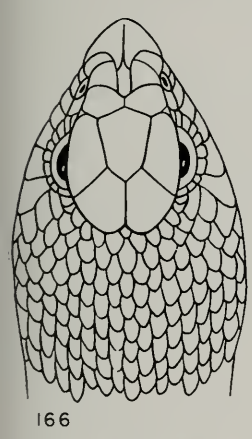
Fig. 162.—Portion of the body of a snake, illustrating method of counting scale rows. Counts are customarily made one head length behind the head, at approximately mid-body, and just in front of the anus.

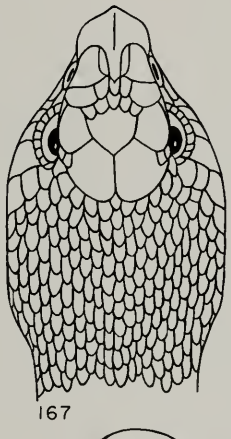
25. Scale rows 27–33; infralabials 11 or more on each side of head 26
Scale rows 25 or less; infralabials 10 on each side of head.....27

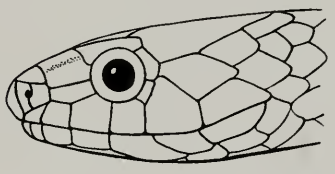
26. Suboculars separating eye from labials; venter predominantly dark, with light spots, fig. 172 ..... *Natrix cyclopion cyclopion*
No suboculars, fig. 173; venter yellow, with dark spots ..... *Natrix rhombifera rhombifera*
27. Venter unmarked, yellow or red .. 28
Venter marked with brown or black spots or blotches 29
28. Ventral color red or red-orange, not touching first scale rows; dorsum black ..... *Natrix erythrogaster neglecta*
Ventral color yellow or orange-yellow, encroaching on lowermost lateral scale rows; dorsum brownish black ..... *Natrix erythrogaster flavigaster*
29. Dorsal bands fewer than 20 ..... *Natrix sipedon confluens*
Dorsal bands 20 or more 30

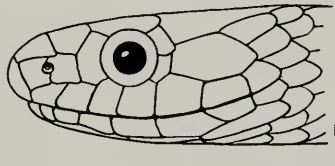


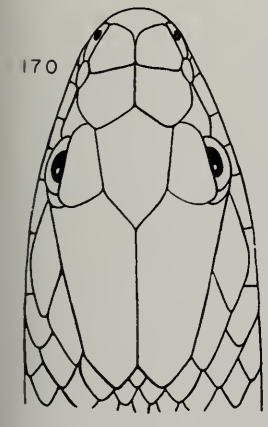


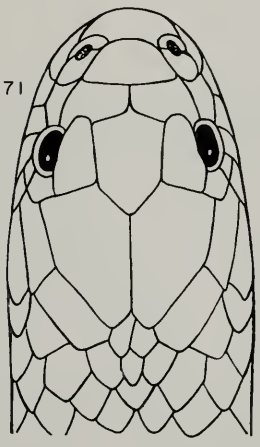


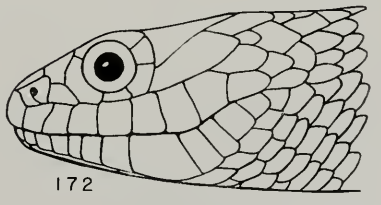


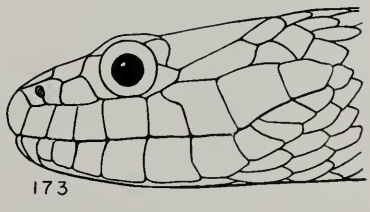












Figs. 163–173.—Characteristics of snakes: 163, head of *Agkistrodon piscivorus,* showing loreal pit; 164, divided anal plate; 165, entire anal plate; 166, head of *Heterodon platyrhinos;* 167, head of *Heterodon nasicus;* 168, head of *Virginia valeriae,* showing elongate scale between eye and nostril that is termed loreal because its length is twice its height; 169, head of *Storeria dekayi;* 170, head of *Opheodrys vernalis;* 171, head of *Farancia abacura;* 172, head of *Natrix cyclopion,* showing suborbital scales; 173, head of *Natrix rhombifera.*

30. Dorsal bands and spots 30 or more; lateral bars wider than interspaces; anterior transverse bands 3 to 10 ..... *Natrix sipedon sipedon*
Dorsal bands and spots less than 30; lateral bars narrower than interspaces; anterior transverse bands 5 to 15 ..... *Natrix sipedon pleuralis*
31. Scale rows 27 or more; prefrontals 3 or more ..... *Pituophis melanoleucus sayi*
Scale rows less than 27; prefrontals 2 32
32. Infralabials 8 or more on each side of head 33
Infralabials less than 8 on each side of head 37
33. Lateral stripe involving fourth scale row; parietal light spots usually present..34
Lateral stripe not touching fourth scale row; no parietal spots 36
34. Supralabial sutures margined with black; tail length less than 27 per cent of total length ..... *Thamnophis radix radix*
Supralabials uniform greenish white or yellow; tail length 27 per cent or more of total length 35
35. Groundcolor black, with orange middorsal and greenish white lateral stripes; supralabials usually 8 on each side ..... *Thamnophis sauritus proximus*
Groundcolor dark brown, with orange or yellow middorsal and yellow lateral stripes; supralabials usually 7 on each side ..... *Thamnophis sauritus sauritus* × *proximus*
36. Lateral stripes regularly interrupted on anterior third or fourth of body by black crossbars ..... *Thamnophis sirtalis semifasciata*
Lateral stripes uninterrupted by black crossbars ..*Thamnophis sirtalis sirtalis*
37. Dorsum and venter unmarked ..... *Virginia* spp. (couplet 16)
Dorsum with longitudinal light stripes; venter with a pair of longitudinal dark stripes or double row of spots ..... *Tropidoclonion lineatum lineatum*
38. Anal plate divided, fig. 164 44
Anal plate entire, fig. 165 39
39. Dorsal pattern of distinct dark blotches on light groundcolor 41
Dorsal pattern of white dots on black groundcolor 40
40. Yellow spots on almost all dorsal scales ..... *Lampropeltis getulus holbrooki*
Yellow spots few, tending to form rings around body ..... *Lampropeltis getulus niger*
41. Venter unmarked; rostral plate with wartlike protuberance ..... *Cemophora doliata*
Venter with dim gray spots on greenish yellow groundcolor or with prominent black squares on a white groundcolor; rostral scale without protuberance...42
42. Ventral spots gray and indistinct against the greenish yellow background; borders of dorsal blotches narrower than half a scale length ..... *Lampropeltis calligaster calligaster*
Ventral spots black, in sharp contrast to the white groundcolor; dorsal blotches with black margins, each margin almost as wide as the length of one scale. 43
43. Dorsal blotches red, extending down sides to first or second scale rows, fewer than 35 ....*Lampropeltis triangulum syspila*
Dorsal blotches brown, extending down sides to fourth or fifth scale rows, more than 35 ..... *Lampropeltis triangulum triangulum*
44. Scale rows 19 or more; venter black, marked with transverse red bands ..... *Farancia abacura reinwardti*
Scale rows fewer than 19; venter not black or marked with red bands 45
45. Neck with a yellow ring just behind head 46
Neck without yellow ring behind head 48
46. Chin without black spots; venter immaculate or with an interrupted median row of black spots ..... *Diadophis punctatus edwardsi*
Chin with black spots; venter with scattered black spots or a continuous median row of black spots 47
47. Venter with a median row of spots, often fused and forming a median stripe; usually 15 scale rows ..... *Diadophis punctatus stictogenys*
Venter with scattered black spots or several rows of spots; usually 17 scale rows .....*Diadophis punctatus arnyi*
48. Loreal present, fig. 168 49
Loreal absent ..... *Tantilla gracilis hallowelli*
49. Preoculars 1 or more on each side of head 52
Preoculars none 50
50. Scale rows 13 51
Scale rows more than 13 ..... *Virginia valeriae elegans*
51. Dorsal color black; ventral color salmon, extending onto third scale row ..... *Carphophis amoenus vermis*
Dorsal color brown; ventral color salmon or pink, extending onto first or second scale rows *Carphophis amoenus helenae*
52. Anterior temporals 1 on each side of head; color green above ..... *Opheodrys vernalis blanchardi*
Anterior temporals 2 or 3 on each side of head; color never green 53
53. Scale rows at posterior end of body 13 or fewer. *Masticophis flagellum flagellum*
Scale rows at posterior end of body 15 54
54. Back with 50 to 80 blotches, becoming obscured posteriorly ..... juvenile *Coluber constrictor*
Back unmarked, blue-green or blue-black 55
55. Caudals averaging less than 90; venter and chin pale yellow or light gray; dorsum dark blue or blue-green ..... *Coluber constrictor flaviventris*
Caudals averaging 90 or more; venter slate gray, chin white; dorsum blue-black ..... *Coluber constrictor priapus* × *flaviventris*

COLUBRIDAE

Thirty-eight genera of this large, widespread family occur within the United States and Canada. Seventeen genera are represented in Illinois.

Carphophis Gervais

This genus consists of a single species, which occurs only in eastern North America.

Carphophis amoenus (Say)

Three subspecies of worm snakes are recognized, two of which are found in Illinois.

Carphophis amoenus helenae (Kennicott) Midwest Worm Snake

Celuta helenae Kennicott 1859:100 (type locality: Monticello, Mississippi).
Carphophiops helenae, Cope 1875:34.
Carphophis helenae, S. Garman 1883:101, 166.
Carphophis amoena helenae, Bocourt 1883:536.
Carphophis amoenus helenae, Perkins 1949:27.
Celuta amaena, Kennicott 1855:592.
Carphophiops amaenus, Surface 1906:134.
Carphophiops amoenus, Cope 1875:34.
Carphophis amoenus amoenus nec Say, H. Garman 1892:309–10.
Carphophis amoenus, Boulenger 1894:325.
Carphophiops amoenus amoenus nec Say, Cope 1900:736.
Carphophis amoena, S. Garman 1883:167.
Carphophis amoena amoena nec Say, Jordan 1929:235.
Carphophiops vermis nec Kennicott, Cope 1877:64.
Carphophis amoenus vermis nec Kennicott, H. Garman 1892:309–10.
Carphoris vermis nec Kennicott, Hurter 1393: 255.

Diagnosis.—A small burrowing snake (largest Illinois specimen 309 mm. in total length), fig. 174, with smooth scales in 13 rows; ventrals 118 to 129 in males, 127 to 137 in females; caudals 32 to 40 in males, 24 to 27 in females; supralabials 5 + 5; infralabials 6 + 6; postoculars 1 + 1; a minute, sharp spur on the tip of the tail; dorsum brown; venter pink, the ventral color extending dorsad onto the lowermost one-half to 1½ scale rows; internasals and prefrontals fused into large plates (in 89 per cent, Blanchard 1924*a*); no preoculars.

Variation.—In 26 specimens from which data were taken, the males possess 118 to 129 ventrals (average 121.8), 32 to 40 caudals (average 38.3); the tail comprises 16.9 to 19.9 per cent of the total length. Females have 127 to 137 ventrals (average 132), 24 to 27 caudals (average 26); the tail comprises 10.7 to 14.8 per cent of the total length.

Juveniles usually are more sharply bicolored than adults because of their darker brown or black dorsal color.

No geographic and surprisingly little individual variation in scutellation are evident in the 26 specimens studied in detail. Mean ventral and caudal numbers for samples from the Mississippi Border and Shawnee Hills differ by only 1 scale, despite the

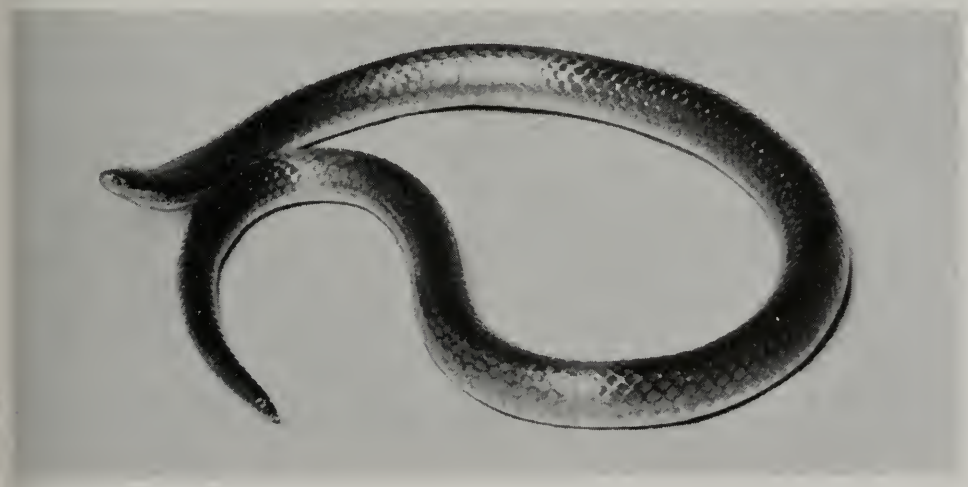


Fig. 174.—An adult *Carphophis amoenus helenae* from Union County, Illinois. The color above is brown or black; below, pale pink to salmon color.

proximity of a *Carphophis amoenus vermis* population that has higher counts.

All 26 specimens agree in the possession of 13 scale rows, 5 + 5 supralabials, fused prefrontal and internasals, and the absence of a preocular. The infralabial formula of 5 + 6 and the postocular formula of 1 + 2 are each represented by single specimens, the remaining 25 snakes displaying formulae of 6 + 6 and 1 + 1, respectively.

In the Midwest worm snake, color and pattern are more variable than lepidosis. In the Lower Mississippi Border sample, the pattern appears somewhat more sharply bicolored than in the Shawnee Hills sample, but the difference may be due to the greater number of juveniles in the specimens available from the Mississippi River bluffs. The encroachment of the ventral color onto the lowermost scale rows is not correlated with geographical distribution. In samples of 13 specimens from the Lower Mississippi Border and 13 from the Shawnee Hills, the same range of individual variation is exhibited. The ventral color extends onto half of the lowermost scale row on some specimens and onto the lower 1¼ in others, averaging 1.15 scales in each sample.

Habits.—The Midwest worm snake is fossorial. In early spring it is found under rocks, logs, or the bark of stumps. As the ground becomes dry in summer, the worm snake seeks moist situations. This snake appears temporarily dazed when first uncovered, but in a few seconds it becomes active, seeking to burrow into the soil. The writhing, hard, slick body is difficult to pick up, and even when captured this snake has a way of slipping between the collector's fingers. It usually endeavors to press the tiny spur on the tip of its tail into the restraining hand. The worm snake is known to feed on earthworms; it may possibly feed on soft-bodied arthropods also.

Females collected in late spring contain two to four elongate, proportionately very large eggs. The eggs are probably deposited in hollows under large rocks or within hollow logs.

Illinois Distribution.—The Midwest worm snake occurs in abundance along the Mississippi River bluffs from Pike County southward and throughout the Shawnee Hills. Also it is known from scattered localities in eastern Illinois, almost invariably in the vicinity of rock outcrops, fig. 175.

Fig. 175.—Distribution of *Carphophis amoenus.* Vertical hatching indicates the presumed range of the subspecies *helenae;* horizontal hatching, the presumed range of the subspecies *vermis;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Murphysboro (Ditmars 1945); ST. CLAIR COUNTY: (Hurter 1893); WABASH COUNTY: Mount Carmel (Cope 1877).

Carphophis amoenus vermis (Kennicott) Western Worm Snake

Celuta vermis Kennicott 1859:99 (type locality: Missouri).
Carphophis amoena vermis, Langebartel 1947: 27–8.

Diagnosis.—A subspecies of *Carphophis amoenus* (largest Illinois specimen 285 mm.

in total length) differing from *C. a. helenae*, by the more sharply contrasting purplish black dorsal color and the salmon-pink ventral color, the latter color extending dorsad onto the lowermost 1½ to 3 scale rows; the usual presence of internasals; and the higher ventral and caudal counts.

Variation.—Three specimens of the western worm snake are known from Illinois: a female with 140 ventrals, 24 caudals, ventral color extending onto 2½ lower scale rows, and a tail length of 11.9 per cent of the total length; and two males with 135 and 127 ventrals, 38 and 39 caudals, ventral color extending onto the lower 1⅔ and 2½ scale rows, and tail lengths 12.1 and 17.0 per cent of the total lengths. All three specimens are purplish black above and bright pink beneath. All possess internasals. Other counts are the same as in *helenae*.

Of the three Illinois specimens, the male from Calhoun County approaches *helenae* in its low number of ventrals. Otherwise, the two forms appear specifically distinct.

Habits.—The remarks concerning behavior of *C. a. helenae* apply to this subspecies as well. No information on life history is available for the subspecies in Illinois.

Illinois Distribution. — The western worm snake is known in Illinois only from Calhoun, Adams, and Hancock counties, fig. 175, all of which border the Mississippi River. The range of this race in the state is probably limited to these three counties, inasmuch as *C. a. helenae* is known in the adjacent counties to the east and south.

Farancia Gray

One eastern North American species with two subspecies is included in this highly specialized genus. One of the subspecies inhabits Illinois.

Farancia abacura reinwardti (Schlegel) Western Mud Snake

Homalopsis reinwardtii Schlegel 1837:173 (type locality: Louisiana; revised to vicinity of New Orleans by Schmidt 1953).
Farancia abacura reinwardtii, Cagle 1941:20.
Farancia abacura reinwardti, Schmidt 1953: 186.
Farancia abacura, Cope 1877:64.
Hydrops abacurus, S. Garman 1883:36.

Diagnosis.—A large aquatic snake (largest Illinois specimen 1,254 mm. in total

Fig. 176.—An adult *Farancia abacura reinwardti* from Jackson County, Illinois. The color above is shiny blue-black; below there are bright red crossbands.

Table 47.—Sexual variation in Illinois *Farancia abacura*. Figures in parentheses are numbers of specimens.

Characteristic	Males (4)		Females (3)	
	Range	Mean	Range	Mean
Ventrals	188–194	191.6	167–171	169.2
Caudals	36–37	36.6	46–49	47.0
Light tail bars	8–11	9.3	10–12	11.2
Tail length as percentage of total length	10.7–11.2	11.0	14.6–16.0	15.2

length), fig. 176, lustrous blue-black above with 56 to 76 bright red transverse bars alternating with black bars beneath; red bars extending up onto lowermost scale rows; eyes degenerate; tail tip ending in a sharp spur; scales smooth, in 19 or 20 rows; ventrals 167 to 194; caudals 36 to 49; supralabials 7 + 7, sometimes 6 on a side; infralabials 8 + 8, sometimes 9 on a side; postoculars usually 2 on a side, sometimes 1 or none.

Variation.—Sexual characters in *Farancia* are remarkably abundant. The male differs from the female in having a large, bulbar tail, conspicuous suranal zone of reduced scales, and keels on the suranal scales. Other sexual variation is summarized in table 47.

According to H. Smith (1938), the juveniles are like the adults in details of color and pattern.

Nonsexual variation illustrated by seven specimens is as follows: size range 762 to 1,254 mm.; scale rows 20–20–19 in one, 20–19–19 in three, and 19 in three specimens; supralabials 7 + 7 in five, 6 + 7 in two; infralabials 8 + 8 in three, 9 + 9 in four specimens; postoculars 1 + 0 in one, 1 + 1 in one, 1 + 2 in two, and 2 + 2 in three specimens; light, transverse body bars 48 to 64 (average 57); separation medially of neck bars 9 scale rows in one, 10 in one, and 11 in five specimens.

Habits.—Shallow ponds and sloughs with many partially decayed and water-soaked logs provide ideal habitat for the western mud snake. Most of the Illinois specimens, however, have been found crossing roads on rainy nights. Although this species is known locally as the "stinging snake," most residents of southern Illinois do not seem to realize that this is the reptile presumably responsible for the "hoop snake" fable. A captured individual presses the sharp, horn-like scale on the tip of the tail into the collector's hand; this defensive mechanism is more startling than painful. Cagle (1942*a*) reported that a captive ate *Siren*. The species is known to feed on tadpoles and *Amphiuma*.

Fig. 177.—Distribution of *Farancia abacura*. Hatching indicates the presumed range of the subspecies *reinwardti* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Cagle (1942*a*) had a captive female that coiled about her 22 eggs laid on wet wood

rot in early July. The irregular, flexible eggs, which averaged 34.5 × 19.9 mm., hatched in mid-August, after an incubation period of 41 days.

Illinois Distribution.—This southern species is characteristic of the swamps of the Austroriparian division, fig. 177. It is found in vegetation-choked ponds and floodplain swamps in the Shawnee Hills area, also. The occurrence of this snake in the Wabash River valley near Mount Carmel has not been substantiated with recent collections, and *Farancia* may have been exterminated in that part of the state.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: PERRY COUNTY: (Cagle 1942*a*); WABASH COUNTY: Mount Carmel (Cope 1877).

Diadophis Baird & Girard

Three species, each with several subspecies, of this North American genus are known.

Diadophis punctatus (Linnaeus)

Five subspecies of the eastern ringneck snake are recognized; three meet and intergrade with one another in Illinois. All are similar above, fig. 178.

Diadophis punctatus arnyi Kennicott
Prairie Ringneck Snake

Diadophis arnyi Kennicott 1859:99 (type locality: Hyatt, Anderson County, Kansas); Cope 1875:38.
Diadophis punctatus arnyi, S. Garman 1883: 158.
Diadophis regalis arnyi, Cope 1900:746.
Diadophis punctatus arnyi × *stictogenys,* Minton & Minton 1948:382.
Diadophis punctatus nec Linnaeus, Stejneger & Barbour 1917:76.
Diadophis regalis nec Baird & Girard, Ditmars 1922:272.

Diagnosis.—A relatively small burrowing snake (largest Illinois specimen 370 mm. in total length), with 15 to 17 rows of smooth scales at mid-body; dorsum slate, blue-black, or brownish black; venter yel-

Fig. 178.—An adult *Diadophis punctatus edwardsi* from Effingham County, Illinois. In all Illinois subspecies of *D. punctatus,* the color above ranges from slate gray to blue-black; below the color is yellow or orange-yellow. The ring around the neck is yellow.

low or orange-yellow; a distinct, narrow yellow ring across the neck above; chin dark spotted; venter with scattered dark spots or transverse dark markings; ventrals 149 to 160 in males, 165 to 173 in females; ventrals minus caudals 100 to 110 in males, 121 to 132 in females; supralabials usually 7 + 7.

Variation.—In *Diadophis punctatus arnyi*, the male differs from the female in having a higher caudal count, lower ventral count, and smaller difference between ventrals and caudals, table 48. Many males (38 per cent in Illinois) have keels on the scales just above the anus. Juveniles tend to be darker above than adults.

Single individuals from Carroll and Rock Island counties and a sample of nine specimens from Hancock County are assignable to *arnyi*. These specimens are at variance with more western specimens in the heavy black spots on the chin and venter, but the increased amount of black in no way suggests intergradation with eastern subspecies.

The major geographic variation in this subspecies is summarized in table 48.

Table 48.—Geographic variation in Illinois *Diadophis punctatus arnyi* and *D. p. arnyi* × *edwardsi* intergrades. Figures in parentheses are numbers of specimens.

Characteristic	Hancock County (4 Males, 5 Females)		Adams County (13 Males, 14 Females)		Monroe-Randolph Counties (11 Males, 11 Females)	
	Range	Mean	Range	Mean	Range	Mean
Ventrals						
Male	149–160	154.8	143–154	148.0	147–159	151.2
Female	165–173	170.0	150–159	156.6	147–165	160.0
Caudals						
Male	46–58	50.2	41–52	49.0	40–51	46.2
Female	40–44	42.2	37–46	41.5	39–48	43.1
Ventrals minus caudals						
Male	100–110	104.6	94–113	102.1	98–113	104.9
Female	121–132	127.7	110–121	115.1	100–122	115.2
Tail length as percentage of total length						
Male	20.6–21.7	21.1	17.3–21.9	20.6	17.3–27.5	20.1
Female	16.2–17.3	16.6	14.5–19.5	16.7	15.8–19.8	17.1
Total length (mm.)	166–370	.....	117–361	.....	109–320	.....
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Chin spotted	100.0		81.5		95.5	
7 + 7 supralabials	100.0		55.5		91.0	
15 scale rows at mid-body	22.2		96.5		13.6	
Venter plain or with median row of spots	11.0		55.5		9.0	

Individual variation, which shows no geographic correlation, for 58 specimens of *arnyi* and *arnyi* × *edwardsi* intergrades is as follows: infralabials 8 + 8 in 76 per cent, 7 + 8 in 7 per cent, 7 + 7 in 14 per cent, and 8 + 9 in 3 per cent; preoculars 2 + 2 in 98 per cent, 1 + 1 in 2 per cent; postoculars 2 + 2 in 92 per cent, 2 + 1 in 5 per cent, 1 + 1 in 1.5 per cent, and 2 + 3 in 1.5 per cent. In the 39 specimens with *arnyi*-type ventral patterns, 82 per cent are irregularly spotted, 18 per cent have transverse bars.

Habits.—The prairie ringneck snake is abundant under flat rocks on hill prairies and wooded bluffs during the spring and fall. In midsummer it seeks moist situations and can sometimes be taken in numbers concentrated in the vicinity of springs or in talus piles bordering low ground. Occasionally several snakes can be found under a single rock. When first uncovered they are temporarily dazed, but in a few seconds they scatter, often before they can be grabbed. Captured individuals do not bite but they excrete a foul-smelling substance. Many individuals curl their tails in corkscrew fashion, displaying the bright red color of the underside. The ringneck snake feeds on salamanders, arthropods, and earthworms. Other small snakes have been reported as food items.

The eggs of the western ringneck snake have not been found in Illinois.

Illinois Distribution.—*D. p. arnyi* is restricted in Illinois to the Mississippi River bluffs from Jo Daviess County to Adams County, fig. 179. Intergrade populations of *edwardsi* × *arnyi* are known from Adams to Jackson counties along the Mississippi River. The influence of *arnyi* is exhibited only in the populations inhabiting the Mississippi River bluffs proper. A few miles east of these bluffs, even in the same county, no evidence of intergradation can be discerned.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: HANCOCK COUNTY: Warsaw (H. Garman 1892).

Fig. 179.—Distribution of *Diadophis punctatus*. Vertical hatching indicates the presumed range of the subspecies *edwardsi* in Illinois; horizontal hatching, the presumed range of the subspecies *arnyi;* diagonal hatching, the presumed range of the subspecies *stictogenys;* crosshatching, the areas of intergradation between subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Diadophis punctatus edwardsi (Merrem)
Northern Ringneck Snake

Coluber edwardsii Merrem 1820:136 (type locality: Pennsylvania; revised to vicinity of Philadelphia by Schmidt 1953).
Diadophis punctatus edwardsii, Van Cleave 1928:133, 136.
Diadophis punctatus punctatus nec Linnaeus, Davis & Rice 1883*a*:29.
Diadophis punctatus, Cope 1900:753.
Diadophis punctatus amabilis nec Baird & Girard, Davis & Rice 1883*a*:29.
Diadophis punctatus arnyi nec Kennicott, Schmidt & Necker 1935:61.
Diadophis punctatus strictogenys nec Cope, ?Cagle 1942*a*:186.

Diagnosis.—A subspecies of *Diadophis punctatus* (largest Illinois specimen 346 mm. in total length), fig. 178, differing from *D. p. arnyi* in the usual presence of 15 scale rows at mid-body; chin usually without dark

spots; venter immaculate or with a median row of round dark spots; ventrals 138 to 147 in males, 151 to 160 in females; ventrals minus caudals 85 to 98 in males, 102 to 114 in females; supralabials usually 8 + 8; underside of tail yellow.

Variation.—Sexual and ontogenetic variation in this subspecies parallel that shown by *D. p. arnyi.* Suranal keels are present on 43 per cent of the Illinois males available.

Geographic variation in *D. p. edwardsi* is summarized in table 49.

Individual, nongeographic variation is as follows: infralabials 8 + 8 in 41.7 per cent of specimens, 7 + 8 in 29.1 per cent, 7 + 7 in 8.3 per cent, 6 + 7 in 4.2 per cent, 6 + 6 in 8.3 per cent, 8 + 9 in 4.2 per cent, and 9 + 9 in 4.2 per cent; preoculars 2 + 2 in 95.8 per cent, 1 + 1 in 4.2 per cent; postoculars 2 + 2 in 87.5 per cent, 1 + 2 in 8.3 per cent, 1 + 1 in 4.2 per cent. In 23 specimens with typical *edwardsi* ventral pattern, 50 per cent possess a median row of dark spots; 50 per cent are plain yellow.

Habits.—Behavior characteristics and feeding habits of this race are apparently much the same as those of *D. p. arnyi.*

Fourteen elongate eggs of *D. p. edwardsi*

Table 49.—Geographic variation in Illinois *Diadophis punctatus edwardsi.* Figures in parentheses are numbers of specimens.

Characteristic	Wabash Border (7 Males, 6 Females)		Shawnee Hills (4 Males, 5 Females)		Greene-Pike Counties (5 Males, 4 Females)	
	Range	Mean	Range	Mean	Range	Mean
Ventrals						
Male	138–146	142.8	143–147	144.7	139–150	144.6
Female	140–157	149.4	151–160	154.6	147–158	152.5
Caudals						
Male	47–56	50.8	47–51	49.0	47–50	48.7
Female	43–54	48.8	46–49	47.6	38–45	41.5
Ventrals minus caudals						
Male	85–97	92.0	92–98	95.7	90–101	96.0
Female	89–109	100.5	102–114	107.0	107–113	111.0
Tail length as percentage of total length						
Male	20.8–23.6	22.2	19.5–22.0	20.6	20.2–22.0	20.1
Female	18.0–22.7	19.6	17.0–21.1	18.8	15.8–17.8	16.7
Total length (mm.)	139–395	.....	118–320	.....	135–306	.....
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Chin spotted	31.0		43.0		33.3	
7 + 7 supralabials	37.5		71.5		55.5	
15 scale rows at mid-body	100.0		100.0		100.0	
Venter plain or with median row of spots	100.0		100.0		100.0	

were found under a flat rock on a floodplain in late June. These eggs, which averaged 23.6 × 9.5 mm., hatched August 18. It is possible that the 14 eggs were laid by more than one female.

Illinois Distribution.—The present range in Illinois, fig. 179, of the northern ringneck snake is of considerable interest. Scattered colonies exist in the Wabash Border counties, across the Shawnee Hills, and along the lower Illinois River bluffs at least in Pike and Greene counties. Most of the interior of Illinois between the Illinois and the Wabash rivers lacks the requisite rock outcrops and appears to be uninhabited by *Diadophis*. The lower Illinois River bluff population, which is evidently pure *edwardsi*, is thus an eastern remnant that is isolated from other *edwardsi* populations by uninhabitable terrain, as are also the intergrade populations of *arnyi* × *edwardsi*.

Blanchard (1942) cites two specimens from Havana, Mason County, Illinois. These specimens cannot be located, but in view of the disjunct range of the race, *edwardsi* is the subspecies to be expected in Mason County.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Murphysboro (Cagle 1942*a*); MASON COUNTY: Havana (Blanchard 1942); WABASH COUNTY: Mount Carmel (Cope 1900).

Diadophis punctatus stictogenys Cope
Mississippi Ringneck Snake

Diadophis punctatus stictogenys Cope 1860*a*: 250 (type locality: unknown; designated as southern Illinois by Schmidt 1953); H. Garman 1892:302.
Diadophis punctatus arnyi × *stictogenys*, Minton & Minton, 1948:382.
Diadophis punctatus strictogenys, Van Cleave 1928:133, 136.
?Diadophis punctatus arnyi nec Kennicott, Blanchard 1942:69–87 (part).

Diagnosis.—A southern subspecies of *Diadophis punctatus* (largest Illinois specimen 225 mm. in total length), differing from *D. p. arnyi* and *D. p. edwardsi* in the following combination of characters: scale rows at mid-body usually 15; chin spotted with dark; venter with median row of spots, with transverse markings, or irregularly spotted; ventrals 126 to 157 in males, 137 to 161 in females; ventrals minus caudals 79 to 111 in males, 98 to 119 in females; supralabials usually 7 + 7.

Variation.—In sexual and ontogenetic variation *stictogenys* presumably does not differ from the other subspecies of *D. punctatus*.

Individual variation for six males and five females is as follows: size range 146 to 267 mm.; ventrals in males 140 to 157 (average 147.3), in females 147 to 161 (average 156.2); caudals in males 45 to 49 (average 47.0), in females 40 to 49 (average 44.4); ventrals minus caudals in males 94 to 111 (average 100.3), in females 98 to 118 (average 111.8); tail length in males 19.3 to 22.8 (average 20.5) per cent of total length; in females 15.7 to 20.9 (average 17.8) per cent; supralabials 7 + 7 in 91 per cent of specimens, 8 + 8 in 9 per cent; infralabials 7 + 7 in 18 per cent, 8 + 8 in 82 per cent; preoculars 2 + 2 in 82 per cent, 1 + 2 in 9 per cent, 1 + 1 in 9 per cent; chin spotted in 91 per cent, plain in 9 per cent; venter with median row of spots in 54 per cent, with scattered spots in 9 per cent, intermediate in 28 per cent, and with transverse markings in 9 per cent; scale rows at midbody 15 in 91 per cent, 17 in 9 per cent.

The Illinois specimens are typical *stictogenys*, except for their high ventral counts (an average of 10 to 15 more ventrals than in the South). The high counts may result from genic exchange with adjacent populations of *edwardsi*, or they may reflect a south-to-north clinal increase in numbers of ventrals in *stictogenys*.

Habits.—Behavior characteristics, habitat, and feeding habits of the Mississippi ringneck snake are similar to those of the other Illinois subspecies of *D. punctatus*. No life history information is available for *stictogenys*, but this race is probably similar to the other races in this respect.

Illinois Distribution.—The Mississippi ringneck snake is known only from bluffs bordering the Mississippi and Ohio river lowlands in Union, Alexander, and Johnson counties, fig. 179. It may occur also in Pulaski and Massac counties.

Heterodon Latreille

Three species, one with several subspecies, of this North American genus occur in

the United States and Canada. Two species are known in Illinois.

Heterodon nasicus Baird & Girard

Three subspecies of the western hognose snake have been described. *Heterodon nasicus* is known in Illinois only from a few scattered relict colonies. The northern relicts are referable to the nominate race; the southern colonies appear to represent an intergrade population of *H. n. nasicus* × *gloydi*. However, additional specimens from Morgan and Cass counties may reveal that the population in these counties invariably has few blotches and is actually typical *H. n. gloydi* rather than an intergrade population.

Heterodon nasicus nasicus
Baird & Girard
Plains Hognose Snake

Heterodon nasicus Baird & Girard 1852:352–3 (type locality: Texas; revised to Amarillo by Schmidt 1953); Vestal 1913:61, 75, 87.
Heterodon simus nasicus, H. Garman 1892: 304–5.
Heterodon nasicus nasicus, Cagle 1941:15.

Diagnosis.—A medium-sized, stout-bodied snake (largest Illinois specimen 593 mm. in total length), fig. 180, with an enlarged, shovel-like rostral plate; rostral sharply upturned as seen in lateral profile; belly and underside of tail predominantly black; scales keeled, usually in 23–23–19 rows; ventrals 130 to 148; caudals 29 to 47; numerous azygous scales on top of snout; 27 to 42 brown dorsal blotches on a grayish tan groundcolor.

Variation.—Sexual dimorphism in this snake, tables 50 and 51, is exhibited in the size of the tail, and number of ventrals, caudals, body blotches, and tail rings.

Very young specimens are proportionately larger headed and are more prominently blotched than adults.

Two samples of this snake are available, one from the scattered sand prairies along the Mississippi River and one from the Illinois River sand area. The latter sample, from Morgan to Tazewell counties and the area between, is tentatively regarded as representing an intergrade population, inasmuch as the average dorsal blotch count is intermediate between that of *Heterodon*

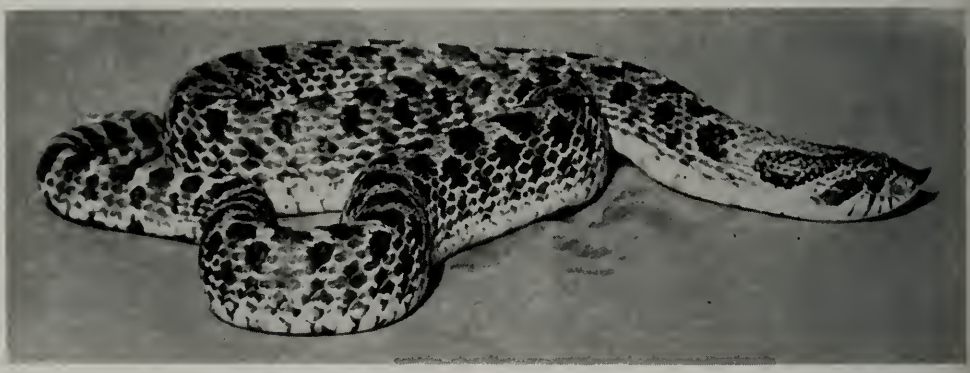


Fig. 180.—An adult *Heterodon nasicus nasicus* from Henderson County, Illinois. The groundcolor is tan, gray, or light brown; the dorsal markings are dark brown; the ventral markings, black.

Table 50.—Sexual variation in Illinois *Heterodon nasicus*. Figures in parentheses are numbers of specimens.

Characteristic	Males (11)		Females (7)	
	Range	Mean	Range	Mean
Tail length as percentage of total length	12.0–19.1	16.8	9.7–13.6	12.1
Ventrals	130–136	132.3	134–148	142.0
Caudals	32–47	41.3	29–36	33.7

Table 51.—Geographic variation in Illinois *Heterodon nasicus*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	MORGAN-TAZEWELL COUNTIES (7 MALES, 3 FEMALES)		NORTHWESTERN ILLINOIS (3 MALES, 5 FEMALES)	
	Range	Mean	Range	Mean
Ventrals				
Male	131–134	132.5	130–136	132.0
Female	134–142	139.3	141–148	144.0
Caudals				
Male	34–44	40.8	32–45	40.5
Female	34–36	35.0	29–36	32.5
Tail length as percentage of total length				
Male	16.1–19.1	17.9	12.0–17.4	15.3
Female	12.8–13.4	13.1	9.7–13.6	11.9
Body blotches				
Male	27–34	32.0	34–41	36.2
Female	34–42	38.0	35–41	38.5
Tail rings				
Male	12–15	13.1	12–14	13.2
Female	11–12	11.3	9–14	11.0
Scales associated with azygous scale	11–15	13.1	13–20	15.8

nasicus nasicus and *H. n. gloydi*. A reduction in the number of scales is also suggested, although the significance of this trend is unknown, since lepidosis is presumably the same for both races. Variation in blotch counts and scutellation for two samples is summarized in table 51.

The numbers of scale rows and labials show no geographic correlation. Scale rows behind the head are usually 23, occasionally 22, 24, or 25; at mid-body usually 23, occasionally 21 or 22; preceding the anus usually 19, occasionally 18. Supralabials are 8 + 8 in 17 specimens, 8 + 9 in 1; infralabials are usually 11 + 11, occasionally 10 on one or both sides.

Habits.—The plains or western hognose snake is slow moving; apparently it spends much of its time searching the sand prairies and adjacent wood lots for toads. In open sand areas, the hognose snake leaves unmistakable signs. The tracks of a snake are unusually wide because of the stout body, and at intervals small craters are found where the snake has dug up resting toads. Unlike most snakes, the hognose snake is seldom found beneath objects. It apparently utilizes mammal holes and remains underground during cold or wet weather. The snake displays a bluffing attitude when first approached. It spreads its head and neck and it hisses loudly. If this bluff fails, the snake feigns death by rolling over on its back. If it is turned right side up it will promptly roll over on its back again. Newly captured individuals usually do not bite.

H. nasicus feeds on toads, frogs, other snakes, birds, and mice. It is oviparous.

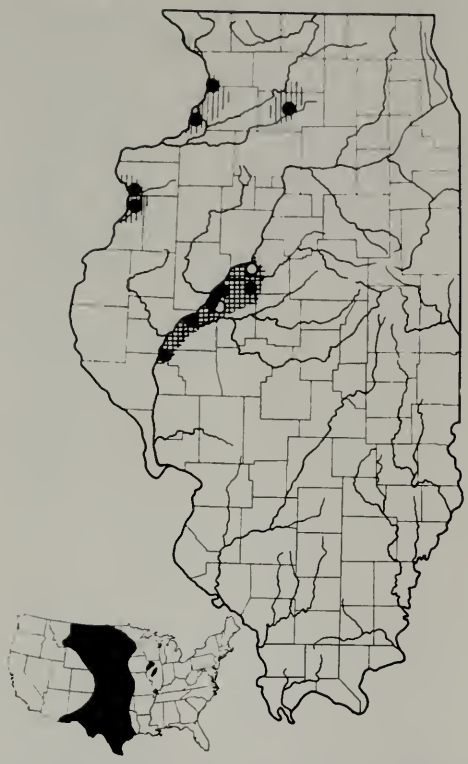


Fig. 181.—Distribution of *Heterodon nasicus*. Vertical hatching indicates the presumed range of the subspecies *nasicus;* crosshatching, the area of intergradation between the subspecies *nasicus* and *gloydi;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States. The southeastern Missouri colony is *gloydi*.

Illinois Distribution.—It is virtually certain that in Illinois the western hognose snake is restricted to the sand areas, fig. 181. Its range is thus a series of small, scattered relicts of a formerly widespread occurrence. Most specimens have been found crossing sandy roads or in brushy or weedy sites in the sand prairies, where *nasicus* is at least as common as the more widespread *H. platyrhinos*.

The Illinois populations are of some zoogeographic interest inasmuch as the small samples available indicate that relict colonies of pure *nasicus* and a relict population of *nasicus* × *gloydi* persist. The differentiation of these subspecies thus appears to antedate the postglacial Xerothermic Period.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: MASON COUNTY: SE Havana (Vestal 1913); TAZEWELL COUNTY: Pekin (H. Garman 1892).

Heterodon platyrhinos Latreille
Eastern Hognose Snake

Heterodon platyrhinos Latreille 1801:432 (type locality: designated vicinity of Philadelphia, Pennsylvania, by Schmidt 1953); Kennicott 1855:592.
Heterodon platyrhinos platyrhinos, A. Smith 1951:4.
Heterodon platyrhinus platyrhinus, Yarrow 1882*a*:138–9.
Heterodon platyrhinus, Cope 1900:768, 769.
Heterodon platirhinos, Hay 1891:114.
Heterodon platyrhinus niger, H. Garman 1892: 302–4.
Heterodon contortrix, Frison & Miller 1926: 471.
Heterodon contortrix contortrix, Pope 1944*b*: 165–8.
Heterodoa platyrhinus, Adcock 1922:196.

Diagnosis.—A medium-sized, stout-bodied snake (largest Illinois specimen 913 mm. in total length), fig. 182, with an enlarged, shovel-like rostral plate; rostral, as seen in lateral profile, not turned up; belly light or dark, underside of tail always light; usually 25–25–19 rows of keeled scales around the body; ventrals 122 to 147; caudals 38 to 57; 1 or 2 unpaired scales on snout behind the rostral plate; 19 to 29 dark body blotches on a gray, tan, or brownish groundcolor, or dorsal surface olive, brown, or black and without spots.

Variation.—In this species, the male differs from the female in the relative tail length and in the number of ventrals, caudals, body blotches, and tail rings. Sexual variation for 32 males and 22 females is summarized in table 52.

Young specimens are proportionately larger headed and more prominently blotched than adults. In the young, the venter, except the neck and the under part of the tail, is black. Older specimens may retain the juvenile dorsal pattern, but in adults the venter is light. The dorsal pattern of adults is extremely variable; some specimens are distinctly blotched, some are melanistic, and others are intermediate in varying degrees. Occasional specimens are brick-red, with black blotches.

Fig. 182.—An adult *Heterodon platyrhinos* from Lee County, Illinois. The groundcolor may be tan, gray, rusty red; the markings, dark gray, brown, or black. Frequent specimens are unicolor olive or black; others, dark with vestiges of the blotched pattern.

Table 52.—Sexual variation in Illinois *Heterodon platyrhinos*. Figures in parentheses are numbers of specimens.

Characteristic	Males (32)		Females (22)	
	Range	Mean	Range	Mean
Ventrals	122–134	128.2	134–147	141.6
Caudals	44–57	48.7	38–48	42.6
Body blotches	19–29	22.6	21–29	24.9
Tail rings	7–11	8.9	6–10	7.9
Tail length as percentage of total length	15.7–20.8	17.9	12.7–16.6	14.4

No geographic variation in scutellation in Illinois *Heterodon platyrhinos* has been discerned. Of 54 specimens examined, 3.7 per cent have 24 anterior rows of scales, 67 per cent have 25, 18 per cent have 26, and 11 per cent have 27; 6 per cent have 23 scale rows at mid-body, 4 per cent have 24, 83 per cent have 25, 5 per cent have 26, and 2 per cent have 27; 6 per cent have 18 posterior scale rows, 85 per cent have 19, 2 per cent have 20, and 7 per cent have 21. Supralabials are 7 + 8 in 7 per cent, 8 + 8 in 87 per cent, and 8 + 9 in 6 per cent. Infralabials are 8 + 9 in 2 per cent, 9 + 9 in 6 per cent, 9 + 10 in 11 per cent, 10 + 10 in 60 per cent, 9 + 11 in 2 per cent, 10 + 11 in 6 per cent, 11 + 11 in 11 per cent, and 11 + 12 in 2 per cent.

Other variation is summarized in table 53. The average number of body blotches tends to be higher in snakes from northern localities than in those from other parts of the state.

Habits.—The eastern hognose snake is similar in habits to *Heterodon nasicus*. When encountered in the field it spreads its head and neck widely and hisses; if this bluff fails, it rolls over on its back and "plays

Table 53.—Geographic variation in Illinois *Heterodon platyrhinos*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southern Illinois (8 Males, 8 Females)		Southern Illinois North of Shawnee Hills (12 Males, 5 Females)		North-Central Illinois (7 Males, 7 Females)		Extreme Northern Illinois (5 Males, 2 Females)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ventrals								
Male	126–132	129.0	126–134	129.0	123–132	128.2	122–134	126.6
Female	140–147	145.8	134–146	141.8	136–143	138.5	138–143	140.5
Caudals								
Male	44–53	48.8	48–57	50.7	44–53	48.2	44–52	47.2
Female	40–46	43.2	41–44	42.0	38–44	41.0	41–48	44.5
Body blotches								
Male	19–25	21.7	20–24	21.8	22–25	22.8	22–29	24.2
Female	21–27	25.0	21–25	22.7	21–28	24.0	27–29	28.0
Tail rings								
Male	8–10	9.2	7–10	8.0	8–10	9.4	8–11	9.0
Female	7–9	8.1	7–8	7.2	6–9	7.5	8–10	9.0
Tail length as percentage of total length								
Male	16.4–20.8	18.2	18.6–20.3	19.4	16.3–20.1	18.1	15.7–20.4	18.2
Female	12.7–16.2	14.6	13.6–14.3	14.1	12.7–15.2	13.8	14.3–16.6	15.4
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Juvenile pattern	6		18		14		0	
Melanistic	25		23		36		14	
Intermediate pattern	68		59		50		86	

possum." Although this species rarely bites, it is unpleasant to handle because of its copious, ill-smelling excretions. It feeds primarily on toads and to some extent on frogs and treefrogs. Captive specimens have been induced to take crickets and even chunks of raw liver. The hognose, though not especially hardy, is a popular snake pet.

The elongate eggs of this snake are sometimes found under rocks. A captive deposited 15 eggs on June 21; these hatched between August 11 and 17. Another captive laid 17 eggs on August 28, none of which hatched, probably because of captivity-induced delay in oviposition. These eggs averaged 30 × 18 mm. Cagle (1942*a*) recorded broods of 4 and 35 eggs; he found the average length to be much less, suggesting that egg size is correlated with the size of the female snake.

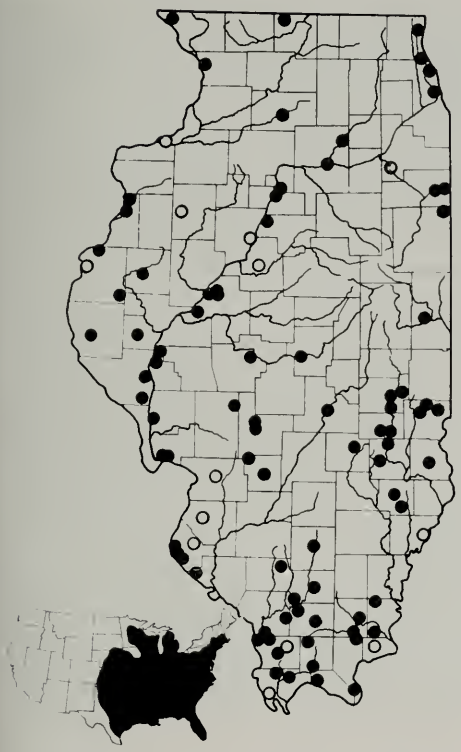


Fig. 183.—Distribution of *Heterodon platyrhinos*. The species apparently occurs throughout Illinois, although there are small localized areas where it appears to be absent. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Illinois Distribution.—The eastern hognose snake is state-wide in occurrence in Illinois, fig. 183. The snake is evidently rare in much of the central part of the state, especially in areas that were originally muck prairie. Its rarity in these areas may be explained by its apparent avoidance of soil rich in organic matter, or its near extermination from areas intensively cultivated. The species is abundant throughout the southern half of Illinois, particularly on floodplains, in forest-edge habitats, and in dry, open woods where the soil is clay or sandy loam. The hognose snake is apparently common in the sand areas of northern Illinois, where the abundance of toads, the principal food of *Heterodon*, is probably an important factor.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: ALEXANDER COUNTY: Horseshoe Lake (Minton & Minton 1948); HANCOCK COUNTY: 7 mi. S Nauvoo (Langebartel 1947); HARDIN COUNTY: Shawnee National Forest (H. Smith 1956); KNOX COUNTY: 2½ mi. E Galesburg (Adcock 1922); MADISON COUNTY: (Hurter 1911); MONROE COUNTY: Waterloo (Burt 1935); PEORIA COUNTY: (H. Garman 1892); ROCK ISLAND COUNTY: Rock Island (Yarrow 1882*a*); ST. CLAIR COUNTY: Belleville (Yarrow 1882*a*); TAZEWELL COUNTY: (H. Garman 1892); UNION COUNTY: Saratoga (H. Garman 1892); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*); WILL COUNTY: Wilmington (Schmidt & Necker 1935).

Opheodrys Fitzinger

Two species of this North American and Asiatic genus occur in the United States and Canada. Both are found in Illinois.

Opheodrys aestivus (Linnaeus)
Rough Green Snake

Coluber aestivus Linnaeus 1766:387 (type locality: Carolina; revised to Charleston, South Carolina, by Schmidt 1953).
Cyclophis aestivus, Cope 1875:38.
Phyllophilophis aestivus, H. Garman 1892: 283–4.
Phillophilophis aestivus, Hurter 1893:256.
Opheodrys aestivus, Hurter 1911:191.

Diagnosis.—An extremely slender snake (largest Illinois specimen 847 mm. in total length), fig. 184, with 17–17–15 rows of keeled scales; supralabials usually 7 + 7 and infralabials 8 + 8; preoculars usually 1 + 1 and postoculars 2 + 2; nasal single; ventrals 139 to 171; caudals 116 to 152; tail length 32.7 to 46.4 per cent of total length; body green (blue or black in preservative) above, white or yellowish white below.

Variation.—Because of the great amount of overlap in sexual characters in this species, the greater number of caudals, the longer tails, and the reduced ventral counts of males can be detected only in the averages. Fifteen adult male specimens possess 126 to 140 caudals (average 132.9) and 150 to 164 ventrals (average 154.7); tail length ranges from 36.0 to 45.4 (average 40.0) per

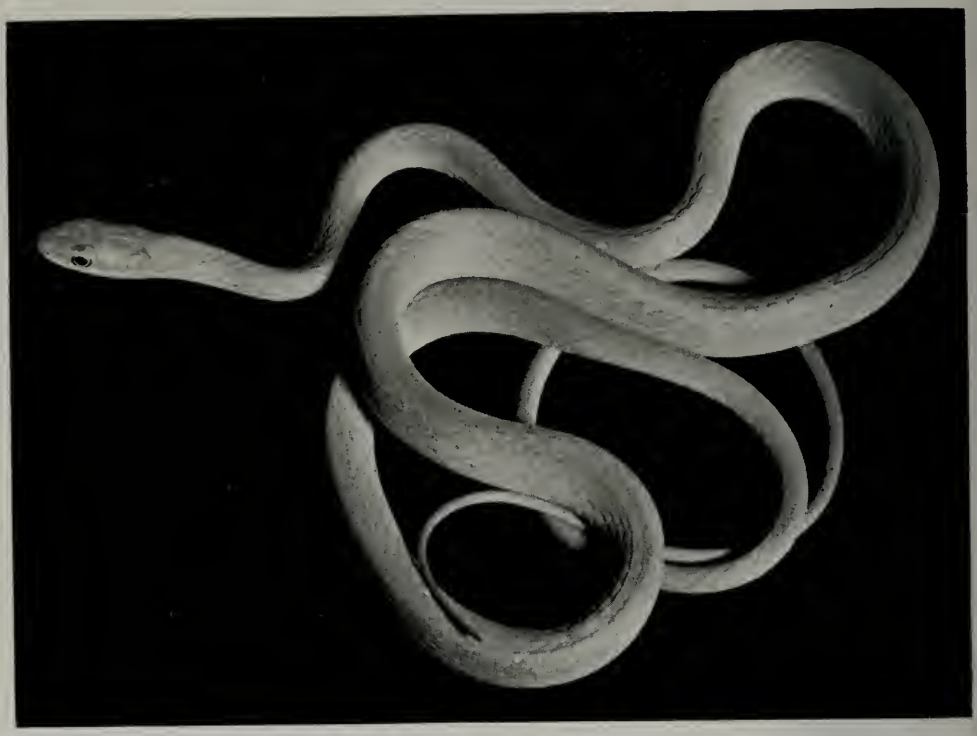


Fig. 184.—An adult *Opheodrys aestivus* from Monroe County, Illinois. The color above is bright green; below, yellowish white.

Table 54.—Geographic variation in Illinois *Opheodrys aestivus*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Southern Illinois (10 Males, 11 Females)		Southeastern Illinois (13 Males, 8 Females)		Lower Mississippi Border (6 Males, 5 Females)	
	Range	Mean	Range	Mean	Range	Mean
Ventrals						
Male	150–170	155.7	150–164	154.5	149–161	157.0
Female	139–165	156.0	153–171	159.2	154–157	155.6
Caudals						
Male	126–152	133.4	122–137	131.3	119–133	124.1
Female	116–132	126.1	116–133	123.3	121–128	123.2
Tail length as percentage of total length						
Male	35.4–45.4	39.4	36.8–41.3	39.9	36.4–38.2	37.3
Female	34.4–40.1	37.1	32.7–41.3	35.5	33.8–37.2	35.8
Total length (mm.)	198–347	.....	182–836	.....	213–684	.....

cent of total length. Fifteen adult female specimens possess 116 to 133 caudals (average 123.3) and 152 to 171 ventrals (average 159.1); tail length ranges from 32.7 to 40.0 (average 36.5) per cent of total length.

Juveniles are proportionately larger headed, shorter tailed, and (in preservative) more sharply bicolored. For five juvenile females the tail length averages 34.7 per cent of total length, for four juvenile males 36.3 per cent.

Some geographic variation in the degree of sexual dimorphism in the rough green snake is suggested by a comparison of the means of ventral and caudal counts and ratios of tail length to total length for three samples from extreme southern Illinois, southeastern Illinois, and the Lower Mississippi Border. In females a slight reduction in the number of ventrals and caudals and proportionate tail length can be discerned from east to west; in males the trend is considerably more pronounced. This variation and the size ranges are summarized in table 54.

Other variation in scutellation seems to be individual, although the presence of 2 postoculars tends to be more frequent in eastern specimens than in others. Fifty-three specimens show the following variation in head scutellation: supralabials 7 + 7 in 51, 7 + 8 in 1, and 6 + 7 in 1; infralabials 8 + 8 in 47, 7 + 8 in 5, and 6 + 6 in 1; preoculars 1 + 1 in 40, 2 + 2 in 9, and 2 + 1 in 4; postoculars 2 + 2 in 47, 1 + 2 in 2, 1 + 3 in 1, 1 + 1 in 1, and 2 + 3 in 2.

Habits.—The rough green snake is arboreal and is seen most often in bushes and vines. It is most easily found in vegetation overhanging streams or lakes, particularly after summer showers. The green snake is nervous and quick. Newly captured individuals often open their mouths wide, exposing the purple mouth cavity. Despite its threatening behavior this snake does not bite. Its food consists of various soft-bodied arthropods, insects, and spiders.

The species is oviparous. A clutch of six elongate eggs was once found under a flat rock. No other life history information is available for the green snake in Illinois.

Illinois Distribution.—The rough green snake, a forest-edge species, is more common in the southern half of Illinois than is indicated by the available specimens, fig. 185. In central Illinois it is abundant north to the Shelbyville Moraine, where its range ceases abruptly. In extreme eastern Illinois and along the Mississippi River, apparently suitable habitat extends considerably farther north than the known range of the species.

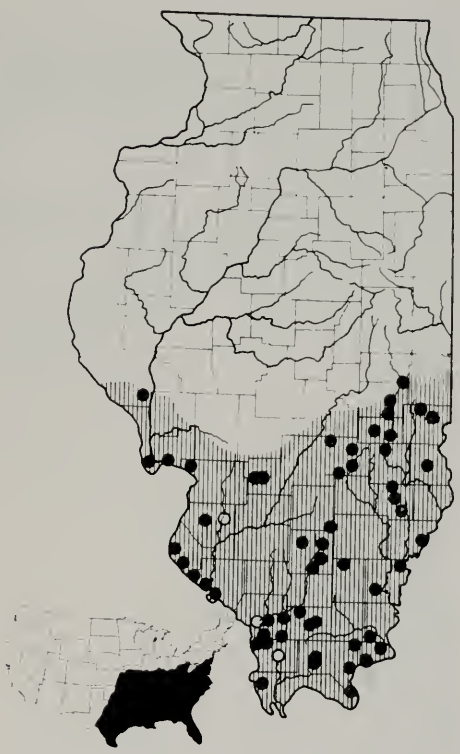


Fig. 185.—Distribution of *Opheodrys aestivus*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: 4 mi. W Murphysboro (Minton & Minton 1948); ST. CLAIR COUNTY: Mascoutah (Hurter 1893); UNION COUNTY: Anna (H. Garman 1892).

Opheodrys vernalis blanchardi Grobman
Western Smooth Green Snake

Opheodrys vernalis blanchardi Grobman 1941: 11 (type locality: Spanish Peaks, Colorado); Cagle 1941:22.

Opheodrys vernalis vernalis × *blanchardi*, Grobman 1941:17, 20.

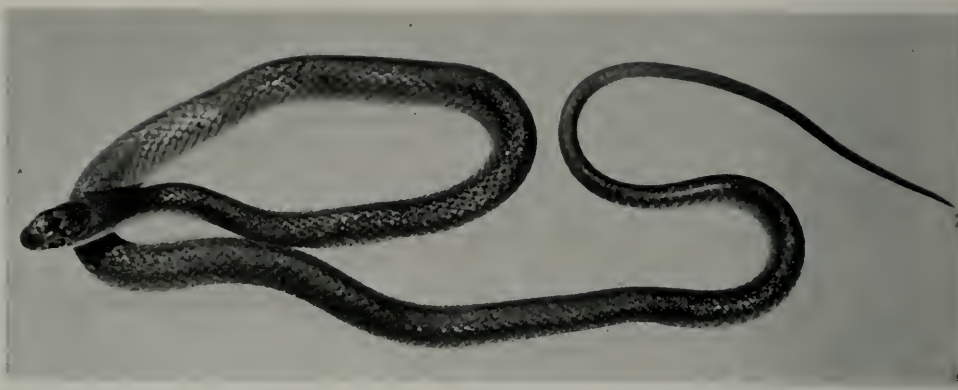


Fig. 186.—An adult *Opheodrys vernalis blanchardi* from Livingston County, Illinois. The color above is bright or dull green; below, white.

Chlorosoma vernalis, Kennicott 1855:592.
Cyclophis vernalis, Davis & Rice 1883*a*:29.
Contia vernalis, Boulenger 1894:259.
Liopeltis vernalis, Cope 1900:783.
Eurypholis vernalis, Schmidt & Necker 1935: 68.
Entechinus vernalis, Pope 1937:216.
Opheodrys vernalis, Necker 1938:2.

Diagnosis.—A small green snake (largest Illinois specimen 565 mm. in total length), fig. 186, with 15 rows of smooth sales around the body; ventrals 127 to 150; caudals 71 to 91; supralabials 7 + 7; infralabials usually 7 + 7; preoculars 1 or 2, and postoculars 2 on each side.

Variation.—In this subspecies the male has a higher caudal count and a longer tail but fewer ventrals than the female. Twenty-two male specimens have 127 to 140 ventrals (average 132.6) and 79 to 96 caudals (average 87.6); the tail length ranges from 24.5 to 36.5 (average 32.2) per cent of total length. Twenty-seven females have 134 to 150 ventrals (average 145.1) and 71 to 86 caudals (average 78.6); the tail length ranges from 23.7 to 30.9 (average 27.7) per cent of total length.

Newly hatched green snakes are dark olive-green. The slightly older juveniles are gray-green. Necker (1939*a*) reported buff-colored anomalies in yearling snakes. Young specimens are proportionately larger headed and shorter tailed than adults. The onto-

Table 55.—Ontogenetic variation in proportionate tail length in three size classes of Illinois *Opheodrys vernalis*. Figures in parentheses are numbers of specimens.

Total Length (mm.)	Tail Length as Per Cent of Total Length	
	Male	Female
Under 200	30.6 (10)	26.7 (11)
200–400	33.1 (7)	28.5 (7)
Over 400	34.1 (5)	28.7 (7)

Table 56.—Geographic variation in Illinois *Opheodrys vernalis*. Figures in parentheses are numbers of specimens.

Characteristic	Northeastern Illinois (13 Males, 8 Females)		Northwestern Illinois (1 Male, 13 Females)		East-Central Illinois (8 Males, 12 Females)		Marion County (1 Female)
	Range	Mean	Range	Mean	Range	Mean	
Ventrals							
Male	127–135	132.1	130	.....	127–140	133.8	.....
Female	139–149	144.0	134–147	142.6	143–150	146.7	149
Caudals							
Male	79–89	85.0	91	.....	79–96	91.1	.....
Female	72–82	76.0	71–82	77.5	76–86	80.6	79

genetic variation in proportionate tail length is summarized in table 55.

The most notable intrastate variation in *Opheodrys vernalis* is the smaller number of caudals in males from northeastern Illinois than in those from elsewhere in the state. In this regard the northeastern Illinois population approaches the nominate race; it was, in fact, regarded as an intergrade population by Grobman (1941). However, the females from this part of the state have caudal counts more or less typical of *blanchardi,* and the ventral counts of all the Illinois green snakes suggest *blanchardi.* Geographic variation within the state in number of ventrals and caudals is summarized in table 56.

Geographic variation in this species is rather unique. The two subspecies of *O. vernalis* are extremely similar morphologically, differing only in averages of a few characters. The two races, nevertheless, appear to be distinct biological entities, one occupying a grassland habitat in the west and the other inhabiting forest in the east. Moreover, despite their slight differences, they seem to be incipient species; in much of the area presumed to be intergrade in nature, the species is extinct or is known from relatively few scattered relicts. Thus, free interbreeding probably does not occur in a large part of the area where *blanchardi* and the nominate race presumably are in contact. The northeastern Illinois population, which shows some influence of *vernalis,* is actually part of a continuous *blanchardi* population but is separated from the closest continuous population of *vernalis* by a hiatus of probably 200 miles.

Individual variation in other features of scutellation in 49 Illinois specimens are as follows: scale rows 15 throughout in 98 per cent, 13–15–15 in 2 per cent; supralabials 7 + 7 in 98 per cent, 7 + 8 in 2 per cent; infralabials 7 + 7 in 51 per cent, 8 + 8 in 25 per cent, 7 + 8 in 14 per cent, 6 + 7 in 8 per cent, and 7 + 5 in 2 per cent; preoculars 1 + 1 in 61 per cent, 1 + 2 in 22 per cent, 2 + 2 in 17 per cent; postoculars 2 + 2 in 98 per cent, 2 + 1 in 2 per cent.

In addition to buff-colored anomalies, Necker (1939*a*) reported a single blue example of the western smooth green snake.

Habits.—The western smooth green snake is terrestrial; specimens are occasionally seen in low bushes and in grass. The most successful collecting method consists of raising pieces of ground cover, such as rocks, boards, paper, and other debris, and grabbing the snakes beneath. This species is a prairie animal. Since destruction of much of the original prairie habitat, scattered colonies have been found mostly in wet meadows and vacant lots in suburban areas. The green snake is rather slow in its movements and does not attempt to bite. Its food consists predominantly of soft-bodied arthropods.

Stille (1954*a*) records the average clutch size for the Chicago region as about 6, with a range of 5 to 15 eggs. The individual eggs measure about 22 × 10.5 mm. In the Chicago area, oviposition occurs in mid-July, and a month is required for the eggs to

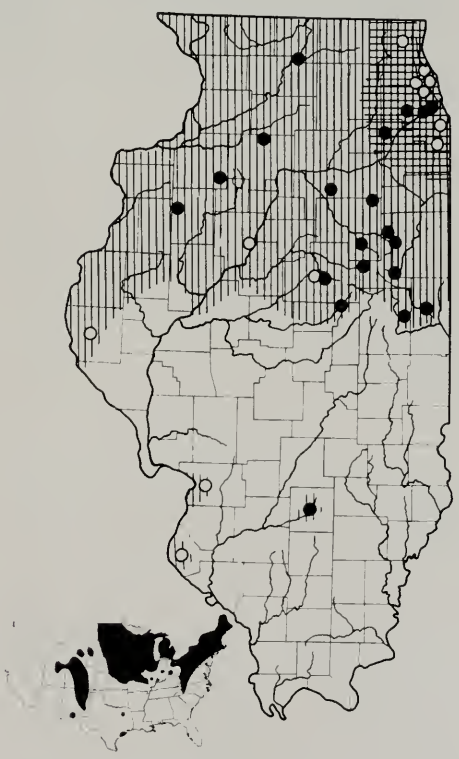


Fig. 187.—Distribution of *Opheodrys vernalis.* Vertical hatching indicates the presumed range of the subspecies *blanchardi* in Illinois; crosshatching, the area of intergradation between the subspecies *blanchardi* and *vernalis;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

hatch. Eighteen eggs, laid by a large female in Champaign County on July 12, hatched on August 10.

Illinois Distribution.—The present distribution of the western smooth green snake, fig. 187, appears to be sporadic. In northern Illinois, colonies are often found in vacant lots, where individuals may be quite abundant. Toward the south, colonies become more widely scattered. Many of them have in all likelihood been exterminated within historic times as more and more prairie areas have been cultivated. There are valid records of the species as far south as Marion, Madison, and Monroe counties, but no specimens have been taken in southern Illinois for many years.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: ADAMS COUNTY: (Grobman 1941); COOK COUNTY: Berwyn, Beverly Hills, Elmwood Park, Evanston, Glencoe (Schmidt & Necker 1935); Harvey (Necker 1939*c*); Homewood, Morgan Park, Park Ridge, Purington (Schmidt & Necker 1935); LAKE COUNTY: (Schmidt & Necker 1935); MCLEAN COUNTY: Normal (H. Garman 1892); MADISON COUNTY: (Hurter 1903); MONROE COUNTY: (H. Garman 1892); PEORIA COUNTY: Peoria (H. Garman 1892).

Coluber Linnaeus

A single species, with numerous subspecies, of this North American and Asiatic genus occurs in the United States and Canada.

Coluber constrictor Linnaeus

Eight subspecies of this wide-ranging species are currently recognized. Geographic variation in this species within Illinois is pronounced but distinctly clinal. Only one race and an intergrade population can be regarded as occurring in the state, despite the many published reports of both the eastern black racer and the western blue racer. Racers from southern Illinois differ from those in central and northern Illinois in color, caudal counts, and relative tail length. Series from the southern part of the state are not typical of the eastern race *constrictor* or the Gulf Coast race *priapus*, but are more or less intermediate between the western race *flaviventris* and either *constrictor* or *priapus*. Although they share with *priapus* the enlarged basal hooks on the hemipenes (and thus differ from *constrictor*), their possession of hemipenial hooks can be explained by regarding these snakes as *constrictor* × *flaviventris* intergrades, inasmuch as *flaviventris* also has enlarged hemipenial hooks. Despite two equally plausible interpretations on strictly morphological grounds, the southern Illinois racers are referred to *C. c. flaviventris* × *priapus* rather than to *C. c. constrictor* × *flaviventris* to conform with the distributional relationships outlined by Auffenberg (1955).

The resurrection of *C. c. foxi* Baird & Girard in the recent check list (Schmidt 1953) for the Prairie Peninsula racers is unexplained. In view of the almost identical scutellation of racers from northwestern Ohio, central Illinois, and Nebraska, *C. c. foxi* is almost certainly a junior synonym of *flaviventris*.

Coluber constrictor flaviventris Say

Eastern Yellow-Bellied Racer Blue Racer

Coluber flaviventris Say 1823:185 (type locality: stone quarry on west side of Missouri River, 3 miles above Boyer's River, Pottawattamie County, Iowa).
Coluber constrictor flaviventris, Ortenburger 1928:179.
Coluber constrictor constrictor × *flaviventris,* Lueth 1941:29.
Bascanion constrictor, Kennicott 1855:592.
Bascanium constrictor, Yarrow 1882*a*:109–10.
Bascanion constrictor constrictor nec Linnaeus, Davis & Rice 1883*a*:30.
Coluber constrictor, H. Garman 1890:187.
Coluber constrictor constrictor nec Linnaeus, Blanchard 1924*b*:536.
Coluber constrictor foxi, Schmidt 1953:187.

Diagnosis.—A moderately slender, large snake (largest Illinois specimen 1,535 mm. in total length), fig. 188, with 17–17–15 rows of smooth scales; ventrals 168 to 189; caudals 71 to 97; supralabials usually 7 + 7; infralabials 8 + 8; preoculars 2 + 2, the lowermost minute; postoculars 2 + 2; temporals usually 2–2–2 on each side; tail length 19 to 27 per cent of total length; adults uniformly blue-green, blue-black, or black above, yellowish white to dark slate color below; chin often conspicuously lighter than venter; juveniles blue-gray, with 55 to 87 red-brown dorsal blotches that become

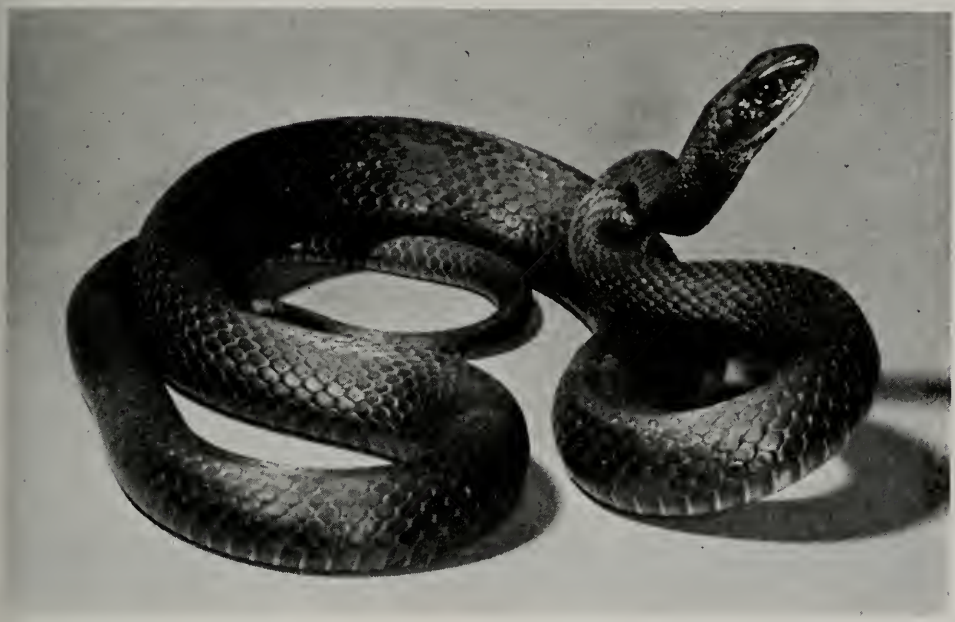


Fig. 188.—An adult *Coluber constrictor flaviventris* × *priapus* intergrade from Union County, Illinois. The color above may be blue-green, blue-black, or slaty black; below, yellowish white, pale gray, or slate color.

indistinct posteriorly, venter with brown markings; each hemipenis with large basal spines.

Variation.—Specimens of this species can be reliably sexed only by determining the presence or absence of hemipenes. The mean difference between the male and the female in number of caudals and ventrals consists of only 3 or 4 scales.

The juvenile is strikingly different from the adult, possessing reddish dorsal blotches that become progressively more closely crowded and more indistinct posteriorly. The tail is usually brownish gray, the venter speckled with brown, and the side of the head spotted with white. Individuals 500 mm. or more in length usually retain the blotches only on the anterior portion of the body. The ventral spotting usually persists in specimens 700–800 mm. in length, although these snakes are unicolorous above. The proportion of tail length to total length does not vary ontogenetically.

Adult racers in extreme southern Illinois are usually blue-black above and slate color below, except for their conspicuously white chins, the edges of which are occasionally flecked with black. Occasional individuals

Table 57.—Geographic variation from north to south in Illinois *Coluber constrictor*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Northern Illinois (15)		West-Central Illinois (15)		East-Central Illinois (15)		Lower Mississippi Border (15)		Extreme Southern Illinois (25)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ventrals	172–182	176.7	170–187	176.5	168–186	179.1	170–184	176.2	173–189	178.7
Caudals	71–87	79.6	76–89	83.6	76–96	85.6	82–95	87.7	84–97	90.9
Tail length as percentage of total length	19.3–23.8	21.7	22.2–25.2	23.8	20.2–26.1	23.5	19.8–27.3	24.1	22.8–26.6	24.4

so colored occur in the Lower Mississippi Border division and Southern Division woodlands. In extreme northwestern Illinois some racers have decidedly greenish dorsums and yellow throats. Over most of the state, however, these features are combined so that the majority of specimens are blue-black above and grayish white beneath.

Juvenile racers in extreme southern Illinois have fewer body blotches than those from the remainder of the state. Six juveniles from the southernmost counties have 55 to 65 blotches (average 60); 15 juveniles from central Illinois have 59 to 77 blotches (average 69); and 4 juveniles from the northernmost counties in the state have 60 to 72 blotches (average 67).

In all Illinois specimens in which the hemipenes have been everted, basal hooks are present.

The major geographic variation is summarized in table 57. Individual variation in other scutellation for 85 specimens is as follows: scale rows 17–17–15 in 81 specimens, 18–17–15 in 4; supralabials 7 + 7 in 71 specimens, 7 + 8 in 10, 8 + 8 in 3, 6 + 6 in 1; infralabials 8 + 8 in 67 specimens, 8 + 9 in 9, 9 + 9 in 7, 7 + 7 in 2; preoculars 2 + 2 in all; postoculars 2 + 2 in 84 specimens, 2 + 3 in 1.

Habits.—The blue racer, although primarily terrestrial, does not hesitate to climb or to take to water when being pursued or when searching for food. It is frequently found under rocks or other objects, particularly when preparing to shed its skin or when temperatures are low. The racer is graceful, agile, and swift, and it is difficult to capture unless taken unaware. When cornered, it vibrates its tail, producing a rattling noise, and strikes savagely. Males reportedly may attack intruders during the mating season. Its food is remarkably varied, consisting of arthropods, annelids, amphibians, reptiles (even small turtles), birds, and mammals. In southern Illinois (Klimstra 1959*c*), its diet consists of insects (approximately 39 per cent), small mammals (32 per cent), amphibians (11 per cent), reptiles (8 per cent), birds (6 per cent), and miscellaneous items (4 per cent). In early spring, it feeds principally on mammals but from May through October subsists largely on insects. Captives are nervous, usually refusing food.

Data presented by Cagle (1942*a*) and Pope (1944*b*) indicate that the blue racer in Illinois mates in May and early June. In late June and in July the 19 to 25 granular, white eggs are laid under rocks or within logs, and hatching occurs by early September. Cagle found the average dimensions of eggs in southern Illinois to be about 24 × 19 mm. A clutch from central Illinois, however, averaged 30 × 19 mm. The difference may be due to the different sizes and ages of the female snakes that laid the eggs.

Illinois Distribution.—The blue racer is almost state-wide in occurrence in Illinois, fig. 189. Records are sparse in the heavily farmed muck prairie of northern and central Illinois and completely lacking in the northeastern corner of the state. In places throughout most of the state where the for-

Fig. 189.—Distribution of *Coluber constrictor*. Vertical hatching indicates the presumed range of the subspecies *flaviventris* in Illinois; crosshatching, the area of intergradation between the subspecies *flaviventris* and *priapus;* solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. There are small localized areas in the state where records are inexplicably absent. The lower map depicts the total range of the species in the United States.

est-edge habitat is widespread, racers are one of the most common large snakes.

Coluber constrictor priapus × *flaviventris* intergrades occur throughout the southern part of Illinois.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CHAMPAIGN COUNTY: Urbana (H. Garman 1892); COOK COUNTY: Chicago (Yarrow 1882*a*); DU PAGE COUNTY: Hinsdale (Stille & Edgren 1948); KANKAKEE COUNTY: Hopkins Park (Schmidt & Necker 1935); KNOX COUNTY: Galesburg (H. Garman 1892); MACOUPIN COUNTY: Standard City (Owens 1941); PEORIA COUNTY: Peoria (H. Garman 1892); UNION COUNTY: Cobden (H. Garman 1892); WILL COUNTY: Birds Ridge (Stille & Edgren 1948).

Masticophis Baird & Girard

This genus is known from northern South America northward into the United States and reaches its greatest abundance in southwestern United States and Mexico; four species, each with numerous subspecies, occur in the United States. One of these species inhabits extreme southwestern Illinois.

Masticophis flagellum flagellum (Shaw) Eastern Coachwhip

Coluber flagellum Shaw 1802:475 (type locality: Carolina and Virginia; revised to Charleston, South Carolina, by Schmidt 1953).

Masticophis flagellum flagellum, Smith & Burger 1950:1.

Diagnosis.—A large, slender snake, fig. 190, usually with 17–17–13 rows of smooth scales; ventrals 186 to 207; caudals 91 to 119; supralabials usually 8 + 8; infralabials 10 + 10 or 11 + 11; preoculars 2 + 2; postoculars 2 + 2; temporals 2–2 on each side; frontal almost twice as wide anteriorly as posteriorly; adults uniform black above and below anteriorly, becoming gradually lighter on the tail; tail red (in Illinois and Missouri) to tan; dorsum in juveniles yellow-brown with dark crossbands, becoming indistinct posteriorly; venter in juveniles cream, with rows of brown spots; head in juveniles irregularly marked with white.

Variation.—From Illinois only two flattened specimens found dead on a road are extant. These were described (Smith & Burger 1950) as follows:

> Both are juveniles, measuring 371 and 404 mm. in length. Scutellation is as follows: ventrals 207 and 200; subcaudals 95 and 91; scale rows 17–16–15 and 17–15–13.

Sexual variation and ontogenetic variation in *Masticophis* are presumably similar to those of *Coluber*.

Habits.—The eastern coachwhip is similar to the racer, sharing many of the attributes described for that species, including its varied food habits. No information is available on the life history of the eastern coachwhip in Illinois.

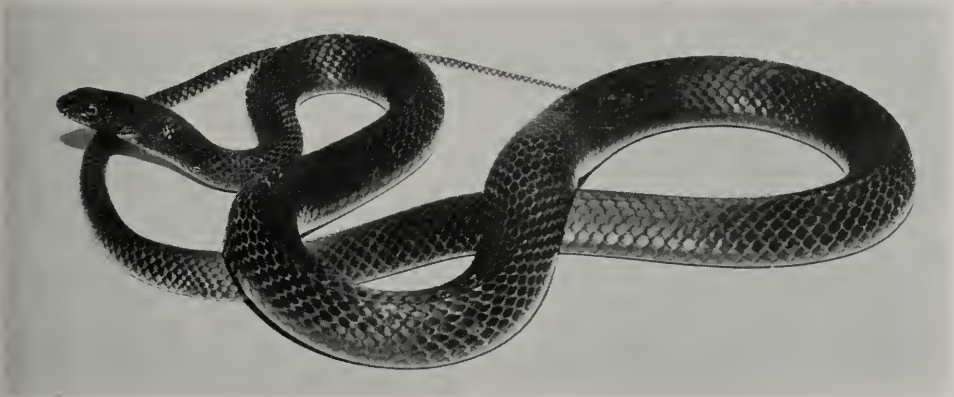


Fig. 190.—An adult *Masticophis flagellum flagellum* from Mayes County, Oklahoma. Examples from Illinois are jet black on the body with rose or tan increasing in extent toward the tip of the tail. (Photo by Isabelle Hunt Conant.)

Illinois Distribution.—This species is known in Illinois only in the vicinity of Fults, Monroe County, fig. 191. Considerable field work along the west-facing Mississippi River bluffs has revealed only four individuals, but additional specimens will likely turn up when the Lower Mississippi Border counties are more thoroughly collected. An adult seen alive could not be captured. Another adult was found killed on the road, according to Douglas A. Rossman of the University of Florida (personal communication), but his specimen has not been available to me for scale counts.

Fig. 191.—Distribution of *Masticophis flagellum*. Hatching indicates the presumed range of the subspecies *flagellum* in Illinois; solid circles indicate localities represented by specimens examined during this study. The lower map depicts the total range of the species in the United States.

Elaphe Fitzinger

Five species of *Elaphe*, most of them with several well-marked subspecies, occur in the United States and Canada. The genus is almost circumglobal in distribution; four species and subspecies inhabit Illinois.

Elaphe guttata emoryi (Baird & Girard) Great Plains Rat Snake

Scotophis emoryi Baird & Girard 1853:157 (type locality: Howard Springs, Ellis County, Oklahoma).
?Coluber emoryi, Cope 1875:39.
Elaphe emoryi emoryi, Wright & Wright 1952:585.
Elaphe guttata emoryi, Schmidt 1953:196.
Elaphe laeta laeta, Smith & Burger 1950:1–2.

Diagnosis.—A large, moderately slender snake (largest Illinois specimen 1,172 mm. in total length), fig. 192, usually with 25–27–19 or 25–27–21 rows of scales; ventrals 210 to 234; caudals 55 to 80; supralabials usually 8 + 8; infralabials usually 11 + 11; preoculars 1 + 1; postoculars 2 + 2; temporals 2–2 on each side; groundcolor gray, olive, or light brown, with 25 to 48 dark brown or red-brown quadrangular, black-bordered dorsal blotches; tail with 8 to 20 spots or crossbars; a pair of prominent brown processes extending from first dorsal blotch onto the head and uniting on the frontal plate; venter prominently checkered with black and white.

Variation.—Males in this subspecies presumably differ from females in the greater average number of caudals.

A juvenile specimen from adjacent Missouri (Iron County) differs from adults primarily in the bolder pattern and in the lack of red or brown tint.

The six Illinois specimens available vary as follows: total length 867 to 1,172 mm.; tail length 14.1 to 16.2 per cent of total length (average 15.0 per cent); ventrals 210 to 221 (average 215.6); caudals 55 to 67 (average 62.8); dorsal blotches 39 to 48 (average 43.3); tail rings 12 to 16 (average 14); infralabials 11 + 11 in three, 10 + 11 in one, 9 + 9 in one, unknown in one. Two specimens are gray, prominently blotched with dark brown; four are decidedly reddish in both groundcolor and color of blotches. Four specimens have 25–27–19 and two have 25–27–21 rows of scales. Four have 8 + 8 supralabials, one has 7 + 7, and one is too damaged to permit counting of supralabials.

A specimen (INHS 6072) from Wayne County, Missouri, is 60 inches long, a foot longer than the largest previously recorded.

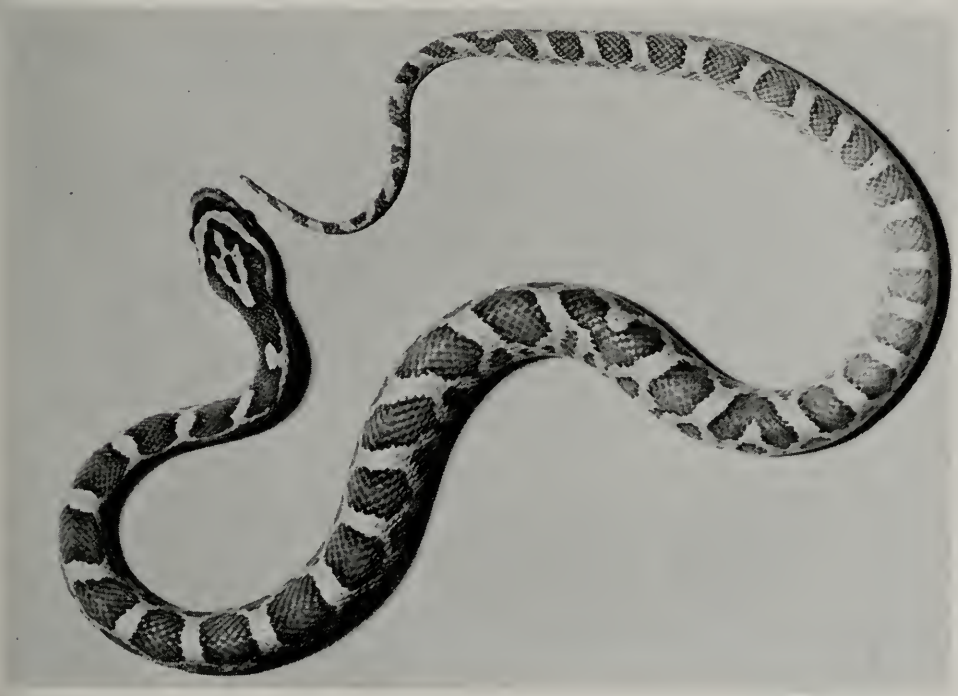


Fig. 192.—A juvenile *Elaphe guttata emoryi* from Reynolds County, Missouri. The ground-color is gray or light tan; the blotches are red-brown to brownish black.

Habits.—The Great Plains rat snake, although more terrestrial in habits than most other members of the genus, has considerable ability in climbing. Its food consists of birds and mammals, which it kills by constriction. Wild individuals vibrate their tails and strike, but captives are slow and even-tempered.

The species is oviparous. Little else is known of its life history.

Illinois Distribution.—Four of the specimens of this species extant from Illinois have been taken dead on the bluff road between Valmeyer, Monroe County, and Prairie du Rocher, Randolph County. This road is bordered on one side by the heavily farmed Mississippi floodplain, on the other by dry, precipitous rock bluffs. Two other specimens have been taken on the forested campus of Principia College near Elsah. Neill (1951*b*) reported having seen a specimen near East St. Louis, St. Clair County. Additional specimens may turn up in other Lower Mississippi Border counties, but it is unlikely that this western subspecies will be found elsewhere east of the Mississippi River, fig. 193.

The ranges of *Elaphe guttata guttata* and *E. g. emoryi* do not meet, even though the two forms are currently regarded as subspecies of a single species. The old published records for *guttata* in the Wabash Border counties are almost certainly based on misidentified specimens of the superficially similar *Lampropeltis calligaster*, as has been suggested in the list of deleted species. The kinship of *guttata* and *emoryi* assumes that intergradation occurred formerly but that the intergrade populations have since disappeared. The morphological relationship of these two subspecies, or incipient species, is obvious. The distributional relationships of *emoryi* focuses attention on another species of rat snake, *E. vulpina*, with similar habits and habitat requirements. These two species have more or less geographically complementary ranges in western Illinois, Missouri, and Kansas. In fact, both are known in the same Illinois county (Jersey) from localities that are scarcely 15 miles apart.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: MADI-

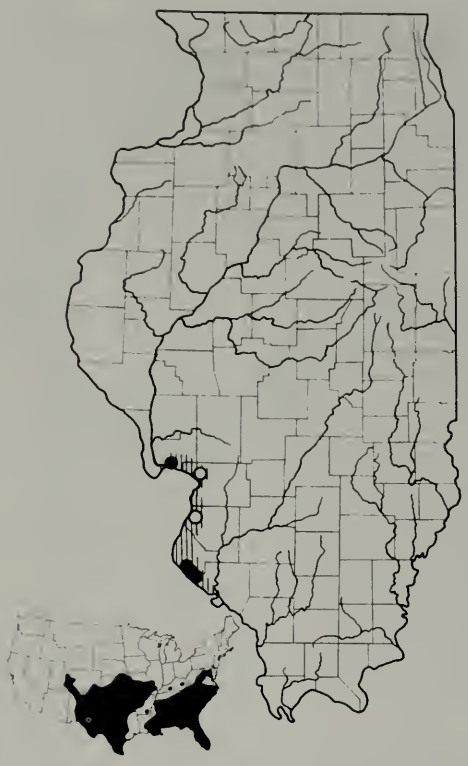


Fig. 193.—Distribution of *Elaphe guttata*. Hatching indicates the presumed range of the subspecies *emoryi* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States; the dots in the hiatus represent *guttata*.

SON COUNTY: Alton (Smith & Burger 1950); ST. CLAIR COUNTY: vicinity of East St. Louis (Neill 1951*b*).

Elaphe obsoleta (Say)

Eight subspecies of *Elaphe obsoleta* are recognized by some authorities, five by others. Two races are found in Illinois, intergrading across the southern fourth of the state.

Elaphe obsoleta obsoleta (Say)

Black Rat Snake Pilot Black Snake

Coluber obsoletus Say 1823:140 (type locality: Isle au Vache [sic] to Council Bluffs on the Missouri River; revised to Council Bluffs, Iowa, by Schmidt 1953); Jordan 1878:178.
Coluber obsoletus obsoletus, Yarrow 1882*a*: 102.
Elaphis obsoletus, H. Garman 1890:187 (part).
Elaphis obsoletus obsoletus, H. Garman 1892: 290–1.
Callopeltis obsoletus, Surface 1906:158.
Elaphe obsoletus, Hankinson 1917:326.
Elaphe obsoleta, Pratt 1923:218.
Elaphe obsoleta obsoleta, Blanchard 1924*b*:536.
Coluber lindheimerii, Davis & Rice 1883*a*:29 (part).
Elaphis obsoletus lindheimeri, S. Garman 1883:152.
Coluber lindheimeri, Davis & Rice 1883*b*:36 (part).
Elaphe lindheimeri, Wright & Wright 1952: 585.
?Coluber vulpinus nec Baird & Girard, Hay 1892*a*:499.
?Bascanion constrictor nec Linnaeus, Praeger 1899:597–9.
Coluber obsoletus confinis, Cope 1877:64 (part).

Diagnosis.—A large, moderately stout-bodied snake (largest Illinois specimen 1,725 mm. in total length), fig. 194, with 23 to 27 rows of scales on the anterior part of body and 17 to 21 rows immediately preceding the anus, formula usually 25–25–19 or 25–27–19; scales feebly keeled; head wider than neck; preoculars usually 1 + 1; postoculars usually 2 + 2; supralabials usually 8 + 8; infralabials 11 to 13 per side; anterior temporals 2 per side; ventrals 225 to 242; caudals 67 to 89. Adult pattern of specimens over most of state consisting of dark groundcolor on the dorsum, with milky white occurring as mottling in the interspaces between the almost obsolete dorsal blotches and as light-edged scales on sides of neck; venter yellowish white, checkered and stippled with black; juvenile pattern consisting of 28 to 40 dark, rectangular dorsal blotches and 1 or 2 rows of alternating, dark lateral spots on a gray groundcolor; venter checkered with dark; tail 14 to 18 per cent of total length; ventral plates decidedly angular laterally.

Variation.—Sexual dimorphism in this snake is illustrated by 16 males and 11 females in table 58. The number of tail rings probably averages higher in males than in females.

Juveniles of the black rat snake differ from adults only in distinctness of pattern, a difference sufficiently great to confuse one unfamiliar with immature rat snakes. The young are prominently blotched with dark on a groundcolor of white or gray. Frequently the anterior dorsal blotches are connected by lateral processes of the blotches, and the lateral spots are usually linear on

the neck. In northern specimens the top of the head is variously mottled, but in southern specimens it is usually plain except for a prominent dark bar traversing the prefrontal plates, a pattern that distinguishes *obsoleta* from all other baby rat snakes.

Four populations, differing strikingly in color and pattern but with no correlated

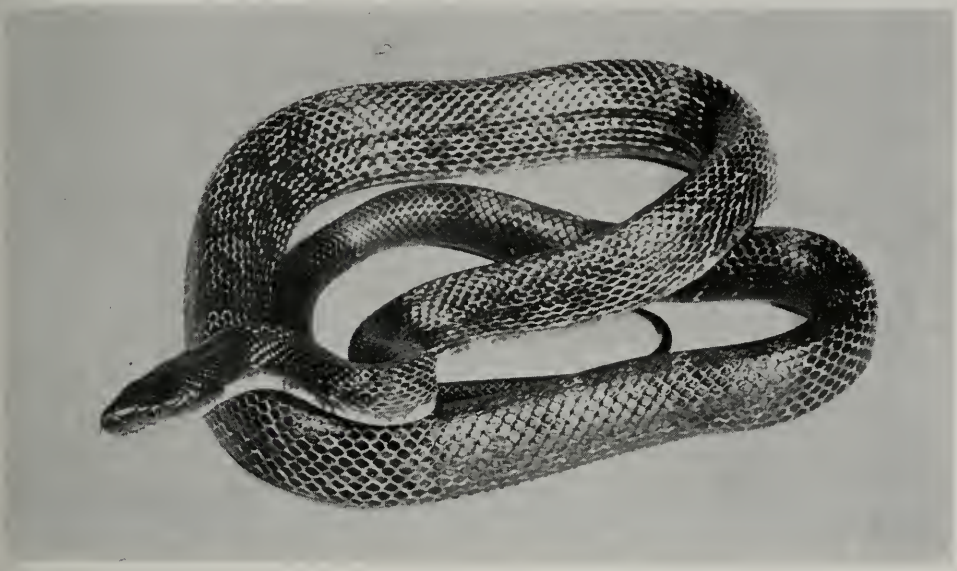


Fig. 194.—An adult *Elaphe obsoleta obsoleta,* blotched phase, from Cumberland County, Illinois. The groundcolor is gray or milky white, suffused with black; the square or quadrangular blotches are jet black.

Fig. 195.—An adult *Elaphe obsoleta obsoleta,* black phase, from Union County, Illinois. The color above is black; below it is pink or red, with black markings.

differences in scutellation, are discernible within the state. (1) Extreme southern Illinois snakes (Alexander and Union counties) are intermediate in distinctness of pattern between the gray rat snake, *Elaphe obsoleta spiloides,* and the darker pilot black snake, *E. o. obsoleta,* and they are accordingly regarded as intergrades. (2) Individuals from the Lower Mississippi Border are usually jet-black above, with little or no trace of blotches, fig. 195. The underside posteriorly is a uniform blue-black; anteriorly the venter is usually pink or red, with black markings. (3) Specimens from the Mississippi Border between Monroe and Pike counties are exceedingly variable, ranging from the solid black phase just described to a conspicuously blotched pattern in which, however, the groundcolor is red, pink, or orange rather than gray. (4) Specimens from over most of Illinois (exclusive of the southern tip, the Lower Mississippi Border, and the Wabash and Ohio river counties) are black above, with definite light mottling at the points of the dorsal interspaces, fig. 194. The venter is yellowish white, with black markings. This fourth subrace is described in the paragraph on diagnosis. There is some indication that specimens from extreme northwestern Illinois may be lighter in color. Examples from Jo Daviess and Carroll counties exhibit a tendency toward dorsolateral stripes that are light colored.

Except for the number of scale rows, which varies considerably among individuals, scutellation in *E. o. obsoleta* is remarkably uniform throughout Illinois. Toward the north there is a slight clinal reduction in number of ventral and caudal scales and a slight increase in the average number of body blotches. These gradients are summarized in table 59.

Individual variation in the scutellation of 47 specimens of *E. o. obsoleta* and *E. o. obsoleta* × *spiloides* intergrades is as follows: scale rows anteriorly 23 in 5 per cent of specimens, 24 in 7 per cent, 25 in 75 per cent, 26 in 2 per cent, 27 in 11 per cent; at mid-body 21 in 2.5 per cent, 24 in 2.5 per cent, 25 in 41 per cent, 26 in 7 per cent, 27 in 47 per cent; posteriorly 17 in 31 per cent, 18 in 5 per cent, 19 in 57 per cent, 21 in 7 per cent; supralabials 8 + 8 in 91.5 per cent, 9 + 9 in 6.4 per cent, 7 + 8 in 2.1 per cent;

Table 58.—Sexual variation in Illinois *Elaphe obsoleta*. Figures in parentheses are numbers of specimens.

Characteristic	Males (16)		Females (11)	
	Range	Mean	Range	Mean
Ventrals	224–236	230.2	226–242	235.6
Caudals	77–89	81.6	67–77	73.4
Body blotches	28–40	32.0	24–35	30.2
Tail length as percentage of total length	15.7–18.4	16.9	14.4–17.3	16.0

Table 59.—Geographic variation from north to south in Illinois *Elaphe obsoleta obsoleta*. Figures in parentheses are numbers of specimens.

Characteristic	Extreme Northwestern Illinois (3 Males, 3 Females)		Central Illinois (11 Males, 4 Females)		Lower Mississippi Border (2 Males, 5 Females)		Alexander-Union Counties (7 Males, 8 Females)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ventrals	226–238	232.2	225–240	233.2	224–242	231.6	225–239	232.6
Caudals								
Male	79–85	81.5	77–89	81.5	81–83	82.0	78–87	82.1
Female	67–74	70.0	72–77	75.0	69–77	73.6	70–80	73.8
Body blotches	32–40	35.5	30–33	31.3	28–29	28.5	24–34	30.2

infralabials 10 + 11 in 2.1 per cent, 11 + 11 in 42.6 per cent, 11 + 12 in 29.8 per cent, 12 + 12 in 12.8 per cent, 12 + 13 in 8.5 per cent, 13 + 13 in 4.2 per cent; preoculars 1 + 1 in 98 per cent, 2 + 2 in 2 per cent; postoculars 2 + 2 in 96 per cent, 2 + 3 in 2 per cent, 3 + 3 in 2 per cent.

Habits.—The black rat snake, or pilot black snake, is an excellent climber. One specimen was found in a tree 40 feet above the ground; another was found on a concrete bridge support more than 20 feet off the ground. How the snake scaled the concrete bridge support is a mystery. In the fall black rat snakes congregate in the vicinity of rock outcrops, where they may hibernate with rattlesnakes and copperheads.

Fig. 196.—Distribution of *Elaphe obsoleta.* Vertical hatching indicates the presumed range of the subspecies *obsoleta* in Illinois; horizontal hatching, the presumed range of the subspecies *spiloides;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

In nature this snake is slow and deliberate. A disturbed individual often "freezes" in the position in which it is encountered, the kinks in its body producing the effect of a crooked stick. If annoyed, this snake raises its head, vibrates the tip of its tail rapidly, and lunges at the tormentor. A captive usually becomes tame and eats well. The species feeds primarily on birds and small mammals. Like other rat snakes, *obsoleta* is a powerful constrictor.

On several occasions the large eggs of this species have been found in wood rot. In almost every instance the approximately one dozen eggs were found in August or early September and contained snakes just ready to hatch.

Illinois Distribution.—The pilot black snake occurs over most of Illinois, fig. 196; it is sporadic in occurrence in predominantly prairie areas. It is common throughout the southern half of the state; it is not common in the Upper Mississippi River Border division. Apparently it is local and quite uncommon in northeastern Illinois. Wooded bluffs seem to provide choice habitat.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: COOK COUNTY: Dalton, Worth (Schmidt & Necker 1935); KNOX COUNTY: Galesburg (H. Garman 1892); MCLEAN COUNTY: (H. Garman 1892); ST. CLAIR COUNTY: near St. Louis (Hurter 1893); STARK COUNTY: Elmira (Yarrow 1882*a*).

Elaphe obsoleta spiloides
Duméril, Bibron, & Duméril
Gray Rat Snake

Elaphis spiloides Duméril, Bibron, & Duméril 1854:219 (type locality: New Orleans, Louisiana).
Coluber spiloides, Wright & Wright 1952:585.
Coluber obsoletus confinis, Cope 1877:64 (part).
Elaphe obsoleta confinis, Cagle 1941:17.
Elaphe obsoleta obsoleta × *confinis,* Neill 1949*a*:8.
Elaphis obsoletus obsoletus nec Say, (H. Garman 1892:290 (part).
Elaphe obsoleta, Breckenridge 1944:120 (part).
Coluber lindheimerii, Davis & Rice 1883*a*:29 (part).
Coluber lindheimeri, Davis & Rice 1883*b*:36 (part).
Elaphis obsoletus lindheimeri, S. Garman 1884:27.

Fig. 197.—An adult *Elaphe obsoleta spiloides* from Pope County, Illinois. The groundcolor is gray; the blotches are black or dark brown.

Diagnosis.—A subspecies of *Elaphe obsoleta* (largest Illinois specimen 1,690 mm. in total length), fig. 197, differing from *E. o. obsoleta* in the retention of a distinctly blotched pattern throughout life. The 26 to 32 dark dorsal blotches and alternating lateral spots on a gray groundcolor can be counted readily on the largest adults.

Variation.—Sexual dimorphism and ontogenetic variation are evidently the same for *E. o. obsoleta* and *spiloides* except that *spiloides* adults do not differ so strikingly from juveniles.

Only 1 of 12 adult and subadult specimens of *spiloides* at hand is so dark that the body blotches cannot be readily counted. The counts of body blotches on the remaining 11 specimens range from 26 to 31 (average 29.4). For the 12 specimens, the tail length ranges from 14.7 to 18.4 (average 16.4) per cent of total length. Scutellation data are almost identical with those of Illinois specimens of *E. o. obsoleta* except for the slightly higher frequency of specimens with 27 scale rows on the anterior half of body. Ten specimens display the following variation: anterior scale rows 24 in 16.7 per cent, 25 in 33.3 per cent, 27 in 50.0 per cent; scale rows at mid-body 25 in 33.3 per cent, 27 in 66.7 per cent; posterior scale rows 17 in 50 per cent, 19 in 50 per cent; ventrals in males 227 to 238 (average 231.1), in females 230 to 235 (average 233.1); caudals in males 78 to 86 (average 82.0), in females 73 to 79 (average 76); supralabials 8 + 8 in all; infralabials 11 + 11 in 42 per cent, 11 + 12 in 29 per cent, 13 + 13 in 29 per cent; preoculars 1 + 1 in all.

Habits.—The gray rat snake, more often called chicken snake in Illinois, is similar in behavior, feeding habits, and reproductive habits to *E. o. obsoleta*. Individuals often enter buildings in search of rodents.

Illinois Distribution.—Individuals identical with Gulf Coast *spiloides* in pattern occur rather consistently in extreme southeastern Illinois, fig. 196. The habitat of *spiloides* is similar to that of *obsoleta*. Specimens referable to *obsoleta* × *spiloides* intergrades have been taken in Alexander, Hamilton, Jackson, Lawrence, Union, and Wabash counties.

Although undocumented by specimens, a published record for the following locality

is believed valid and is indicated on the distribution map by a hollow symbol: WHITE COUNTY: (Minton & Minton 1948).

Elaphe vulpina vulpina (Baird & Girard) Western Fox Snake

Scotophis vulpinus Baird & Girard 1853:75 (type locality: Racine, Wisconsin).
Coluber vulpinus, Yarrow 1882*a*:101.
Elaphe guttatus vulpinus, H. Garman 1892: 292–3.
Elaphe vulpinus, Hurter 1911:178.
Elaphe vulpina, Stejneger & Barbour 1917:84.
Elaphe vulpina vulpina, Conant 1940:10–1.
?Coluber spiloides nec Duméril, Bibron, & Duméril, McLain 1899:3.

Diagnosis.—A large, moderately stout-bodied snake (largest Illinois specimen 1,297 mm. in total length), fig. 198, usually with 25–25–21 rows of feebly keeled scales; ventrals 192 to 210; caudals 53 to 69; supralabials usually 8 + 8; infralabials usually 11 + 11; preoculars usually 1 + 1; postoculars usually 2 + 2; anal plate divided; head wider than neck; adult pattern consisting of 34 to 42 red-brown dorsal spots on a yellow-gray groundcolor; an alternating row of brown lateral spots on each side of body; head coppery colored; venter yellow, boldly marked with black; juvenile similar except that yellow is lacking in groundcolor and blotches are dark chestnut or black.

Variation.—In the western fox snake the tail of the male is proportionately larger than that of the female. Other differences are the number of caudals (58 to 69, average 64, in males; 53 to 58, average 54.7, in females); number of tail rings (12 to 16, average 14, in males; 10 to 13, average 11.6, in females); and proportionate tail length (13.6 to 17.8, average 16.0, per cent of total length in males; 11.1 to 14.8, average 13.0, per cent of total length in females).

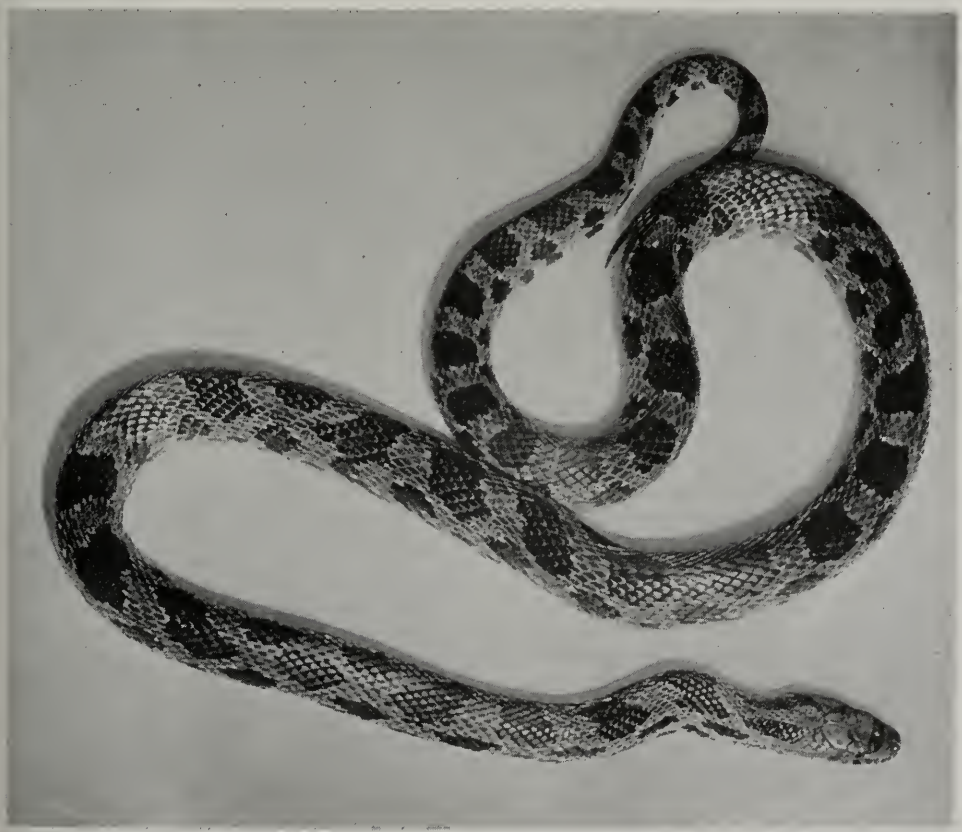


Fig. 198.—An adult *Elaphe vulpina vulpina* from Ford County, Illinois. The groundcolor is tan or yellow-brown; the blotches are chestnut brown.

Table 60.—Geographic variation in number of body blotches of Illinois *Elaphe vulpina vulpina*. Figures in parentheses are numbers of specimens.

Characteristic	Northeastern Illinois (9)		Northwestern Illinois (13)		East-Central Illinois (33)		West-Central Illinois (4)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Body blotches.....	37–52	41.4	35–41	38.6	32–42	37.3	32–41	36.7

The average number of ventrals and body blotches is slightly greater in females than in males.

The juveniles are gray or white, prominently blotched with black or dark chestnut. Older individuals acquire a yellowish cast, and the blotches fade to a rich brown, which is often edged with black. The head becomes copper colored, and the head mottling tends to dim with age.

The only geographic variation discerned in this snake is a north-to-south trend toward a reduction in the number of body blotches. This is illustrated in table 60.

Individual variation in 40 specimens is not pronounced. Their scutellation data are as follows: 25 anterior scale rows in 97 per cent, 25 in 3 per cent; scale rows at midbody 25 in 79.1 per cent, 27 in 10.5 per cent, 23 in 5.2 per cent, 24 in 2.6 per cent, 26 in 2.5 per cent; scale rows posteriorly 21 in 78.5 per cent, 19 in 11.0 per cent, 20 in 8.0 per cent, 23 in 2.5 per cent. Supralabials are 8 + 8 in 83 per cent, 8 + 9 in 11 per cent, 7 + 8 in 6 per cent; infralabials 11 + 11 in 61 per cent, 10 + 11 in 12 per cent, 11 + 12 in 9 per cent, 12 + 12 in 12 per cent, 9 + 9 in 6 per cent. Preoculars are 1 + 1 and postoculars 2 + 2 in 92 per cent, asymmetrical in 8 per cent.

On most specimens some dorsal blotches are as narrow as 2½ scale lengths and other blotches, particularly anteriorly, are 5 scale lengths in width. The average width is approximately 4 scale lengths.

Habits.—The western fox snake is probably the most terrestrial member of the rat snake genus. Occasionally an individual can be found under the bark of standing dead trees or stumps 5 or 6 feet above the ground. The fox snake is abundant in the heavily farmed, black-soil prairies of central Illinois, and it apparently requires little vegetation cover, as it is often found along fencerows and in pastures where little natural cover remains. It can be found from early spring until late fall (one active specimen was collected December 4); there seems to be a burst of activity in early June in the Urbana region. During these few weeks many more snakes are seen dead on the roads than during the rest of the season. An angered fox snake vibrates the tip of its tail and strikes at intruders. In captivity it usually becomes tame, but frequently it refuses to eat. Sixteen individuals were once found in March in an old well, where they had survived the winter. Judged from material regurgitated by captives, the food consists largely of small mammals and birds.

Clutches of 8, 10, and 27 eggs of this snake have been found in soil and under objects on the ground. The egg shells adhere to each other, and the eggs are difficult to pull apart. Hatching occurs in late August and early September.

Illinois Distribution.—The western fox snake is common throughout the northern half of Illinois except in predominantly forested regions, fig. 199. This species apparently does well on the heavily cultivated muck prairies of north-central Illinois, from which many other snakes have been almost or entirely exterminated.

The record of a single adult (INHS 1317) from Jerseyville, Jersey County, would be open to question except that the field tag is still attached to the specimen. It is typical in all respects except for a rather longer head. Jersey County includes some prairie, but the countryside does not appear to be typical *vulpina* habitat.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Bureau County: Milo (Conant 1940); Cook County: Argo (Schmidt & Necker 1935); Bloom Township (Necker 1939*c*); Chicago Ridge (Conant 1940); Evanston,

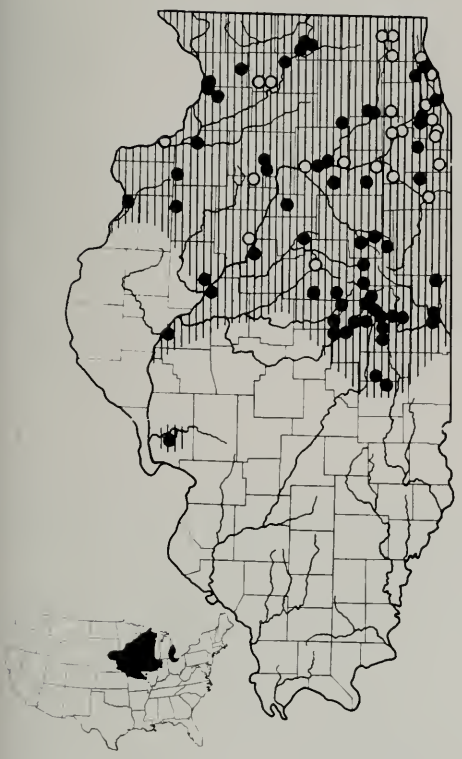


Fig. 199.—Distribution of *Elaphe vulpina*. Hatching indicates the presumed range of the subspecies *vulpina* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Hazelcrest (Schmidt & Necker 1935); Homewood (Conant 1940); Lemont (Necker 1939*c*); DU PAGE COUNTY: Du Page Township (Necker 1939*c*); Naperville (Schmidt & Necker 1935); GRUNDY COUNTY: Pequot (Necker 1939*c*); KANKAKEE COUNTY: Aroma Township (Necker 1939*c*); LAKE COUNTY: Barrington (Necker 1939*c*); Beach (Schmidt & Necker 1935); Sayer Bog, Volo (Necker 1939*c*); LA SALLE COUNTY: 4 mi. E La Salle, 3 mi. E Marseilles (Burt & Hoyle 1934); MCHENRY COUNTY: McHenry (Schmidt & Necker 1935); MCLEAN COUNTY: Bloomington (McLain 1899); Normal (H. Garman 1892); OGLE COUNTY: Polo, White Pines State Park (Conant 1940); PEORIA COUNTY: Peoria (H. Garman 1892); ROCK ISLAND COUNTY: Rock Island (Yarrow 1882*a*); WILL COUNTY: 4 mi. N Beecher (Burt & Hoyle 1934); Custer Park, Joliet (Schmidt & Necker 1935); Romeoville (Conant 1940); Wheatland Township (Schmidt & Necker 1935).

Pituophis Holbrook

This strictly North American genus includes, in the United States, one species with 10 subspecies, or two species, each with several subspecies, the number of species and subspecies contingent upon the viewpoint of the specialist. One subspecies occurs in Illinois.

Pituophis melanoleucus sayi (Schlegel) Bullsnake

Coluber sayi Schlegel 1837:157 (type locality: Missouri; revised to vicinity of St. Louis, Missouri, by Schmidt 1953).
Pityophis sayi sayi, Cope 1875:39.
Pityophis catenifer sayi, S. Garman 1883:151.
Pityophis sayi, Hay 1857*a*:10.
Pituophis sayi, Jordan 1888:196.
Pituophis sayi sayi, Necker 1933:8.
Pituophis catenifer sayi, Edgren & Stille 1948:5.
Pityophis catenifera sayi × *bellona,* H. Garman 1892:286–9.
Pituophis melanoleucus, Brendel 1857:254.
Pityophis catenifer catenifer nec Blainville, H. Garman 1892:286–9.

Diagnosis.—A large, moderately stout-bodied snake (largest Illinois specimen 1,880 mm. in total length), fig. 200, with 26 to 31 rows of scales on the anterior part of the body, 29 to 33 rows at mid-body, and 21 to 25 rows on the posterior part of the body; scales feebly keeled; head wider than neck; rostral plate enlarged and projecting forward; supralabials 8 or 9 on each side, usually with sutures heavily margined with black; infralabials 11 to 13 on each side; preoculars usually 1 + 1 and postoculars 3 + 3 or 4 + 4; prefrontal plates 4; ventrals 213 to 233; caudals 48 to 61; anal plate entire; groundcolor yellow, with 36 to 54 conspicuous dorsal body blotches that alternate with two rows of lateral spots on each side; anterior and posterior body blotches black, mid-body blotches brown; tail with 8 to 15 black rings; venter yellow, checkered with black.

Variation.—The male bullsnake differs from the female in the greater number of caudals, smaller number of ventrals, and

relatively greater tail length. Ten males have 213 to 230 ventrals (average 221.9) and 54 to 61 caudals (average 58.2); tail length ranges from 10.5 to 14.0 (average 12.6) per cent of total length. Ten females have 222 to 233 ventrals (average 227) and 48 to 57 caudals (average 52.1); tail length ranges from 10.1 to 13.0 (average 11.4) per cent of total length.

The juveniles differ from the adults in duller coloration and possession of almost unicolorous body blotches. The groundcolor is usually dull tan, rather than yellow, and the blotches at mid-body are usually black, rather than brown.

The average number of dorsal blotches in this snake is greater in specimens from northern localities than from elsewhere in the state. Twenty-three central Illinois specimens range from 36 to 54 (average 48.5) in blotch counts and from 8 to 15 (average 11.3) in tail rings; eight northwestern Illinois specimens range from 46 to 54 (average 50.1) in blotch counts and from 11 to 14 (average 11.5) in tail rings.

Other variation, which is neither sexual nor geographic, is as follows: anterior scale rows 26 to 31 (average 28); scale rows at mid-body 29 to 33 (average 31.1); posterior scale rows 21 to 25 (average 23.4); upper labials 8 + 8 in 20 per cent of specimens at hand, 8 + 9 in 40 per cent, 9 + 9 in 35 per

Fig. 200.—An adult *Pituophis melanoleucus sayi* from Mason County, Illinois. The groundcolor is bright yellow or tan; the blotches are black anteriorly and posteriorly but rich brown at mid-body.

cent, and 6 + 8 in 5 per cent; infralabials 12 + 12 in 40 per cent, 11 + 12 in 10 per cent, 12 + 13 in 15 per cent, 13 + 13 in 25 per cent, 11 + 13 in 5 per cent, and 13 + 14 in 5 per cent; azygous scales absent in 39 per cent, 1 azygous scale in 50 per cent, 2 scales in 11 per cent. Most Illinois specimens are prominently blotched; a few individuals appear faded.

Habits.—The large bullsnake, although essentially a terrestrial reptile, climbs and burrows readily in search of food. When first encountered, a bullsnake vibrates its tail and hisses loudly, with its mouth partially opened. It is rather vicious, but captives usually become tame and feed well. The food of the bullsnake consists of mammals, birds, and bird eggs. It is a powerful constrictor and is of considerable economic importance because of its predation on injurious rodents.

The species is oviparous. Reproductive habits are probably similar to those of the rat snakes in the genus *Elaphe*.

Illinois Distribution.—The distribution pattern, fig. 201, of the bullsnake is one of the most puzzling of those of Illinois reptiles. The species occurs commonly in the extensive sand prairies of central and northern Illinois and less commonly in the black-soil prairies east of the sand areas to at least De Witt County. Although bullsnakes are occasionally found in small wooded areas, they apparently do not occur in extensively forested regions. The paucity of records just west of the Illinois River is not readily explained; the available evidence suggests that bullsnakes are uncommon there. In northeastern Illinois, bullsnakes are closely restricted to the Kankakee sand area.

A bullsnake (FAS 19) reportedly found near Urbana, Champaign County, and a published record for Champaign (Stull 1940) have not been plotted on the map, fig. 201, since there is some possibility that the specimens might have been collected elsewhere. It hardly seems possible that this large, spectacular species could occur in a region so well studied and still be known from only two examples. The published record by Gaige (1914) for Richland County has been dismissed as probably being based on misidentification, inasmuch as she reported the bullsnake as common there but failed to mention the abundant prairie kingsnake. Richland County does not appear to contain suitable *Pituophis* habitat. However, a small relict colony of *Pituophis* is known in the sandy soil of Knox County, Indiana, a few miles to the east of Richland County. Old published records for *Pituophis* in Madison and St. Clair counties are believed to be

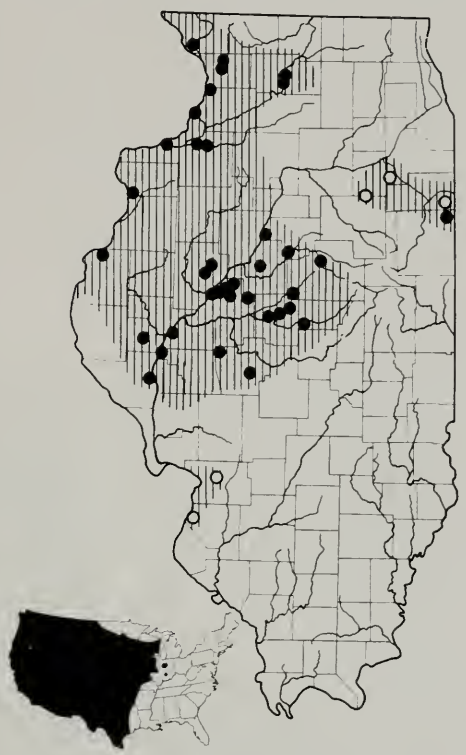


Fig. 201.—Distribution of *Pituophis melanoleucus*. Hatching indicates the presumed range of the subspecies *sayi* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of the bullsnake complex of subspecies in the United States. It does not include the pine snakes.

valid, the absence of museum specimens notwithstanding.

Sometimes bullsnakes are found under objects on the ground, but the majority of the bullsnakes taken as specimens are discovered while they are crossing roads or they are encountered in cultivated fields or sand prairies.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: GRUNDY COUNTY: vicinity of Dwight (Stille &

Edgren 1948); KANKAKEE COUNTY: Pembroke Township (Schmidt & Necker 1935); MADISON COUNTY: (Stull 1940); ST. CLAIR COUNTY: opposite St. Louis (Hurter 1903); WILL COUNTY: Custer Park (Stille & Edgren 1948).

Lampropeltis Fitzinger

This New World genus is represented in the United States by seven species, some of which have several well-marked subspecies. Five species and subspecies are known in Illinois. Many of the subspecies are sufficiently distinctive in general appearance to suggest different species of snakes, but they are known to have geographically complementary ranges and to interbreed where their ranges meet.

Lampropeltis calligaster calligaster (Harlan) Prairie Kingsnake

Coluber calligaster Harlan 1827:359 (type locality: Missouri; revised to vicinity of St. Louis, Missouri, by Schmidt 1953).

Ophibolus calligaster, Cope 1875:37.

Lampropeltis calligaster, Jordan 1888:197.

Lampropeltis calligaster calligaster, P. W. Smith 1947:34.

Ophibolus evansii Kennicott 1859:99 (type locality: prairies of central Illinois).

Coluber emoryi nec Baird & Girard, Cope 1875:39.

Ophibolus rhombomaculatus nec Holbrook, Davis & Rice 1883*a*:29.

Lampropeltis rhombomaculatus nec Holbrook, Jordan 1888:197.

?Pituophis catenifer sayi nec Schlegel, Gaige 1914:4.

Fig. 202.—An adult *Lampropeltis calligaster calligaster* from Sangamon County, Illinois. The groundcolor is gray, tan, brown, or light olive; the frequently indistinct blotches are dark gray or brown. Some individuals appear almost unicolorous; others, especially those in southeastern Illinois, have distinct red-brown blotches.

Diagnosis.—A large, moderately slender snake (largest Illinois specimen 1,327 mm. in total length), fig. 202, usually with 25 scale rows on the anterior half of the body and 19 or 21 posterior rows; scales smooth; head little wider than neck; eyes small; supralabials 7 + 7 or 8 + 8; infralabials 9 to 11 on each side; preoculars 1 + 1; postoculars 2 + 2; ventrals 194 to 213; caudals 41 to 57; anal plate entire; groundcolor gray, brown, or straw-color with 41 to 64 dark dorsal body blotches and two or three

Table 61.—Sexual dimorphism in Illinois *Lampropeltis calligaster calligaster*. Figures in parentheses are numbers of specimens.

Characteristic	Males (24)		Females (13)	
	Range	Mean	Range	Mean
Ventrals	194–210	203.2	195–213	206.3
Caudals	44–57	50.0	41–48	44.8
Tail length as percentage of total length	11.3–14.7	13.3	11.9–14.4	12.8
Tail rings	10–21	14.1	9–14	12.1

Table 62.—Blotch count of male and female specimens of Illinois *Lampropeltis calligaster calligaster*. Figures in parentheses are numbers of specimens.

Character-istic	Southern Illinois				East-Central Illinois				West-Central Illinois			
	Males (6)		Females (4)		Males (17)		Females (14)		Males (9		Females (4)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Blotch count	41–51	45.1	42–49	45.0	43–57	49.1	40–51	45.9	44–64	49.3	43–46	44.7

Table 63.—Geographic variation in Illinois *Lampropeltis calligaster calligaster*. Figures in parentheses are numbers of specimens.

Characteristic	Southern Illinois (9 Males, 5 Females)		West-Central Illinois (6 Males, 5 Females)		East-Central Illinois (6 Males, 5 Females)	
	Range	Mean	Range	Mean	Range	Mean
Ventrals						
Male	200–210	205.3	197–207	203.0	194–207	200.5
Female	210–213	211.5	199–209	205.5	195–209	202.0
Caudals						
Male	44–53	49.6	47–57	52.1	46–51	48.2
Female	45–47	46.0	42–47	45.0	41–48	43.5
Tail length as percentage of total length						
Male	12.0–13.8	12.8	12.8–14.7	13.8	11.3–13.4	12.8
Female	12.0–13.6	12.9	12.1–14.4	13.1	11.9–13.1	12.5
Body blotches	41–51	45.0	43–64	47.6	43–57	48.9

series of dark spots on each side, alternating with the dorsal blotches; dorsal blotches extending ventrad to scale row 5, 6, or 7; venter gray-white or yellowish gray, with irregular and usually dim dark markings.

Variation.—In the prairie kingsnake, sexual dimorphism in scutellation is slight, but it can be detected by comparing averages, table 61.

In central Illinois specimens, there is a tendency toward a higher blotch count in males than in females; in southern Illinois specimens, blotch count means are identical in the two sexes. This characteristic is summarized in table 62.

The juvenile differs from the adult chiefly in color and prominence of pattern. The baby kingsnake has distinct reddish blotches, with black borders above; the venter is distinctly marked with black. In pattern the young *calligaster* closely resembles the young of the related milk snake, *Lampropeltis triangulum,* but it can be distinguished by the narrower blotches, which extend ventrad only to the fifth or sixth scale row (fourth or lower in the milk snake).

Except for the tendency toward greater sexual dimorphism in the northern part of the range, no geographic variation is obvious for the prairie kingsnake in Illinois. Variation data for three samples are summarized in table 63.

The number of scale rows anteriorly is distributed as follows: 23 in 7.5 per cent of specimens, 24 in 7.5 per cent, 25 in 77.5 per cent, 26 in 7.5 per cent; at mid-body, 23 in 2.5 per cent, 25 in 90.0 per cent, 26 in 5.0 per cent, 27 in 2.5 per cent; posteriorly, 19 in 39.5 per cent, 20 in 7.5 per cent, 21 in 53.0 per cent. Supralabials are 6 + 7 in 2.8 per cent of the specimens, 7 + 7 in 50.2 per cent, 7 + 8 in 30.4 per cent, 8 + 8 in 11.0 per cent, 7 + 9 in 2.8 per cent, and 8 + 9 in 2.8 per cent. Infralabials are 9 + 9 in 31.0 per cent of the specimens, 9 + 10 in 33.0 per cent, 9 + 11 in 2.8 per cent, 10 + 10 in 22.0 per cent, 10 + 11 in 5.5 per cent, 11 + 11 in 2.8 per cent, and 12 + 13 in 2.8 per cent. Preoculars are 1 + 1 in 94 per cent of the specimens, 1 + 2 in 3 per cent, 2 + 2 in 3 per cent; postoculars are 2 + 2 in 91 per cent, 2 + 3 in 6 per cent, and 3 + 3 in 3 per cent.

Occasional adult specimens retain a well-pronounced pattern of reddish blotches with black margins. A few individuals are almost unicolorous, only traces of the blotches being evident; in some of these are dim, longitudinal light bands in the form of a pair of paravertebral bands and a lateral stripe. The majority of adults and subadults are distinctly blotched, but the pattern is not in great contrast to the groundcolor.

A specimen (from Springfield) in the Chicago Academy of Sciences is aberrant in pattern in that a pair of dorsolateral dark stripes extend almost the length of the body, replacing the usual blotched pattern. The spots on the tail have not fused to form stripes.

Another aberrant specimen (INHS 6189) collected December 2, 1951, 3 miles south of Philo, Champaign County, suggests a *triangulum* × *calligaster* hybrid. This snake, a female, 575 mm. in total length, has 24–25–19 scale rows, 203 ventrals, 51 caudals, 7 + 8 supralabials, 10 + 10 infralabials, 1 + 2 oculars, and 42 dorsal body blotches. The chin and venter are prominently checkered with black and white, and the dorsal blotches extend ventrad onto the fourth and fifth scale rows anteriorly. Except for the presence of a prominent suborbital dark spot, the head pattern is typical of *calligaster*.

Habits.—The prairie kingsnake shows a preference for old fields. In bluegrass plots the species is easily confused with the racer, as it sometimes moves so fast that the blotched pattern is not evident. Captured individuals vibrate the tail tip and usually try to bite. Most captives become tame, but they usually do not feed well in cages. This kingsnake occasionally hibernates in road embankments. On mild days some individuals may be enticed from their hibernating chambers by the winter sun. They have been found active in November, December, and February, and they are among the first snakes to be seen in early March. Captives have disgorged small mammals, and one specimen regurgitated an equally large prairie kingsnake. Klimstra (1959*a*) noted that, in southern Illinois, small mammals make up 68.6 per cent of the diet and that amphibians, reptiles, birds, and insects constitute the remaining percentage.

A captive specimen from central Illinois laid 9 eggs on July 5. Cagle (1942*a*) reported a clutch of 9 eggs for a southern Illinois specimen. Young of the year are in evidence in September.

Illinois Distribution.—The prairie kingsnake, abundant in prairie regions in the southern two-thirds of Illinois, is a characteristic species of the Outlier Prairies of the Southern Division, fig. 203. The species extends northward on the central prairies to Tazewell and McLean counties, but it is much less common on the heavily farmed black-soil prairies and apparently is restricted to small areas of poorer soil that support a brushy cover. *L. calligaster* has not been found in the vicinity of Urbana. The prairie kingsnake and the ecologically similar fox snake overlap in distribution, but they may not compete inasmuch as the fox snake seems to thrive in heavily cultivated black soils.

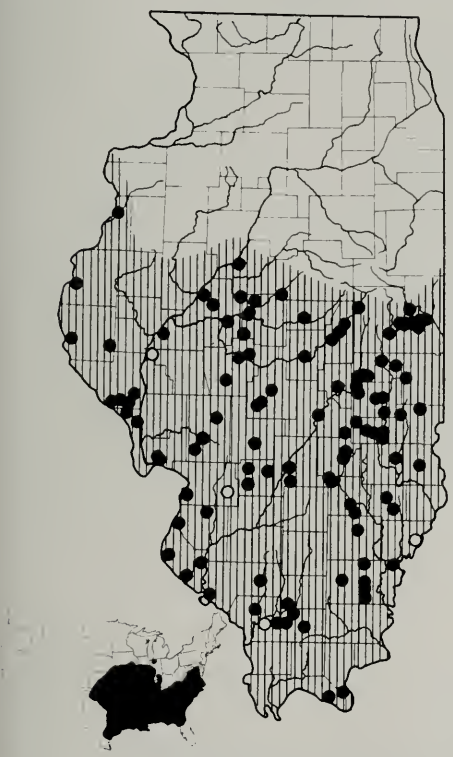


Fig. 203.—Distribution of *Lampropeltis calligaster*. Hatching indicates the presumed range of the subspecies *calligaster* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although *L. calligaster* occurs in the extreme southern tip of the state, it is evidently uncommon in the predominantly forested regions there.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Murphysboro (Ditmars 1945); MADISON COUNTY: Highland (Hurter 1893); MORGAN COUNTY: Meredosia (Weed 1923); WABASH COUNTY: Mount Carmel (Schneck 1880*a*).

Lampropeltis getulus (Linnaeus)

Nine subspecies of this transcontinental species occur in the United States. Two inhabit Illinois, intergrading in the southern third of the state.

Lampropeltis getulus holbrooki Stejneger
Speckled Kingsnake

Lampropeltis holbrooki Stejneger 1902:150 (type locality: valley of the Mississippi); Stejneger & Barbour 1917:88.
Lampropeltis getulus holbrooki, Hurter 1911: 185.
Ophibolus getulus sayi, Cope 1875:37.
Lampropeltis getulus sayi, Jordan 1888:196.

Diagnosis.—A large, moderately slender snake (largest Illinois specimen 1,232 mm. in total length), fig. 204, usually with 21 anterior and 17 or 19 posterior rows of smooth scales; anal plate entire; head little wider than neck; supralabials usually 7 + 7; infralabials usually 9 + 9; preoculars 1 + 1, postoculars, 2 + 2; 2, 3, or 4 temporals on each side; ventrals 201 to 219; caudals 41 to 56; groundcolor above black, each scale containing a yellow spot, sometimes dots fused to form traces of crossbands; venter checkered with black and yellow, the black usually predominating; labial sutures heavily margined with black.

Variation.—Since the two Illinois subspecies of *Lampropeltis getulus* are identical in scutellation and proportions, variation for both races as well as intergrades is included here.

Twelve males have 42 to 56 (average 49.5) caudals; tail length ranges from 11.2 to 14.6 (average 12.9) per cent of total length. Twelve females have 41 to 49 (average 45.2) caudals; tail length ranges from 10.7 to 14.5 (average 12.1) per cent of total length.

Fig. 204.—An adult *Lampropeltis getulus holbrooki* from Randolph County, Illinois. The groundcolor is blue-black; each scale contains a round yellow or yellowish white spot.

Juveniles of *L. g. holbrooki* differ from adults in that some of their middorsal scales lack light dots. Prominent light crossbands as well as light spots are present in juveniles but sometimes difficult to count because of their irregularity. Three juveniles have 69, 78, and 82 crossbands on the body. Adults are too speckled for reliable counts to be made. Twelve specimens of Illinois *L. g. niger,* both juveniles and adults, have 40 to 56 crossbands. Otherwise, juveniles of *holbrooki* are indistinguishable from those of *niger*; the possible difference in number of crossbands needs checking with additional specimens.

Individual variation in a sample of 25 specimens of *L. getulus* is as follows: anterior scale rows 19 in 16 per cent, 20 in 24 per cent, 21 in 60 per cent of specimens; scale rows at mid-body 21 in 88 per cent, 22 in 4 per cent, 23 in 8 per cent; posterior scale rows 17 in 17 per cent, 18 in 4 per cent, 19 in 71 per cent, 20 in 8 per cent; ventrals 201 to 218 (average 211.7); supralabials 7 + 7 in 96 per cent, 8 + 7 in 4 per cent; infralabials 7 + 8 in 4 per cent, 8 + 8 in 4 per cent, 8 + 9 in 8 per cent, 9 + 9 in 76 per cent, and 9 + 10 in 8 per cent.

Habits.—This powerful kingsnake is slow and deliberate in its movements. When first encountered, an individual vibrates its tail and strikes viciously. Captives usually become tame quickly, however, and they are popular as pets. The species is most often encountered under flat rocks or logs or found crossing roads. Captive individuals feed on other snakes, birds, and mammals, all of which are constricted by the muscular body of the kingsnake before being swallowed.

A large captive female deposited 13 large, smooth eggs on July 19 and 20. These eggs, strongly adherent, averaged 21 × 37 mm. By October 12 they had increased in size to an average of 39 × 26 mm. but had not hatched. Each egg contained a well-formed but dead snake. Cagle (1942*a*) recorded that a clutch of 9 eggs was laid in mid-June and was hatched in mid-August.

Illinois Distribution.—The speckled kingsnake probably occurs sporadically throughout western Illinois south of Peoria, fig. 206. The requisite habitat of wooded, hilly terrain is so restricted in most of that part of the state that the rarity of *holbrooki* in collections is not surprising. Though the

Illinois range of *holbrooki* is more extensive than that of the closely related *niger, holbrooki* is apparently much less common. Most of the Illinois specimens have been taken in the Lower Mississippi Border division.

Intergradation of *holbrooki* and *niger* is exhibited by specimens from extreme southwestern Illinois, and intergrades probably occur in most of the Southern Division. Single juveniles cannot be referred with certainty to either race, since the subspecific difference is one of pattern only. In a series from southern Union County, the *niger* influence predominates. In material from Jackson and northern Union counties, the two pattern types are about equally distributed. In eastern Illinois, no intergrades have been taken. Specimens from Effingham County are typical *holbrooki*; those from adjacent Cumberland and Jasper counties are typical *niger*.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Elkville, Makanda (Cagle 1942*a*); Murphysboro (Ditmars 1945); PEORIA COUNTY: Peoria (H. Garman 1892); ST. CLAIR COUNTY: (Hurter 1911).

Lampropeltis getulus niger (Yarrow)
Black Kingsnake

Ophibolus getulus niger Yarrow 1882*b*:438 (type locality: Wheatland, Indiana); Yarrow 1882*a*:93.
Lampropeltis getulus niger, Blanchard 1921: 18, 43–8.
Lampropeltis getulus nigra, Pratt 1923:221.
Ophibolus getulus sayi nec Holbrook, Yarrow 1882*a*:93 (part).
Lampropeltis getulus holbrooki nec Stejneger, Myers 1926:291.

Diagnosis.—A subspecies of *Lampropeltis getulus* (largest Illinois specimen 1,369 mm. in total length), fig. 205, differing from *L. g. holbrooki* only in detail of dorsal pattern: speckling reduced to 40 to 56 narrow crossbands, each of which forks on the side; some of lateral scales with light centers, others black.

Variation.—Sexual variation is identical in *holbrooki* and *niger*. Juveniles of *niger* differ from the adults only in having a somewhat brighter pattern.

Comparison of means for counts and measurements of three specimens from Cumberland and Jasper counties and 15 from extreme southeastern Illinois reveals no trends in geographic variation. Individual variation in scutellation and proportions for

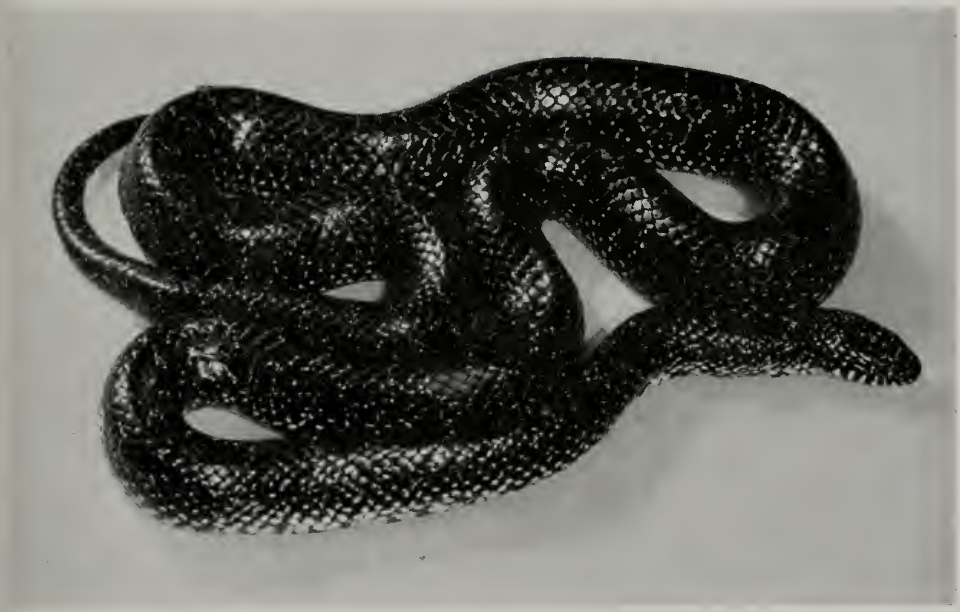


Fig. 205.—An adult *Lampropeltis getulus niger* from Alexander County, Illinois. The groundcolor is blue-black; small dots of yellowish white tend to form crossbars at regular intervals.

Fig. 206.—Distribution of *Lampropeltis getulus*. Vertical hatching indicates the presumed range of the subspecies *holbrooki* in Illinois; horizontal hatching, the presumed range of the subspecies *niger;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of the species in the United States.

the species is summarized under *L. g. holbrooki*. Individuals vary in pattern from those that are almost uniformly black to those, usually juveniles, in which the crossbands are almost a scale length in width.

Habits.—The black kingsnake is similar to the speckled kingsnake in behavior and reproductive habits. A captive female deposited 13 eggs in early July. The 13 young hatched on August 30 and 31.

Illinois Distribution.—The black kingsnake occurs throughout eastern Illinois from Edgar County southward, fig. 206. The number seen dead on highways indicates that this snake is rather common in southeastern Illinois.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: UNION COUNTY: Dug Hill (H. Garman 1892); WABASH COUNTY: Mount Carmel (Yarrow 1882*b*).

Lampropeltis triangulum (Lacépède)

Ten subspecies of *Lampropeltis triangulum* are currently recognized. Two particularly well-marked races occur in Illinois. They intergrade in a wide belt across the central part of the state; in this area their characters show a bewildering overlap.

The trivial name *doliata* of Linnaeus is applied to the milk snakes by most recent authors, who believe that *doliata*, which has priority over *triangulum*, refers to a milk snake. The name *triangulum* is retained for the species by other authors who believe that the description of *doliata* better fits the scarlet snake of the genus *Cemophora*.

Lampropeltis triangulum triangulum (Lacépède) Eastern Milk Snake

Coluber triangulum Lacépède 1788:86 (type locality: America; revised to vicinity of New York City, New York, by Schmidt 1953).
Lampropeltis triangulum triangulum, Blanchard 1921:108, 205.
Lampropeltis triangulum, Ditmars 1929:90.
Lampropeltis doliata triangulum, Wright & Wright 1952:585.
Lampropeltis triangulum triangulum × *syspila,* Langebartel 1947:27–8.
Ophibolus doliatus triangulus, Yarrow 1882*a*: 91.
Ophibolus triangulus triangulus, H. Garman 1892:295–6.
Lampropeltis doliatus triangulus, Surface 1906:178.
Osceola doliata triangula, Cope 1900:886.
Ophibolus doliatus nec Linnaeus, H. Garman 1892:299.
Lampropeltis doliatus nec Linnaeus, Hankinson 1917:327.
Ophibolus eximus, Kennicott 1855:592.

Diagnosis.—A medium-sized, moderately slender snake (largest Illinois specimen 1,110 mm. in total length), fig. 207, usually with 21 anterior and 17 or 19 posterior rows of smooth scales; anal plate entire; head little wider than neck; supralabials usually 7 + 7; infralabials usually 9 + 9; preoculars 1 + 1; postoculars 2 + 2; ventrals 198 to 215; caudals 36 to 52; groundcolor gray or white, with 33 to 46 black-margined, brown dorsal blotches alternating with 1 or 2 rows

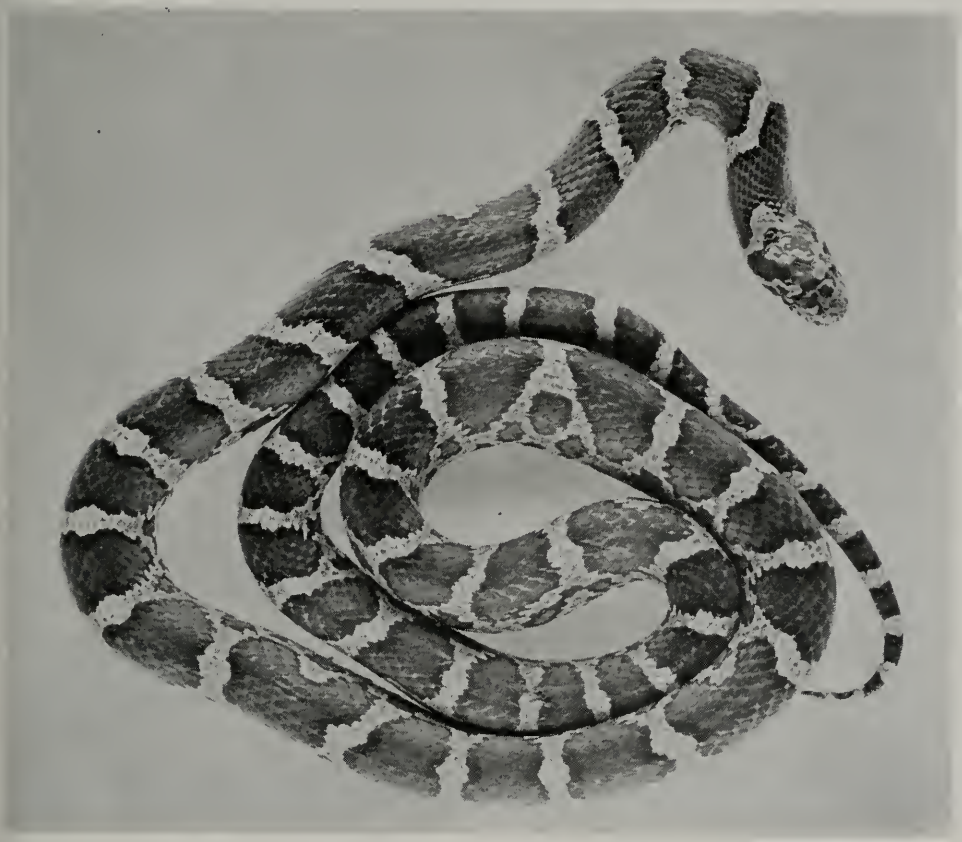


Fig. 207.—A juvenile *Lampropeltis triangulum triangulum* from Lake County, Illinois. The groundcolor is light gray or tan; the blotches are red-brown or dark brown, heavily margined with black.

of lateral spots on each side; dorsal blotches extending ventrad to scale row 2, 3, 4, or 5; venter prominently checkered with black and white; head pattern a dark chevron-shaped marking.

Variation.—In *Lampropeltis triangulum triangulum* the average number of caudals is greater in males than in females and, surprisingly, males have a slightly higher blotch count on the body. The usual dimorphism in proportionate tail length and number of tail rings is not evident. Seven males and five females, exclusive of *triangulum* × *syspila* intergrades, have, respectively, 46 to 52 (average 49.6) caudals and 35 to 46 (average 40.3) dorsal body blotches; 42 to 46 (average 44.6) caudals and 33 to 43 (average 38.6) body blotches.

Juveniles of *triangulum* are more brightly colored than adults; they possess black-margined red, rather than brown, dorsal and lateral spots. There is some indication of a proportionately shorter tail in hatchlings.

Geographic variation is summarized in table 64. Eastern milk snakes from the northernmost Illinois counties are phenotypically *triangulum*. Yet in the sample from northwestern Illinois some slight influence of *syspila* is suggested by the number of tail rings, by the lateral rows of spots, and by the size of dorsal blotches.

Intergradation of *triangulum* and *syspila* in western Illinois occurs at least as far south as Pike County, one specimen from near Pearl being approximately intermediate but closer to *syspila*. Specimens from Hamilton and Adams counties are unassignably intermediate. Intergradation in eastern Illinois apparently occurs in a narrower zone. Material from Tazewell and De Witt counties is closer to *triangulum*; Champaign and Vermilion county specimens are almost

Table 64.—Geographic variation in Illinois *Lampropeltis triangulum triangulum* and *L. t. triangulum* × *syspila* intergrades. Figures in parentheses are numbers of specimens.

Characteristic	Northeastern Illinois (8)		Northwestern Illinois (4)		West-Central Illinois (4)		East-Central Illinois (9)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ventrals	202–215	209.3	201–209	204.0	205–213	208.7	198–213	204.8
Caudals	45–52	48.5	42–46	44.0	45–48	46.7	36–52	47.5
Tail length as percentage of total length	12.9–15.1	13.9	11.7–12.6	12.2	12.5–13.1	12.8	12.4–15.1	13.4
Rows of lateral spots	2	.....	1⅔–2	.....	1	.....	0–1⅔	.....
Scale row contacting dorsal blotch at mid-body	2–6	4.1	2–5	3.4	1–2	1.7	0–4	2.0
Body blotches	35–46	39.1	33–43	39.0	21–33*	26.9	25–38	29.8
Tail rings	9–12	10.2	8–10	8.7	6–9*	7.3	7–11	8.2

*Counts based on 10 rather than 4 specimens.

exactly intermediate; a series from Coles County shows more *syspila* influence. Most intergrades from areas where the *syspila* influence predominates look like *syspila* because of their red color, but they exhibit intergradation in details of pattern.

Individual variation in the number of scale rows and in head squamation is apparently identical in *L. t. triangulum* and *syspila*. Accordingly, these counts for 40 specimens of *triangulum, syspila,* and the intergrades are combined and are presented here. Anterior scale rows are 21 in 95.0 per cent, 22 in 2.5 per cent, 23 in 2.5 per cent of specimens; scale rows at mid-body are 21 in 95 per cent, 23 in 5 per cent; posterior scale rows are 17 in 51.0 per cent, 18 in 5.5 per cent, 19 in 41.0 per cent, and 21 in 2.5 per cent; supralabials are 7 + 7 in 97 per cent, 7 + 8 in 3 per cent; infralabials are 8 + 9 in 14.5 per cent, 9 + 9 in 82.5 per cent, and 9 + 10 in 3.0 per cent.

An albino specimen (INHS 5409), a male bearing the label "Chicago Area," is 929 mm. in total length. This male is typical in scutellation but it is cream colored and has dark red eyes. Anteriorly the venter has an obscure checkered pattern; posteriorly it is immaculate. Traces of the dorsal pattern are discernible in the form of blotch margins. This specimen has approximately 35 body blotches and 10 tail rings.

Habits.—The eastern milk snake is apparently common in the Chicago area but distinctly uncommon over the rest of Illinois. It is most often found by raising logs, rocks, or debris. The scanty information available on habits of the species in Illinois is based largely on behavior of captives. Like other kingsnakes this rather small snake vibrates its tail when disturbed. The species is known to eat small mammals, lizards, and snakes.

Pope (1944*b*) recorded that 8 to 16 adherent eggs are laid in June and early July, but it is not certain that his observation was based on Illinois specimens.

Illinois Distribution.—The eastern milk snake is a forest species, although in Illinois it evidently is not strictly confined to wooded regions. *L. t. triangulum* occurs in the northern third of the state, extending south to about Iroquois and Whiteside counties, fig. 208. *L. t. triangulum* × *syspila* intergrades occur from these localities southward to Clark and Greene counties.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Bureau County: Milo (Cope 1900); Cook County: Beverly Hills, Chicago Ridge, Edgebrook (Schmidt & Necker 1935); Glen-

Fig. 208.—Distribution of *Lampropeltis triangulum*. Vertical hatching indicates the presumed range of the subspecies *triangulum* in Illinois; horizontal hatching, the presumed range of the subspecies *syspila;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of the species in the United States.

view (Necker 1939*c*); Kenilworth, Northbrook, Richton Park, Willow Springs (Schmidt & Necker 1935); DU PAGE COUNTY: Glen Ellyn, Hinsdale (Schmidt & Necker 1935); Naperville (Necker 1939*c*); KANE COUNTY: Elburn (Necker 1939*c*); KANKAKEE COUNTY: Rock Creek Park (Stille & Edgren 1948); KNOX COUNTY: Galesburg (H. Garman 1892); LAKE COUNTY: Deerfield, Grass Lake (Schmidt & Necker 1935); Waukegan (Necker 1939*c*); MCHENRY COUNTY: McHenry (Necker 1939*c*); MCLEAN COUNTY: Normal (H. Garman 1892); MENARD COUNTY: Athens (Blanchard 1921); PEORIA COUNTY: Peoria (H. Garman 1892); STARK COUNTY: Elmira (Yarrow 1882*a*); STEPHENSON COUNTY: Freeport (H. Garman 1892); VERMILION COUNTY: Danville (Blanchard 1921); WILL COUNTY: Joliet (Schmidt & Necker 1935); Romeoville (Necker 1939*c*).

Lampropeltis triangulum syspila (Cope) Red Milk Snake

Ophibolus doliatus syspilus Cope 1888:384 (type locality: Richland, Illinois; revised to Richland County, Illinois, by Blanchard 1921).
Osceola doliata syspila, Cope 1900:892.
Lampropeltis triangulum syspila, Blanchard 1921:179–87.
Lampropeltis doliata syspila, Wright & Wright 1952:585.
Ophibolus doliatus doliatus nec Linnaeus, Yarrow 1882*a*:89.
Ophibolus triangulum doliatus nec Linnaeus, H. Garman 1892:295–6.
Lampropeltis doliatus nec Linnaeus, Hurter 1911:184.
Ophibolus doliatis nec Linnaeus, Hurter 1893: 255.
Osceola doliata doliata nec Linnaeus, Cope 1900:890.
Osceola doliata collaris, Cope 1893*a*:1069.
Osceola doliata clerica, Cope 1900:888.
Ophibolus doliatus clericus, Brown 1901:73.
Osceola elapsoidea nec Holbrook, Davis & Rice 1883*a*:29.
Ophibolus elapsoideus nec Holbrook, H. Garman 1892:299–300.
Lampropeltis elapsoides elapsoides nec Holbrook, Wright & Wright 1952:586.
Ophibolus doliatus coccineus nec Schlegel, Davis & Rice 1883*a*:29.
Lampropeltis doliatus coccineus nec Schlegel, Jordan 1888:197.

Diagnosis.—A subspecies (largest Illinois specimen 844 mm. in total length) of *Lampropeltis triangulum*, fig. 209, differing from *L. t. triangulum* in color and pattern: 19 to 26 crimson, black-edged dorsal blotches between head and anus; dorsal blotches extending ventrad on the sides to ventrals or at least to first or second scale rows; one or less than one complete row of lateral spots alternating with dorsal saddles; tail with 4 to 8 black-margined red rings; head pattern without a chevron-shaped mark, with a pair of supraocular light spots.

Variation.—Sexual variation in *L. t. syspila* parallels that in *L. t. triangulum*. Eight males have 45 to 50 (average 47.0) caudals and 19 to 26 (average 23.1) body blotches; six females have 42 to 49 (average 44.2) caudals and 21 to 26 (average 22.5) body blotches.

Juveniles and adults are alike in pattern.

Fig. 209.—An adult *Lampropeltis triangulum syspila* from Union County, Illinois. The groundcolor is light gray or white; the blotches are bright red, heavily margined with black.

No geographic variation within Illinois has been discerned for *syspila* except for intergradation with *triangulum*, which has been described under that subspecies.

Individual variation in a sample of 14 specimens of *syspila* is as follows: ventrals 197 to 213 (average 202.5), tail length 11.9 to 14.1 (average 13.0) per cent of total length. Variation in scale rows and head squamation has been summarized under *L. t. triangulum*. The dorsal blotches in 14 specimens at hand extend to the edges of the ventrals or onto the first or second scale row. Forty-three per cent of the specimens possess a complete row of lateral spots alternating with the dorsal saddles; the others possess an incomplete row. An extreme case of the latter pattern is found in a Jasper County specimen in which the lateral spots are on only the posterior third of the body.

Habits.—This brightly colored snake is similar in habits to the eastern milk snake. There is some evidence that it is at least partially nocturnal. Individuals have been found in rotten logs or under bark of stumps.

Feeding and reproductive habits are presumably similar to those of the eastern milk snake.

Illinois Distribution.—The red milk snake, one of the most colorful of the Illinois reptiles, occurs in wooded regions of southern Illinois north to the Shelbyville Moraine in the eastern part of the state and to Calhoun County in the western, fig. 208. More individuals have been collected under flat rocks on wooded or grassy hillsides of the Lower Mississippi Border division than elsewhere in the state, but even there *syspila* is quite uncommon.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: CALHOUN COUNTY: Hardin (Blanchard 1921); JACKSON COUNTY: Murphysboro (Ditmars 1945); PULASKI COUNTY: Grand Chain (Blanchard 1921); RICHLAND COUNTY: (Cope 1888); ST. CLAIR COUNTY: (Hurter 1893); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*).

Fig. 210.—An adult *Cemophora doliata* from Calhoun County, Florida. The groundcolor is gray or white; the blotches are bright red, heavily margined with black. The venter is plain white. (Photo by Isabelle Hunt Conant.)

Cemophora Cope

One monotypic species of *Cemophora* is known in southeastern United States. The majority of American herpetologists now assign the name *C. coccinea* (Blumenbach) to this species. Other authors, however, regard the name *doliata* Linnaeus as applicable to the scarlet snake.

Cemophora doliata (Linnaeus)
Scarlet Snake

Coluber doliatus Linnaeus 1766:379 (type locality: Carolina; revised to vicinity of Charleston, South Carolina, by Schmidt 1953).
Cemophora doliata doliata, Bennett 1953:164.

Diagnosis.—A small, moderately slender snake (less than 600 mm. in total length), fig. 210, with 19 rows of smooth scales; anal plate entire; rostral scale pointed and wartlike; loreal present; supralabials 6 + 6; infralabials 6 to 8 on each side; preoculars 1 + 1, postoculars usually 2 + 2; top of snout red; groundcolor above gray, white, or yellow, with broad, black-bordered red rings; venter immaculate white or yellowish white.

Variation.—Details of sexual and ontogenetic variation are unknown for the species in this part of its range.

A single male of this species (SIU 542) is known from Illinois. This specimen has 19 scale rows, 161 ventrals, 41 caudals, 6 + 6 supralabials, 6 + 7 infralabials, 1 + 1 preoculars, 1 + 2 postoculars, and 1–2 temporals on each side, 19 body blotches, 8 tail rings, and a total length of 448 mm., the tail comprising 14.7 per cent of the total length. The groundcolor dorsally is dark gray, the red saddles appearing lighter; the venter is unmarked.

Fig. 211.—Distribution of *Cemophora doliata*. The lower map depicts the total known range of the species in the United States.

Habits.—The scarlet snake presumably feeds on lizards, other snakes, and young mice. This small constrictor is fossorial and

apparently nocturnal. No information is available on the number or dimensions of the eggs in the northern part of the range of the species.

Illinois Distribution.—The sole Illinois specimen bears the label "Wolf Lake Swamp, Union Co., Illinois, July 26, 1942, F. R. Cagle." It was mistakenly cataloged as *Lampropeltis triangulum syspila*. Bennett (1953), at my suggestion, reported the error and recorded the genus for Illinois. Despite heavy collecting in the area, this specimen remains the only record for the state, fig. 211. There is growing doubt in the minds of herpetologists at Southern Illinois University that the specimen actually came from Wolf Lake. I am inclined to accept the record as valid, in view of similar circumstances in Indiana and Missouri, where many years elapsed before the initial records were substantiated by additional specimens, and in view of the failure of many hundreds of collectors over many decades to find *Tantilla gracilis* and *Natrix cyclopion* in the Wolf Lake area. *Cemophora* probably occurs on the slopes of Pine Hills rather than in the swamp.

Tantilla Baird & Girard

This New World genus contains, in the United States, nine species, some of which have several subspecies. One species is found in southwestern Illinois.

Tantilla gracilis hallowelli Cope
Northern Flat-Headed Snake

Tantilla hallowelli Cope 1860*a*:77 (type locality: Manhattan, Kansas).
Tantilla gracilis hallowelli, Smith & Burger 1950:2.

Diagnosis.—A diminutive snake (largest Illinois specimen 203 mm. in total length), fig. 212, with 15 rows of smooth scales; flattened head, little wider than neck; frontal about four times the size of either supraocular; no loreal; preoculars 1 + 1, postoculars 1 + 1; supralabials usually 6 + 6; infralabials usually 6 + 6; eyes minute; anal plate divided; ventrals 121 to 132; caudals 42 to 51; color above tan or yellow-brown, with the top of the head darker, sometimes with a definite cap; venter salmon or orange

Fig. 212.—A subadult *Tantilla gracilis hallowelli* from Union County, Illinois. The color above is tan or light gray with a black cap on the head; below, salmon-pink.

medially, becoming white laterally and anteriorly.

Variation.—The male northern flat-headed snake has fewer ventrals, more caudals, and a proportionately longer tail than the female. The juvenile tends to have a darker and more conspicuous head cap than the adult.

Only 13 specimens of this snake have been found in Illinois. Eleven are available for study. Four males from Union County vary as follows: ventrals 121 to 124 (average 123), caudals 49 to 51 (average 49.7), tail length 21.1 to 23.7 (average 22.7) per cent of total length. Four females from the same locality have characters as follows: ventrals 125 to 132 (average 129.2), caudals 42 to 47 (average 43.7), tail length 18.4 to 20.4 (average 19.4) per cent of total length. Three females from Monroe County vary as follows: ventrals 129 to 132 (average 130.6), caudals 44 to 45, tail length 17.9 to 20.2 (average 19.0) per cent of total length. Scale rows are 15 in all 11 snakes; supralabials are 5 + 6 in one, 6 + 6 in seven, 6 + 7 in two, 7 + 7 in one; infralabials are 6 + 6 in nine, 6 + 7 in one, and 6 + 5 in one; preoculars are 1 + 1 in nine, postoculars 1 + 1 in eight, 2 + 2 in one, and oculars undeterminable in two.

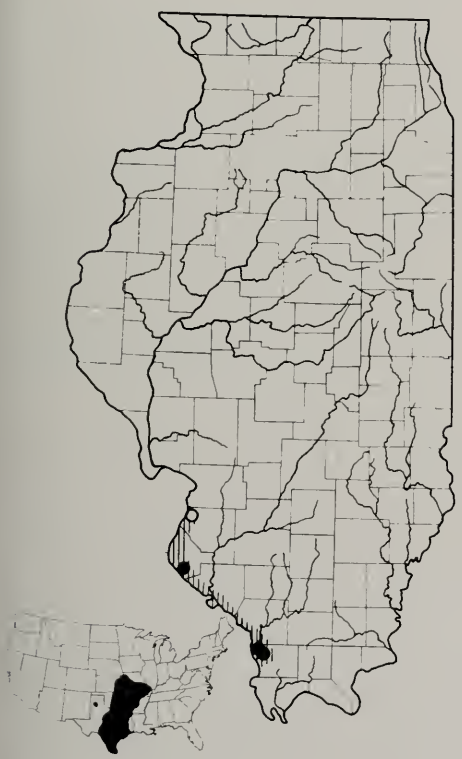


Fig. 213.—Distribution of *Tantilla gracilis*. Hatching indicates the presumed range of the subspecies *hallowelli* in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

Habits.—The northern flat-headed snake, the smallest Illinois snake, is strictly fossorial. Specimens are usually found by raising flat rocks in dry talus slides. Although these tiny snakes possess minute poison glands and rear fangs, they are too small to bite man. Their food consists of small arthropods. I have not seen the eggs of the species.

Illinois Distribution.—The available specimens of this snake were found along the relatively arid Mississippi River bluffs in Monroe and Union counties, fig. 213. Neill (1951*b*) recalls having taken a snake of this species in St. Clair County, but it was not saved.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: ST. CLAIR COUNTY: near East St. Louis (Neill 1951*b*).

Thamnophis Fitzinger

Eleven species of *Thamnophis*, many with subspecies, are found in the United States and Canada. Other species occur in Mexico and Central America.

Thamnophis sauritus (Linnaeus)

Three subspecies of the ribbon snake are recognized in the United States. A western subspecies occurs in Illinois, presumably intergrading with the nominate form in the extreme southeastern part of the state, although there is some likelihood that the intergrade population has been recently exterminated.

Thamnophis sauritus proximus (Say) Western Ribbon Snake

Coluber proximus Say 1823:187 (type locality: stone quarry on west side of Missouri River,

3 mi. above mouth of Boyer River, Pottawattamie County, Iowa).
Thamnophis sauritus proximus, Ruthven 1908*b*:43, 98–107.
Thamnophis proximus, Ditmars 1945:59.
Eutania proxima, Kennicott 1855:592.
Eutaenia proxima, Davis & Rice 1883*a*:30.
Eutainia saurita proxima, H. Garman 1892: 264–5.
Thamnophis proxima, McLain 1899:3.
Eutaenia faireyi, Cooper 1860:299.
Eutainia saurita faireyi, H. Garman 1892: 264–5.
Eutainia faireyi, Hurter 1893:256.
Thamnophis proxima faireyi, Hurter 1911:160.
Eutaenia saurita, Yarrow 1882*a*:114.
Eutainia saurita saurita nec Linnaeus, H. Garman 1892:264–5 (1).
Thamnophis sauritus sauritus nec Linnaeus, Van Cleave 1928:133, 136.
Thamnophis sauritus, Necker 1933:8.

Diagnosis.—A medium-sized, very slender snake (largest Illinois specimen 993 mm. in total length), fig. 214, usually with 19–19–17 rows of strongly keeled scales; ventrals 163 to 181; caudals 83 to 131; anal plate entire; supralabials usually 8 + 8; infralabials usually 10 + 10; preoculars usually 1 + 1, postoculars usually 3 + 3; tail length usually more than 25 per cent of total length; groundcolor usually jet black, with three distinct, longitudinal, light stripes; middorsal stripe orange; lateral stripes greenish white, involving third and fourth scale rows; a pair of prominent, light parietal spots nearly always present; venter, labials, and chin immaculate greenish white; a light bar on each preocular.

Variation.—The male of *Thamnophis sauritus proximus* is longer tailed than the female and has a slightly higher ventral count mean, table 65. Juveniles and adults are similar in color and pattern, but the young are more slender bodied.

The most striking geographic variation in *T. s. proximus* is found in the approach of southeastern Illinois specimens to *T. s. sauritus.* In fact, seven specimens from Richland and Wabash counties are perhaps referable to that race, inasmuch as they are more or less typical of eastern specimens in scutellation, table 66. All seven are very old and faded, and the colors are therefore not reliable. They appear to be intergrades, however, showing more brown and less distinct parietal spots than other Illinois specimens of comparable age. Ruthven (1908*b*) nevertheless assigned these same specimens to *proximus,* pointing out that they resembled *sauritus* in several respects. No fresh material from eastern Illinois is available. When, and if, specimens turn up from this area, it will not be surprising if they are typical *T. s. sauritus* in color and pattern features. Specimens taken in the northern half of Illinois show little deviation in scale count averages from those taken in southwestern Illinois, table 66.

Individual variation in a sample of 40 specimens is as follows: scale rows 18–19–17 in 2.8 per cent of specimens, 19–17–17 in 8.5 per cent, 19–19–17 in 83.0 per cent, 20–19–17 in 5.7 per cent; infralabials 9 + 9 in 7.8 per cent, 9 + 10 in 5.2 per cent, 10 + 10 in 86.8 per cent; preoculars 1 + 1 in 100 per cent; postoculars 2 + 2 in 2.8 per cent, 2 + 3 in 2.8 per cent, 3 + 3 in 77.8 per cent, 3 + 4 in 13.8 per cent, and 4 + 4 in 2.8 per cent.

Habits.—This slender and brightly colored snake is quick in its movements. It climbs readily and swims rapidly. In the summer it is found around swamps and marsh edges and occasionally in upland woods. In the fall in southern Illinois the western ribbon snake occurs commonly at the bases of rock bluffs, where it apparently hibernates in rock crevices with rattlesnakes, copperheads, and black snakes. Newly captured individuals threaten with their mouths opened wide, but they rarely try to bite. Captives feed readily on frogs and small fish. On one occasion a large specimen ate two smaller ribbon snakes.

Data concerning the number of young produced by the female of this ovoviviparous species are meager in Illinois. One female had 12 young in early August. An intergrade *T. s. sauritus* × *proximus,* from adjacent Indiana, had 11 young on July 17.

Illinois Distribution.—The range of the western ribbon snake in Illinois is problematical, fig. 215. The species is fairly common along the Mississippi River bluffs and it is quite common in southwestern Illinois. Elsewhere in the state, it is extremely rare. No recent records are available for the central and eastern parts of Illinois, although such records are available for adjacent Indiana. This curious situation is not readily explained, for the scarcity of the species in the Shawnee Hills cannot be attributed to extensive cultivation of land or drainage.

Although undocumented by specimens, published records for the following localities

Fig. 214.—An adult *Thamnophis sauritus proximus* from Union County, Illinois. The groundcolor is black; the middorsal stripe, orange; the lateral stripes and venter are greenish white.

Table 65.—Sexual variation in Illinois *Thamnophis sauritus*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	MALES (15)		FEMALES (22)	
	Range	Mean	Range	Mean
Ventrals	166–181	172.8	163–177	170.1
Caudals	108–131	115.9	83–114	100.7
Tail length as percentage of total length	29.2–33.6	31.0	24.0–31.9	28.3

Table 66.—Geographic variation in Illinois *Thamnophis sauritus*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	NORTHWESTERN ILLINOIS (8)		SOUTHWESTERN ILLINOIS (22)		RICHLAND-WABASH COUNTIES (7)	
	Range	Mean	Range	Mean	Range	Mean
Ventrals						
Male	170–181	172.8	166–181	173.5	165–173	169.3
Female	165–172	169.3	163–177	174.4	165–167	166.0
Caudals						
Male	111–114	112.5	108–131	114.1	120–124	121.6
Female	83–103	93.0	9 –114	99.5	110–111	110.3
Tail length as percentage of total length						
Male	31.2–31.4	31.3	29.2–31.6	30.2	31.3–33.6	32.7
Female	24.7–29.1	27.1	24.0–30.0	27.8	31.0–31.9	31.3
	PER CENT OF SPECIMENS		PER CENT OF SPECIMENS		PER CENT OF SPECIMENS	
Supralabials						
7 + 7	12.5		9.1		42.8	
7 + 8	12.5		9.1		28.6	
8 + 8	75.0		81.8		28.6	

Fig. 215.—Distribution of *Thamnophis sauritus*. Vertical hatching indicates the presumed range of the subspecies *proximus* in Illinois; crosshatching, the area of intergradation between the subspecies *proximus* and *sauritus;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The species may no longer occur in the middle and eastern counties. The lower map depicts the total range of the species in the United States.

are believed valid and are indicated on the distribution map by hollow symbols: HANCOCK COUNTY: Dallas City (Ditmars 1907); JERSEY COUNTY: (H. Garman 1892); MADISON COUNTY: (Hurter 1911).

Thamnophis radix radix
(Baird & Girard)
Eastern Plains Garter Snake

Eutainia radix Baird & Girard 1853:34 (type locality: Racine, Wisconsin); H. Garman 1892:266.
Eutania radix, Kennicott 1855:256.
Eutaenia radix, Hay 1881:738.
Tropidonotus radix, S. Garman 1884:23.
Tropidonotus ordinatus radix, Boulenger 1893: 211.
Thamnophis radix, Ruthven 1908*b*:70–87.
Thamnophis radix radix, Van Cleave 1928: 133, 136.
?Eutaenia vagrans nec Baird & Girard, Davis & Rice 1883*a*:30.
?Eutaenia vagrans vagrans nec Baird & Girard, Davis & Rice 1883*b*:39.
?Eutainia vagrans nec Baird & Girard, H. Garman 1892:268.
?Eutaenia butleri nec Cope, Ditmars 1922:241.
?Thamnophis butleri nec Cope, Necker 1938:3.
?Thamnophis radix butleri nec Cope, Wright & Wright 1952:585.
?Thamnophis, Blaufuss 1943:56.

Diagnosis.—A medium-sized, moderately slender snake (largest Illinois specimen 756 mm. in total length), fig. 216, with 19 to 21 anterior and usually 17 posterior rows of strongly keeled scales; 143 to 165 ventrals; 59 to 82 caudals; anal plate entire; supralabials usually 7 + 7; infralabials 9 or 10 per side; 1 preocular and 3 postoculars per side; proportionate tail length usually less than

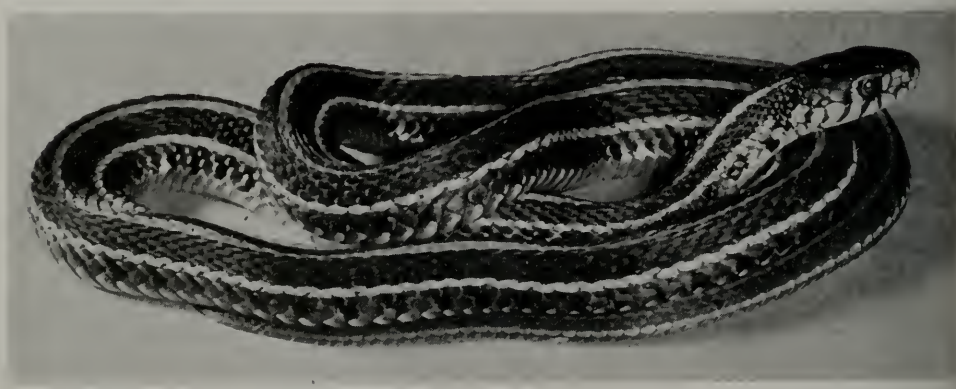


Fig. 216.—An adult *Thamnophis radix radix* from Champaign County, Illinois. The groundcolor is brown on which are superimposed black markings and three longitudinal stripes. The median stripe is dull orange; the others are yellowish gray.

25 per cent of total length; groundcolor brown, with three longitudinal light stripes; middorsal stripe orange-yellow and occupying one row of middorsal scales and half of each adjacent row in width; lateral stripes narrower, yellow-gray, and involving the third and fourth scale rows on each side; dark groundcolor on either side of middorsal stripe, with two rows of alternating black spots or squares; a pair of light occipital dots usually present; venter gray-green, with dark spots at least on edges of ventrals; labials barred with dark.

Variation.—Males of *Thamnophis radix radix* have higher ventral and caudal counts and proportionately longer tails than females, table 67. Juveniles and adults are similar in proportions and pattern.

Geographic variation in scutellation is rather slight within Illinois, but a reduced ventral count in the northeastern population is suggested, table 68.

The five specimens at hand from Madison County have a higher average number of scale rows than northern samples; the significance of this variation is unknown.

A trend toward melanism is found in the northeastern sample, many specimens having rather heavy black spots or streaks on the sides of the ventral scutes. Ventral spotting is less frequent in samples from western and southern Illinois. Specimens exhibiting a bright red-brown groundcolor occur occasionally in all parts of the state where the species occurs. May (1952) has described an albinistic specimen from the Chicago area.

Table 67.—Sexual variation in Illinois *Thamnophis radix radix*. Figures in parentheses are numbers of specimens.

Characteristic	Males (29)		Females (32)	
	Range	Mean	Range	Mean
Ventrals	154–165	158.0	143–163	152.4
Caudals	68–82	74.8	59–70	65.3
Tail length as percentage of total length	20.8–25.5	24.0	19.3–23.7	21.2

Table 68.—Geographic variation in Illinois *Thamnophis radix radix*. Figures in parentheses are numbers of specimens.

Characteristic	East-Central Illinois (12 Males, 14 Females)		Madison County (1 Male, 4 Females)		Northeastern Illinois (11 Males, 13 Females)		Northwestern Illinois (6 Males, 5 Females)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ventrals								
Male	154–165	159.0	154	.....	154–160	156.6	154–163	158.3
Female	149–160	154.6	149–156	152.5	143–163	150.3	149–154	151.8
Caudals								
Male	68–82	77.4	.....	.....	71–78	74.2	70–74	72.1
Female	60–70	65.8	67–71	68.6	59–69	64.2	65–68	66.7
Tail length as percentage of total length								
Male	23.7–25.5	24.4	.....	.....	22.6–25.4	23.9	20.8–24.8	23.7
Female	19.3–23.4	21.1	21.5–23.6	22.7	20.2–23.7	21.5	19.5–22.8	20.7

Other variation in *T. r. radix* shows no correlation with geography. In 61 specimens the anterior scale rows are 17 in 2 per cent of specimens, 19 in 80 per cent, 20 in 5 per cent, and 21 in 13 per cent; scale rows at mid-body are 19 in 74 per cent, 20 in 3 per cent, and 21 in 23 per cent; posterior scale rows are 15 in 8 per cent, 16 in 3 per cent, 17 in 87 per cent, and 18 in 2 per cent. Variation in head scutellation for these 61 snakes is as follows: supralabials 6 + 6 in 1 per cent, 6 + 7 in 1 per cent, 7 + 7 in 73 per cent, 7 + 8 in 22 per cent, 8 + 8 in 3 per cent; infralabials 8 + 8 in 2 per cent, 8 + 9 in 3 per cent, 9 + 9 in 22 per cent, 9 + 10 in 27 per cent, and 10 + 10 in 46 per cent; preoculars are 1 + 1 in 98 per cent, 1 + 2 in 2 per cent; postoculars 1 + 1 in 3 per cent, 2 + 2 in 3 per cent, 2 + 3 in 3 per cent, and 3 + 3 in 91 per cent. Light occipital dots are present on 87 per cent.

A specimen from Douglas County (INHS 3009) is anomalous, inasmuch as the lateral stripes encroach on the second scale rows as well as the third and fourth.

Habits.—The eastern plains garter snake is best known in vacant lots of cities and villages in the state. Comparatively few specimens have been found in remote areas. In the spring, this snake abounds in trashy areas and in meadows and pastures near villages. On wet or cool days, several individuals may congregate under a single object. Most individuals do not try to bite when captured, but they throw fecal matter that apparently consists largely of digested earthworms. Numerous specimens have been observed eating earthworms. These snakes may eat amphibians and other invertebrates also; captives have displayed no interest in insects.

Broods of 10, 10, 12, 13, 17, and 27 have been born in the laboratory, most of them in late August. A female killed at Volo on October 14 had 12 fully formed young still within her body.

Illinois Distribution.—The eastern plains garter snake is extremely abundant in certain muck prairie areas in the northern half of Illinois and it seems to thrive in the most heavily cultivated districts, fig. 217. The species has not been found in many Indiana counties bordering Illinois, probably because of the more forested aspect of these counties. The scarcity of records for west-central Illinois may be because the original prairie areas in this part of the state, rolling and relatively well drained, lacked the extensive prairie marshes typical of much of the Grand Prairie. The southernmost recent record of this snake is from a prairie outlier in Cumberland County. Two old records for southern Illinois (Madison and Wabash counties) are based on USNM specimens collected in the last century. It is likely that the Madison County specimens were from a relict colony on a prairie outlier, a colony later exterminated. The Wabash County specimen was probably incorrectly cataloged, and the record is not accepted here.

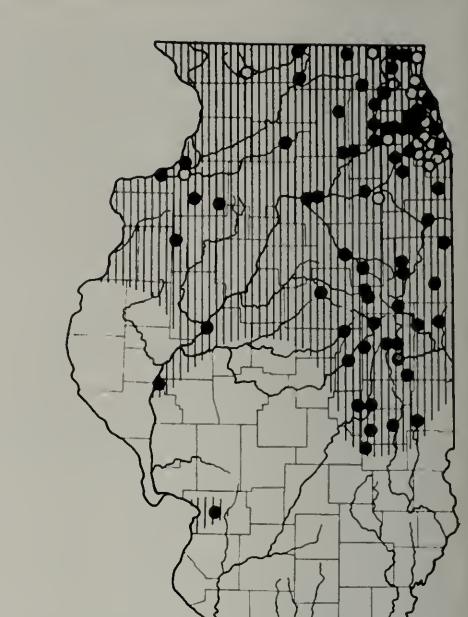


Fig. 217.—Distribution of *Thamnophis radix*. Hatching indicates the presumed range of the subspecies *radix* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid; most are shown on the distribution map by hollow symbols: COOK COUNTY: Argo (Schmidt & Necker 1935);

Arlington Heights (Necker 1939*c*); Berwyn (A. Smith 1949); Beverly Hills (Schmidt & Necker 1935); Blue Island (A. Smith 1949); Braeside, Chicago Lawn, Chicago Ridge (Schmidt & Necker 1935); Evanston (Necker 1939*c*); Flossmoor (A. Smith 1949); Forest Park, Homewood (Schmidt & Necker 1935); Kenilworth (A. Smith 1949); La Grange, Lambert (Necker 1939*c*); Longwood, Morgan Park, Palos Park (Schmidt & Necker 1935); Pullman (Necker 1939*c*); Riverdale, Summit (Schmidt & Necker 1935); Wheeling (Necker 1939*c*); Willow Springs, Winnetka, Wolf Lake (Schmidt & Necker 1935); DU PAGE COUNTY: Lombard, Naperville (Schmidt & Necker 1935); West Chicago, Wooddale (Necker 1939*c*); GRUNDY COUNTY: Diamond (A. Smith 1949); Pequot (Necker 1939*c*); HENRY COUNTY: Colona (H. Garman 1892); LAKE COUNTY: Barrington, Briggs Lake (A. Smith 1949); Deerfield, Fox Lake (Schmidt & Necker 1935); Highland Park (Necker 1939*c*); Waukegan (A. Smith 1949); MCHENRY COUNTY: Richmond (Schmidt & Necker 1935); ROCK ISLAND COUNTY: Milan (H. Garman 1892); STEPHENSON COUNTY: Freeport (H. Garman 1892).

Thamnophis sirtalis (Linnaeus)

Eleven subspecies of *Thamnophis sirtalis* are recognized in the United States and Canada. The wide-ranging nominate subspecies and a subspecies restricted to the lower western and southern border of Lake Michigan occur in Illinois.

Thamnophis sirtalis sirtalis (Linnaeus) Eastern Garter Snake

Coluber sirtalis Linnaeus 1758:222 (type locality: Canada; revised to vicinity of Quebec by Klauber 1948).
Eutania sirtalis, Kennicott 1855:592 (part).
Eutaenia sirtalis, Schneck 1882:1008.
Eutaenia sirtalis sirtalis, Davis & Rice 1883*a*: 30 (part).
Eutainia sirtalis, Hay 1891:110.
Eutainia sirtalis sirtalis, H. Garman 1892: 266–7.
Thamnophis sirtalis sirtalis, Ruthven 1908*b*: 176–86 (part).
Thamnophis sirtalis, Hurter 1911:163.
Eutaenia sirtalis parietalis nec Say, Cope 1875:41.
Eutainia sirtalis parietalis nec Say, H. Garman 1892:266–8.
Thamnophis sirtalis parietalis nec Say, Ruthven 1908*a*:392.
Thamnophis parietalis nec Say, Weed 1923:47.
Eutaenia sirtalis obscura, Yarrow 1882*a*:126.
Eutaenia sirtalis dorsalis nec Baird & Girard, Davis & Rice 1883*a*:30 (part).
Eutaenia vagrans nec Baird & Girard, Davis & Rice 1883*a*:30 (part).

Diagnosis.—A medium-sized, moderately slender snake (largest Illinois specimen 1,044 mm. in total length), fig. 218, usually with 19–19–17 rows of strongly keeled scales; ventrals 147 to 165; caudals 61 to 82; anal plate entire; supralabials usually 7 + 7; infralabials usually 10 + 10; usually 1 preocular and 3 postoculars per side; tail length usually less than 25 per cent of total length; groundcolor brown, red-brown, or dark blue-green, with black spots or squares between longitudinal light stripes; middorsal stripe gray or yellow, on median scale row and halves of adjacent rows; lateral stripes similarly colored involving second and third scale rows, noninterrupted; venter gray-green, with dark spots at edges of most of the ventrals; head usually without paired light parietal dots; labials with dark bars.

Variation.—The male of the eastern garter snake has a longer tail and a slightly higher caudal count average than the female, table 69.

Juvenile garter snakes are like the adults except that the baby snakes have proportionately larger heads. A few very large adults of *Thamnophis sirtalis* have tails that are proportionately shorter than those of juveniles, but the proportionate tail length averages in large series of adults and of juveniles are almost identical.

Geographic variation in scutellation of the eastern garter snake is remarkably slight in Illinois. The means for ventral and caudal counts and the proportionate tail lengths of approximately 40 snakes from eastern Illinois and a sample of similar size from the western side of the state vary no more than 1 per cent. Likewise, comparison of these scale counts for specimens from extreme southern and extreme northern Illinois reveals no geographic variation. The mean ventral and caudal counts are somewhat at variance with those from an Ohio sample (Conant 1938), but they are much closer to those from Ohio than to those of a Nebraska sample of *T. sirtalis parietalis* (Hudson 1942).

The red pigment in the groundcolor, an

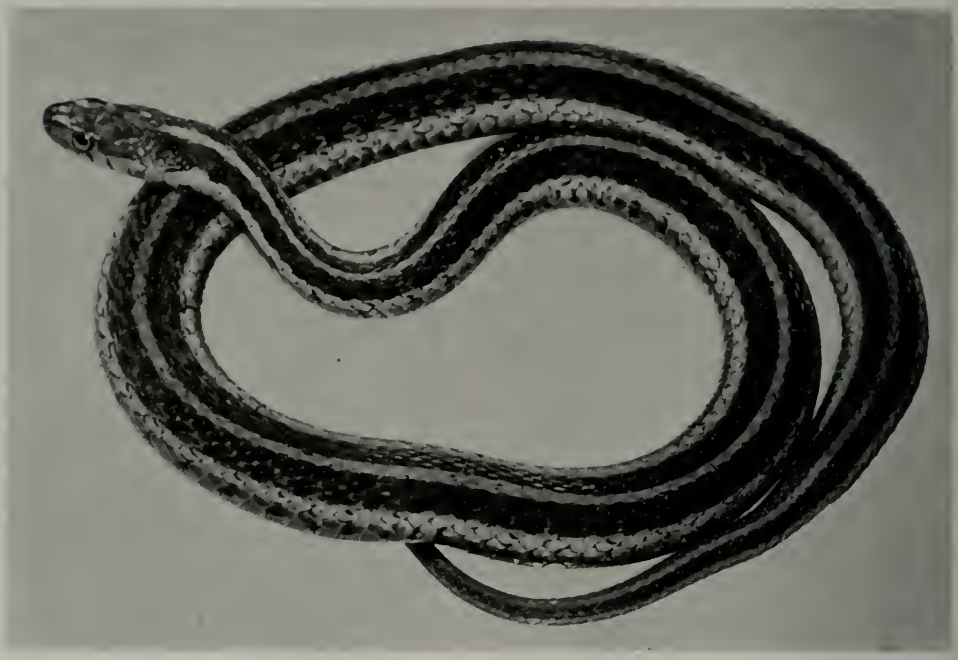


Fig. 218.—An adult *Thamnophis sirtalis sirtalis* from Douglas County, Illinois. The groundcolor is brown on which are superimposed black markings and three longitudinal tan stripes.

Table 69.—Sexual variation in Illinois *Thamnophis sirtalis*. Figures in parentheses are numbers of specimens.

Characteristic	Males (38)		Females (54)	
	Range	Mean	Range	Mean
Ventrals	150–163	156.9	147–165	153.6
Caudals	70–82	76.3	61–74	67.0
Tail length as percentage of total length	22.8–26.0	24.2	18.0–24.4	21.7

alleged diagnostic character of *parietalis*, appears occasionally in populations of *T. sirtalis* throughout Illinois. Thirty-three per cent of a sample of 12 snakes from northwestern Illinois, 42 per cent of a sample of 20 snakes from east-central Illinois, 55 per cent of a sample of 20 snakes from west-central Illinois, and 26 per cent of a sample of 20 snakes from extreme southern Illinois have some red on the sides of the body.

In view of the homogeneity of garter snakes in Illinois in scutellation and in color, there is no basis for including *T. s. parietalis* as a part of the Illinois fauna, the numerous reports of it and of *sirtalis* × *parietalis* intergrades in the western part of the state notwithstanding.

In pattern, however, there is pronounced geographic variation among garter snakes within Illinois. Toward the northeast the lateral stripes on the anterior part of the body tend to be interrupted at regular intervals by crossbars formed by the fusion of the black spots just above and just below the lateral line. The crossbarred pattern is sufficiently constant in garter snakes found along the southwestern border of Lake Michigan for the population to be recognized subspecifically as *semifasciata*. Intergradation between *sirtalis* and *semifasciata* is manifested by the increasing frequencies, toward the northeast, of specimens with the crossbarred pattern. The cline is steep from west to east, sloped from south to north.

Scutellation is apparently identical in the two Illinois subspecies of *T. sirtalis*. Individual variation in 91 specimens of both races is as follows: anterior scale rows are 19 in 95.5 per cent, 20 in 4.5 per cent; scale rows at mid-body are 18 in 5.5 per cent, 19 in 93.5 per cent, 20 in 1.0 per cent; posterior scale rows are 16 in 2 per cent, 17 in 98 per cent; supralabials are 6 + 6 in 1 per cent, 6 + 7 in 3 per cent, 7 + 7 in 89 per cent, 7 + 8 in 6 per cent, 8 + 9 in 1 per cent; infralabials are 8 + 8 in 3 per cent, 9 + 9 in 7 per cent, 9 + 10 in 11 per cent, 10 + 10 in 73 per cent, 11 + 11 in 3 per cent, 8 + 10 in 3 per cent; preoculars are 1 + 1 in 100 per cent; postoculars are 2 + 3 in 2 per cent, 3 + 3 in 95 per cent, 3 + 4 in 1 per cent, 2 + 4 in 1 per cent, and 4 + 4 in 1 per cent.

Fig. 219.—Distribution of *Thamnophis sirtalis*. Vertical hatching indicates the presumed range of the subspecies *sirtalis* in Illinois; horizontal hatching, the presumed range of the subspecies *semifasciata;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of the species in the United States.

Habits.—The eastern garter snake, although occasionally found in shrubbery and in water, is essentially terrestrial. It occurs in a variety of places but seems to prefer a forest-edge habitat. Most individuals of *T. sirtalis* bite and void excrement when captured. This species feeds on a variety of animals including frogs, toads, salamanders, earthworms, fish, young birds, and leeches.

The number of young per brood varies considerably. A captive female gave birth to 27 young in the laboratory in September. Cagle (1942*a*) recorded a litter of 53 born in early July.

Illinois Distribution.—*T. s. sirtalis* is generally distributed throughout Illinois except in the northeastern fourth of the state, where it is replaced by *semifasciata*, fig. 219. It is relatively uncommon in many parts of central Illinois.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: KNOX COUNTY: 2½ mi. E Galesburg (Adcock 1922); MADISON COUNTY: (Hurter 1911); MONROE COUNTY: 3 mi. N Red Bud (Blanchard 1924*b*); PEORIA COUNTY: Peoria (H. Garman 1892); ST. CLAIR COUNTY: Belleville (Yarrow 1882*a*).

Thamnophis sirtalis semifasciata (Cope)
Chicago Garter Snake

Eutaenia sirtalis semifasciata Cope 1892:692–3 (type locality: Des Plaines, Illinois, and Wisconsin).
Thamnophis sirtalis semifasciata, P. W. Smith 1956*a*:81–4.
Eutania sirtalis nec Linnaeus, Kennicott 1855: 592 (part).
Eutaenia sirtalis sirtalis nec Linnaeus, Yarrow 1882*a*:123–4.
Eutaenia sirtalis nec Linnaeus, Gastman 1884: 89 (I).
Thamnophis sirtalis sirtalis nec Linnaeus, Ruthven 1908*b*:176–86 (part).
Thamnophis sirtalis nec Linnaeus, Weed 1923: 46.
Eutaenia sirtalis parietalis nec Say, Davis & Rice 1883*b*:40 (part).
Thamnophis sirtalis parietalis nec Say, Weed 1922:85.
Thamnophis parietalis nec Say, Weed 1923:47 (part).
Eutaenia sirtalis obscura, Davis & Rice 1883*a*: 30.
Eutaenia sirtalis dorsalis nec Baird & Girard, Davis & Rice 1833*a*:30.
Eutaenia vagrans vagrans nec Baird & Girard, Davis & Rice 1883*a*:30.

Eutaenia vagrans nec Baird & Girard, Davis & Rice 1883*b*:39 (part).
Eutainia vagrans nec Baird & Girard, H. Garman 1892:268.
Thamnophis, Blaufuss 1943:56.
Thamnophis ordinatus, Mertens 1951:13.

Diagnosis.—A medium-sized snake, a subspecies (largest Illinois specimen 905 mm.) of *Thamnophis sirtalis,* differing from *T. s. sirtalis* only in markings; lateral stripes on anterior part of body interrupted at regular intervals by black crossbars, which are formed by fusion of the black spots just above and just below the lateral stripe on each side of body, fig. 220.

Variation.—Sexual and ontogenetic variation are apparently identical in *T. s. sirtalis* and *semifasciata* and are described in the account of *T. s. sirtalis.*

Geographic variation in the Chicago garter snake consists of a clinal reduction toward the west and south in the frequency of snakes with black crossbars. In northwestern Illinois the area in which typical *sirtalis* replaces typical *semifasciata* is probably no more than 40 miles in width. In central Illinois the area of intergradation is as much as 100 miles wide. Crossbars in 118 specimens of *semifasciata* and 45 intergrades have been arbitrarily classified in table 70

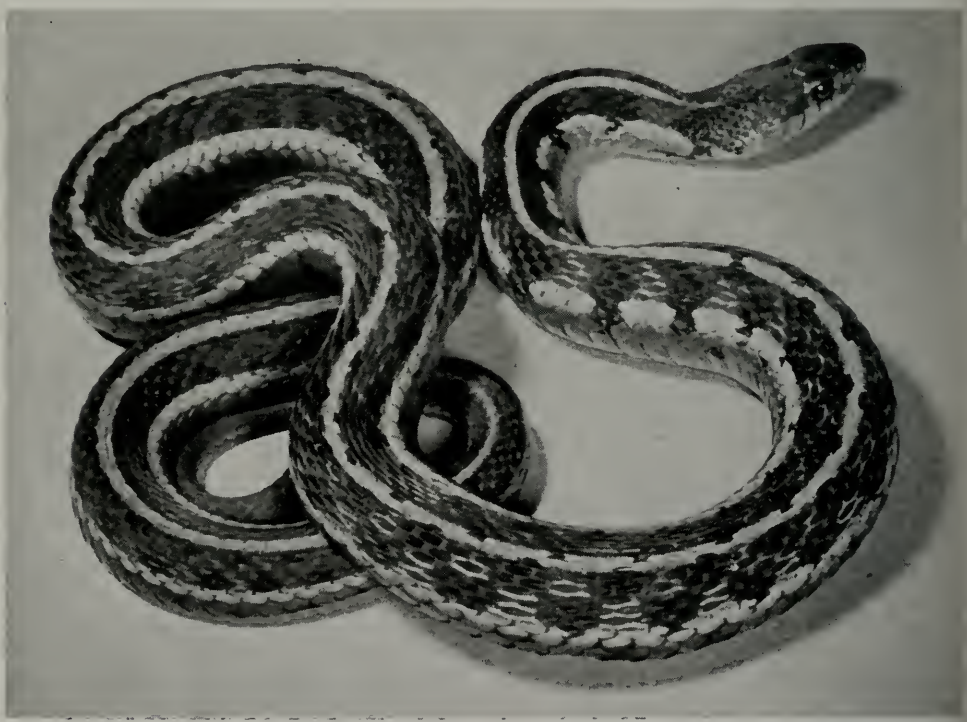


Fig. 220.—An adult *Thamnophis sirtalis semifasciata* from Lake County, Illinois. The groundcolor is brown on which are superimposed black markings and three longitudinal tan stripes.

Table 70.—Geographic variation in crossbarred pattern in Illinois *Thamnophis sirtalis semifasciata* and *T. s. sirtalis* × *semifasciata* intergrades, expressed in per cent. Figures in parentheses are numbers of specimens.

Crossbarred Pattern	*T. s. semifasciata* (118)	*T. s. sirtalis* × *semifasciata* (45)
Prominent	59	22
Weak	37	40
Absent	4	38

as "Prominent" if more than three crossbars interrupt the lateral stripe on each side of the body and if the crossbars are readily discernible, "Weak" if only one to three crossbars interrupt each lateral stripe or if all the crossbars are dim, and "Absent" if the lateral stripes are not interrupted at all.

Individual variation for *semifasciata* in scutellation and in color apparently parallels that described under *sirtalis*.

Habits.—The remarks concerning the habits of *T. s. sirtalis* apply equally well to those of *semifasciata*. Pope (1944*b*) records the range in litter size of 12 to 42; and, although the provenance of his specimens is not stated, his counts presumably were made on Chicago area snakes.

Illinois Distribution.—The Chicago garter snake occurs in typical form from Lake Michigan south to Kankakee and La Salle counties and west to Lee and Winnebago counties, fig. 219. Intergradation with the nominate race occurs from these localities south to Iroquois and Peoria counties and west almost to the Mississippi River.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Aux Plaines (Ruthven 1908*b*); Berwyn, Beverly (Schmidt & Necker 1935); Deer Grove (Necker 1939*c*); Evanston (Schmidt & Necker 1935); Glenview (Necker 1939*c*); Lemont, Morgan Park, Niles Center, Northbrook (Schmidt & Necker 1935); Northfield (Yarrow 1882*a*); Palatine, Palos Park, Summit (Schmidt & Necker 1935); DU PAGE COUNTY: Naperville (Schmidt & Necker 1935); KANE COUNTY: Batavia (Stille & Edgren 1948); LAKE COUNTY: Beach (Schmidt & Necker 1935); Dead River (Necker 1939*c*); Fox River Grove, Highland Park, Pistakee Lake (Schmidt & Necker 1935); Sayer Bog (Necker 1939*c*); MCHENRY COUNTY: Richmond, Woodstock (Schmidt & Necker 1935).

Tropidoclonion Cope

A single species with three subspecies is placed in this genus. The few Illinois specimens extant are tentatively assigned to the nominate race, in accordance with a recent study by Ramsey (1953). The material from Illinois is at variance with the description of the subspecies *lineatum*, particularly in caudal and ventral counts; but our series is not large enough to ascertain the significance of the differences in these characters. An adequate sample of Illinois specimens is extant in a personal collection but has not been available to me for scale counts.

Tropidoclonion lineatum lineatum (Hallowell) Northern Lined Snake

Microps lineatus Hallowell 1857:241 (type locality: Kansas; revised to Kansas City by Schmidt 1953; revised to Fort Leavenworth by Ramsey 1953).
Tropidoclonium lineatum, Jordan 1888:361.
Tropidoclonion lineatum, Stejneger 1892:504.
Tropidoclonio lineatum, Wright & Wright 1952:585.
Tropidoclonion lineatum lineatum, Ramsey 1953:11, 21, 22.
Tropidoclonium lineata, H. Garman 1890: 187–8.

Diagnosis.—A small, moderately slender, burrowing snake (largest Illinois specimen 314 mm. in total length), fig. 221, with 15 to 17 anterior, 17 to 19 mid-body, and 16 to 17 posterior rows of strongly keeled scales; ventrals 135 to 150; caudals 26 to 47; anal plate usually entire; supralabials 5 to 7 per side; infralabials 6 or 7 per side; preoculars 1 + 1 and postoculars 2 + 2; tail length less than 20 per cent of total length; ground-color brown above, with three longitudinal gray stripes; middorsal stripe occupying median and adjacent halves of scale rows; lateral stripe involving second scale row anteriorly, second and third posteriorly; each longitudinal stripe bordered by single series of minute black dots; venter gray or white, with a double series of black half-moon-shaped markings from chin to tip of tail.

Variation.—Eight of the 10 specimens of the lined snake at hand are females; the scale counts given by Garman (1890) for three Champaign County specimens presumably refer to females, although he did not indicate the sex of his specimens. Ramsey (1953) stated that males have an average caudal count of about 8 scales more than females and that the proportionate tail length mean is greater in males by about 4 per cent.

Juveniles are much like adults, but their striped dorsal pattern is perhaps more evident. The black dots bordering the longitudinal stripes are somewhat more conspicuous in young snakes than in adults.

Fig. 221.—A subadult *Tropidoclonion lineatum lineatum* from Sangamon County, Illinois. The groundcolor above is brown with three varyingly distinct, longitudinal gray stripes; below, white with paired black spots.

A summary of the variation for the eight females examined and for Garman's counts is as follows: the number of ventrals 138 to 150 (average 145.2); caudals ?26 to 38 (average ?32.7); supralabials 5 + 5 in 36 per cent of specimens, 6 + 6 in 46 per cent, 6 + 7 in 18 per cent; infralabials 6 + 6 in 88 per cent, 7 + 7 in 12 per cent; preoculars 1 + 1 in 100 per cent, postoculars 2 + 2 in 100 per cent; anterior scale rows 17 in 50 per cent, 16 in 38 per cent, 15 in 12 per cent; scale rows at mid-body 17 in 27 per cent, 18 in 18 per cent, 19 in 55 per cent; posterior scale rows 16 in 25 per cent, 17 in 75 per cent; tail length 11.6 to 15.3 (average 13.1) per cent of total length. One specimen has a divided anal plate. Data for the two males are as follows: ventrals 144 and 145; caudals 40 and 46; supralabials and infralabials 6 + 6; preoculars 1 + 1; postoculars 2 + 2; scale row formula 17–18–16 and 17–19–17; and tail length 16.4 and 16.5 per cent of total length.

The scale counts of the Illinois series agree more closely with those of *Tropidoclonion lineatum annectans,* the race occurring in the Great Plains from north Texas to central Kansas, than with those of the nominate subspecies, which occurs in Nebraska and adjacent parts of Kansas, South Dakota, Iowa, and Missouri. When more specimens are available from Illinois, Iowa, and Missouri, it may be necessary to revise the distributional relationships of the subspecies *lineatum* and *annectans.*

Habits.—The lined snake has the appearance of a diminutive garter snake. It has semifossorial habits; all the specimens available have been found under rocks, logs, or trash. Captured individuals are completely passive. Earthworms are their chief food.

Little is known of the reproductive habits of this snake in Illinois. Farther west, however, the seven or eight young per brood are born in August or September.

Illinois Distribution.—The rare lined snake apparently occurs in central Illinois in a few scattered colonies, most of which are probably vacant lot populations within cities, fig. 222. The present distribution of this species east of the Mississippi River is believed to consist of relicts of the Xerothermic Period. The range of *Tropidoclonion* was probably reduced to scattered small colonies before Illinois was settled; cultivation and related practices in all likelihood have aided the climatic shifts in reducing the number of populations except those which by accident had cities grow up about them.

Not included with the records plotted on the accompanying map is a report of a specimen seen at Moline. Richard B. Loomis of Long Beach, California, informed me by letter that he captured a lined snake at Moline, Rock Island County, in 1942 but that this snake escaped before it could be preserved.

Attempts to find recent specimens of this snake in vacant lots of Urbana have been fruitless. The colony reported there by Garman (1890) has probably been destroyed.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: CHAM-

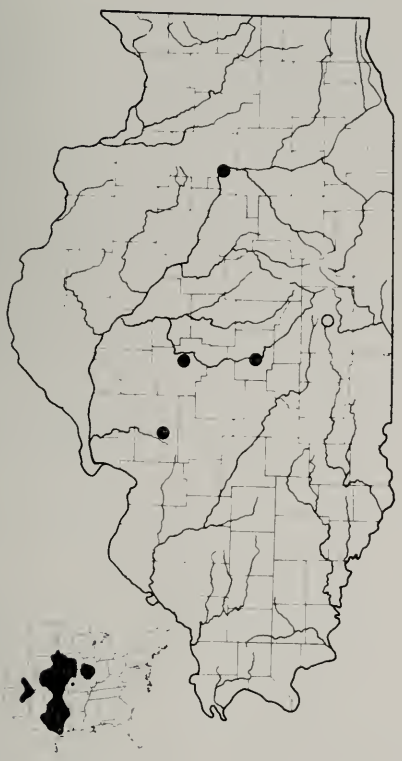


Fig. 222.—Distribution of *Tropidoclonion lineatum*. Solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total known range of the species in the United States.

PAIGN COUNTY: Urbana (H. Garman 1890).

Virginia Baird & Girard

This North American genus comprises a monotypic and a polytypic species. A western subspecies of the latter occurs in Illinois. Until recently the generic name *Haldea* was applied to these species.

Virginia valeriae elegans Kennicott
Western Earth Snake

Virginia elegans Kennicott 1859:99 (type locality: timbered regions of southern Illinois).
Virginia harpetii elegans, Bocourt 1886:32, figs. 4, 4*a*.
Virginia valeriae elegans, Blanchard 1923*a*: 351–6.
Haldea valeriae elegans, Stejneger & Barbour 1939:132.
Virginia valeriae, Cope 1875:35.
Haldea valeriae, Murrill 1945:23.
Haldea valeriae valeriae nec Baird & Girard, Wright & Wright 1952:586.
Haldea striatula nec Linnaeus, Cope 1877:64.
Potamophis striatulus nec Linnaeus, Van Cleave 1928:133, 136.

Diagnosis.—A small, moderately stout-bodied snake (largest Illinois specimen 300 mm. in total length), fig. 223, with 17 rows of faintly keeled scales; ventrals 118 to 132; caudals 31 to 46; anal plate divided; supralabials 6 + 6; infralabials 5 to 7 on a side; tail length less than 22 per cent of total

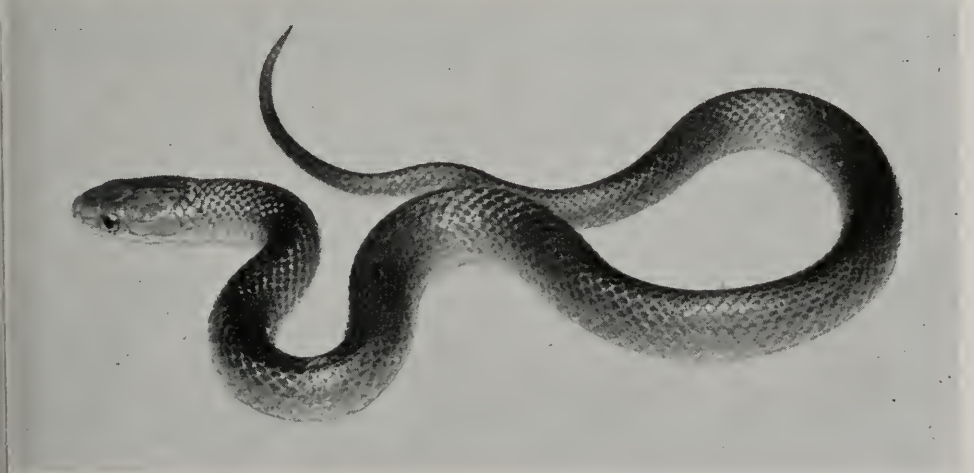


Fig. 223.—A juvenile *Virginia valeriae elegans* from Union County, Illinois. The color above is brown; below, greenish white. The specimen pictured here is proportionately large headed because it is a juvenile.

Table 71.—Sexual variation in Illinois *Virginia valeriae elegans*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	MALES (10)		FEMALES (12)	
	Range	Mean	Range	Mean
Ventrals	118–127	121.5	124–132	127.7
Caudals	38–46	43.3	31–38	34.9
Tail length as percentage of total length	18.6–21.4	20.2	15.1–18.5	16.3

Table 72.—Geographic variation in Illinois *Virginia valeriae elegans*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	SHAWNEE HILLS (11)		SOUTHERN ILLINOIS NORTH OF SHAWNEE HILLS (11)	
	Range	Mean	Range	Mean
Ventrals				
Male	118–123	120.4	119–127	122.6
Female	125–132	128.5	124–131	127.0
Caudals				
Male	38–46	41.8	44–46	44.8
Female	31–38	34.3	35–36	35.5
Tail length as percentage of total length				
Male	18.6–21.2	19.8	20.4–21.4	20.7
Female	15.1–17.8	16.0	15.6–18.5	16.6

length; head thick; nose rather sharply pointed; dorsum olive, medium brown, or gray-brown, sometimes with minute dark flecks; venter white, sometimes with a few dark flecks on sides of the ventrals.

Variation.—In this species the males have a lower average number of ventrals than the females but higher caudal counts and proportionately longer tails, table 71. The juveniles have proportionately larger heads than the adults.

The material available lends itself to being placed in three groups, one from the Wabash Border region, one from extreme southern Illinois, and one from the Lower Mississippi Border. Means of ventral and caudal counts for the eastern and western samples are almost identical, and they have accordingly been lumped in order to compare them with those for the extreme southern Illinois sample, table 72. This comparison reveals a general trend toward higher average ventral and caudal counts and longer tails in the more northern sample. The northern sample is at the periphery of the range of this species.

Individual variation in other features of scutellation for 22 snakes is as follows: scale rows 17 in 91.0 per cent of specimens, 15–17 in 4.5 per cent, 17–16–17 in 4.5 per cent; supralabials 6 + 6 in 100 per cent; infralabials 5 + 5 in 4.5 per cent, 5 + 6 in 4.5 per cent, 6 + 6 in 77.0 per cent, 6 + 7 in 14.0 per cent; preoculars absent in 91 per cent, a tiny preocular present on at least one side of the head in 9 per cent; postoculars 1 + 1 in 4 per cent, 1 + 2 in 4 per cent, 1 + 3 in 4 per cent, 2 + 2 in 46 per cent, 2 + 3 in 32 per cent, and 3 + 3 in 9 per cent. One specimen has partially fused internasals; the other 21 specimens have divided internasals.

The dorsal color varies from medium brown to light brown; the venter is white, usually with a slight greenish yellow tint but sometimes with a flesh-color tint. Many specimens have minute dark flecks on the dorsum and small brown dots on the edges of the ventral plates. Occasionally an individual is found that has a faint, middorsal light band.

Habits.—This small snake is semifossorial in habits, and it is usually found under

rocks on wooded hillsides. It has been found abroad at night on several occasions. The most productive collecting sites have proved to be ditches or other excavations into which these reptiles have fallen. Several specimens have been raked up with forest-floor litter in material for Berlese samples. The food of this snake probably consists of soft-bodied arthropods and earthworms.

Broods of five tiny young have been born in the laboratory on two occasions, both in mid-August.

Illinois Distribution. — The western earth snake is evidently generally distributed south of the Shelbyville Moraine, fig. 224. The label of a specimen, USNM 7303, "Cook County, Illinois," almost certainly represents an error in cataloging, and the record has been rejected by most authors.

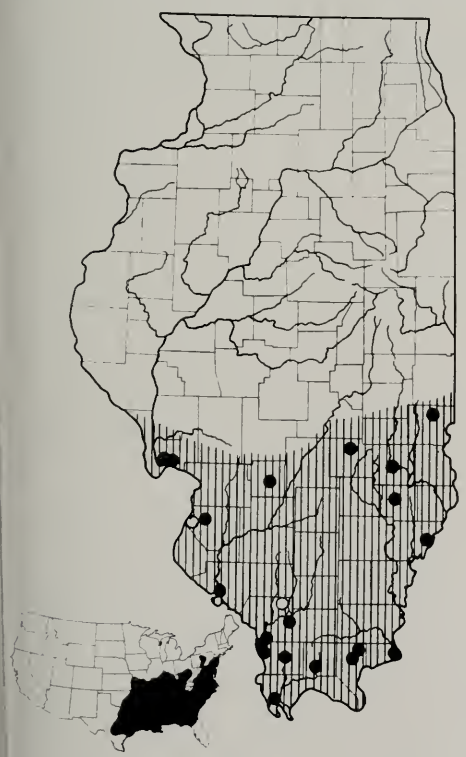


Fig. 224.—Distribution of *Virginia valeriae*. Hatching indicates the presumed range of the subspecies *elegans* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Virginia valeriae elegans is probably more common in the southern third of Illinois than the records indicate, but specimens are difficult to collect because of their preference for forest-floor debris, their small size, and their nocturnal habits.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Elkville (Cagle 1942*a*); ST. CLAIR COUNTY: Bluff Lake (Hurter 1893).

Storeria Baird & Girard

Two polytypic species of this North American genus occur in the United States. Both are found in Illinois.

Storeria dekayi wrightorum Trapido
Midland Brown Snake De Kay's Snake

Storeria dekayi wrightorum Trapido 1944:57 (type locality: Reelfoot Lake, Tennessee).
Storeria dekayii wrightorum, Langebartel 1947:27–8.
Storeria dekayi, Kennicott 1855:592.
Ischnognathus dekayi, Boulenger 1893:287.
Storeria De Kayi, Hurter 1893:257.

Diagnosis.—A small, moderately stout-bodied snake (largest Illinois specimen 425 mm. in total length), fig. 225, with 17 rows of strongly keeled scales; ventrals 122 to 142; caudals 43 to 59; anal plate divided; tail length 17 to 26 per cent of total length; supralabials usually 7 + 7; infralabials usually 7 + 7; preoculars usually 1 + 1; postoculars usually 2 + 2; groundcolor gray or light brown, usually with a dim middorsal light stripe; middorsal stripe with numerous narrow dark crossbars, giving the middle of the back a ladder-like appearance, or middorsal stripe with a series of small dark spots or transverse dashes bordering either side; a more prominent dark blotch on either side of neck just behind the head and a dark spot below each eye; venter pinkish white and unmarked except for fine stippling on the sides of the ventrals.

Variation.—Males of the midland brown snake have fewer ventrals but more caudals and longer tails than females, table 73. Juveniles differ from adults and subadults in the possession of a white or light gray collar just behind the head. This collar, sometimes retained in the subadult, is distinctive and suggests a different species.

Fig. 225.—An adult *Storeria dekayi wrightorum* from Douglas County, Illinois. The groundcolor is light brown; the spots are dark brown or black.

Table 73.—Sexual variation in Illinois *Storeria dekayi wrightorum*. Figures in parentheses are numbers of specimens.

Characteristic	Males (22)		Females (35)	
	Range	Mean	Range	Mean
Ventrals	122–131	126.5	127–142	133.9
Caudals	50–59	55.0	43–54	49.0
Tail length as percentage of total length	20.2–25.6	23.7	17.7–23.2	20.4

Geographic variation in *Storeria dekayi* within Illinois, as indicated by four samples (extreme northern, eastern, western, and southern Illinois) is not pronounced, but a southward trend toward a reduction in the number of ventrals in males is suggested. This situation can be expressed as an increasing degree of sexual dimorphism in ventral counts toward the south, table 74. The frequency of specimens with dark crossbars on the dorsum, one of the alleged diagnostic characters of *S. d. wrightorum*, appears to vary geographically. The samples available suggest that the crossbarred condition occurs rarely in northeastern Illinois samples and in approximately two-thirds of the snakes from eastern Illinois, but it is usually present on western and southern Illinois examples.

Other variation in a sample of 56 snakes is as follows: scale rows 17 in 100 per cent; supralabials 7 + 7 in 94 per cent, 7 + 6 in 2 per cent, 7 + 8 in 2 per cent, 6 + 6 in 2 per cent; infralabials 7 + 7 in 90 per cent, 7 + 8 in 4 per cent, 7 + 6 in 2 per cent, 6 + 6 in 4 per cent; preoculars 1 + 1 in 98 per cent, 2 + 1 in 2 per cent; postoculars 2 + 2 in 85 per cent, 2 + 3 in 8 per cent, 2 + 1 in 6 per cent, 3 + 3 in 1 per cent.

Despite the low frequency of eastern specimens with typical *wrightorum* dorsal patterns, table 74, these snakes are nevertheless referable to *wrightorum* on the basis of the sums of ventral and caudal counts and the

Table 74.—Geographic variation in Illinois *Storeria dekayi wrightorum*.

Characteristic	Northeastern Illinois*		East-Central Illinois*		West-Central Illinois*		Southwestern Illinois*	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Ventrals								
Male	126–130	128.4	125–131	126.8	124–130	126.8	122–125	124.0
Female	131–136	132.6	128–141	133.7	130–142	134.8	129–141	133.6
Difference	4–6	4.2	3–10	6.9	6–12	7.9	7–16	10.0
Caudals								
Male	53–57	54.6	51–58	55.1	50–58	54.6	53–59	55.7
Female	47–50	48.3	43–54	48.5	45–53	49.0	43–52	47.6
Sum of ventrals and caudals	178–186	182.2	174–193	181.9	175–195	183.3	177–187	181.0
	Per Cent of Specimens†		Per Cent of Specimens†		Per Cent of Specimens†		Per Cent of Specimens†	
Dorsal pattern crossbarred	0		66		79		90	
Dark bar on anterior temporal	89		100		93		84	

*Data based on 5 males and 3 females in northeastern Illinois, 6 males and 12 females in east-central Illinois, 7 males and 10 females in west-central Illinois, and 4 males and 9 females in southwestern Illinois.
†Data based on 9 specimens in northeastern Illinois, 29 specimens in east-central Illinois, 19 specimens in west-central Illinois, and 39 specimens in southwestern Illinois.

high percentage of specimens with dark bars on the anterior temporals.

An albinistic subadult was captured in Charleston, Coles County, in 1942. This specimen, which was not preserved, was cream colored and had pink dorsal spots.

Habits.—This small snake occurs in forest and prairie habitats and on both floodplains and uplands. It has been found most frequently under debris in urban vacant lots and in forest-edge habitats, such as partially wooded pastures and parklike groves. An unusual concentration of several dozen snakes was found along the highway near Fountain Bluff, Jackson County, in October of 1952. These snakes had evidently congregated along the highway shoulder to hibernate, and they had probably moved into this site from adjacent cultivated fields on the Mississippi River floodplain. *S. dekayi* feeds primarily on earthworms. Pope (1944*b*) recorded that it eats newly transformed toads.

Captive females from central Illinois have given birth to broods of 5, 6, 12, 23, and 17 young in late July or August. Cagle (1942*a*) reported a southern Illinois specimen had 8 young in early August, and Pope (1944*b*) recorded a brood of 24 young born August 1 to a female from Cook County.

Illinois Distribution.—De Kay's snake is abundant in all parts of Illinois, fig. 226. The difficulty in obtaining specimens by conventional collecting techniques accounts for the gaps on the accompanying map.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: Cook County: Aux Plaines (Yarrow 1882*a*); Berwyn, Beverly Hills (Schmidt & Necker 1935); Braeside, Edgebrook, Elmwood Park, Homewood, Lambert (Necker 1939*c*); Longwood, Pullman, Riverdale, Summit, Willow Springs (Schmidt & Necker 1935); Englewood (H. Garman 1892);

Fig. 226.—Distribution of *Storeria dekayi*. The subspecies *wrightorum* occurs throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

DU PAGE COUNTY: Downers Grove, Ingalton (Schmidt & Necker 1935); Naperville (Necker 1939*c*); KANE COUNTY: Batavia, West Dundee (Stille & Edgren 1948); LAKE COUNTY: Pistakee Lake (Schmidt & Necker 1935); Sayer Bog (Necker 1939*c*); PEORIA COUNTY: Peoria (H. Garman 1892); WILL COUNTY: New Lenox (Schmidt & Necker 1935); WOODFORD COUNTY: Kappa (H. Garman 1892).

Storeria occipitomaculata occipitomaculata (Storer) Northern Red-Bellied Snake

Coluber occipito-maculatus Storer 1839:230 (type locality: Amherst, Massachusetts).
Storeria occipito maculata, Kennicott 1855:592.
Storeria occipitomaculata, Yarrow 1882*a*:129.
Storeria occipitomaculata occipitomaculata, Pope 1944*b*:201–4.
Storeria occipito-maculata, Weed 1922:87.
Storeria occipito-maculata occipito-maculata, Trapido 1944:20–33.

Diagnosis.—A small, moderately slender snake (largest Illinois specimen 311 mm. in total length), fig. 227, with 15 rows of strongly keeled scales; ventrals 117 to 130; caudals 41 to 54; anal plate divided; tail length 20 to 26 per cent of total length; supralabials 6 + 6; infralabials usually 7 + 7; preoculars usually 2 + 2; postoculars usually 2 + 2; groundcolor above black, gray, or brown, with three light spots just behind head, sometimes with a light middorsal band; ventral color deep red or pale orange; usually a small but conspicuous light blotch on the fifth supralabial.

Variation.—Males of the northern red-bellied snake have higher caudal counts, proportionately longer tails, and lower ventral counts than females, table 75. Juvenile snakes tend to have more distinct occipital light spots than adults. Too few juvenile specimens are available to permit discerning other ontogenetic variation.

No definite clinal variation has been discerned in the small series available for study. The 32 specimens for which scale counts have been made are separable into a northern and a southern Illinois sample; the scutellation data for the two samples are offered separately, table 76, for what they may be worth.

In other features of scutellation, individual variation for the 32 specimens is as follows: scale rows 15 in 91 per cent of specimens, 16–15–15 in 3 per cent, 15–15–14 in 3 per cent, and 14–15–13 in 3 per cent; supralabials 5 + 6 in 4 per cent, 6 + 6 in 74 per cent, 6 + 7 in 22 per cent; infralabials 7 + 7 in 84 per cent, 7 + 8 in 13 per cent, 8 + 8 in 3 per cent; preoculars 2 + 2 in 93.0 per cent, 1 + 2 in 3.5 per cent, 2 + 3 in 3.5 per cent; postoculars 2 + 2 in 100 per cent.

Color in the 32 specimens is sufficiently variable to suggest two different species of snakes, if the extremes are compared. Although specimens that are intermediate in color occur, the majority of the Illinois specimens tend to be separable into two color phases. In the more common phase the snakes are dark gray to almost black above and have a sharply delineated red ventral color. In this phase there is often a light middorsal band that is sometimes margined with dark flecks. In the other phase the

snakes are tan or red-brown, with an orange ventral color that tends to merge gradually with the brown color of the sides; the occipital light spots are less prominent than on the dark phase. If two color phases are recognized, the phenomenon is of limited geo-

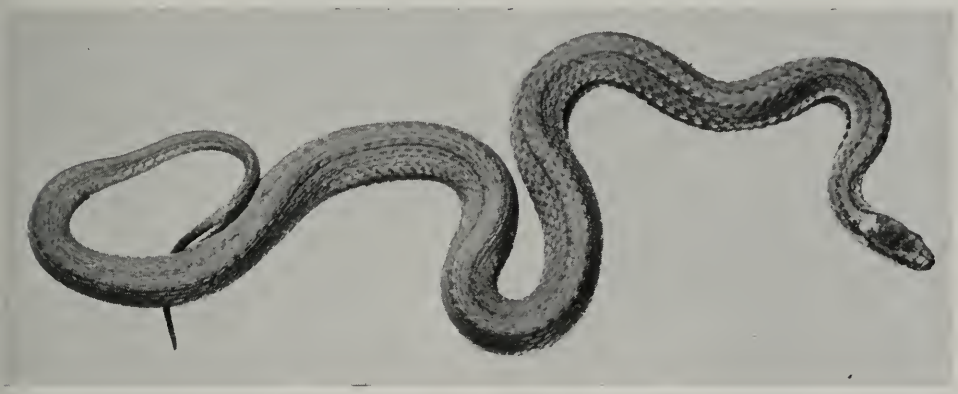


Fig. 227.—An adult *Storeria occipitomaculata occipitomaculata* from Piatt County, Illinois. The groundcolor above is grayish black or red-brown; below, red or orange.

Table 75.—Sexual variation in Illinois *Storeria occipitomaculata occipitomaculata*. Figures in parentheses are numbers of specimens.

Characteristic	Males (12)		Females (19)	
	Range	Mean	Range	Mean
Ventrals	117–126	121.5	121–130	125.6
Caudals	47–54	51.0	41–49	44.5
Tail length as percentage of total length	22.0–25.8	24.1	19.9–24.4	21.4

Table 76.—Geographic variation in Illinois samples of *Storeria occipitomaculata occipitomaculata*. Figures in parentheses are numbers of specimens.

Characteristic	Northern Illinois (5 Males, 8 Females)		Southern Illinois (7 Males, 12 Females)	
	Range	Mean	Range	Mean
Ventrals				
Male	117–126	121.0	119–126	122.0
Female	123–130	126.5	121–128	124.9
Caudals				
Male	48–56	52.2	47–53	50.2
Female	41–47	44.7	41–49	44.4
Tail length as percentage of total length				
Male	22.0–25.8	24.3	22.8–24.8	23.9
Female	19.9–22.7	21.3	19.9–24.4	21.5

graphic significance, as snakes of each type have been found together on several occasions. The material available, however, suggests that the darkly pigmented form (hence more sharply bicolored snakes) is the one that occurs more frequently in northern Illinois; 11 of 12 specimens from the northern part of the state are dark, whereas 15 of 20 specimens from the southern part of the state are dark.

Some specimens have numerous dark dots or dashes outlining the middorsal light stripe and also have light flecks on the lowermost row of scales and adjacent ventral edges separated from the red ventral color by a row of dark spots. The width of the red ventral color varies; it depends on how far ventrad the dorsal color encroaches. The red ventral color tends to be narrower in the northern than in the southern specimens.

Habits.—This small snake is similar to *Storeria dekayi wrightorum* in most respects. Although it is sometimes found in pastures and wet meadows, it usually inhabits wooded areas. On two occasions individuals have been seen climbing in vegetation above the ground. Captive specimens, according to Pope (1944*b*), feed on earthworms and slugs. The broods are small and probably are born in August or September. A captive specimen gave birth to 14 young in early September.

Illinois Distribution.—The northern red-bellied snake is a forest species, and its occurrence in all parts of Illinois, fig. 228, including predominantly prairie areas, is surprising, particularly in view of its limited occurrence in Indiana and Ohio. Trapido (1944) regarded the only central Illinois locality known to him (Menard County) as doubtful and suggested that the species was absent in the steppe peninsula of Illinois, Indiana, and Ohio. Recent records show that the species occurs throughout Illinois but it is distinctly uncommon except in the forested morainal region of Cook and Lake counties.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Braeside (Schmidt & Necker 1935); Evanston (Trapido 1944); Niles Center, Palos Park (Schmidt & Necker 1935); River Forest (Weed 1922); Thatcher Woods (Trapido 1944); Willow Springs (Schmidt & Necker 1935); MCLEAN COUNTY: Normal (H. Garman 1892); MENARD COUNTY: Athens (Trapido 1944); UNION COUNTY: Anna (H. Garman 1892).

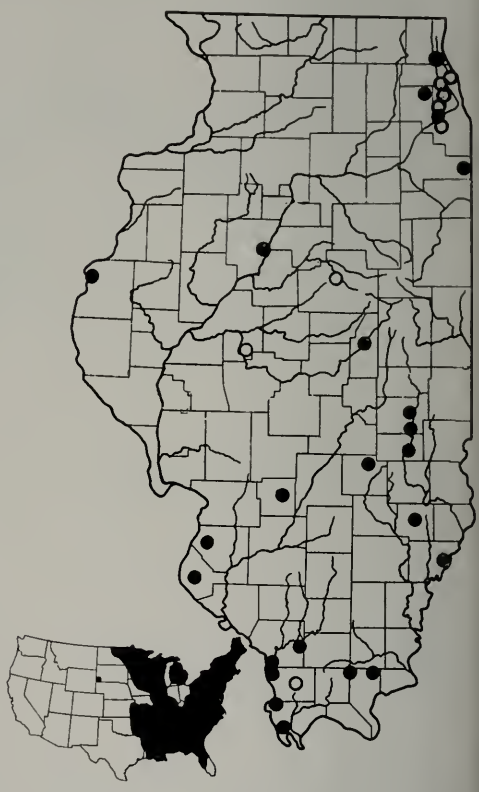


Fig. 228.—Distribution of *Storeria occipitomaculata*. The subspecies *occipitomaculata* apparently occurs in wooded areas throughout Illinois. Solid circles indicate localities represented by specimens examined during this study; open circles, published records believed to be valid. The lower map depicts the total range of this widespread species in the United States.

Natrix Laurenti

Nine species, several with subspecies, of this world-wide genus occur in the United States and Canada. Ten species and subspecies are known in Illinois.

Natrix cyclopion cyclopion
(Duméril, Bibron, & Duméril)
Green Water Snake

Tropidonotus cyclopion Duméril, Bibron, & Duméril 1854:576 (type locality: New Orleans, Louisiana).
Natrix cyclopion, Jordan 1888:194.

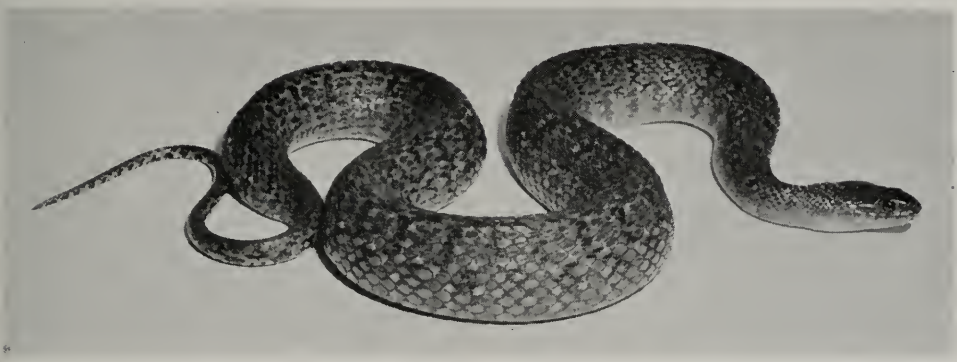


Fig. 229.—An adult *Natrix cyclopion cyclopion* from Harris County, Texas. The groundcolor is usually olive; the rather indistinct pattern, brown or black. (Photo by Isabelle Hunt Conant.)

Natrix cyclopion cyclopion, Curran & Kauffeld 1937:261.
Tropidonotus cyclopium, Yarrow 1882*a*:137.
Nerodia cyclopium, H. Garman, 1892:271–2.
Natrix cyclopium, Cope 1892:673.

Diagnosis.—A large, heavy-bodied water snake (largest Illinois specimen 1,000 mm. in total length), fig. 229, with 23 to 29 anterior and 21 posterior rows of strongly keeled scales; ventrals 141 to 144; caudals 59 to 68; anal plate divided; supralabials usually 8 + 8; infralabials 10 to 13 on each side; preoculars 1 or 2; postoculars 2 or 3 on each side; suboculars always separating eye from supralabials; groundcolor greenish brown or olive-brown, with approximately 50 narrow, dim black crossbars; ventral color predominantly dark brown posteriorly and blotched with semicircles and squares of yellowish white.

Variation.—Scale counts for the three females and one male of the green water snake available from Illinois are as follows: scale rows 29–27–21, 27–27–21, 27–29–21, and 27–24–21; ventrals 142, 141, 143, and 144; caudals 59, 61, 62, and 68; supralabials 8 + 8 in three specimens, 8 + 9 in one; infralabials 10 + 10, 13 + 11, 12 + 12, and 11 + 11; tail length 21.8, 19.8, 22.6, and 21.0 per cent of total length. The dorsal pattern is dim on all specimens, and the crossbars cannot be counted with accuracy.

Habits.—No information is available concerning the habits of *Natrix cyclopion* in the northern part of its range. On the Gulf Coast, this large water snake inhabits lakes and swamps. Its food consists of fish and amphibians. Like most of the large water snakes, it is pugnacious in behavior.

The young are surprisingly large at birth. The size of the brood varies with the age and size of the mother snake.

Illinois Distribution.—The green water snake, *N. c. cyclopion,* is known in Illinois

Fig. 230.—Distribution of *Natrix cyclopion.* Hatching indicates the presumed range of the subspecies *cyclopion* in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed valid. The lower map depicts the species range in the United States.

only from the extreme southern part of the state, fig. 230. Until quite recently the species was known here by only three CNHM specimens, collected at Olive Branch in 1907, and one equally old USNM specimen bearing the label "southern Illinois." Considerable field work by many different collectors in extreme southern Illinois failed to yield additional specimens until late 1956, when a juvenile was found at Pine Hills Recreation Area in Union County (Keiser 1958). Since that time nearly a dozen specimens have been collected at the same locality, but unfortunately they have not been available to me for study. The reasons for the relative abundance of this snake at present and its apparent rarity prior to 1956 are not known.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: UNION COUNTY: Bluff Lake (H. Garman 1892).

Natrix erythrogaster Forster

Four subspecies of the copper-bellied water snake are recognized, two of which occur in Illinois. An eastern race traverses extreme southern Illinois, intergrading with a Gulf Coast race in the Mississippi River valley.

Natrix erythrogaster flavigaster Conant Yellow-Bellied Water Snake

Natrix erythrogaster flavigaster Conant 1949: 2, fig. 3 (type locality: Frenier Beach, St. John the Baptist Parish, Louisiana).
Tropidonotus sipedon erythrogaster nec Forster, Yarrow 1882*a*:136 (I).
Nerodia sipedon erythrogaster nec Forster, H. Garman 1892:269–71 (I).
Natrix fasciata erythrogaster nec Forster, Cope 1900:977 (I).
Natrix sipedon erythrogaster nec Forster, Jordan 1929:241 (I).
Natrix erythrogaster erythrogaster nec Forster, Conant 1938:71 (I).
Natrix sipedon erythro-gaster nec Forster, Hurter 1893:257 (I).

Diagnosis.—A large, heavy-bodied water snake (largest Illinois specimen 1,316 mm. in total length), fig. 231, usually with 23 anterior and 17 posterior rows of strongly keeled scales; ventrals 145 to 156; caudals 59 to 84; anal plate divided; 8 + 8 supralabials; usually 10 + 10 infralabials; usually 1 preocular and 3 postoculars on each side; groundcolor (except in juveniles) uni-

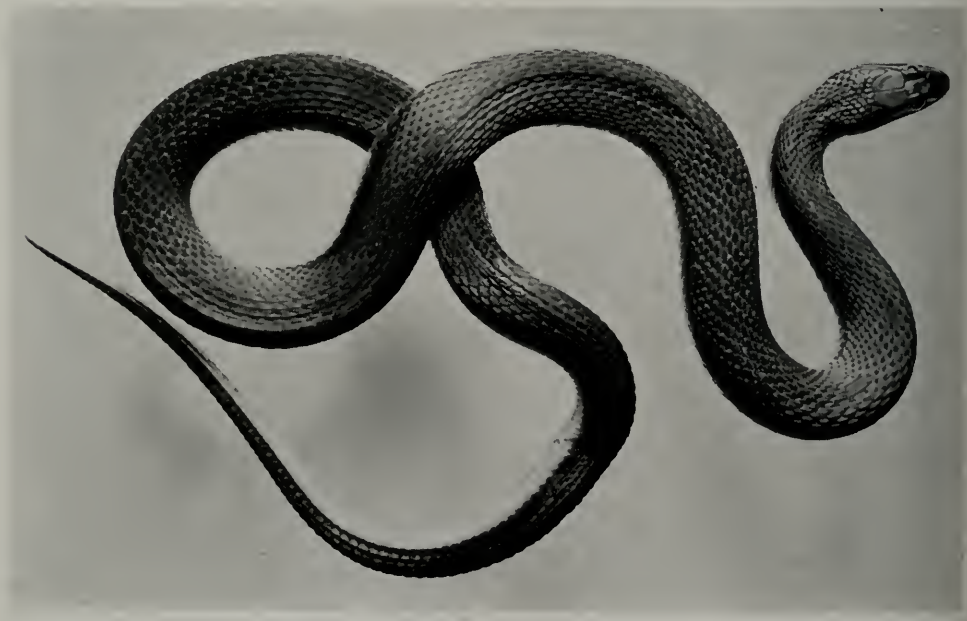


Fig. 231.—An adult *Natrix erythrogaster neglecta* × *flavigaster* intergrade from Alexander County, Illinois. The groundcolor above is black, dark brown, or very dark olive-gray; below, orange and black in *neglecta* and yellow in *flavigaster*.

Table 77.—Sexual variation in Illinois *Natrix erythrogaster*. Figures in parentheses are numbers of specimens.

Characteristic	Males (17)		Females (18)	
	Range	Mean	Range	Mean
Caudals	67–84	78.2	59–72	67.2
Tail length as percentage of total length	21.4–25.8	23.8	19.4–23.7	21.4

formly dark brown or black above, yellow below; venter usually unmarked except for slight encroachment of dark dorsal color on lateral edges of ventral scutes; groundcolor of juveniles gray, with 29 to 35 closely crowded black dorsal blotches; venter of juveniles yellowish white, with a narrow dark transverse bar bordering each ventral scute.

Variation.—Males of *Natrix erythrogaster* have longer tails than females and accordingly have higher caudal counts. Since lepidosis in the two Illinois races, *neglecta* and *flavigaster,* is identical, data on sexual dimorphism for these races are combined in table 77.

The baby snakes are blotched; the subadults become uniformly dark above and yellow below. Traces of the blotched pattern are retained in occasional specimens 700 mm. in total length. The venter is usually unmarked, except for the lateral edges of the ventral scutes in specimens 500 mm. or more in length and in juveniles.

Geographic variation in color and pattern is rather pronounced in this snake. The more northern specimens are yellow below, with the dark groundcolor of the upper parts encroaching a short distance on each posterior ventral. Anteriorly the ventrals are plain. In a series from extreme southwestern Illinois some specimens have this pattern type and some have a pattern in which the venter is orange and the dorsal color traverses the venter, reducing the ventral color to a median series of orange semilunar markings. Other specimens in the series are approximately intermediate but show a more pronounced influence of the latter pattern type. These extreme southwestern Illinois specimens are intergrades between *neglecta* and *flavigaster*.

Individual variation in scutellation for *N. e. flavigaster* and *N. e. neglecta* is unimodal, and therefore the counts have been summarized as follows for the 35 Illinois specimens of *N. erythrogaster* studied: ventrals 145 to 156 (average 150.5); anterior scale rows 19 in 3 per cent of specimens, 21 in 13 per cent, 22 in 11 per cent, 23 in 73 per cent; scale rows at mid-body 20 in 3 per cent, 21 in 6 per cent, 22 in 17 per cent, 23 in 65 per cent, 24 in 3 per cent, and 25 in 6 per cent; posterior scale rows 16 in 11 per cent, 17 in 68 per cent, 18 in 16 per cent, 19 in 5 per cent; supralabials 8 + 8 in 100 per cent; infralabials 10 + 10 in 87 per cent, 11 + 11 in 13 per cent; preoculars 1 + 1 in 90 per cent, 1 + 2 in 5 per cent, 2 + 2 in 5 per cent; postoculars 2 + 3 in 8 per cent, 3 + 3 in 78 per cent, 3 + 4 in 11 per cent, and 3 + 5 in 3 per cent.

Habits.—Like the green water snake, this large water snake shows a preference for the quiet waters of ponds, lakes, and swamps. Cornered individuals strike viciously and when captured excrete foul-smelling material on the collector. At Horseshoe Lake, Alexander County, this snake congregates in numbers at the spillway, where it captures the fish carried over the retaining wall. Catfishes frequently are found in the stomachs of yellow-bellied water snakes, which eat frogs and probably crayfish also. The yellow-bellied water snake apparently leaves hibernation early in the spring; active specimens have been seen the first part of March.

Cagle (1942*a*) records copulation of these snakes in May and the presence of 28 large ovarian eggs in a female. The young captured in the fall are considerably smaller than new-born individuals of *N. cyclopion*.

Illinois Distribution.—The range of *N. e. flavigaster* in its typical form, as indicated by the few available specimens, is puzzling, fig. 232. Although the distribution of this subspecies centers in the lower Mississippi River valley, all of the Illinois specimens of seemingly pure *flavigaster* are from

north of the Shawnee Hills region. The extreme southwestern Illinois specimens which could more logically be expected to display *flavigaster* characters are actually *neglecta* × *flavigaster* intergrades. *N. e. flavigaster,* at least formerly, extended up the Illinois River. Conant (1949) viewed Garman's Peoria record with doubt, but I once examined a specimen of *flavigaster,* in the collection of H. J. Van Cleave, labeled "Havana, Illinois." Havana is only a few miles south of Peoria. This specimen has since been lost, but others are extant from Calhoun County, the eastern border of which is on the Illinois River. Specimens from the Mississippi River floodplain (Alexander to Jackson counties) are *neglecta* × *flavigaster.*

Fig. 232.—Distribution of *Natrix erythrogaster.* Vertical hatching indicates the presumed range of the subspecies *flavigaster* in Illinois; horizontal hatching, the presumed range of the subspecies *neglecta;* crosshatching, the area of intergradation between the two subspecies; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Carbondale, Crab Orchard (Cagle 1942*a*); PEORIA COUNTY: Peoria (H. Garman 1892); UNION COUNTY: Anna (H. Garman 1892).

Natrix erythrogaster neglecta Conant
Northern Copperbelly
Red-Bellied Water Snake

Natrix erythrogaster neglecta Conant 1949:5, fig. 1 (type locality: 3 mi. E Mount Victory, Hardin County, Ohio).

Tropidonotus sipedon erythrogaster nec Forster, Yarrow 1882*a*:136 (I).

Nerodia sipedon erythrogaster nec Forster, H. Garman 1892:269–71 (I).

Natrix sipedon erythrogaster nec Forster, Jordan 1929:241 (I).

Natrix erythrogaster erythrogaster nec Forster, Conant 1938:7 (I).

Natrix sipedon erythro-gaster nec Forster, Hurter 1911:155 (I).

Diagnosis.—A subspecies of *Natrix erythrogaster* (largest Illinois specimen 1,082 mm. in total length), fig. 231, differing from *N. e. flavigaster* in color and pattern as follows: groundcolor above black, below bright orange; dark groundcolor of dorsum encroaching well onto the venter; orange ventral color usually reduced posteriorly to a median series of narrow, orange, semilunar markings.

Variation.—Sexual and ontogenetic variation in *N. e. neglecta* parallels that in *N. e. flavigaster.* The juvenile blotched pattern appears to be lost at a smaller size in *neglecta,* however, probably because this subspecies has a more intense black pigment on the dorsum.

Individual variation for the species is as described in the discussion of *N. e. flavigaster.*

Habits.—The northern copperbelly is similar in habits to the yellow-bellied water snake. East of Illinois it frequents bogs.

Illinois Distribution.—The northern copperbelly is apparently uncommon in Illinois, fig. 232. Although few specimens have been collected, this subspecies probably occurs throughout the lower Wabash and Ohio River valleys. The northernmost record, from an island in the Mississippi River, suggests a relict distribution elsewhere.

Natrix grahami (Baird & Girard)
Graham's Water Snake

Regina grahamii Baird & Girard 1853:47 (type locality: Rio Salado; revised to Salado Creek, Bell County, Texas, by Schmidt 1953); Kennicott 1855:592.
Tropidonotus grahamii, Hay 1891:113.
Natrix grahamii, Hay 1892*a*:589.
Tropidonotus grahami, Yarrow 1882*a*:131.
Regina grahami, H. Garman 1892:273–4.
Natrix grahami, Hurter 1893:257.
Tropidonotus leberis, Davis & Rice 1883*a*:30.
Regina leberis, H. Garman 1889:132.
Natrix rigida nec Say, McLain 1899:3.

Diagnosis.—A medium-sized, moderately stout-bodied water snake (largest Illinois specimen 854 mm. in total length), fig. 233, usually with 20–19–17 rows of strongly keeled scales; ventrals 158 to 173; caudals 54 to 67; anal plate divided; supralabials 7, occasionally 8 on each side; infralabials 8 to 10 on each side; groundcolor brown or dark olive above, with a yellow or a light olive-green stripe along either side of the body, involving the lower three scale rows; lateral stripe prominently bordered below by a narrow, irregular black stripe along the outer edges of the ventrals; lateral stripe sometimes bordered above by a dark line; median light stripe 2 to 3 scale rows in width sometimes present; venter yellow or greenish white, with faint median dark line or row of dots on posterior third of belly.

Variation.—Males in this species differ from females in the somewhat higher ventral

Fig. 233.—An adult *Natrix grahami* from Cumberland County, Illinois. The groundcolor is olive or grayish brown; the lateral bands and venter are greenish gray or yellowish white.

Table 78.—Sexual variation in Illinois *Natrix grahami.* Figures in parentheses are numbers of specimens.

Characteristic	Males (15)		Females (16)	
	Range	Mean	Range	Mean
Ventrals	162–175	169.1	155–169	160.9
Caudals	60–67	64.0	54–64	57.4
Tail length as percentage of total length	17.4–20.4	19.1	16.0–20.1	18.2

Table 79.—Geographic variation in Illinois *Natrix grahami*. Figures in parentheses are numbers of specimens.

CHARACTERISTIC	NORTHERN ILLINOIS (13)		CENTRAL ILLINOIS (11)		SOUTHERN ILLINOIS (8)	
	Range	Mean	Range	Mean	Range	Mean
Ventrals						
Male	162–170	165.7	171–172	171.3	167–175	171.7
Female	158–169	161.6	155–163	159.5	159–163	160.3
Caudals						
Male	62–65	63.8	60–67	63.7	63–66	64.5
Female	57–64	59.5	54–57	55.7	55–60	57.0
Tail length as percentage of total length						
Male	18.3–20.4	19.5	18.7–20.4	19.5	17.4–19.8	18.5
Female	17.0–19.7	18.8	17.4–20.1	18.3	16.0–17.7	17.1

and caudal counts and slightly longer tails, table 78.

The juveniles differ from the adults in the greater contrast between dorsal groundcolor and color of the lateral stripes. The venter and lateral stripes are more yellowish in young and the occurrence of a middorsal light band, bordered by dark lines, is more frequent in juveniles.

There is some evidence that in specimens from the northern part of Illinois the midventral stripe or median series of dark spots on the posterior part of the belly is more prominent than in specimens from the southern part. Also, a smaller number of ventrals in northern males is suggested, as shown by a comparison of the means of samples from northern, central, and southern Illinois, table 79.

Individual variation in scale rows, labials, and oculars in a sample of 31 specimens is as follows: anterior scale rows 20 in 67 per cent of specimens, 19 in 33 per cent; scale rows at mid-body 19 in 100 per cent; posterior scale rows 17 in 92 per cent, 18 in 4 per cent, 19 in 4 per cent; supralabials 7 + 7 in 72 per cent, 7 + 8 in 16 per cent, 8 + 8 in 12 per cent; infralabials 8 + 8 in 8 per cent, 8 + 9 in 16 per cent, 9 + 9 in 52 per cent, 9 + 10 in 16 per cent, 10 + 10 in 4 per cent, 9 + 11 in 4 per cent; preoculars 1 + 2 in 4 per cent, 2 + 2 in 96 per cent; postoculars 1 + 2 in 8 per cent, 2 + 2 in 65 per cent, 2 + 3 in 19 per cent, and 3 + 3 in 8 per cent.

Habits.—This striped water snake is found in sluggish water areas such as lakes, river-bottom sloughs, and prairie marshes. Newly captured specimens do not bite, but they are unpleasant to handle because of the quantity of fecal matter they expel. Individuals may be seen basking on rock piles around lakes and on branches overhanging the water. They are shy and usually difficult to catch. Graham's water snake feeds largely on newly molted crayfish. It feeds on fish and amphibians also.

A captive individual of this species had 9 young on August 15.

Illinois Distribution.—Although Graham's water snake occurs in most of Illinois, fig. 234, it reaches the eastern limit of its range in this state and has never been recorded from Indiana. It probably occurs throughout Illinois except for the Wabash and Ohio River counties.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: BUREAU COUNTY: Milo (Cope 1900); COOK COUNTY: Glenview (Schmidt & Necker 1935); FRANKLIN COUNTY: West Frankfort (Cagle 1942*a*); JACKSON COUNTY: Murphysboro (Cagle 1942*a*); KANE COUNTY: Geneva (H. Garman 1892); KNOX

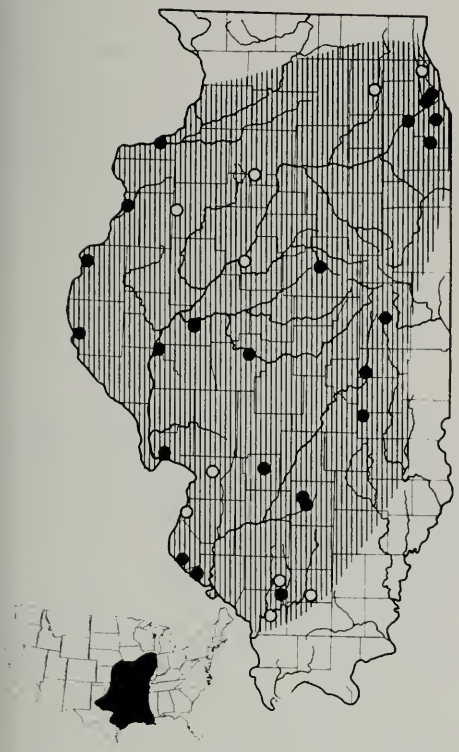


Fig. 234.—Distribution of *Natrix grahami*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

COUNTY: Galesburg (H. Garman 1892); MADISON COUNTY: (Hurter 1911); PERRY COUNTY: Du Quoin (Cagle 1942*a*); ST. CLAIR COUNTY: opposite St. Louis (Hurter 1911); TAZEWELL COUNTY: Pekin (H. Garman 1892).

Natrix kirtlandi (Kennicott)
Kirtland's Water Snake

Regina kirtlandii Kennicott 1856:95 (type locality: northern Illinois; revised to West Northfield, Illinois, by Conant 1943).
Tropidoclonion kirtlandii, Cope 1860*b*:340.
Tropidoclonium kirtlandii, Cope 1875:42.
Tropidonotus kirtlandii, S. Garman 1883:29, 143.
Clonophis kirtlandii, Cope 1892:674.
Ischnognathus kirtlandii, Boulenger 1893:286.
Natrix kirtlandii, Cope 1900:997.
Tropidoclonium kirtlandi, Jordan 1878:176.
Tropidonotus kirtlandi, S. Garman 1884:24.
Clonophis kirtlandi, Jordan 1888:192.
Regina kirtlandi, H. Garman 1890:187.
Natrix kirtlandi, Hay 1892*a*:506.
Olonophis kirtlandi, Surface 1906:140.

Diagnosis.—A small, stout-bodied water snake (largest Illinois specimen 470 mm. in total length), fig. 235, usually with 19–19–17 rows of strongly keeled scales; ventrals 127 to 137; caudals 49 to 62; divided anal plate; supralabials usually 6 + 6; infralabials usually 7 + 7; preoculars usually 1 + 1; postoculars usually 2 + 2; groundcolor above gray or brown, on which are superimposed four rows of 46 to 57 round or nearly square black blotches, giving the dorsum a checkerboard appearance; blotches most distinct anteriorly and laterally, sometimes fading out middorsally on the posterior part of the body; venter bright red, brick red, or a faded orange, and bordered laterally by a series of dark spots on each side.

Variation.—Males in this species are proportionately longer tailed and shorter bodied than females. This dimorphism is illustrated in table 80.

In young Kirtland's water snakes the color is much darker than in adults, and the checkered dorsal pattern is not prominent. In baby snakes the head is black, and the venter is usually bright red. In older individuals the color appears to be somewhat faded, but the checkered or spotted pattern of the dorsum is more evident.

Too few specimens are available from extreme northern Illinois to indicate much in the way of geographic variation trends in this species. In a sample of 18 specimens from east-central Illinois, 11 are females with the following variation: ventrals 129 to 137 (average 132.9); caudals 49 to 57 (average 53.2); lateral body spots 46 to 56 (average 50.8); and tail length 19.7 to 23.4 (average 20.8) per cent of total length. The three specimens from northeastern Illinois, all of which are females, have ventrals 130 to 133 (average 131); caudals 51 to 54 (average 52.6); lateral body spots 46 to 59 (average 54.6); and tail length 19.5 to 19.9 (average 19.7) per cent of total length. Thus, a reduction in number of scales and proportionate tail length and an increase in number of spots toward the north is suggested, but these characteristics are based on so few specimens that any apparent trends are of uncertain significance. Northern specimens tend to be darker.

Individual variation in number of labials and oculars for a series of 19 specimens is slight: supralabials 6 + 6 in 84 per cent of specimens, 5 + 6 in 16 per cent; infralabials 7 + 7 in 95 per cent, 7 + 8 in 5 per cent; preoculars 1 + 1 in 95 per cent, 2 + 2 in 5 per cent. Coloration is more variable. Some adults retain the jet black markings of juveniles; others have a faded appearance, with brown spots and a poorly defined middorsal gray stripe. The venter is bright brick-red or orange-red usually, but one adult taken near St. Joseph, Illinois, had an almost yellow venter. This oddly colored specimen escaped before it could be preserved.

Habits.—This small, innocuous water snake is the least aquatic of the Illinois species of *Natrix*. Specimens found during the day are almost invariably hiding beneath rocks, boards, or other objects. *N. kirtlandi* flattens its body when disturbed and remains so until touched. Then it uncoils violently and seeks to escape by wriggling away. Captives eat earthworms readily.

Copulation in this species has been observed on May 10 and May 14. Conant

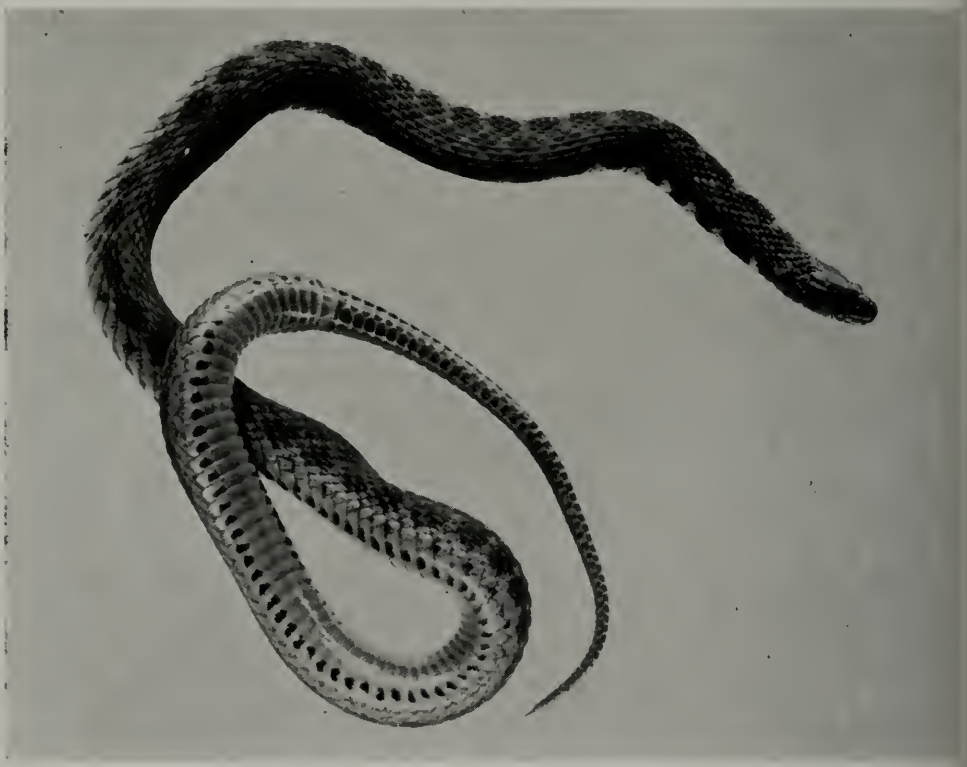


Fig. 235.—An adult *Natrix kirtlandi* from Coles County, Illinois. The groundcolor above is gray or brown with black spots or squares arranged in checkerboard fashion; below, red or orange bordered by a row of black spots along each side.

Table 80.—Sexual variation in Illinois *Natrix kirtlandi*. Figures in parentheses are numbers of specimens.

Characteristic	Males (7)		Females (14)	
	Range	Mean	Range	Mean
Ventrals	127–134	130.5	129–137	132.5
Caudals	58–62	59.8	49–57	53.0
Tail length as percentage of total length	22.1–25.2	23.9	19.5–23.4	20.6

(1943) recorded that, in Ohio, 4 to 13 young per female are born in August and September.

Illinois Distribution.—Kirtland's water snake is apparently restricted in Illinois to the northeastern and east-central part, north of the Shelbyville Moraine, fig. 236.* This snake is considered a glacial relict. Specimens have been found in vacant lots and in wooded ravines near Charleston and in ditches in cultivated fields near Urbana.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: COOK COUNTY: Evanston (Schmidt & Necker 1935); Palos Park, River Forest (Necker 1939*c*); West Northfield (Kennicott 1856).

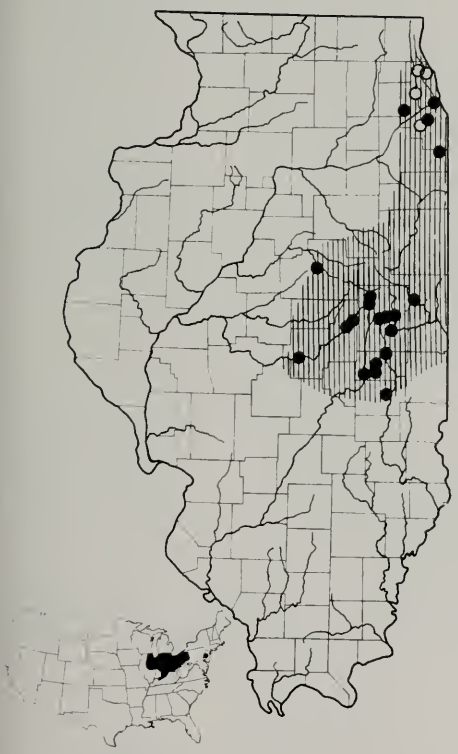


Fig. 236.—Distribution of *Natrix kirtlandi*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

*Since this account was written, a specimen has been taken in southwestern McDonough County, extending the known range almost to the Mississippi River.

Natrix rhombifera rhombifera (Hallowell)

Diamond-Backed Water Snake

Tropidonotus rhombifer Hallowell 1852:177 (type locality: Arkansas River and its tributaries near the northern boundary of the Creek Nation; revised to Fort Smith, Arkansas, by Schmidt 1953); Cope 1861:298.
Natrix rhombifer, Jordan 1888:194.
Nerodia sipedon rhombifer, H. Garman 1892: 269–71.
Natrix rhombifera, Cope 1892:668, 673.
Natrix rhombifera rhombifera, Clay 1938:177.

Diagnosis.—A large, heavy-bodied water snake (largest Illinois specimen 1,349 mm. in total length), fig. 237, with 24 to 28 rows of scales anteriorly and usually 21 rows posteriorly; scales strongly keeled; ventrals 135 to 146; caudals 59 to 82; anal plate divided; supralabials usually 8 + 8; infralabials 10 to 12 on each side; preoculars usually 1 + 1; postoculars 3 or 4 on each side; groundcolor yellow, gray, or light olive, with 25 to 37 dark lateral bands, most of which bifurcate dorsally, the dark, narrow processes crossing the back and meeting their partners, thus enclosing light, diamond-shaped middorsal blotches; venter predominantly yellow, with semilunar dark markings, which are most numerous posteriorly.

Variation.—Males of this water snake have higher average caudal counts and slightly longer tails than females, table 81. They also have slightly higher mean ventral counts and a tendency toward reduction of the number of scale rows around the body, but neither ventral nor scale row counts are constant enough to aid in sexing specimens.

Juveniles of the diamond-backed water snake differ from adults in the somewhat brighter pattern and more slender head and body.

No geographic variation trends have been discerned for this snake in Illinois, the means of scale and blotch counts of samples from various parts of the state being remarkably close. There is considerable individual variation in number of scale rows around the body. In 40 specimens the anterior scale rows are 24 in 2.5 per cent, 25 in 27.5 per cent, 26 in 27.5 per cent, 27 in 32.5 per cent, and 28 in 10.0 per cent. Scale rows at midbody are 24 in 7.5 per cent of the specimens, 25 in 40.0 per cent, 26 in 25.0 per cent, 27 in 17.5 per cent, and 28 in 10.0 per cent. Pos-

terior scale rows are 19 in 2.5 per cent of the specimens, 20 in 5.0 per cent, 21 in 82.5 per cent, 22 in 5.0 per cent, and 23 in 5.0 per cent.

Individual variation in number of ventrals is not great, ranging in 40 specimens from 135 to 146, averaging 140.9. Supralabials are 7 + 7 in 2.5 per cent of the specimens, 7 + 8 in 2.5 per cent, 8 + 8 in 74.0 per cent, 8 + 9 in 9.2 per cent, 9 + 9 in 9.2 per cent, and 9 + 10 in 2.5 per cent. Infralabials are 10 + 10 in 9.5 per cent, 10 + 11 in 9.5 per cent, 11 + 11 in 59.5 per cent, 11 + 12 in 4.7 per cent, 12 + 12 in 12.0 per cent, and 12 + 13 in 4.7 per cent. Preoculars are 1 + 1 in 91.0 per cent, 1 + 2 in 2.5 per cent, 2 + 2 in 4.0 per cent, and 3 + 3 in 2.5 per cent. Postoculars are 2 + 3 in 5 per cent, 3 + 3 in 64 per cent, 3 + 4 in 26 per cent, and 4 + 4 in 5 per cent. The number of dark lateral bands in 40 specimens ranges from 25 to 37, averaging 31.5. In occasional specimens the lateral bands anteriorly have light-colored centers.

Habits. — The diamond-backed water snake is most abundant in the quiet waters

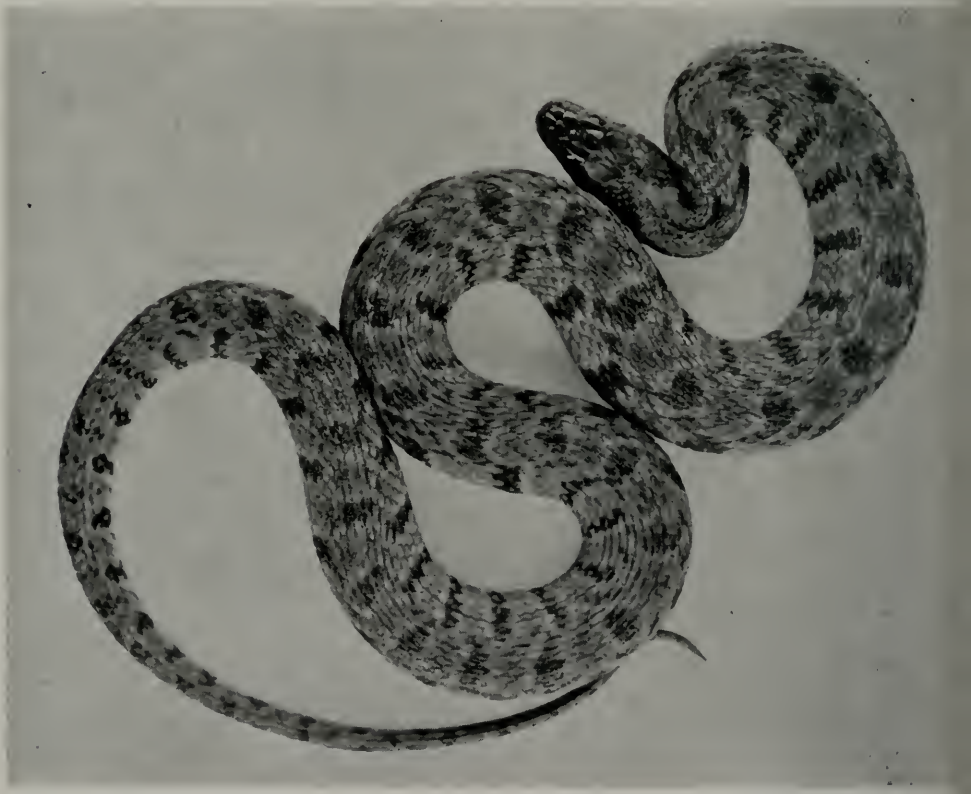


Fig. 237.—An adult *Natrix rhombifera rhombifera* from Alexander County, Illinois. The groundcolor above is dull yellow; the markings are olive or brown.

Table 81.—Sexual variation in Illinois *Natrix rhombifera rhombifera*. Figures in parentheses are numbers of specimens.

Characteristic	Males (16)		Females (25)	
	Range	Mean	Range	Mean
Caudals	71–82	74.6	59–68	61.8
Tail length as percentage of total length	23.8–26.3	24.7	19.0–23.5	21.5

of shallow lakes, sloughs, and swamps. In the shallow marshes on the Mississippi floodplain of southern Illinois, this snake thrives in water that is so warm that a snake could hardly be expected to survive such a temperature. The diamond-back is an ill-tempered and unpleasant snake to collect. Its bite is painful and the excrement it voids is foul smelling. Although active individuals may be found in the daytime, the species is most active at night. It is fond of basking on limbs overhanging water, sometimes several feet high. It is primarily a fish eater, although captives take frogs readily.

Captives have had broods of 23 and 32 young in September and early October. The young are quite large at birth, averaging about 265 mm. in total length.

Illinois Distribution.—The diamond-backed water snake is very common in lakes, ponds, and river sloughs of the Mississippi-Ohio river lowlands and in the Lower Mississippi Border floodplain sloughs. Elsewhere in the state it appears to be limited to the major rivers, occurring as far north as Fayette County on the Kaskaskia, Peoria County on the Illinois, and Henderson County on the Mississippi. No records are available for eastern Illinois except in the lower Wabash River. This species has been known previously in Illinois only in the southern tip of the state, and the specimens now at hand extend the known range approximately 175 miles northward in the Mississippi River valley, fig. 238. Garman's (1892) record for Cook County is far outside the known range of the species and undoubtedly in error.

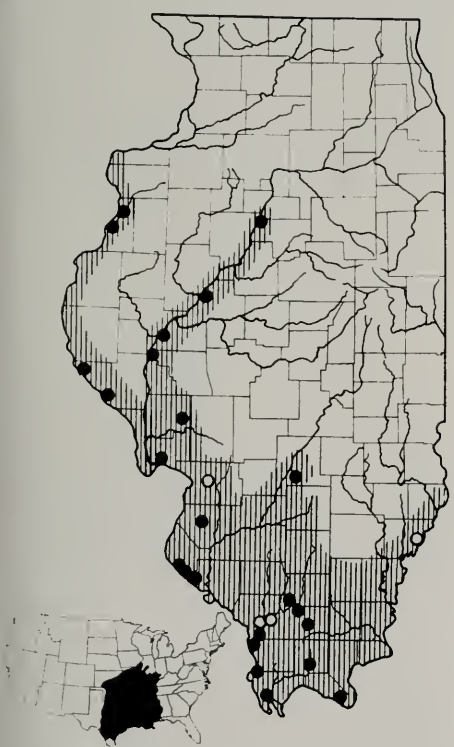


Fig. 238.—Distribution of *Natrix rhombifera*. Hatching indicates the presumed range of the subspecies *rhombifera* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the species range in the United States.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: JACKSON COUNTY: Grimsby (Cagle 1942*a*); Murphysboro (Ditmars 1945); MADISON COUNTY: (Hurter 1897); WABASH COUNTY: Mount Carmel (Yarrow 1882*a*).

Natrix septemvittata (Say)
Queen Snake

Coluber septemvittatus Say 1825:240 (type locality: Pennsylvania).
Natrix septemvittata, Weed 1922:87.
Regina leberis, Kennicott 1855:592.
Tropidonotus leberis, Ditmars 1907:243.
Regina rigida nec Say, Jordan 1888:193.

Diagnosis.—A medium-sized, moderately stout-bodied water snake (largest Illinois specimen 890 mm. in total length), fig. 239, usually with 19–19–17 rows of strongly keeled scales; ventrals 140 to 153; caudals 68 to 85; anal plate divided; supralabials 7 + 7; infralabials 8 to 10 on a side; preoculars 2 + 2; postoculars 2 + 2; groundcolor dark brown or dark gray, with a yellow or yellow-white stripe along either side of body involving most of the first and second rows of scales; lateral edges of ventrals brown, forming a distinct dark lateroventral stripe on each side; venter yellow, with a pair of dark median longitudinal stripes extending from about the fifteenth ventral to the tip of the tail, or venter much suffused with dark and having a narrow median light stripe present; middorsal light band or narrow dark line sometimes present.

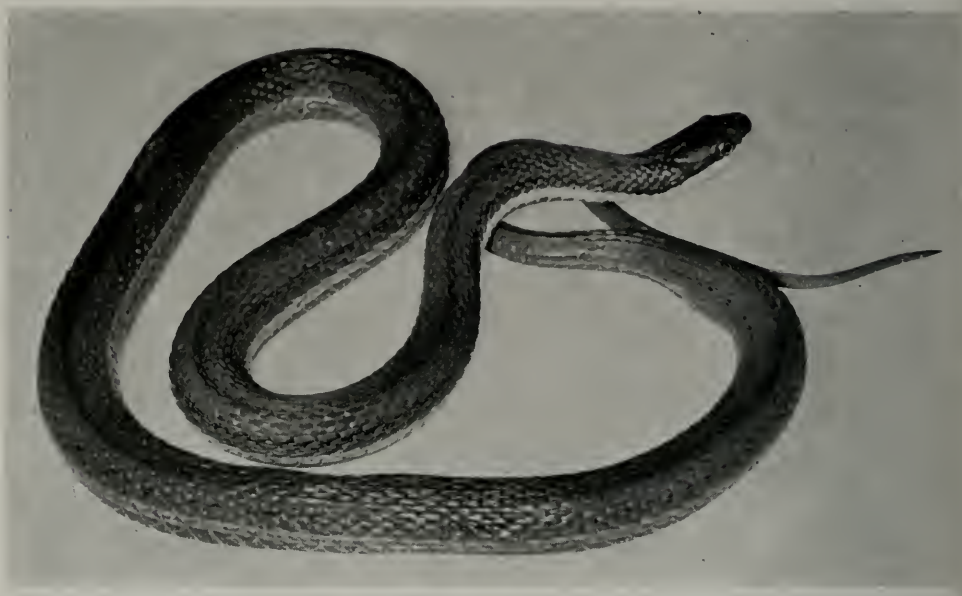


Fig. 239.—An adult *Natrix septemvittata* from Vermilion County, Illinois. The groundcolor above is dull brown; the lateral stripes are grayish yellow; the groundcolor below is dull yellow with a pair of longitudinal red-brown stripes.

Table 82.—Sexual variation in Illinois *Natrix septemvittata*. Figures in parentheses are numbers of specimens.

Characteristic	Males (10)		Females (20)	
	Range	Mean	Range	Mean
Caudals	78–85	80.5	68–78	72.2
Tail length as percentage of total length	26.0–28.6	27.2	19.9–26.9	24.5

Variation.—The male of *Natrix septemvittata* has a slightly longer tail and a greater number of caudals than the female, table 82.

The juveniles differ from the adults in having a more pronounced pattern. Young snakes have two distinct dark midventral stripes and a conspicuous light ventrolateral stripe on each side of the body. In many older snakes the ventral stripes are obscured by dark mottling on the posterior part of the belly and the lateral stripe fades out on the posterior third of the body.

No geographic variation for this snake has been discerned within Illinois. The average number of caudals is higher in Illinois than in the Ohio specimens, studied by Wood & Duellman (1950). Individual variation in a sample of 31 Illinois specimens is as follows: ventrals 140 to 153 (average 145.6); 18 anterior scale rows in 3 per cent of specimens, 19 in 57 per cent, 20 in 37 per cent, and 21 in 3 per cent; 19 scale rows at mid-body in 90 per cent, 18 in 7 per cent, and 17 in 3 per cent; 17 posterior scale rows in 100 per cent; supralabials 7 + 7 in 90 per cent, 6 + 7 in 7 per cent, 7 + 8 in 3 per cent; infralabials 10 + 10 in 52 per cent, 9 + 10 in 21 per cent, 9 + 9 in 17 per cent, 8 + 9 in 7 per cent, and 8 + 8 in 3 per cent; preoculars 2 + 2 in 100 per cent; postoculars 2 + 2 in 97 per cent, and 2 + 1 in 3 per cent.

Habits.—This slender, innocuous water snake is the stream counterpart of *N. grahami*. The two species are similar in appearance as well as in habits but they are unlike in habitat preference; the queen snake occurs in fast streams in forested regions, Graham's water snake in sluggish water in prairie areas. *N. septemvittata* is shy and it is difficult to capture except when

under rocks. Like Graham's water snake, this species apparently feeds chiefly on newly molted crayfish. Newly captured individuals have been known to regurgitate small fish.

Three captive females gave birth to broods of 7, 9, and 12 young in late August.

Illinois Distribution.—The queen snake occurs in the northeastern quarter of Illinois, west at least to Ogle and Fulton counties and south to Vermilion County, fig. 240. The species is most abundant along small, rocky streams in the wooded areas near the Indiana-Illinois state line. The known localities in Fulton, Woodford, and La Salle counties probably represent a southwestern extension of range along the wooded bluffs of the upper Illinois River, since specimens have not been found in the adjacent prairie counties of central Illinois.

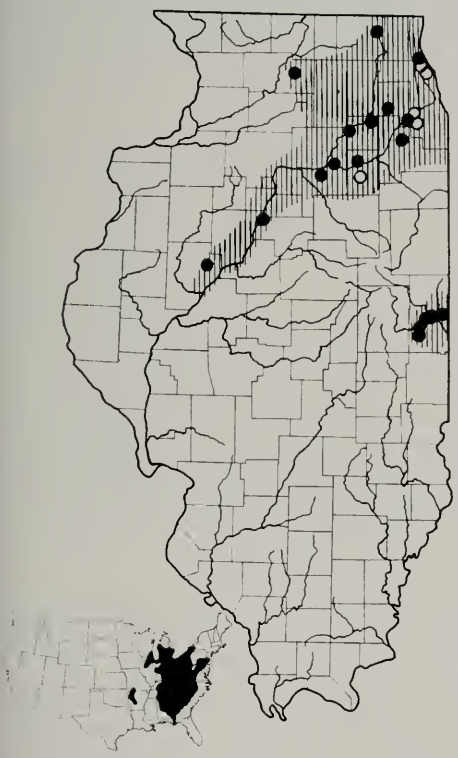


Fig. 240.—Distribution of *Natrix septemvittata*. Hatching indicates the presumed range of the species in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: Bowmanville, Evanston, Glencoe, Lambert, Palos Park, Willow Springs (Schmidt & Necker 1935); GRUNDY COUNTY: Morris (Stille & Edgren 1948).

Natrix sipedon (Linnaeus)

Ten subspecies of *Natrix sipedon* are recognized in the United States and Canada; three of them occur in Illinois. The nominate race and an Interior Low Plateau race (*pleuralis*) intergrade in an extremely wide belt across central Illinois. A distinctive race of the lower Mississippi River valley (*confluens*) extends northward to the southern tip of the state. Intergradation between *confluens* and *pleuralis* has not been clearly demonstrated.

Natrix sipedon sipedon (Linnaeus)
Northern Water Snake

Coluber sipedon Linnaeus 1758:219 (type locality: North America; revised to vicinity of New York City by Schmidt 1953).
Nerodia sipedon, Kennicott 1855:592.
Tropidonotus sipedon sipedon, Yarrow 1882*a*: 134–5.
Nerodia sipedon sipedon, H. Garman 1892:269–72.
Natrix sipedon, Hurter 1897:500 (I).
Natrix fasciata sipedon, Cope 1900:971–2.
Natrix sipedon sipedon, Van Cleave 1928:133, 136.
Tropidonotus sipedon woodhousei, Cope 1877: 64.
Natrix sipedon woodhousei, Jordan 1888:194.
Natrix fasciatus nec Linnaeus, Gaige 1914:4 (I).
?Natrix sp., Hankinson 1910:25 (I).

Diagnosis.—A large, heavy-bodied water snake (largest Illinois specimen 1,229 mm. in total length), fig. 241, with 23 anterior and 17 or 19 posterior rows of strongly keeled scales; ventrals 135 to 149; caudals 58 to 80; anal plate divided; supralabials usually 8 + 8; infralabials usually 10 or 11 on each side; preoculars usually 1 + 1; postoculars 3 + 3; groundcolor gray, tan, or light brown, with 30 or more red-brown or dark brown dorsal blotches or transverse bands; usually less than 10 transverse bands, succeeded by 20 or more dorsal blotches that alternate with lateral dark bars; lateral

Fig. 241.—An adult *Natrix sipedon sipedon* from Will County, Illinois. The groundcolor is gray or light brown; the blotches are red-brown or brownish black.

Table 83.—Sexual variation in Illinois *Natrix sipedon*. Figures in parentheses are numbers of specimens.

Characteristic	Males (21)		Females (30)	
	Range	Mean	Range	Mean
Caudals	72–80	75.5	57–72	63.2
Tail length as percentage of total length	23.5–27.3	25.6	20.5–24.8	22.6

Table 84.—Geographic variation in pattern features of Illinois *Natrix sipedon sipedon* and *N. s. sipedon* × *pleuralis* intergrades. Figures in parentheses are numbers of specimens.

Characteristic	Area I* (10 Males, 12 Females)		Area II* (13 Males, 18 Females)		Area III* (11 Males, 14 Females)		Area IV* (4 Males, 7 Females)		Area V* (9 Males, 11 Females)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Body blotches and rings	30–40	36.2	26–44	33.1	25–35	31.3	25–33	28.8	24–30	26.4
Transverse body rings	5–17	9.2	5–29	11.6	6–30	13.9	7–18	12.0	5–28	13.1
Tail rings										
Male	20–27	24.5	16–23	19.7	16–23	19.7	17–25	21.5	18–29	20.8
Female	17–26	21.5	16–22	18.1	16–22	18.1	15–23	19.0	14–19	15.6
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
Lateral blotches narrower than interspaces	0.9		9.6		17.0		50.0		45.0	
Lateral blotches wider than interspaces	68.0		51.0		62.0		20.0		10.0	

*Area I is approximately the northern third of Illinois. Area II is east-central Illinois, the region enclosed by Vermilion and Clark, Logan and Christian counties. Area III is west-central Illinois, the area enclosed by Mercer, Fulton, and Jersey counties. Area IV is southwestern Illinois; it includes the counties from Madison and Fayette south through Randolph and Franklin counties. Area V is southeastern Illinois; it includes the region enclosed by Crawford and Effingham through Wabash and Wayne counties. The sample from Area I consists of genetically pure *N. s. sipedon*; samples from all other areas are *N. s. sipedon* × *pleuralis* intergrades.

dark bars usually wider than light interspaces; tail usually with 20 or more dark rings; venter with numerous semilunar brown or red markings, occasionally the ventral pattern almost obliterated by dark stippling.

Variation.—The male of the northern water snake is longer tailed than the female. Sexual variation is identical in *Natrix sipedon sipedon* and the allied race, *N. s. pleuralis*. It is illustrated by 51 specimens of both races as well as by intergrade specimens, table 83.

The number of dark tail rings varies both sexually and geographically. The male of *N. s. sipedon* has 20 to 27 (average 24.5) rings; the female has 17 to 26 (average 21.5). The number of tail rings in individuals decreases toward the south, but the males continue to average 1 to 3 more rings than females.

Juveniles of this subspecies differ from the adults in the greater contrast between groundcolor and blotches; in baby snakes the blotches appear almost black on a white background. The ventral markings are black in young, brown or reddish in subadults.

The only geographic variation discerned in this snake is in pattern. Lepidosis is apparently identical in all Illinois subspecies of *N. sipedon*. The pattern variation consists of a reduction, from north to south, in the number of dorsal blotches and tail rings, a narrowing in width of these markings, and a proportionately higher number of transverse bands at the expense of the alternating dorsal and lateral blotches. These trends are illustrated in table 84.

Inasmuch as scutellation is apparently identical in *N. s. sipedon* and *N. s. pleuralis*, individual variation in scale counts has been summarized for 54 specimens of both races as well as intergrade specimens. Anterior scale rows are 22 in 4 per cent of the specimens, 23 in 87 per cent, 24 in 7 per cent, and 25 in 2 per cent; scale rows at mid-body are 22 in 11 per cent, 23 in 67 per cent, 24 in 20 per cent, and 25 in 2 per cent; posterior scale rows are 17 in 33 per cent, 18 in 37 per cent, and 19 in 30 per cent. Supralabials are 7 + 8 in 2 per cent, 8 + 8 in 89 per cent, 8 + 9 in 5 per cent, 9 + 9 in 2 per cent, and 8 + 10 in 2 per cent; infralabials 10 + 9 in 2 per cent, 10 + 10 in 81 per cent, 10 + 11 in 9 per cent, 11 + 11 in 2 per cent, 12 + 12 in 4 per cent, and 10 + 12 in 2 per cent; preoculars 1 + 1 in 94 per cent, 1 + 2 in 4 per cent, and 2 + 2 in 2 per cent; postoculars 2 + 2 in 9 per cent, 3 + 3 in 82 per cent, and 2 + 3 in 9 per cent. The number of ventrals ranges from 135 to 149, averaging 141.8.

Habits.—The northern water snake is essentially a stream species, although it can be found around lakes and ponds as well. It is active both day and night and in disposition is similar to the other large water snakes. Most specimens have been collected by raising rocks at the edge of the water and grabbing the snakes before they could escape. Their food consists primarily of fish and amphibians.

Captive females have given birth to broods of 8, 9, 11, 12, 17, and 51 young in late August and in September.

Illinois Distribution.—*N. s. sipedon* in its typical form occurs in northern Illinois: south to Champaign County in eastern Illinois and to Henderson County in the western part of the state, fig. 244. Specimens intermediate between *sipedon* and *pleuralis* occur in a broad belt extending from Champaign and Henderson counties as far south as White and Randolph counties. Specimens north of a line drawn from Charleston to Quincy, although intergrade in pattern, show a greater influence of *sipedon* and can usually be referred to the northern race.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: COOK COUNTY: West Northfield (Yarrow 1882*a*); Worth (Schmidt & Necker 1935); DU PAGE COUNTY: Glen Ellyn (Schmidt & Necker 1935); KNOX COUNTY: 2½ mi. E Galesburg (Adcock 1922); LAKE COUNTY: Beach (Schmidt & Necker 1935); Dead River (Necker 1939*c*); ST. CLAIR COUNTY: Belleville (Yarrow 1882*a*); Bluff Lake, Cahokia (Hurter 1893); WILL COUNTY: Wheatland Township (Necker 1939*c*).

Natrix sipedon pleuralis Cope
Midland Water Snake

Natrix fasciata pleuralis Cope 1892:672 (type locality: probably Summerville, South Carolina).
Natrix sipedon pleuralis, Clay 1938:178.
Nerodia sipedon, Kennicott 1855:592 (part).
Tropidonotus sipedon sipedon nec Linnaeus, Yarrow 1882*a*:134–5.

Nerodia sipedon sipedon nec Linnaeus, H. Garman 1892:269–72.
Natrix sipedon, Hurter 1897:500 (I).
Natrix fasciata sipedon nec Linnaeus, Cope 1900:971–2 (I).
Natrix sipedon sipedon nec Linnaeus, Blanchard 1924*b*:539.
Tropidonotus sipedon woodhousei, Cope 1877: 64 (I).
Natrix sipedon woodhousei, Jordan 1888:194.
?Tropidonotus fasciatus nec Linnaeus, Davis & Rice 1883*a*:31.
Nerodia sipedon fasciatus nec Linnaeus, H. Garman 1892:269–71.
Natrix fasciatus nec Linnaeus, Gaige 1914:4 (I).
?Natrix sp., Hankinson 1910:25 (I).

Diagnosis.—A subspecies of *Natrix sipedon* (largest Illinois specimen 1,144 mm. in total length), fig. 242; similar in scutellation to *N. s. sipedon* but differing in the following details of pattern: usually less than 30 body blotches, which ordinarily consist of more than 10 transverse bands on anterior part of body and less than 20 alternating dorsal spots and lateral bars; lateral dark bars and sides of transverse bands usually much narrower than light interspaces; tail with less than 19 dark rings; ventral pattern usually with semilunar red markings, tending to form longitudinal rows.

Variation.—In addition to the dimorphism in number of caudals and in proportionate tail length (which is described under *N. s. sipedon*), the greater length of the tail in males of *N. s. pleuralis* is reflected by the number of dark tail rings. Ten males at hand exhibit a range of 15 to 18 tail rings, averaging 17; 15 females show a range of 11 to 17, averaging 14.4.

Ontogenetic variation of *N. s. pleuralis* is similar to that found in *N. s. sipedon.* Old

Fig. 242.—An adult *Natrix sipedon pleuralis* from Union County, Illinois. The groundcolor is light gray or tan; the bands and blotches are rich red-brown. The underside is conspicuously spotted with red semilunar markings.

individuals of *pleuralis* seldom show the dark stippling and general suffusion of dark pigment which characterizes very large specimens of the subspecies *sipedon*.

Geographic variation is not well marked in Illinois *pleuralis*, inasmuch as the range of the race in its typical form occupies only a little more than a dozen counties. The number of dorsal body blotches ranges from 22 to 28, averaging 24.7. The number of transverse bands on the anterior portion of the body ranges from 6 to 25, averaging 15.1. The lateral bars are definitely narrower than the light interspaces in 96 per cent of the 25 specimens at hand and equal to the interspace width in 4 per cent.

Individual variation in scutellation has been summarized for both *N. s. sipedon* and *N. s. pleuralis* under the account for the subspecies *sipedon*.

Occasional specimens from the southern counties of Illinois are peculiar in appearance because of the extremely narrow transverse bands. Many of these ringed snakes, even as juveniles, have a brownish groundcolor rather than the light gray or white characteristic of baby *N. s. sipedon*. These differences suggest influence of *N. s. confluens*. It is not difficult to derive the *confluens*-type pattern from *pleuralis*-type by envisioning fusion of pairs of dark rings and a general darkening of the groundcolor. Nevertheless, no specimens have been examined which are not clearly referable to either *pleuralis* or *confluens*.

Habits.—The habits of this water snake are very similar to those of *N. s. sipedon*, although *pleuralis* in Illinois shows a more marked preference for swift-running streams.

Brood counts of 50, 32, and 13 young are available for southern Illinois females of *pleuralis*. The average brood size is much smaller. Young are born in August and September. A female captured July 2 contained 10 small, living embryos and three large, dead young. The dead young were somewhat calcified, evidently having been retained by the mother from the previous season.

Illinois Distribution.—The range of typical *pleuralis* in Illinois consists of those counties south of Randolph and White counties, excluding the floodplain swamps of Union and Alexander counties, fig. 244. Although primarily a stream snake, *pleuralis* occurs occasionally in lakes and ponds. Specimens have not been found in the Austroriparian swamps.

Although undocumented by specimens, a published record for the following additional locality is believed valid and is indicated on the distributional map by a hollow symbol: WABASH COUNTY: Mount Carmel (Cope 1877).

Natrix sipedon confluens Blanchard
Broad-Banded Water Snake

Natrix fasciata confluens Blanchard 1923*b*:1 (type locality: Butler County, Missouri).
Natrix sipedon confluens, Necker 1934:129.
?Natrix fasciata nec Linnaeus, Hurter 1911: 154.
?Natrix sipedon fasciata nec Linnaeus, Löding 1922:35.

Diagnosis.—Presumably a subspecies of *Natrix sipedon* (largest Illinois specimen 931 mm. in total length), fig. 243; similar in scutellation to other races of *N. sipedon* but differing markedly in pattern and color as follows: a light wedge-shaped mark on each side of the head extending from the sides of the parietals diagonally to the throat; groundcolor yellowish, with 14 to 26 wide, black or chestnut-brown dorsal blotches, separated by narrow yellow interspaces; 21 to 35 lateral bars of black or brown extending from the ventrals to the dorsal blotches; venter yellow, heavily checkered with black or brown squares or rectangular blotches.

Fig. 243.—A juvenile *Natrix sipedon confluens* from Alexander County, Illinois. The groundcolor is yellow, suffused with brown or black; the bands are black or brown.

Table 85.—Sexual variation in Illinois *Natrix sipedon confluens*. Figures in parentheses are numbers of specimens.

Characteristic	Males (9)		Females (11)	
	Range	Mean	Range	Mean
Caudals	69–78	72.3	60–66	62.5
Tail length as percentage of total length	22.6–27.4	25.1	20.5–24.4	22.8

Variation.—Males in this subspecies have longer tails and greater numbers of caudals than females, table 85.

The juveniles are more distinctly banded than the adults, and the groundcolor is usually clear yellow or tan, lacking the dusky suffusion of large specimens.

Individual variation in scutellation of 21 specimens from a single Illinois locality is slight. Ventrals range from 133 to 143, averaging 138.4; supralabials 8 + 8 in 80 per cent of specimens, 8 + 9 in 15 per cent, 9 + 9 in 5 per cent; infralabials 9 + 10 in 10 per cent, 10 + 10 in 65 per cent, 10 + 11 in 20 per cent, 11 + 11 in 5 per cent; preoculars 1 + 1 in 95 per cent, 1 + 2 in 5 per cent; postoculars 2 + 2 in 15 per cent, 2 + 3 in 35 per cent, 3 + 3 in 50 per cent.

In this series the pattern is more variable than the scutellation. The number of dorsal blotches ranges from 14 to 26, averaging 18.3. The number of dark lateral bands per side ranges from 20 to 35, averaging 25.1. The ventral pattern varies from a predominantly black venter to a yellow venter with scattered black or brown squares.

This series is somewhat atypical because of the high blotch count, and it is, in fact, intermediate in this character between *confluens* and Gulf Coast *fasciata*. Specimens with high blotch counts tend to have better-defined lateral bands; and, although these may be interpreted as expressions of slight *pleuralis* influence, the Illinois specimens are actually almost identical with coastal *fasciata*. They are best regarded as *confluens*, however, since *fasciata* is restricted to the Gulf region between the Mississippi River and peninsular Florida. All 21 specimens possess the head markings characteristic of both *confluens* and *fasciata* but not characteristic of other Illinois races of *N. sipedon*.

Habits.—The broad-banded water snake, unlike *N. s. sipedon* and *N. s. pleuralis*, occurs in lakes and cypress swamps and is, in fact, the only *sipedon* representative in this type of habitat. Otherwise, it is similar in habits to the other subspecies.

A female from Horseshoe Lake, Alexander County, contained 13 full-sized embryos.

Fig. 244.—Distribution of *Natrix sipedon*. Vertical hatching indicates the presumed range of the subspecies *sipedon* in Illinois; horizontal hatching, the presumed range of the subspecies *pleuralis;* diagonal hatching, the presumed range of the subspecies *confluens;* crosshatching, the area of intergradation between *sipedon* and *pleuralis;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Illinois Distribution.—This brightly marked banded water snake is known in Illinois only from the vicinity of Horseshoe Lake, Alexander County, and it is decidedly uncommon, fig. 244. Field work in similar habitats elsewhere on the Mississippi floodplain in Alexander and Union counties has not revealed other populations. In fact, no specimens of the *N. sipedon* group have been found in these localities.

CROTALIDAE

Pit vipers are found in the New World, Asia, and eastern Europe. Three genera are known in the United States, and all are represented in Illinois. The pit vipers are regarded by some authors as a subfamily of the Viperidae.

Agkistrodon Beauvois

Two polytypic species of *Agkistrodon* occur in the United States and in Illinois. The distribution of the genus is similar to that of the family Crotalidae.

Agkistrodon piscivorus leucostomus (Troost)

Western Cottonmouth Water Moccasin

Acontias leucostoma Troost 1836:176 (type locality: western Tennessee; revised to 10 mi. NE of Bolivar, Hardeman County, by Schmidt 1953).

Agkistrodon piscivorus leucostoma, Gloyd & Conant 1943:164–5.

Ancistrodon piscivorus leucostoma, Schmidt 1953:225.

Agkistrodon piscivorus leucostomus, Smith & Taylor 1945:178.

Ancistrodon piscivorus, Cope 1877:64.

Ancistrodon piscivorus piscivorus nec Lacépède, Yarrow 1382*a*:79.

Agkistrodon piscivorus, Jordan 1888:199.

Diagnosis.—A large, very heavy-bodied snake (largest Illinois specimen 1,121 mm. in total length), fig. 245; usually with 25 anterior and 21 posterior rows of strongly keeled scales; ventrals 132 to 137; caudals 39 to 47, only the posterior third or half of which are divided; anal plate entire; head flattened, much wider than neck; top of head with 9 large symmetrical plates; pit between eye and nostril on each side of head; supralabials 7 or 8, infralabials from 9 to 12, usually 11 on a side; eye pupil elliptical; body with 12 to 18 broad, usually dim crossbands that are narrowest at mid-back; venter heavily blotched with black; groundcolor above red-brown in young, rusty brown in subadults, and dark olive in adults.

Variation.—Sexual dimorphism is not well marked in *Agkistrodon piscivorus,* and specimens can be reliably sexed only by dissection. Sixteen males range from 42 to 47 (average 44.5) in caudal counts and from 12.3 to 17.9 (average 15.2) per cent in proportionate tail length. Twelve females range from 39 to 45 (average 42.5) in caudals and

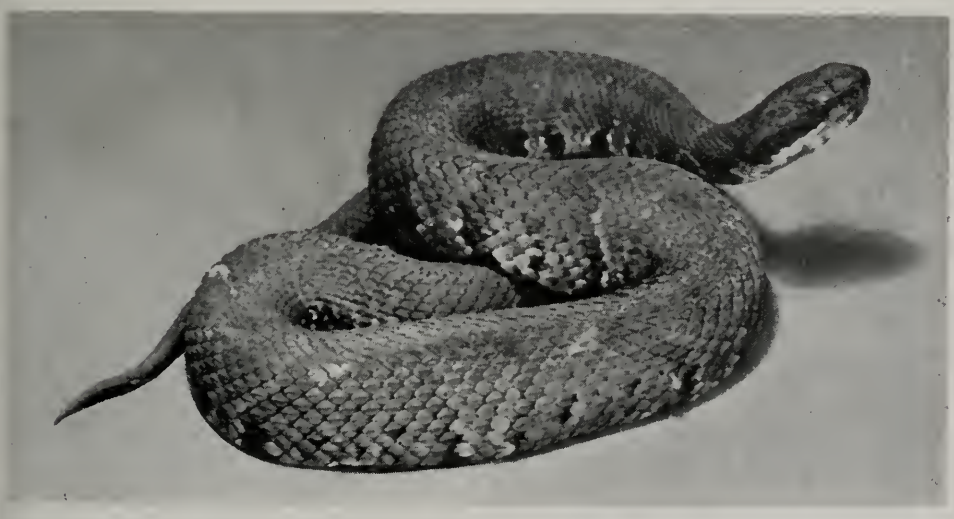


Fig. 245.—A subadult *Agkistrodon piscivorus leucostomus* from Jackson County, Illinois. The groundcolor varies from dark rusty brown to dark olive; the bands are dark brown to black.

in tail length from 12.1 to 16.5 (average 14.5) per cent of total length. Females occasionally (25 per cent in our sample) have 23 posterior rows of scales; all males in the sample at hand have 21.

Ontogenetic variation in water moccasins consists of four general color phases based on age. Individual variation is considerable in each size-class.

Baby water moccasins, in the first color phase, are conspicuously banded with wide saddles that are narrowest on the middorsum. These bands are heavily margined with black. The groundcolor is light redbrown, often with a wash of orange. Although Gloyd & Conant (1943) stated that the dull juvenile color of *A. p. leucostomus* is a diagnostic character of the subspecies, many southern Illinois juveniles are so brightly colored as to resemble copperheads. A distinct black postorbital stripe is present on each side of the head. The tip of the tail is sulfur yellow.

The second color phase includes older juveniles. These snakes differ from the newly born snakes in that the pattern details have dimmed and the bright coloration has been replaced by a dirty rusty brown groundcolor. The yellow tail tip is evident ventrally only or is completely lost.

Subadults, in the third color phase, are very dark. The venter, particularly on the posterior part of the body, and the dorsal side of the tail are predominantly black. The crossbands are usually indicated by light-flecked scales that border the bands.

Large water moccasins, in the fourth color phase, are dark olive above and below and have dark crossbands. The pattern on the dorsum and venter is more pronounced in large adults than in subadults in the second and third color phases.

Individual variation in a sample of 30 snakes is as follows: ventrals 132 to 137 (average 135.2); anterior scale rows 23 in 7 per cent of specimens, 24 in 10 per cent, 25 in 24 per cent, 26 in 52 per cent, 27 in 7 per cent; scale rows at mid-body 23 in 7 per cent, 25 in 90 per cent, 26 in 3 per cent; posterior scale rows 19 in 4 per cent, 21 in 86 per cent, 23 in 10 per cent; supralabials 8 + 8 in 86 per cent, 7 + 7 in 10 per cent, 7 + 8 in 4 per cent; infralabials 11 + 11 in 69 per cent, 10 + 10 in 14 per cent, 11 + 12 in 10 per cent, 10 + 11 in 3.5 per cent, 9 + 11 in 3.5 per cent; body crossbands 12 to 18 (average 13.3). The mean number of caudals for both sexes is 43.5. The number of entire caudals ranges from 8 to 36, averaging 24.8.

Habits.—In the summer months, this ugly, ill-tempered snake frequents sloughs and swamps and in the fall migrates to rock bluffs, where it hibernates in fissures in the rocks along with rattlesnakes and black snakes. Occasionally the water moccasin is encountered during the day, but it is essentially nocturnal. In the wild the moccasin will sometimes run if found near vegetation or water, but if met in the open it usually draws its head back and opens its mouth in threatening behavior. If further annoyed the heavy tail is vibrated and the snake coils to strike, continuing to expose the inside of its mouth. Although recent deaths in Illinois due to the bite of the moccasin are unknown, the bite is serious, and care should be taken to avoid this snake. The cottonmouth feeds on a variety of animals, including snails, fish, amphibians, snakes, and mammals. At least one instance of carrion-feeding is known. Klimstra (1959*b*) noted that in southern Illinois fish constitute 32 per cent of its diet, amphibians 26 per cent, reptiles 18 per cent, and mammals 18 per cent.

Captives have given birth to broods of three to five young in the laboratory during early September.

Illinois Distribution.—The cottonmouth in Illinois is restricted to the southern tip of the state, fig. 246. It is abundant on the Mississippi River floodplain and adjacent rock bluffs from Jackson County southward, but numerous visits to the counties to the north have yielded specimens from only one locality—a marsh near Fults, Monroe County. The amount of field work in Randolph County, where moccasins are expected but have not been found, strongly suggests that the Fults population may be an isolated relict. Hurter (1897) reported having seen the species opposite St. Louis. Residents in this area are not familiar with the moccasin, although they recognize copperheads and rattlesnakes. It is therefore possible that Hurter's snakes might have been a localized colony similar to that at Fults.

A parallel situation may have existed along the Wabash River, as Ridgway (Cope 1877) reported the species at Mount Carmel. Fishermen and other residents who have been questioned do not believe the cot-

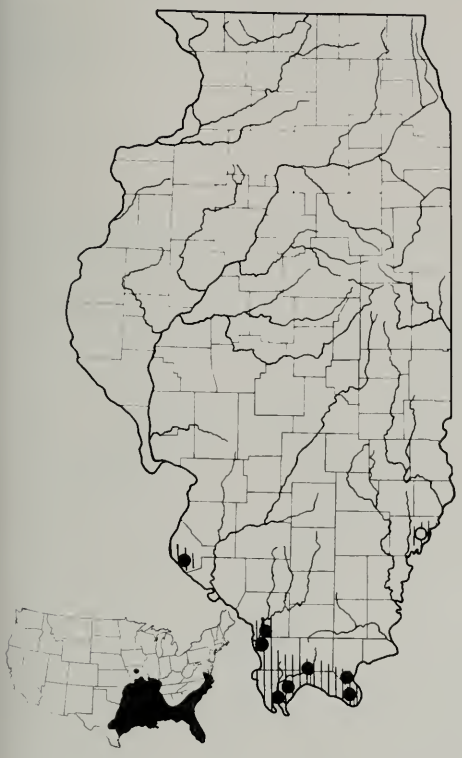


Fig. 246.—Distribution of *Agkistrodon piscivorus*. Hatching indicates the presumed range of the subspecies *leucostomus* in Illinois; solid circles indicate localities represented by specimens examined during this study; the open circle indicates a locality represented by a published record believed to be valid. The lower map depicts the total range of the species in the United States.

tonmouth occurs anywhere on the Wabash River. It appears that the moccasin does not at present inhabit the Wabash Valley, as there are no recent records for Illinois or adjacent Indiana. It is more common in the southern tip than the map indicates.

Although undocumented by specimens, a published record for the following locality is believed valid and is indicated on the distribution map by a hollow symbol: WABASH COUNTY: Mount Carmel (Cope 1877).

Agkistrodon contortrix (Linnaeus)

Four North American subspecies of the copperhead are recognized. An eastern subspecies and an intergrade population combining characters of the eastern race and the nominate race occur in Illinois.

Agkistrodon contortrix mokeson (Daudin) Northern Copperhead

Cenchris mokeson Daudin 1803:358 (type locality: vicinity of Philadelphia, Pennsylvania).
Agkistrodon mokeson mokeson, Gloyd & Conant 1943:150–3.
Agkistrodon contortrix mokeson, Perkins 1949: 24.
Agkistrodon d. mokeson, Wright & Wright 1952:585.
Ancistrodon contortrix mokeson, Schmidt 1953:224.
Agkistroton contortrix, Brendel 1857:254.
Ancistrodon contortrix, Davis & Rice 1883*a*:28.
Agkistrodon contortrix, Stejneger 1895:404.
Agkistrodon contortrix contortrix, Perkins 1949:24 (I).
Agkistrodon d. contortrix, Wright & Wright 1952:585 (I).
Ancistrodon contortrix contortrix, Schmidt 1953:224 (I).
Agkistrodon mokasen, Stejneger & Barbour 1917:106–7.
Agkistrodon mokasen mokasen, Conant 1934: 22.
Agkistrodon mokasen cupreus, Gloyd & Conant 1938:164–5.
Agkistrodon mokeson austrinus Gloyd & Conant 1943:153 (type locality: Gentilly, Orleans Parish, Louisiana).
Agkistrodon mokasen austrinus, Minton & Minton 1948:387.

Diagnosis.—A large, moderately heavy-bodied snake (largest Illinois specimen 1,383 mm. in total length), fig. 247, with 23 to 27 anterior and 19 or 21 posterior rows of strongly keeled scales; ventrals 147 to 155; caudals 41 to 50, the posterior fourth of which are divided; anal plate entire; head flattened, wider than neck; top of head with 9 large symmetrical plates; loreal present; pit present between eye and nostril on each side of head; supralabials 7 to 9, usually 8 per side; infralabials 8 to 11, usually 9 or 10 per side; eye pupil elliptical; groundcolor light red-brown or yellowish brown, with 11 to 18 hourglass-shaped crossbands having broad dark margins; venter light yellow-brown or red-brown, with brown blotches on the sides of ventrals; lateroventral blotches alternating with dorsal crossbands; a thin dark line on each side of head extending from eye to angle of jaws; head above this line red-brown, below yellowish white; a pair of dark parietal dots. The copperhead resembles the juvenile cottonmouth.

Variation.—In *Agkistrodon contortrix* sexual dimorphism in scutellation and proportions is slight, table 86.

Baby copperheads, like juvenile cottonmouths, have sulfur-yellow tails. As the snakes become older, the yellow is replaced by black. There is a slight tendency toward proportionately shorter tails in adult snakes, table 87.

Geographic variation in this snake is discernible only in details of color and pattern, table 88. Specimens from the Mississippi River counties show some influence of the Austroriparian race, *A. c. contortrix*, by having relatively paler hues, more con-

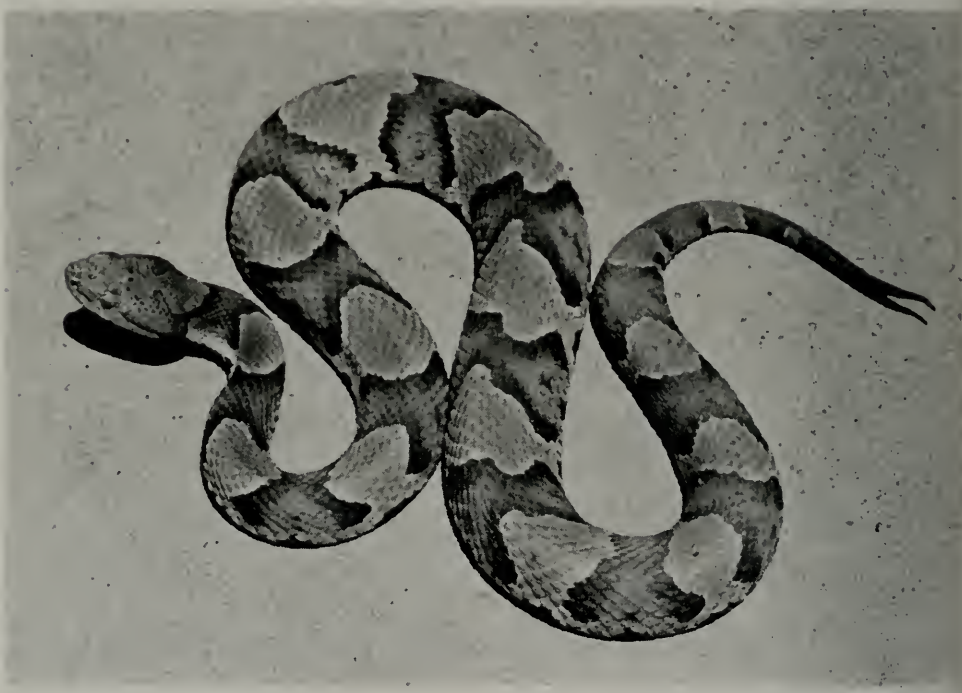


Fig. 247.—An adult *Agkistrodon contortrix mokeson* from Alexander County, Illinois. The groundcolor is tan or light red-brown; the bands are rich red-brown.

Table 86.—Sexual variation in Illinois *Agkistrodon contortrix*. Figures in parentheses are numbers of specimens.

Characteristic	Males (23)		Females (16)	
	Range	Mean	Range	Mean
Caudals	41–50	46.5	41–46	44.0
Tail length as percentage of total length	10.1–16.7	14.4	11.2–15.1	13.6

Table 87.—Ontogenetic variation in proportionate tail length in Illinois *Agkistrodon contortrix*. Figures in parentheses are numbers of specimens.

Characteristic	Under 500 mm. Total Length (19)		500–800 mm. Total Length (12)		Over 800 mm. Total Length (6)	
	Range	Mean	Range	Mean	Range	Mean
Tail length as percentage of total length	13.9–16.7	15.2	11.2–14.2	12.7	10.1–13.6	11.9

Table 88.—Geographic variation in pattern and color of Illinois *Agkistrodon contortrix*. Figures in parentheses are numbers of specimens.

Characteristic	East-Central Illinois (6)		Southeastern Illinois (19)		West-Central Illinois (9)		Southwestern Illinois (18)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Per cent of crossbands complete on individual specimen	73.5–100.0	88.3	62.5–100.0	87.0	28.5–93.0	71.0	44.5–100.0	81.5
Average width of crossbands (expressed in scale lengths)	2.2–3.3	2.6	2.0–3.4	2.6	1.8–2.8	2.4	2.0–3.1	2.5
	Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens		Per Cent of Specimens	
With pale colors of *A. c. contortrix*	0		0		50		41	
With paired dark dorsal spots between crossbands	100		94.5		25.0		41.0	

stricted crossbands dorsally, and a larger number of interrupted crossbands. This observation is in agreement with the findings of Gloyd & Conant (1943), although in all Illinois populations the influence of *mokeson* predominates.

Paradoxically, the sample from west-central Illinois exhibits more *contortrix* characters than the sample from extreme southwestern Illinois. This is the reverse of the expected condition, and the intergradation pattern parallels that of the *Natrix erythrogaster* races.

Individual variation in Illinois copperhead scutellation that shows no correlation with sex, age, and geography is as follows: ventrals 147 to 155 (average 150.0); body bands 11 to 18 (average 15.2); supralabials 7 + 8 in 16.5 per cent of specimens, 8 + 8 in 80.5 per cent, 8 + 9 in 3.0 per cent; infralabials 8 + 10 in 3.0 per cent, 9 + 9 in 30.5 per cent, 9 + 10 in 22.0 per cent, 9 + 11 in 5.5 per cent, 10 + 10 in 30.5 per cent, 10 + 11 in 8.5 per cent; anterior scale rows 23 in 5.0 per cent, 24 in 40.0 per cent, 25 in 25.0 per cent, 26 in 12.5 per cent, 27 in 15.0 per cent, 28 in 2.5 per cent; scale rows at mid-body 23 in 92.0 per cent, 24 in 5.5 per cent, 25 in 2.5 per cent; posterior scale rows 18 in 5.5 per cent, 19 in 73.0 per cent, 20 in 2.5 per cent, 21 in 19.0 per cent.

In general those Illinois copperheads with darker markings tend to have less constricted dorsal crossbands and to have varying amounts of dusky stippling on the venter. The presence of paired dark spots between the crossbands is probably also correlated with the prominence of the crossbands. The last-named feature has not been noted in published descriptions of copperheads insofar as I am aware.

Habits.—The richly colored copperhead inhabits wooded hillsides or bluffs, particularly those with rock outcrops. The species is active both at night and during the day. In spring and fall it may be numerous in talus slides at the foot of rock bluffs. During summer it is occasionally seen in meadows and fields. Abandoned sawmills and dilapidated buildings are particularly attractive to the copperhead, probably because of the usual presence of mice at such sites. The copperhead usually attempts to escape by running. When cornered it draws back its head and vibrates the tip of its tail. Although no deaths in Illinois are known from copperhead bites, the species is dangerous. The food consists of small mammals, birds, frogs, and some insects.

Captive females have given birth to broods of 3, 4, 5, 8, and 11 young. The earliest date of birth is July 30; the latest date September 10.

Illinois Distribution.—Copperheads occur in the southern third of Illinois, fig. 248, and they are moderately common in the

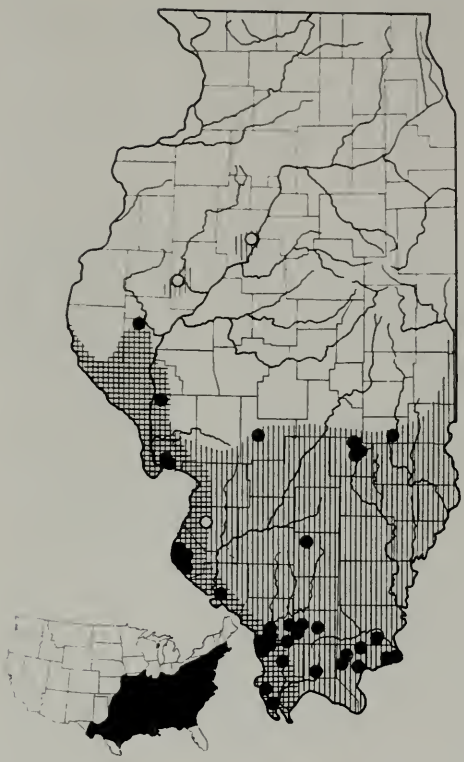


Fig. 248.—Distribution of *Agkistrodon contortrix*. Vertical hatching indicates the presumed range of the subspecies *mokeson* in Illinois; crosshatching, the area of intergradation between the subspecies *mokeson* and *contortrix;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Shawnee Hills and along the Mississippi River bluffs north to the mouth of the Illinois River. The region north of the Shawnee Hills and east of the Mississippi is probably occupied by a very few scattered relict colonies. The requisite wooded, rocky hillsides are sparse in this region, and even in those few local habitats which still appear suitable for *Agkistrodon,* copperheads may have been either completely exterminated or greatly reduced in numbers.

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: FULTON COUNTY: (Necker 1939*b*); PEORIA COUNTY: Peoria (H. Garman 1892); ST. CLAIR COUNTY: (Hurter 1911).

Sistrurus Garman

Two species of *Sistrurus,* each with several subspecies, occur in the United States and Canada. The genus is confined to North America. One form occurs in Illinois.

Sistrurus catenatus catenatus
(Rafinesque)
Eastern Massasauga Swamp Rattlesnake

Crotalinus catenatus Rafinesque 1818:41 (type locality: prairies of upper Missouri; revised to vicinity of Kansas City, Missouri, by Schmidt 1953).
Sistrurus catenatus, Hay 1891:109.
Crotalophorus catenatus, Hay 1892*b*:387.
Sistrurus catenatus catenatus, Cope 1900:1149.
Crotalophorus kirtlandii, Kennicott 1855:592.
Crotalophorus tergeminus nec Say, Baird 1854*b*:108.
Caudisona tergemina nec Say, Davis & Rice 1883*a*:28.

Diagnosis.—A moderate-sized, stout-bodied rattlesnake (largest Illinois specimen 885 mm. in total length), fig. 249, with 24 to 27 anterior and 18 or 19 posterior rows of strongly keeled scales; ventrals 138 to 151; caudals 22 to 31, the last few of which may be divided; a rattle or, in juvenile, a large "button" on tip of tail; supralabials 11 to 13 per side; infralabials 12 to 14 per side; top of head with 9 enlarged symmetrical plates; a pit present between eye and nostril on each side of head; groundcolor above gray or light brown, with 29 to 40 middorsal light-edged, dark, round, or concave blotches; each side of body with 2 or 3 rows of alternating round dark spots; tail with 4 to 7 dark rings; venter heavily mottled with black; narrow but distinct light stripe extending from pit to angle of jaws on each side of head; top of head with a pair of dark bars extending from the parietal onto the neck.

Variation.—Sexual variation in this snake is not pronounced but it is illustrated in several characters, table 89.

The juvenile massasauga differs from the adult in having a paler groundcolor, more distinct pattern, yellow on tip of tail, and a "button" rather than a rattle. The ventral mottling is also more discrete in young massasaugas than in adults, many of which are almost black beneath.

Adequate samples of this snake are not available to discern definite trends in geographic variation, although a blotch count

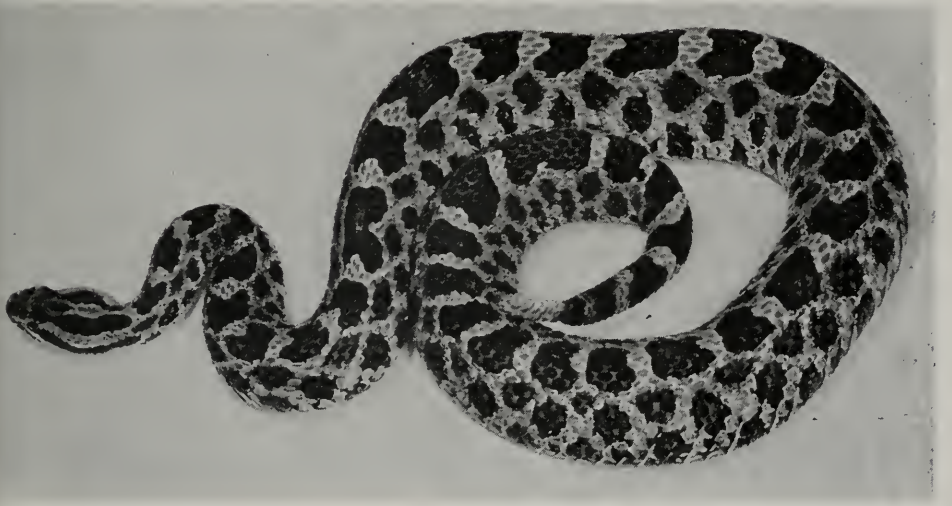


Fig. 249.—An adult *Sistrurus catenatus catenatus* from Piatt County, Illinois. The groundcolor is gray, tan, or light brown; the blotches are dark gray or dark brown.

Table 89.—Sexual variation in Illinois *Sistrurus catenatus catenatus*. Figures in parentheses are numbers of specimens.

Characteristic	Males (8)		Females (10)	
	Range	Mean	Range	Mean
Ventrals	138–145	140.8	138–151	143.4
Caudals	27–31	29.0	22–29	24.2
Body blotches	30–35	32.3	29–40	33.6
Tail rings	5–7	6.2	4–6	5.0
Tail length as percentage of total length	8.0–9.8	9.2	5.6–10.2	7.5

gradient from north to south is suggested when the average number of dorsal blotches of specimens from central Illinois is compared with that of specimens from southwestern Illinois. Fifteen specimens from the central part of the state have 23 to 40 (average 32.3) dorsal blotches; seven specimens from Madison and Fayette counties have 26 to 34 (average 29.5).

Individual variation in a sample of 18 specimens is as follows: anterior scale rows 25 in 29 per cent of specimens, 26 in 29 per cent, 27 in 35 per cent, and 28 in 6 per cent; scale rows at mid-body are 24 in 12 per cent, 25 in 70 per cent, 26 in 12 per cent, and 27 in 6 per cent; posterior scale rows are 18 in 18 per cent, 19 in 82 per cent. Some variation in darkness of groundcolor is apparent, but, in the course of this study, no melanistic specimens have been found. Kennicott (1855), however, mentions a black example from Cook County.

Habits.—Although this small rattlesnake occurs in bogs and other wooded areas, the preferred habitat is probably prairie marshes or old fields with heavy bluegrass cover. Specimens are occasionally found under objects such as logs or grain shocks, but most individuals are encountered sunning themselves on clumps of grass or crossing roads. Several of these snakes have been caught in snap traps set in mice runs in a prairie near Monticello. Wild specimens usually are retiring; a cornered individual may throw its body into coils and vibrate its rattle. A few persons in Illinois are known to have been bitten by massasaugas; although hospitalization was required for the bitten persons, they were not in serious danger. Small mammals appear to be the most important food item of massasaugas; birds are probably other items in the diet. A captive massasauga fed on small snakes, frogs, and mice.

According to Wright (1941) the brood size in northern Illinois ranges from 5 to 14, and the young are born in late August and early September.

Illinois Distribution.—The massasauga presumably was common over the northern four-fifths of Illinois before intensive cultivation and drainage of prairie marshes. The species now occurs in widely scattered colonies, fig. 250, where the land is too marshy for cultivation or where, for various reasons, agricultural practices have diminished.

Although undocumented by specimens, published records for the following localities are believed valid; most are indicated on the distribution map by hollow symbols: CLARK COUNTY: near Casey (P. W. Smith 1947); COLES COUNTY: Charleston (Hankinson 1917); COOK COUNTY: Palos Park (Pope 1944*b*); Wheeling (Schmidt & Necker 1935); EDGAR COUNTY: Paris (Hay 1892*b*); JACKSON COUNTY: Murphysboro (Gloyd 1940); KNOX COUNTY: Galesburg (H. Garman 1892); LAKE COUNTY: Deerfield (Schmidt & Necker 1935); MCLEAN COUNTY: Normal (H. Garman 1892); PEORIA COUNTY: Peoria (H. Garman 1892); WILL COUNTY: Crete (Stille & Edgren 1948); between Crete and Goodenow (Pope 1944*b*).

Fig. 250.—Distribution of *Sistrurus catenatus*. Hatching indicates the presumed range of the subspecies *catenatus* in Illinois; solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

Crotalus Linnaeus

Thirteen species of this North and South American genus occur within the continental United States. Most of the species have two or more subspecies.

Crotalus horridus Linnaeus

Two subspecies of timber rattlesnake are known. The nominate race and an intergrade population that exhibits characters of the Gulf Coastal race occur in Illinois.

Crotalus horridus horridus Linnaeus
Timber Rattlesnake

Crotalus horridus Linnaeus 1758:214 (type locality: America; revised to vicinity of New York City by Schmidt 1953); Davis & Rice 1883*a*:28.
Crotalus horridus horridus, Klauber 1936:246.
Crotalus horridus atricaudatus, Pope 1937:224.
Crotalus horridus horridus × *atricaudatus,* Necker 1939*b*:39.
Crotalurus cyanurus, Rafinesque 1820:5.
Crotalus duressus nec Linnaeus, Kennicott 1855:592.
Crotalus durissus nec Linnaeus, Brendel 1857: 254.

Diagnosis.—A large, stout-bodied snake (largest Illinois specimen 1,524 mm. in total length), fig. 251, with 21 to 27 anterior and 19 to 21 posterior rows of strongly keeled scales; ventrals 162 to 178; caudals 19 to 30, the last 1 or 2 of which may be divided; tip of tail with rattle or enlarged "button"; supralabials 12 to 16 per side; infralabials 13 to 18 per side; top of head covered with small asymmetrical scales and two enlarged plates; pit present between eye and nostril on each side of head; groundcolor gray, light yellow, or greenish white above, with 20 to 26 black dorsal blotches or angular rings; tail usually uniform black; venter gray, white, or yellow, with blotching and stippling present on sides of ventral plates; a middorsal rust-colored stripe occupying 2 to 5 scale widths on the anterior part of the

Fig. 251.—An adult *Crotalus horridus horridus* × *atricaudatus* intergrade from Jackson County, Illinois. The groundcolor may be pale gray, greenish white, or yellowish white; the bands are sooty black; a vague, middorsal rust-colored stripe is present on the anterior part of the body.

Table 90.—Sexual variation in Illinois *Crotalus horridus*. Figures in parentheses are numbers of specimens.

Characteristic	Males (14)		Females (15)	
	Range	Mean	Range	Mean
Ventrals	162–174	168.5	163–178	170.0
Caudals	21–30	26.0	19–23	20.7
Tail length as percentage of total length	5.4–9.6	7.4	5.1–8.0	6.3

body; a dark postorbital bar usually present on each side of head.

Variation.—The male of the timber rattlesnake has a slightly lower ventral count average than the female, table 90.

The juvenile differs from the adult most markedly in the presence of a terminal "button" rather than a rattle and in having a lighter groundcolor. Tail rings are sometimes visible on young snakes; the tails of subadults and adults are uniform black.

On the basis of the number of scale rows at mid-body and average adult size, the rattlesnakes of extreme southwestern Illinois are referable to the Coastal Plain race, *Crotalus horridus atricaudatus*, table 91. In ventral count averages and most details of pattern these snakes resemble the more northern specimens. Specimens from the Mississippi River counties of Illinois from Jackson County southward are therefore regarded as *C. h. horridus* × *atricaudatus*

Table 91.—Geographic variation in Illinois *Crotalus horridus*. Figures in parentheses are numbers of specimens.

NUMBER OF SCALE ROWS AT MID-BODY	ALEXANDER-PERRY COUNTIES (12)	MONROE-PIKE COUNTIES (8)	ROCK ISLAND-JO DAVIESS COUNTIES (5)	COLES-JASPER COUNTIES (4)
With 21 rows (per cent of specimens)	0	0	0	25
With 23 rows (per cent of specimens)	33	76	80	25
With 24 rows (per cent of specimens)	25	12	0	25
With 25 rows (per cent of specimens)	42	12	20	25

intergrades. This disposition of Illinois specimens is in complete agreement with the range definition of the two races as pointed out by Gloyd (1940).

Other variation in a sample of 30 timber rattlesnakes from various parts of Illinois is apparently individual. There is some evidence that snakes in one colony may differ from those in another colony in minor details of pattern. This variation among colonies is not clear-cut and may be fortuitous. Anterior scale rows in the 30 snakes mentioned above are as follows: 24 in 13 per cent of sample, 25 in 17 per cent, 26 in 50 per cent, and 27 in 20 per cent; posterior scale rows 18 in 3 per cent, 19 in 74 per cent, 20 in 20 per cent, and 21 in 3 per cent. Supralabials are highly variable; they range from 12 to 16 per side; 13 or 14 occur most frequently. Infralabials range from 13 to 18, 14 or 15 occuring most frequently. The number of body bands ranges from 20 to 26, averaging 23.6. A dark postorbital stripe on each side of the head is present in most snakes; it is dim in occasional specimens, particularly in those from northwestern and eastern Illinois. Light-centered lateral spots on anterior portion of body and black spots or dashes between the bands occur on nearly all the Illinois timber rattlers.

The black phase, which occurs in more eastern populations of timber rattlesnakes, has not been encountered in this state, and only one of the Illinois specimens (INHS 1548 from Greene County) has the decidedly yellow groundcolor of eastern snakes. Most Illinois specimens of *C. horridus* are light gray, with sooty black bands.

Habits.—This large rattlesnake is usually found in areas where there are forested bluffs and rock outcrops. It is active day and night. During the summer months, it may be found in upland forests or even in cultivated fields. Abandoned buildings, old sawmills, and brush piles are especially at-

Fig. 252.—Distribution of *Crotalus horridus*. Vertical hatching indicates the presumed range of the subspecies *horridus* in Illinois; cross-hatching, the area of intergradation between the subspecies *horridus* and *atricaudatus;* solid circles indicate localities represented by specimens examined during this study; open circles, localities represented by published records believed to be valid. The lower map depicts the total range of the species in the United States.

tractive places, probably because of the small mammals to be found in such sites. In the fall the timber rattler congregates at den sites, which are usually rock bluffs with many deep cracks and fissures. The species is not aggressive, but in the wild it usually does not try to run. Once disturbed it coils quickly, sounds its rattle, and prepares to strike. The bite of the timber rattlesnake is serious, and deaths of human beings have been caused by Illinois snakes of this species. The food of this snake apparently consists almost exclusively of mammals and birds.

Captive females of this species have given birth to broods of eight and nine young in late August.

Illinois Distribution.—The timber rattlesnake still occurs in all the Mississippi River counties of Illinois in which the river bluffs have not been denuded of forest. The species is fairly common in a few areas along the Mississippi River where rock outcrops are extensive. It occurs in widely scattered colonies in Illinois south of the Shelbyville Moraine, fig. 252, but it has become so rare in this part of the state that the killing of a rattlesnake is usually recorded in the local newspapers. The timber rattler formerly occurred in bluffs up the Illinois River to at least La Salle County. J. F. Toedte of Chicago possesses a snapshot of a large *C. horridus* killed near Bailey Falls about 1924. However, the occurrence of the species in the Chicago area within historic times is highly questionable, despite the statement "rare in Cook County" made by Kennicott (1855).

Although undocumented by specimens, published records for the following localities are believed valid and are indicated on the distribution map by hollow symbols: ADAMS COUNTY: Quincy (Gloyd 1940); COLES COUNTY: 3 mi. E Charleston (Hankinson 1917); FULTON COUNTY: (Necker 1939*b*); HANCOCK COUNTY: Augusta (Necker 1939*b*); Warsaw (Gloyd 1940); JEFFERSON COUNTY: Mount Vernon (H. Garman 1892); LA SALLE COUNTY: Bailey Falls (J. F. Toedte, personal communication); PEORIA COUNTY: Peoria (H. Garman 1892); PULASKI COUNTY: (Necker 1939*b*); RANDOLPH COUNTY: (Necker 1939*b*); ST. CLAIR COUNTY: Falling Springs (Hurter 1911); WABASH COUNTY: (H. Garman 1892).

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INDEX

The following index to scientific names includes synonyms as well as currently valid names. Synonymic names and combinations, variant spellings, and names of extralimital forms have page references in lightface; the currently valid name for each taxon that occurs in Illinois is recognizable because one page reference, that indicating where the taxon is discussed, is in **boldface**. For convenience in indexing, specific and subspecific names are given equal rank. Thus, a reference for the Illinois form *Bufo woodhousei fowleri* will be found under *Bufo fowleri; fowleri, Bufo; Bufo woodhousei;* and *woodhousei, Bufo*. The boldface reference will be found under *Bufo fowleri* and *fowleri, Bufo,* but not under *Bufo woodhousei* or *woodhousei, Bufo,* inasmuch as the nominate subspecies (*woodhousei*), which does not occur in Illinois, is not discussed in detail. Hybrids and intergrade populations are written in the conventional fashion with × to denote the relationship. The name of the parent population whose phenotypic influence predominates appears first. Individuals and populations of mixed parentage are regarded as genetically distinct from both parental taxa.

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