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Contributions to the Herpetology of Iowa

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CONTRIBUTIONS TO THE HERPETOLOGY OF IOWA.

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During the summer of 1907, the University of Michigan Museum was enabled, through the generosity of Mr. Bryant Walker, to send a collector to northwestern Iowa for the purpose of investigating the fauna of that region. With the appropriation the writer engaged Mr. Max M. Peet to assist him in the work.

The time spent in the field was from July 1 to September 1, and during this time attention was confined almost exclusively to mammals, birds, reptiles, amphibians, and mollusks. Besides the actual collecting of specimens, notes were made on the habitat relations of the forms, and the stomach contents of the vertebrates were saved in as many instances as possible. The present paper is the second[1] to appear on the results of this expedition.

To Mr. Max M. Peet the museum is under great obligations, for he accompanied the expedition with no other recompense than his expenses, and was untiring in his efforts to make the trip a successful one. Our thanks are also due to Mr. George A. Lincoln, State Game Warden of Iowa, who, after ascertaining the nature of our work, generously extended to us all of the privileges compatible with the law, and to Dr. Leonard Stejneger for comparing our specimens of *Eumeces septentrionalis* with the type in the U. S. National Museum and for verifying our determination of the specimens of *Chrysemys cinerea bellii*.

GENERAL ENVIRONIC CONDITIONS IN THE REGION.

The region explored lies within the adjacent parts of Clay and Palo Alto counties, Iowa. More exactly, collecting was confined to the townships of Riverton, Sioux, Lake, Freeman, and Logan, Clay county, and Lost Island and Highland in Palo Alto county. This area is in the prairie region, so-called, but lies near its western boundary, i. e., where it merges into the higher and more arid Great Plains.[2]

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* University of Michigan Museum.

[1]Ruthven, Alexander G., The Faunal Affinities of the Prairie Region of Central North America. Amer. Natur., XLII, pp. 388-393.

[2]Compare Harvey, LeRoy H., Floral Succession in the Prairie Grass Formation of Southeastern South Dakota. Bot. Gaz., XLVI, p. 81.

[3]Calvin, Samuel, Physiography of Iowa. The Iowa State Atlas (1904), pp. 258-259.

As is well known, the topography of Iowa is essentially that of an extensive plain. It is described by Calvin[3] as follows:

> The zero point on the river gauge at Keokuk has an elevation above tide of 477 feet; the elevation of Sibley, the highest important railway station in Iowa, is 1572 feet. It is possible that Ocheyedan mound or some of the morainic protuberances in Osceola County rises 100 feet higher than Sibley, but even then there is less than 1200 feet of difference between the lowest and highest points in the state. One hundred feet is gained at once by ascending the bluffs at Keokuk and passing on to the upland a short distance northwest of the city, so there is left but about 1100 feet as the sum of all the variations in level occurring over the general surface of the great state of Iowa. There are stretches, many miles in extent, so monotonously level that differences in altitude are scarcely perceptible.

While the state as a whole is thus a plain, it does not exhibit the tabular smoothness of the plains area to the westward. This is due to the fact that the region was large glaciated during the Glacial Epoch. From the standpoint of the region under discussion, the last ice-sheet, the Wisconsin, was the most important. It entered the state from the north, and on its retreat left extensive deposits of morainic material in the triangular area which it occupied. Calvin[4] defines the area glaciated by this ice sheet as follows: "The base of the triangle, where the comparatively narrow ice lobe crossed from Minnesota to Iowa, extends from Worth county to Osceola; the apex is at Des Moines. Through the western part of Worth, Cerro Gordo, Franklin and Hardin counties the edge of the Wisconsin drift overlaps the Iowan one; the apex of the Wisconsin lobe rests at Des Moines on the older Kansan. The Wisconsin area is in general a level ill-drained plain. The traveler may go for scores of miles without seeing a definite drainage trench so much as a foot in width or depth. Saucer-shaped depressions or 'kettle holes,' varying from a rod or two, to an eighth or a quarter of a mile in diameter, are common features of the Wisconsin plain." However, the Wisconsin ice sheet also formed large terminal moraines, and a well defined belt was developed along the western margin of the drift area, extending from Osceola, Dickinson and Emmet counties through eastern Clay and western Palo Alto counties to Guthrie county. In Clay and Palo Alto counties the topography consists of alternating hills and ridges—often 150 to 200 feet high—with intervening depressions containing meadows, lakes, ponds, or swamps according to the depth and drainage. A detailed description of the physiography of these two counties may be found in Volumes XI and XV of the Iowa Geological Survey reports.

The northwestern part is both the driest and coldest in the state. According to Sage[5] there is an east to west and south to north decrease in

[4] *Loc. cit.*, pp. 258-259.

[5] Sage, John R., Climatology of Iowa. The Iowa State Atlas (1904), pp. 259-260.

precipitation, the nine counties in the northwestern corner having a yearly average of 28.16 inches, 77 per cent of which occurs between April and September. According to the climatological maps published in the Atlas of Iowa, the region studied lies in a belt having a mean annual precipitation of 25-30 inches. Similarly there is a south to north decrease in temperature, the three northern tiers of counties having a mean annual temperature of 44 to 45 degrees. The physiographic and climatic conditions in the state are summarized in an excellent way in the Atlas of Iowa referred to above.

HABITATS.

Owing to the relief there is more diversity in the biotic environments of the region investigated than is usual in the prairie-plains region. The ridges and knobs, varying in height, are sparated by small areas of flat or gently rolling prairie, and everywhere are lakes, ponds and sloughs of various sizes. The immediate area studied was on the water-shed between the Missouri and Mississippi river systems, the lakes examined (lying near the Clay-Palo Alto county line) being the source of streams tributary to the different systems. Most of these lakes are drained by the Little Sioux river, which flows approximately through the center of Clay county, emptying into the Missouri, but a few are drained by tributaries of the Des Moines, which flows through Palo Alto county and is a tributary of the Mississippi.

The habitats at the present time may be classified as follows:

UPLAND.

Upland Prairie. Uncultivated areas, covered by the original vegetation of grasses and herbs, are still to be found on some of the ridges. These areas are, however, becoming fewer in number yearly, as more land is placed under cultivation. (Figs. 1 and 2.)

Grain Fields. The greater part of the higher land has, within the past thirty years, been placed under cultivation, and this has been mostly at the expense of the upland prairie areas. (Fig. 3.)

Groves. In many places groves of soft maple, cottonwood, willow, and box-elder have been planted on the uplands. These are so open, however, as to have no appreciable effect on the terrestrial vertebrate fauna, with the exception of the birds, the local distribution of which they are profoundly modifying. (Fig. 4.)

LOWLAND.

Lowland Prairie (Meadows). The low, generally poorly drained, areas have in many instances been reserved for hay-land or pasture. In

some places the original vegetation has been supplanted by tame grasses; in other places it remains undisturbed. The original vegetation consists of a dense growth of tall grasses and herbaceous forms. (Figs. 5 and 8.)

Swamps (Sloughs). The swamps are mostly devoid of trees and filled with a rank growth of grasses and sedges. The vegetation grows principally in clumps and on hummocks composed of roots and decaying vegetation. They are mostly uninfluenced by man, except as they are drained. (Fig. 5.)

Shores of Lakes and Streams (Marginal forests). This habitat supports the only natural timber in the region, and, where undisturbed, there is always a comparatively dense growth along the shores of the streams and larger lakes. The timber zones are, however, much narrower, and the trees more scrubby, than in the southern parts of the state. In most places at the present time this timber has been largely removed. (Fig. 6.)

AQUATIC.

The aquatic life is found in the lakes, ponds, sloughs and streams. The conditions in these habitats are very similar, as the lakes are for the most part shallow and the streams slow-flowing. (Figs. 9, 10, 11.)

AFFINITIES OF THE FAUNA.

Iowa is primarily a prairie state being situated well within the region of central North America that has long been noted for its rich growth of grasses and general lack of forest cover. With the exception of a small area in the northern part, the state lies entirely within the Carolinian area, or eastern humid division of the Upper Austral Zone, of Merriam. This area has been defined by Merriam[7] as follows:

> The Carolinan faunal area occupies the larger part of the Middle States, except the mountains, covering southeastern South Dakota, eastern Nebraska, Kansas, and part of Oklahoma; nearly the whole of Iowa, Missouri, Illinois, Indiana, Ohio, Maryland and Delaware; more than half of West Virginia, Kentucky, Tennessee, and New Jersey, and large areas in Alabama, Georgia, the Carolinas, Virginia, Pennsylvania, New York, Michigan, and southern Ontario. On the Atlantic coast it reaches from near the mouth of Chesapeake Bay to southern Connecticut, and sends narrow arms up the valleys of the Connecticut and Hudson rivers. A little farther west another slender arm is sent northward, following the east shore of Lake Michigan nearly or quite to Grand Traverse Bay.

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[6]For detailed notes on the flora of the immediate region see: Macbride, T. H., Iowa Geological Survey, Vol. XL., pp. 499-508; Cratty, R. I., Iowa Geological Survey, Vol. XV, pp. 260-276; Pammal, L. H., The Iowa State Atlas (1904), p. 268.

[7]Merriam, C. Hart, Life Zones and Crop Zones of the United States. U. S. Dept. Agri., Bureau Biol. Surv., Bull. X, pp. 30-31.

It has been shown elsewhere[8] that the prairie region cannot be merged with the forested region of the states east of Illinois, but that neither, on the other hand, can it be classed with the arid plains. The environic conditions differ from those of the eastern forest region in being more arid and principally characterized by grass associations, and from the arid plains in being less arid and supporting a greater tree growth. Furthermore and in harmony with these conditions, the terrestrial vertebrate fauna consists almost entirely of a mixture of eastern and western forms. In view of these conditions the region must be considered as a transition area.[9]

This point will not be discussed further, but it should be noted that the different elements in the fauna of northwestern Iowa occupy, as a rule, different habitats—the prairie forms being western, and the marginal forest forms eastern types, while in general it is those associated with aquatic conditions that occur in both regions. For instance, it is in the marginal forests along the shores of the streams and lakes (also now in the groves) that one finds the Blue Jay, Baltimore Oriole, Red-headed woodpecker and many other forms characteristic of the forest of eastern North America; it is on the prairie that one finds the prairie Hare, Thirteen-lined Spermophile, Franklin Spermophile, Western Meadow Lark, Grasshopper Sparrow, Prairie Chicken, Burrowing Owl, and many others, that are distinctly arid plains forms; while it is in the aquatic habtats that one finds the generally widely distributed water birds and amphibious mammals. That the elements in the amphibian-reptile fauna show the same distribution is, I believe, shown by the following table in which an attempt has been made to summarize briefly the local and general distribution of the forms.

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[8] Ruthven, Alexander G., *loc. cit.*

[9] In his former paper on the vertebrate fauna of the prairie region the writer did not attempt to discuss the literature, intending the paper as a contribution of additional data to the subject. To those not familiar with the literature it should be pointed out that Allen (Bull. American Museum of Nat. Hist., IV, p. 231, and The Auk, X, p. 129) has called attention to the fact that the eastern forest and plains faunae intergrade in the prairie region, in the following words: "The transition between the Humid and Arid Provinces is nowhere abrupt; they gradually merge into each other everywhere along their line of junction, as the prairies of the Mississippi Valley gradually become more arid and take on the characteristic aspect of the plains. There is thus here the usual 'transition' belt occurring between contiguous faunal areas." More than this, he has also called attention to the fact that the eastern birds by clinging to the borders of the streams push beyond the eastern forest region into the prairie-plains region (The Auk, X., p. 132).

DISTRIBUTION OF THE AMPHIBIANS AND REPTILES OF NORTHWESTERN IOWA.

E; occurring principally in the eastern forest region. G; occurring in both the prairie plains and the eastern forest regions. W; occurring principally west of the eastern forest region.

Prairie	Groves	Meadows	Sloughs	Shores of Lakes and Streams	Aquatic
				Acris gryllus (G)	A. gryllus (G) (Larvae)
Rana pipiens (G)		R. pipiens (G)	R. pipiens (G)	R. pipiens (G)	R. pipiens (G) (Larvae)
Bufo americanus (G)	B. americanus (G)	B. americanus (G)	B. americanus (G)	B. americanus (G)	B. americanus (G) (Larvae)
		Chorophilus nigritus triseriatus			C. n. triseriatus (Larvae)
					Chrysemys cinerea bellii (G)
					Chelydra serpentina (G)
Ambystoma tigrinum (G)	A. tigrinum (G)	A. tigrinum (G)		A. tigrinum (G)	A. tigrinum (G) (Larvae)
Thamnophis sirtalis parietalis (W)		T. sirtalis parietalis (W)	T. sirtalis parietalis (W)	T. sirtalis parietalis (W)	
Thamnophis radix (W)	T. radix (W)	T. radix (W)	T. radix (W)	T. radix (W)	
Heterodon nasicus (W)					
Liopeltis vernalis (G)		L. vernalis (G)			
Eumeces septentrionalis (W)					

It will be apparent from the table that there are exceptions to the above mentioned rule of distribution, as the aquatic *Chrysemys cinerea bellii* occurs principally to the west of the eastern forest region, while *Liopeltis vernalis* is an open habitat form and occurs both in the eastern forest and prairie-plains regions. These cases are exceptions, however, and do not disprove the general statement. It will also be noted that unlike the ornis there are few decidedly eastern forms in the fauna. I believe that this is due largely to the lack of collections from this habitat, and that when the fauna of the region is more perfectly known more eastern forms will be found in the region and associated with the marginal forest habitats.

However this may be, the table shows that, as far as our present knowledge goes, the reptile-amphibian fauna of northwestern Iowa is composed chiefly of a mixture of those forms that are either of western distribution or occur both in the plains and eastern forest regions and that the majority of the prairie types are western, and the forms closely associated with the aquatic conditions of wide ranging, distribution. This is not other than should be expected for:

1. The habitat conditions in the marginal forest along the streams and lakes most closely resemble those of the eastern forest region, as shown by the fact that the habitats are occupied by plants from the eastern forest.

2. The aquatic and shore habitats of the prairie-plains region are in direct communication with the eastern forest region by means of the tributaries of the Mississippi and Missouri rivers.

3. The prairie (especially the upland) habitats most nearly approach the general conditions on the Great Plains, into which they merge to the westward.

Referring to plants, Harvey[10] has recently stated similar conclusions as follows:

> A study of the floristics shows indisputably the commingling of forms of diverse geographical affinity. An unmistakable floristic relation, in many cases specific, exists with a southwestern and southeastern center of post-glacial dispersal. To the east and southeast the deciduous forest type becomes increasingly characteristic, while to the west and southwest the plain or prairie type gradually predominates; the region thus lies in the western border of the tension zone in which migration from these two competing centers of distribution meet. From the southeast the dispersal route has been up the Missouri valley; while the northwestern migration has spread diagonally across natural drainage lines, following the upland plains.

[10] *Loc. cit.*, p. 85. The reader is referred to Harvey's paper for a detailed discussion of the factors involved in the distribution of the flora in this region.

LIST OF SPECIES.

1. *Rana pipiens* Schreber.—Leopard Frog. This is the common frog of the region. It was found principally in the sloughs, but was not uncommon in the meadows and even on the prairie.

2. *Bufo americanus* Le Conte.—American Toad. The American toad is of general distribution in the region studied. The eggs are laid in the ponds and sloughs, and soon after the young are hatched they are found in the grassy margins of the sloughs and along the shores of the lakes and ponds. From here many of them work into the meadows and upon the upland prairies. The larger individuals are more abundant in the meadows, in the groves on the uplands, and in the timber zones on the shores of the lakes and streams.

3. *Chorophilus nigritus triseriatus* (Wied).—Swamp Tree Frog. The northwestern Iowa specimens are referred to this form, as the snout is produced, and the hind limb is short—the heel barely reaching the tympanum when the limb is extended along the side. The species is apparently rare in Clay and Palo Alto counties, and only a single specimen was found by the expedition. This individual was taken in the grass near a small pond on the prairie in Freeman township. The only other individuals observed in this region by the writer was in 1903, when they were found to be not uncommon in a stubble field just north of the locality where the above mentioned specimen was taken.

4. *Acris gryllus* Le Conte.—Cricket Frog. This frog was only found in one locality—in the eastern part of Riverton township, Clay county. Here large numbers were observed on the mud in abandoned channels of the Ocheyedan river. Probably owing to the habitat, most of the specimens are so dark as to obscure all of the markings, but in some the spots on the limbs may be made out, and the usual light stripes on the sides of the head are represented by small markings on the margin of the upper jaw.

5. *Ambystoma tigrinum* (Green).—Tiger Salamander. Two large individuals of this species were found in the cellar of a house in Highland township, Palo Alto county. It is not an uncommon species in the region. The writer has occasionally found it in the abandoned holes of the Spermophiles.

6. *Eumeces septentrionalis* (Baird).—Northern Skink. This specimen is apparently rather rare in Clay and Palo Alto counties. It was found on the uplands and in the higher meadows, but only very rarely. Individuals were observed in Highland township, Palo Alto county, and

in Freeman township, Clay county, and the writer has observed it in the latter locality in previous years. Its principal habitat is undoubtedly the upland prairie.

The coloration of the single specimen obtained is very distinctive (Fig. 7). The pale bluish green of the under surface is continued upward on the sides nearly to the first lateral band. This lateral band is pale bluish, of about one-third the width of a scale, and extends from the ear, just above the insertion of the limbs, upon the tail; it is narrowly and irregularly margined below with black and is itself rather irregular, giving off above some irregular pale marks. The sides are black to the upper lateral stripe, which lies about two scales above the first and extends from above the eye upon the tail. This upper stripe is pale yellow and even narrower than the first, but is more regular. Above the upper lateral band there is a band of black (two half scale rows wide) extending upon the head to the supraocular region. On the median six rows the predominating color is pale brownish olive, as is also the top of the head and the snout. The wide olive dorsal band is irregularly broken up with black which is mostly confined to the edges of the scale rows, forming narrow broken bands the median two of which are the better defined. The chin is pale yellow, and the tail olive with narrow black bands. Cope's[11] figures show the scutellation very well. There are 4 supraoculars, 7 supralabials, a postmental, and no postnasal.

The range of the species is as yet very imperfectly known. Originally[12] described from "Minnesota and Nebraska," other specimens have since been listed by Cope from Red River of the North; Sand Hills, Nebraska; Neosho Falls, Kansas; Fort Kearney, Nebraska; and Old Fort Cobb. It seems that this is the first record for Iowa. Hoy[13] says that in Wisconsin the species is not uncommon as far north as Lake Winnebago, but, in the opinion of the writer, this statement needs verification.

7. *Thamnophis radix* (Baird and Girard).—Racine Garter-snake. This species is the common snake as well as the common garter-snake of the region studied. It is of general distribution, occurring both in the wet and dry habitats. It is most common, however, about the margin of the sloughs. The large number of specimens obtained by this expedition were used in the writer's monograph[14] of the genus, and need not be redescribed. The habits of the specimens have also been summarized

[11]Cope, E. D., the Crocodilians, Lizards, and Snakes of North America. Rept. U. S. National Museum, 1898, p. 657.

[12]Baird, S. F., Proc. Acad. Nat. Sci. Phila., 1858, p. 256.

[13]Hoy, P. R., Catalogue of the Cold-blooded Vertebrates of Wisconsin, Geol. Surv. Wis., Vol. I, p. 423.

[14]Ruthven, Alexander G., The Variations and Genetic Relationships of the Garter Snakes. Bull. 61, U. S. National Museum.

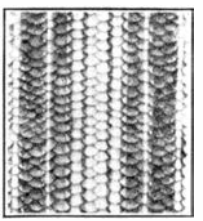

Figure 7. Color pattern of dorsal surface of *Eumeces septentrionalis* (Baird).

in that work. It may be added, however, that, while, as stated in that paper, the pregnant females examined had a maximum number of 25 embryos, two females later kept in captivity each gave birth to 35 young.

8. *Thamnophis sirtalis parietalis* (Say).—Red-sided Garter-snake. This garter-snake is much less common in Clay and Palo Alto counties than is its relative, *T. radix*. Only three specimens (the only ones seen) were secured by the expedition. Of these one was taken on the margin of a slough in Freeman township, Clay county, another in a similar habitat in Highland township, Palo Alto county, and a third near a marshy spot on upland prairie in Highland township, Palo Alto county. In 1903, the writer took three other specimens in Freeman township, Clay county, in a stubble field on high ground. Descriptions of the western Iowa specimens may be found in the revision of the genus cited above.

9. *Liopeltis vernalis* (De Kay).—Green Snake. A single specimen of this snake was taken on the upland prairie in Freeman township, Clay county. The species is apparently rather uncommon in this region, but has been observed by the writer in the meadows of western Palo Alto, and eastern Clay counties. The single specimen obtained has 15 scale rows for the entire length (as is usual in the species), 7 supralabials, 8 infralabials, 74 subcaudals and 141 ventral plates.

10. *Heterodon nasicus* Baird and Girard.—Western Hog-nosed Snake. As has been elsewhere stated,[15] *H. nasicus* is the representative of the genus in Clay and Palo Alto counties. While not uncommon in this region, the species apparently has a very restricted distribution. We found it only on the uplands where the original prairie conditions had not been disturbed. All of the specimens obtained were taken in Freeman township, Clay county, but the writer has observed it in Highland township, Palo Alto county.

The scutellation of the five specimens obtained is quite uniform. The dorsal scale formula is 23-21-19-17, and the supralabials 8, in every specimen. The infralabials are 10 in three specimens, 10-11 in one, and 11-12 in another. In two males the ventrals are 139 and 142, in two females they are 148 and 150. The tails are broken in several so that the number of urosteges cannot be determined. In all of these specimens the plates on the surface of the muzzle are considerably broken up, the accessory scales separating the prefrontals, the internasals from the azygos, and the anterior nasals from the posterior prolongation of the rostral. The color needs no other description than the statement that it is normal. The brownish gray ground color above is relieved by the usual brown

[15]Ruthven, Alexander G., Amer. Natur., Vol. XLII, p. 391.

or black spots and the dark and light bands on the head. The center of the belly is black with a few irregular yellow spots. The ends of the gastrosteges are yellow, except that the black of the middle of the belly is prolonged across every second or third scute.

A large female, taken on July 20, laid five eggs on August 4, but died shortly afterward without passing the rest of those in the oviducts. Branson[16] states that he found a full grown meadow-lark in the stomach of one of these snakes. One specimen which we found in a stubble field near a patch of upland prairie had eaten a large toad, and one in captivity ate a large leopard frog. Brous[17] records the finding of individuals of this species attached to the hind leg of the box tortoise (*Terrapene ornata*), which they had partially digested. From this, Brous and Branson both conclude that the snake sometimes attaches itself to the tortoise in this way for the purpose of sucking the blood. This hardly seems probable in view of the known food-habits of the snake. A much more plausible explanation is that the observed snakes had seized the leg in an attempt to swallow the tortoise, and, this being impossible, were unable to release their hold, owing to the fact that the long posterior fangs had become deeply imbedded.

11. *Chrysemys cinerea bellii* (Gray). — Bell's Turtle. This was found to be the common turtle in Clay and Palo Alto counties. It was observed in nearly every slough, pond, lake and stream examined, in both counties.

The specimens taken are typical *bellii*. The ground color of the carapace varies from olive to black. There is usually on the costals a rather prominent yellowish line, and on the costals and vertebrals a number of smaller and more obscure ones. The yellow bands that usually margin the costal and vertebral scutes in *cinerea* are present or absent but when present are narrower or more irregular than in the typical form. A narrow vertebral stripe is present in most of the specimens. The color pattern of the marginals is distinctive: the dark ground color of the upper face is relieved by a prominent median and two fainter lateral bands; these markings are yellowish in color, vertical in position, and the median is, at its outer end, continued laterally to form an outer narrow light border to the marginal. The inferior face of each marginal also possesses a prominent median yellow band (directly below its fellow on the superior face) that extends laterally along the outer edge of the plates, and also tends to be extended at its inner end and connected with its neighbors, restricting the black ground color to a spot. The black

[16]Branson, E. B., Snakes of Kansas. Kansas Univ. Sci. Bull., II, p. 377.

[17]Brous, H. A., Notes on the Habits of Some Western Snakes. Amer. Nat., XVI., pp. 564-566.

spots thus formed have usually a small yellow center and occasionally other light marks, and are frequently extended below and fused with the adjacent spots, restricting the median yellow band to a bar (as in *marginata*), but this is not the rule. The plastron is pale, and has a large dark patch that occupies the middle and sends out prominent extensions along the transverse sutures.

12. *Chelydra serpentina* (Linnaeus).—Snapping Turtle. The snapping turtle is apparently common in this region, but it is perhaps more characteristic of the larger streams than the bodies of quiet water. However, it was found rather commonly in Virgin Lake, Palo Alto county, and a single individual was taken on land near the outlet of Lost Island Lake, in Clay county. It was quite common in the Ocheyedan river, west of Spencer, young turtles being numerous in the ponds in the abandoned channels.

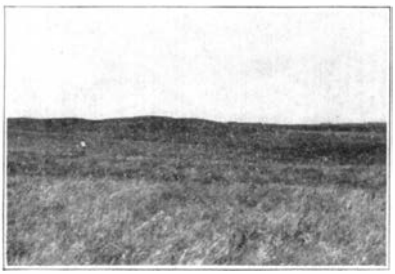

FIG. 1.

FIG. 4.

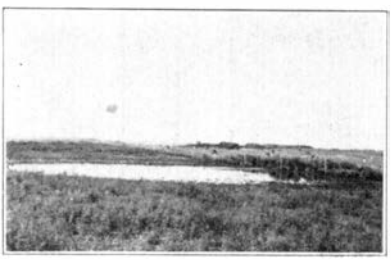

FIG. 2.

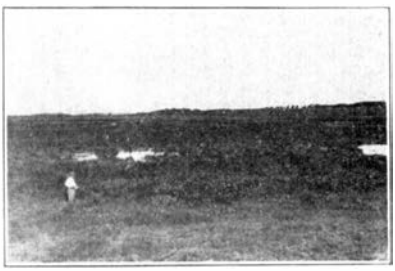

FIG. 5.

FIG. 3.

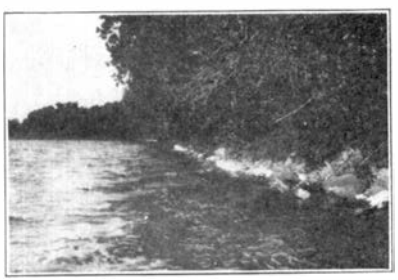

FIG. 6.

HABITATS IN NORTHWESTERN IOWA.

Figure 1. Original prairie in Clay County.

Figure 2. Pond on prairie in Clay County.

Figure 3. Grain field in Clay County.

Figure 4. Grove in Clay County.

Figure 5. Meadow running into a slough Clay County.

Figure 6. Shore of Elk Lake, Clay County.

Fig. 8. Meadow in Clay County.

Fig. 9. East end of Elbow Lake, Palo Alto County.

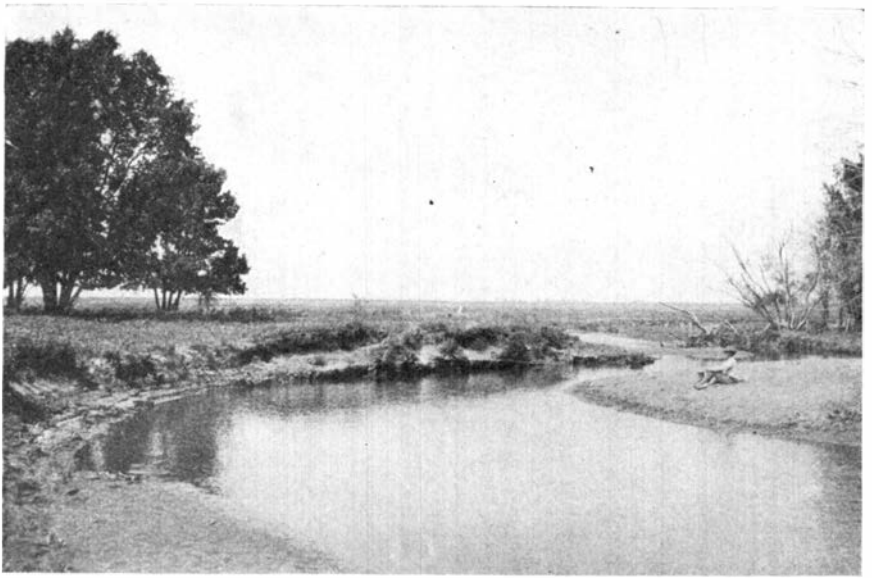

Fig. 10. Ocheyedan River at Spencer, Clay County.

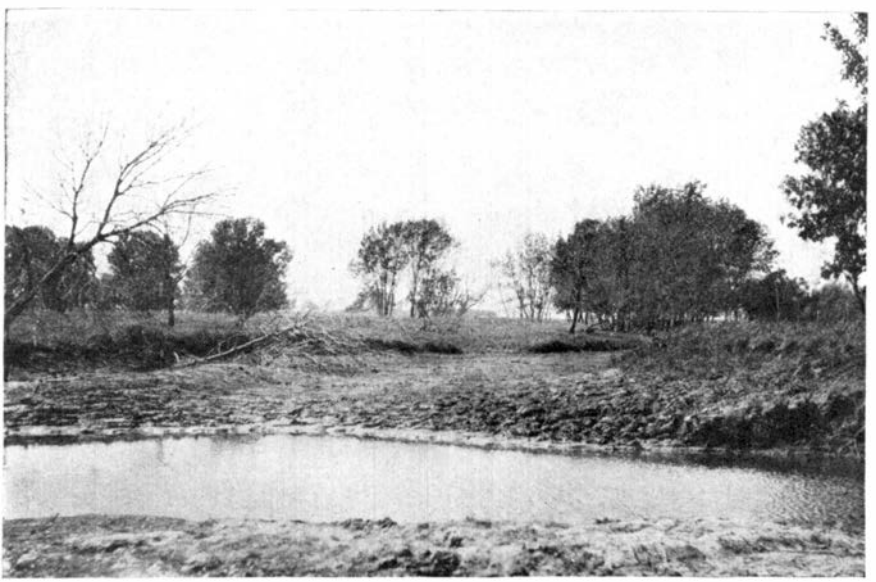

Fig. 11. Pond in abandoned channel of Ocheyedan River, Clay County.