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HERPETOFAUNA OF THE SANDAHL LOCAL FAUNA
(PLEISTOCENE:ILLINOIAN) OF KANSAS

By

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MUSEUM OF PALEONTOLOGY
THE UNIVERSITY OF MICHIGAN
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HERPETOFAUNA OF THE SANDAHL LOCAL FAUNA (PLEISTOCENE:ILLINOIAN) OF KANSAS

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ABSTRACT—The herpetofauna of the Sandahl local fauna of McPherson County, Kansas, includes two turtles, a salamander, five anurans, three lizards, and six snakes. None of these animals are extinct, and all represent forms that live in or near the area today. The presence of a permanent stream community, a stream border community, a gallery forest community, and grasslands, as indicated by the fish fauna and the mammal fauna, is supported by the herpetofauna. But the mammal fauna differs from the fish fauna and the herpetofauna in that it has extralimital species of rodents with western affinities. Based on a comparison of areas of sympatry of extant fishes, amphibians, reptiles, and mammals in the Sandahl local fauna, it is tentatively suggested that the climate of the area in the Pleistocene was similar to that of northeastern Nebraska today, and that the two extralimital species of western rodents may have been relicts of more xeric times.

INTRODUCTION

THE SANDAHL LOCAL FAUNA consists of several local faunules from the McPherson Formation, McPherson County, Kansas, elevation 1420 feet, that represent the Illinoian glacial stage of the Pleistocene (Semken, 1966; Hibbard, 1970). Semken detailed the mammalian elements of the Sandahl local fauna; mentioned the occurrence of mollusks, fishes, amphibians, reptiles, and birds; redefined the age of the deposits; and made comments about the stratigraphic relationships and paleoecology. Other less comprehensive references to faunal studies of the Sandahl local fauna are Cope (1889), Harnly (1934), Hibbard (1952, 1970), Lillegraven (1966), Lindahl (1891), Miller (1970), Nininger (1928), and Semken & Griggs (1965). With the exception of two turtles identified to genus, the herpetofauna has heretofore remained unstudied. Thus, the object of the present paper is to detail the herpetofauna of the Sandahl local fauna in order to fit the amphibians and reptiles into the paleoecological picture.

Amphibians and reptiles discussed in this report come from four localities (local faunules) in northwestern McPherson County, Kansas, designated as follows.

Anderson gravel pit.—SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 19, T 17 S, R 5 W, property of J. E. Anderson.

Flohr gravel pit.—NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T 18 S, R 4 W, property of Miss Frances Flohr.

Hammann gravel pit.—NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 31, T 18 S, R 4 W, property of L. W. Hammann.

Sandahl gravel pit.—SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 29, T 18 S, R 4 W, property of Sandahl and Son's Dairy.

The specimens were collected by Dr. C. W. Hibbard and party of The University of Michigan Museum of Paleontology, summer of 1963, and Dr. Holmes A. Semken, Jr., now of the University of Iowa Department of Geology, summer of 1964, under NSF project G 19458. I should here like to thank these gentlemen for the privilege of studying fossils collected and curated by them.

Numbers used in the following report are those of the Vertebrate Collections of The University of Michigan Museum of Paleontology (UMMP V). All measurements are in millimeters unless otherwise designated. Data for Recent ranges and habitats of Kansas amphibians and reptiles are from H. Smith (1956).

Following is a checklist of the amphibians and reptiles of the Sandahl local fauna as to their occurrence in the four localities (local faunules). The turtles were identified by Holmes A. Semken, Jr.

ANDERSON GRAVEL PIT

Trionyx sp. Softshell turtle

FLOHR GRAVEL PIT

- Ambystoma tigrinum* Tiger salamander
Scaphiopus bombifrons Plains spadefoot
Bufo woodhousei woodhousei Rocky Mountain toad
Rana pipiens Leopard frog
 ?*Pseudemys* Slider turtle
Eumeces sp. Striped skink
Heterodon cf. *H. platyrhinos* Eastern hognose snake
Tropidoclonion lineatum Lined snake
 Natricinae indet. Indeterminate natricine snakes

HAMMANN GRAVEL PIT

- ?*Pseudemys* Slider turtle

SANDAHL GRAVEL PIT

- Ambystoma tigrinum* Tiger salamander
Scaphiopus bombifrons Plains spadefoot
Bufo cognatus Great Plains toad
Bufo woodhousei woodhousei Rocky Mountain toad
Bufo sp. indet. Indeterminate toad
Pseudacris triseriata Chorus frog
Rana pipiens Leopard frog
 Sceloporinae indet. Indeterminate sceloporine lizard
Eumeces sp. Striped skink
Cnemidophorus cf. *C. sexlineatus* Six-lined race-runner
Heterodon cf. *H. platyrhinos* Eastern hognose snake
Coluber or *Masticophis* Racer or Coachwhip
 Colubrinae indet. Indeterminate colubrine snakes
Natrix sipedon Common water snake
Thamnophis sp. Garter snake
Tropidoclonion lineatum Lined snake
 Natricinae indet. Indeterminate natricine snakes
Crotalus cf. *C. viridis* Western rattlesnake

SYSTEMATIC PALEONTOLOGY

Class AMPHIBIA

Order CAUDATA

Family AMBYSTOMATIDAE

AMBYSTOMA TIGRINUM (Green)

Material.—Flohr gravel pit: UMMP V-60315, one vertebra. Sandahl gravel pit: UMMP V-51882, 14 vertebrae, one left and one right femur, one humerus; UMMP V-51893, one vertebra.

Remarks.—Tihen (1958) and Holman (1969) have discussed the identification of vertebrae of *Ambystoma tigrinum*. The above fossils represent small adult tiger salamanders. The species occurs in the area today although there are no specific locality records for McPherson County.

Habitat.—Today, breeding adults are found in temporary ponds and pools. Non-breeding adults are found hiding under material near ponds or pools, or they may be at some distance from the water in the holes of mammals or of crayfish.

Order SALIENTIA

Family PELOBATIDAE

SCAPHIOPUS BOMBIFRONS Cope

Material.—Flohr gravel pit: UMMP V-60316, one right ilium. Sandahl gravel pit: UMMP V-51817, one sphenethmoid; V-51818, three sphenethmoids; V-51819, two sphenethmoids; V-51820–51829, 10 sphenethmoids; V-51879, one sphenethmoid; V-51880, two sphenethmoids; V-51910, one left and one right ilium; V-51912, seven left and three right ilia; V-51883, one sacrococcyx; V-51884, six sacrococcyges.

Remarks.—Tihen (1960) and Holman (1970) have discussed characters (sacrococcyges, Tihen; sphenethmoids, Holman) for the identification of *Scaphiopus bombifrons*. This species occurs in the Recent fauna of McPherson County.

Habitat.—At present, this species is found in fairly arid regions on loose or sandy soil, and it is normally associated with grasslands rather than with flood plains or woodlands.

Family BUFONIDAE

BUFO COGNATUS Say

Material.—Sandahl gravel pit: UMMP V-51919, one right ilium; V-51913, one left ilium; V-51897, one sacrum; V-51901, two sacra.

Remarks.—These two large *Bufo* ilia differ from those of Recent *B. americanus*, *B. debilis*, *B. punctatus*, and *B. woodhousei* and are similar to Recent *B. cognatus* and *B. speciosus* in having a very high, rather than a moderately high to low ilial prominence. But I am unable to separate the latter two species on ilial characters (Holman, 1964 and 1969). Nevertheless, the sacral vertebrae of *B. cognatus* appear to be separable from those of both *B. speciosus* and *B. w. woodhousei* on the basis that, in dorsal view, the condyles end only slightly posterior to the posterior border of the neural arch in *B. cognatus*, whereas in *B. speciosus* and *B. w. woodhousei* the condyles project well posterior to the posterior border of the neural arch. This character holds in two *B. cognatus*, nine *B. speciosus*, and seven *B. w. woodhousei*. The fossil sacra resemble *B. cognatus* in this character. *Bufo cognatus* occurs from the Middle Pliocene to the Recent (Tihen, 1962). *Bufo cognatus* is found in the Recent fauna of the

area today, although there are no specific locality records for McPherson County.

Habitat.—Today, this species is said to be most common in the long grass and the mixed grass prairies, and to be less common in the short grass areas where it tends to be restricted to the vicinity of streams. It is said to be rare in woodlands except as carried accidentally downstream into them.

BUFO WOODHOUSEI WOODHOUSEI Girard

Material.—Flohr gravel pit: UMMP V-60317, one right ilium. Sandahl gravel pit: UMMP V-60318, one left and five right ilia; V-60319, one left ilium; V-51920, one left and five right ilia; V-51900, three sacral vertebrae.

Remarks.—The ilial prominences of these fossils are higher than in *Bufo americanus*, *B. debilis*, *B. punctatus*, and *B. woodhousei fowleri*, but they are lower than in *B. cognatus* and *B. speciosus*, and are most similar to *B. w. woodhousei*. The sacral vertebrae have the condyles projecting well posterior to the posterior border of the neural arch. It is interesting to note that the subspecies *B. w. woodhousei* and *B. w. fowleri* may be consistently separated on the basis of the higher ilial prominence of *B. w. woodhousei*. This has been reported by Tihen (1962). According to Tihen, the earliest verifiable occurrence of *B. w. woodhousei* is the Jinglebob fauna of Meade County, Kansas, which is of Sangamon or early Wisconsin age. The Sandahl record thus extends the range of this subspecies back in time to the Illinoian. Recent *B. w. woodhousei* occurs in the area today, but there are no specific locality records for McPherson County.

Habitat.—At present, these toads are said to be most abundant in long grass and mixed grass prairies, where they inhabit a large variety of situations, and they are likely to enter wooded areas.

BUFO sp. indet.

Material.—Sandahl gravel pit: UMMP V-51898, one fragmentary sacrum.

Remarks.—A sacrum of a large toad is too fragmentary for specific determination.

Family HYLIDAE

PSEUDACRIS TRISERIATA (Wied)

Material.—Sandahl gravel pit: UMMP V-60320, one left ilium; V-60452, one left ilium; V-51914, 12 right and four left ilia; V-51892, three left and five right humeri; V-51902, five sacra; V-51903, two sacra.

Remarks.—Chantell (1968) provided a de-

tailed study of the osteology of *Pseudacris*. Based on characters of the ventral acetabular expansion (Chantell, 1968, p. 386, fig. 3, and p. 388) all of the Sandahl ilia appear to represent the species *P. triseriata*. None of the eight fossil humeri have a reduced secondary ventral crest as is said to occur in Recent *P. t. triseriata* (Chantell, 1968), but have only a shallow channeling in this area as in Recent *P. t. feriarum*, *P. t. maculata*, and *P. brimleyi*. There is some variation in characters in the five sacra (condyles widely separated in two, narrowly separated in three; prezygapophyses truncated in three, rounded in two), but this kind of variation was common in a series of 31 skeletons of Recent *P. triseriata*. The subspecies *P. t. triseriata* is found near McPherson County, Kansas, today, but based on the humeral character noted above the fossils may represent another subspecies. According to the mammalian fauna (Semken, 1966), which contains Wyoming species that do not enter Kansas today, the possibility exists that the subspecies represented is *P. t. maculata*, a form that occurs just to the northwest of Kansas in northeastern Colorado and southwestern Nebraska. There is a broad zone of intergradation between *P. t. triseriata* and *P. t. maculata* throughout most of eastern and central Nebraska. The status of the humeral character in the intergrade populations is unknown.

Habitat.—The habitat of the chorus frog today is swampy and marshy places, and in flood plains.

Family RANIDAE

RANA PIPIENS Schreber

Material.—Flohr gravel pit: UMMP V-60321, one right and one left ilium. Sandahl gravel pit: UMMP V-60322, six left and six right ilia; V-60323, five left and five right ilia; V-51899, three sacral vertebrae.

Remarks.—The ilia of *Rana pipiens* are easily separated from those of *Rana catesbeiana* on the basis of having a much more gentle, less precipitous slope of the posterodorsal border of the ilial crest into the dorsal acetabular expansion. The ilia of *R. pipiens* may be separated from those of *R. areolata* on the basis that in *R. areolata* (*R. a. areolata* three; *R. a. circulosa* three, *R. a. aesophus* one) the vastus prominence (Holman, 1965b) is narrower, more rounded, and less flattened than in *R. pipiens*. Moreover, in most specimens of *R. pipiens* the posterodorsal border of the ilial crest slopes more gently into the dorsal acetabular expansion in *R. areolata* than in *R. pipiens*. *Rana*

pipiens has been recorded from the Recent fauna of McPherson County.

Habitat.—At present, *Rana pipiens* is a ubiquitous anuran that is said to frequent about any aquatic situation during the breeding season, but during much of the year individuals may reside in damp places rather far from water.

Class REPTILIA
Order CHELONIA

Two turtles, *Trionyx* sp. (softshell turtle) and ?*Pseudemys* sp. (slider turtle) were reported from the Sandahl local fauna by Semken (1966, p. 138).

Family IGUANIDAE
SCELOPORINAE sp. indet.

Material.—Sandahl gravel pit: UMMP V-51878, two fragmentary right maxillae.

Remarks.—The more fragmentary of the two bones has more distinctly tricuspid teeth than the more complete bone. The small sceloporine lizards, *Sceloporus undulatus* and *Holbrookia maculata*, are recorded from the Recent fauna of McPherson County, Kansas.

Family SCINCIDAE
EUMECES sp. indet.

Material.—Flohr gravel pit: UMMP V-60324, one partial left dentary. Sandahl gravel pit: UMMP V-51881, one left dentary.

Remarks.—The dentary is smaller and has more slender teeth than in adult *Eumeces aboletus*, but I am unable to carry the identification to species. Small lizards of the genus *Eumeces* that occur in or near the area today are *E. anthracinus*, *E. fasciatus*, and *E. septentrionalis*.

Family TEIIDAE
CNEMIDOPHORUS cf. CNEMIDOPHORUS
SEXLINEATUS (Linnaeus)

Material.—Sandahl gravel pit: UMMP V-60325, a partial left dentary.

Remarks.—The dentary represents a small *Cnemidophorus* that is very similar to Recent *C. sexlineatus*. The bone represents the anterior part of a dentary, and it contains nine teeth and two empty alveoli. The two anteriormost teeth are unicuspid, but the next seven are bicuspid. *Cnemidophorus sexlineatus* is recorded from the Recent fauna of McPherson County.

Habitat.—Today, the habitat is in relatively dry areas where there is sandy or other loose soil and where there is short grass or other kinds of low vegetation.

Family COLUBRIDAE

HETERODON cf. HETERODON PLATYRHINOS
Latreille

Material.—Flohr gravel pit: UMMP V-50485, one vertebra. Sandahl gravel pit: UMMP V-50451, 13 vertebrae.

Remarks.—Based on the flatter anterior borders of their prezygapophyseal faces (Holman, 1963) I tentatively assign these vertebrae to *H. platyrhinus* rather than to *H. nasicus*; although based on a greater number of Recent skeletal specimens than were available in 1963, there is some overlap in this character, as one of 19 *H. platyrhinus* has the rounded condition, and there are some intermediate conditions in three of 13 *H. platyrhinus* and one of three *H. nasicus*. *Heterodon platyrhinus* is found in the Recent fauna of the area today, but there are no specific locality records for McPherson County.

Habitat.—At present, this species prefers dry areas where ample sunlight reaches the ground. These snakes are to be found in dry woods, or sandy river shores, in sand dunes; but they are seldom found in moist or heavily wooded areas.

COLUBER or MASTICOPHIS sp. indet.

Material.—Sandahl gravel pit: UMMP V-60326, six fragmentary vertebrae.

Remarks.—These fragmentary vertebrae represent either *Coluber* or *Masticophis*, but I have not been able to carry the identification any farther. *Coluber constrictor* and *Masticophis flagellum* are found in the area today, although specific locality records are not available for McPherson County.

COLUBRINAE sp. indet.

Material.—Sandahl gravel pit: UMMP V-60327, 11 fragmentary vertebrae.

Remarks.—These vertebrae represent snakes of the subfamily Colubrinae, but the bones are so worn and fragmentary that I cannot identify any of them to the generic level.

NATRIX SIPEDON (Linnaeus)

Material.—Flohr gravel pit: UMMP V-60328, three vertebrae. Sandahl gravel pit: UMMP V-60329, 48 vertebrae.

Remarks.—These relatively large natricine vertebrae (see Brattstrom, 1967, p. 189) are assigned to the genus *Natrix* rather than to *Thamnophis*. Some of these vertebrae are complete enough to compare at the specific level. These complete fossils resemble Recent *Natrix sipedon* and differ from Recent *N. erythro-*

gaster and *N. rhombifera* in having much lower neural spines. They resemble *N. sipedon* and differ from *Regina (Natrix) grahamsi* in having the tips of the hypapophyses pointed or narrowly rounded rather than truncated. This species occurs in the Recent fauna of the area today, but there are no specific locality records for McPherson County.

Habitat.—This snake is presently found near streams, rivers, marshes, permanent ponds, and lakes. It is said to wander several hundred feet from water at times.

THAMNOPHIS sp. indet.

Material.—Sandahl gravel pit: UMMP V-60453, 12 vertebrae.

Remarks.—These relatively large, elongate natricine vertebrae (see Brattstrom, 1967, p. 189) are assigned to the genus *Thamnophis*. Most of them are incomplete, but one large vertebra that is almost complete is more similar to Recent *Thamnophis marcianus* and *T. radix* than to *T. sirtalis* and *T. proximus* in that the posterior part of the neural spine has a well-developed overhanging portion, rather than having its posterior edge straight or gently curved as in the latter two species. But this fossil is larger than any *T. marcianus* or *T. radix* I have seen (10 *T. radix* and seven *T. marcianus* skeletons). Measurements of the nearly complete fossil are: length through zygapophyses 6.2, width through posterior zygapophyses 5.5, height through neural spine and hypapophyses 5.8. *Thamnophis marcianus* occurs to the west and southwest of McPherson County, Kansas, today, the closest locality record being in Barber County to the southwest. *Thamnophis radix* has been recorded from the Recent fauna of McPherson County.

TROPIDOCOLONION LINEATUM (Hallowell)

Material.—Flohr gravel pit: UMMP V-60330, two vertebrae. Sandahl gravel pit: UMMP V-60331, 45 vertebrae.

Remarks.—All of the very small natricine vertebrae are easily assignable to the species *Tropidocolonion lineatum* based on characters detailed in Holman (1965a, p. 103). This species occurs in the area today, but there are no specific locality records for McPherson County.

Habitat.—Today, these snakes hide under stones, logs, rock fences, and other cover on the surface of the ground, presumably in grassland regions.

NATRICINAE indet.

Material.—Flohr gravel pit: UMMP V-60332, 10 vertebrae. Sandahl gravel pit: UMMP V-60333, 156 vertebrae.

Remarks.—These vertebrae are too fragmentary, are too worn, or are from such parts of the vertebral column that they cannot be assigned to the generic level.

Family CROTALIDAE

CROTALUS cf. CROTALUS VIRIDIS (Rafinesque)

Material.—Sandahl gravel pit: UMMP V-60334, two vertebrae.

Remarks.—These vertebrae are rather fragmentary, but they are very similar to Recent *Crotalus viridis* vertebrae. The largest fossil represents an animal about 10 cm long based on a Recent skeleton at hand. *Crotalus viridis* is found in the Recent fauna of the area today, but specific locality records are lacking from McPherson County.

Habitat.—At present, this species is said to be commonly found in prairies, prairie canyons, and other grasslands.

DISCUSSION

Semken (1966) outlined five major ecological communities indicated by the fossil fishes and mammals of the Sandahl local fauna. The herpetofauna fits well into this picture (table 1). On the other hand, the regional paleoecological picture is puzzling, for the area of sympatry (the area where all of the extant species could be found living together today) of the 11 extant mammals of the Sandahl local fauna lies to the west of the area of sympatry of the 11 extant amphibians and reptiles (text-fig. 1).

Ecological communities. — The ecological communities indicated by the fishes and mammals of the Sandahl local fauna (Semken, 1966) are as follows: (1) a permanent stream community, (2) a stream border community, (3) a gallery forest community, (4) a lowland meadow-savanna community, and (5) an upland prairie community.

Herpetofaunal members of the permanent stream community would include *Trionyx* (the softshell turtle) and *Pseudemys* (the slider turtle). These animals are characteristic of the slower moving parts of permanent streams. *Natrix sipedon* (the common water snake) and *Rana pipiens* (the leopard frog) would enter the water from time to time, the water snake to search for food, the frog to escape predators.

The stream border community would be inhabited by *Natrix sipedon* (the common water snake), *Pseudacris triseriata* (the chorus frog), *Rana pipiens* (the leopard frog), and *Heterodon* cf. *platyrhinos* (the hognose snake), on sandy banks. Occasionally, herpetofaunal members of the gallery forest might come into the stream border community looking for food.

TABLE 1.—SANDAHL HERPETOFAUNA: ECOLOGICAL PREFERENCES; MINIMUM NUMBER OF INDIVIDUALS OF NON-SNAKES; TOTAL NUMBER OF VERTEBRAE OF SNAKES

	Permanent Stream Community	Stream Border Community	Gallery Forest Community	Grasslands	Minimum Number of Individuals	Total Number of Vertebrae
<i>Ambystoma tigrinum</i>			×		2	
<i>Scaphiopus bombifrons</i>				×	20	
<i>Bufo cognatus</i>				×	2	
<i>Bufo w. woodhousei</i>			×		11	
<i>Pseudacris triseriata</i>		×			12	
<i>Rana pipiens</i>		×			12	
<i>Trionyx</i> sp.	×				1	
<i>Pseudemys</i> sp.	×				2	
<i>Eumeces</i> sp.				×	2	
<i>Cnemidophorus</i> cf. <i>sexlineatus</i>				×	1	
<i>Heterodon</i> cf. <i>platyrhinus</i>		×				14
<i>Coluber</i> or <i>Masticophis</i>				×		6
Colubrinae indet.	—	—	—	—		11
<i>Natrix sipedon</i>		×				51
<i>Thamnophis</i> sp.			×			12
<i>Tropidoclonion lineatum</i>				×		47
Natricinae indet.	—	—	—	—		166
<i>Crotalus</i> cf. <i>viridis</i>				×		2
TOTALS	2	4	3	7	65	309

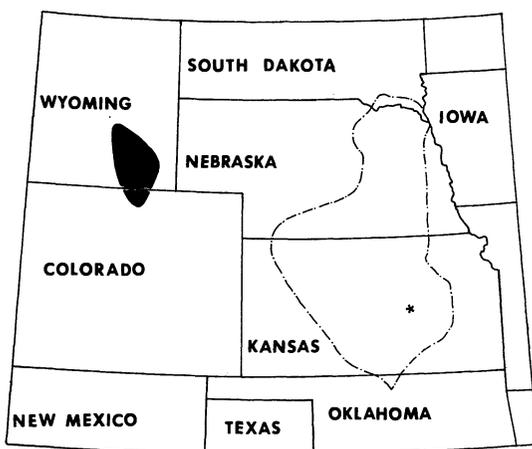
The gallery forest community would have been inhabited by *Ambystoma tigrinum* (the tiger salamander), *Bufo w. woodhousei* (the Rocky Mountain toad), and probably *Thamnophis* (the garter snake).

The remainder of the herpetofauna could be found either in the lowland meadow-savanna community or in the upland prairie community. These communities have been combined under the term "grasslands" in table 1 of this paper. Grassland forms include: *Scaphiopus bombifrons* (the Plains spadefoot), *Bufo cognatus* (the Great Plains toad), *Eumeces* sp. (the

skink), *Cnemidophorus* cf. *sexlineatus* (the six-lined racerunner), *Coluber* or *Masticophis* (the racer or coachwhip), *Tropidoclonion lineatum* (the lined snake), and *Crotalus* cf. *viridis* (the western rattlesnake).

Regional paleoecology.—It is important to note that if the Sandahl local fauna vertebrate fauna is taken as a whole, there is no one area in the United States today where all of the extant species can be found living together. If the area of sympatry of the 11 extant mammals, as plotted by Semken (1966) is compared with the area of sympatry of the 11 extant amphibians and reptiles as plotted in this paper (text-fig. 1) the mammalian area covers southeastern Wyoming and north central Colorado, whereas the herpetofaunal area covers extreme southeastern South Dakota, eastern Nebraska, central Kansas, and barely touches north central Oklahoma. The fish fauna also shows eastern and northern affinities, with *Perca flavescens* (the yellow perch) extending southward only to northeastern Nebraska (Smith, 1963) and *Stizostedion vitreum* (the walleye) extending southward only to northeastern Kansas. Both fishes were identified in the Sandahl locality by Semken (1966).

This is a puzzling situation that I find difficult to interpret. One can account for mixing of northern and southern elements in Pleistocene faunas by envisioning a more moderate climate, with cooler summers and milder winters. But it is difficult to imagine differences in annual moisture that would allow for such a mixing of eastern and western species.



TEXT-FIG. 1.—Present area of sympatry of Sandahl local fauna extant mammals (solid area) and of Sandahl local fauna extant amphibian reptile species (unshaded area). The star indicates the Sandahl localities in McPherson County, Kansas.

Nevertheless, if one removed *Citellus richardsoni* (Richardson's ground squirrel) and *Cynomys* cf. *gunnisoni* (the whitetail prairie dog) from the fauna, the areas of sympatry of the mammalian fauna and the herpetofauna would overlap in eastern Nebraska (see Semken, 1966, fig. 7, light bars, and text-fig. 1, this paper). Both the herpetofaunal and the mammalian areas of sympatry would probably overlap those of *Perca flavescens* (the yellow perch) and *Stizostedion vitreum* (the walleye) in north-eastern Nebraska. Therefore, considering the entire vertebrate fauna, perhaps it is best to tentatively postulate a climate similar to north-eastern Nebraska today, and to consider that the two western rodent species were relicts of more xeric times.

LITERATURE CITED

- BRATTSTROM, B. H., 1967, A succession of Pliocene and Pleistocene snake faunas from the High Plains of the United States: *Copeia*, 1967, p. 188-202.
- CHANTELL, C. J., 1968, The osteology of *Pseudacris* (Amphibia: Hylidae): *American Midl. Naturalist*, v. 80, p. 381-391.
- COPE, E. D., 1889, The Edentata of North America: *American Naturalist*, v. 23, no. 272, p. 651-664.
- HBBARD, C. W., 1952, Vertebrate fossils from Late Cenozoic deposits of central Kansas: *Univ. Kansas Paleontol. Contrib.*, *Vertebrata*, art. 2, p. 1-14.
- , 1970, Pleistocene mammalian local faunas from the Great Plains and Central Lowland provinces of the United States. *In*, Pleistocene and Recent environments of the Central Great Plains: *Dept. Geol. Univ. Kansas Sp. Publ.* 3, p. 395-433.
- HARNLY, H. J., 1934, Vertebrate fossils from McPherson *Equus* beds: *Trans. Kansas Acad. Sci.*, v. 37, p. 151.
- HOLMAN, J. A., 1963, Late Pleistocene amphibians and reptiles of the Clear Creek and Ben Franklin local faunas of Texas: *Jour. Grad. Research Center, So. Methodist Univ.*, v. 31, p. 152-167.
- , 1964, Pleistocene amphibians and reptiles from Texas: *Herpetologica*, v. 20, p. 73-83.
- , 1965a, Pleistocene snakes from the Seymour Formation of Texas: *Copeia*, 1965, p. 102-104.
- , 1965b, Early Miocene anurans from Florida: *Quart. Jour. Florida Acad. Sci.*, v. 28, p. 68-82.
- , 1969, Herpetofauna of the Pleistocene Slaton local fauna of Texas: *Southwestern Naturalist*, v. 14, no. 2, p. 203-212.
- , 1970, A Pleistocene herpetofauna from Eddy County, New Mexico: *Texas Jour. Sci.*, v. 22, p. 29-39.
- LILLEGRAVEN, J. A., 1966, *Bison crassicornis* and the ground sloth *Megalonyx jeffersoni* in the Kansas Pleistocene: *Trans. Kansas Acad. Sci.*, v. 69, p. 294-300.
- LINDAHL, J., 1891, Description of a skull of *Megalonyx leidy* n. sp.: *Trans. American Philos. Soc.*, v. 17, p. 1-10.
- MILLER, B. B., 1970, The Sandahl molluscan fauna (Illinoian) from McPherson County, Kansas: *Ohio Jour. Sci.*, v. 70, p. 39-50.
- NININGER, H. H., 1928, Pleistocene fossils from McPherson County, Kansas: *Trans. Kansas Acad. Sci.*, v. 31, p. 96, 97.
- SEMKEN, H. A., JR., 1966, Stratigraphy and paleontology of the McPherson *Equus* beds (Sandahl local fauna), McPherson County, Kansas: *Contrib. Mus. Paleontology, Univ. Michigan*, v. 20, p. 121-178.
- , & GRIGGS, C. D., 1965, The long-nosed peccary, *Mylohyus nasutus*, from McPherson County, Kansas: *Papers Michigan Acad. Sci., Arts, Letters*, v. 50, p. 267-274.
- SMITH, G. R., 1963, A late Illinoian fish fauna from southwestern Kansas and its climatic significance: *Copeia*, 1963, p. 278-285.
- SMITH, H. M., 1956, Handbook of amphibians and reptiles of Kansas: *Univ. Kansas Mus. Nat. History Misc. Publ.* 9, 2d ed., p. 1-356.
- TIHEN, J. A., 1958, Comments on the osteology and phylogeny of ambystomatid salamanders: *Bull. Florida State Mus.*, v. 3, p. 1-50.
- , 1960, On *Neoscaphiopus* and other Pliocene pelobatid frogs: *Copeia*, 1960, p. 89-94.
- , 1962, A review of New World fossil bufonids: *American Midl. Naturalist*, v. 68, p. 1-50.

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