CONTRIBUTIONS IN QUATERNARY VERTEBRATE PALEONTOLOGY:
A VOLUME IN MEMORIAL TO JOHN E. GUILDAY

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HERPETOFAUNAS OF THE DUCK CREEK AND WILLIAMS LOCAL FAUNAS (PLEISTOCENE: ILLINOIAN) OF KANSAS

J. ALAN HOLMAN

ABSTRACT

The Duck Creek and Williams local faunas of west-central and central Kansas are considered to represent the Illinoian stage of the Pleistocene based on previous faunal and stratigraphic studies. The Duck Creek fauna yielded one salamander, three anurans, and one snake. The Williams fauna yielded one salamander, four anurans, four turtles, and 13 snakes, and is the largest Illinoian herpetofauna known. The major habitat indicated by both herpetofaunas is a pond or slow-moving stream. The presence of prairie flat and hillsides as well as woodland is also indicated. None of the amphibians and reptiles in either fauna are extinct. The presence of three extralimital forms (Rana sylvatica, Emydoidea blandingii, and Elaphe vulpina) that occur mainly to the northeast of the areas today may indicate somewhat cooler, moister conditions. But a full glacial climate or a dominant coniferous forest community is not indicated by the rest of the herpetological species, all of which can be found in the area today. The topics of “disharmonious” Pleistocene faunas and “mosaic” Pleistocene communities are addressed.

INTRODUCTION

Herpetofaunas from the Illinoian stage of the Pleistocene are quite rare. In fact, only one large herpetofauna is now known from an unquestionably Illinoian deposit (Sandahl local fauna, McPherson County, Kansas; Holman, 1971). Thus, the recent availability for study of two Illinoian herpetofaunas from west-central and central Kansas offers the opportunity to add considerably to the knowledge of the amphibians and reptiles of this stage of the Pleistocene. These faunas are especially important in the light of the statement (Holman, 1980: 133) that evidence from the study of the Sandahl herpetofauna did not support the classical idea of a cooler, moister climate for the Illinoian age in Kansas.

ACKNOWLEDGMENTS

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THE DUCK CREEK LOCAL FAUNA

The Duck Creek local fauna near the Smoky Hill River, Ellis County, Kansas (northeast quarter of section 33, T 15 S, R 16 W) was previously studied by Kolb et al. (1975), mollusks; McMullen (1975 and 1978) and Zakrzewski and Maxfield (1971), mammals. Based on its stratigraphic location in the Pfeifer Terrace, and on a comparison with other Pleistocene plains faunas, an Illinoian age was suggested (McMullen, 1978). Five collecting localities (designated by Arabic numerals 1–5) were defined. Different lithologies in these localities suggest different depositional mechanisms. Localities 1 and 2 were in coarse sand with sandy silt lenses that suggested a stream channel. Locality 3 is a clayey deposit that suggested quiet water such as an oxbow lake. Localities 4 and 5 are silt deposits with sandy silt lenses, suggesting a backwater area where current action was slow and where deposition of fine particles might have taken place.

Class Amphibia Linnaeus, 1758
Order Caudata Oppel, 1811
Family Ambystomatidae Hallowell, 1858

Ambystoma tigrinum (Green, 1825)

Material.—Locality 1, vertebra FHSVP 2824; Locality 3, right femur FHSVP 2903; Locality 4, vertebra FHSVP 2905.

Remarks.—Tihen (1958) and Holman (1969) have discussed the identification of vertebrae of Ambystoma tigrinum. The large right femur (FHSVP 2903) is indistinguishable from those in modern skeletons of A. tigrinum. Today in Kansas, adult A. tigrinum spends much of its time beneath the ground in burrows of other animals (Collins, 1974:26). From a
taphonomic standpoint it is interesting to note that *A. tigrinum* bones were found in both high energy (Locality 1) and low energy (Localities 3 and 4) situations. This species occurs in Ellis County, Kansas, today (Collins, 1974: map p. 26).

Order Anura Dumeril, 1807
Family Bufonidae Fitzinger, 1826

*Bufo woodhousei woodhousei* Girard, 1854

*Material.*—Locality 1, a left and a right ilium FHSVP 2857-2858; Locality 2, right ilium FHSVP 2897; Locality 5, two right ilia FHSVP 2922-2933.

*Remarks.*—Holman (1971) and Tiwen (1962) have shown how elements of *Bufo woodhousei woodhousei* may be identified at the subspecific level. This subspecies has also been reported from the Sandahl Illinoian fauna of McPherson County, Kansas (Holman, 1971). According to Collins (1974:56) *B. w. woodhousei* prefers lowlands and sandy areas and is generally the only toad found on the flood plains of the larger streams and rivers in Kansas today. Taphonomically it is of interest that bones of this species are also found in both high energy (Localities 1 and 2) and low energy (Locality 5) situations. This subspecies occurs in Ellis County, Kansas, today (Collins, 1974: map p. 55).

Family Ranidae Bonaparte, 1831

*Rana sylvatica* Le Conte, 1825

*Material.*—Locality 1, left ilium FHSVP 2859 (Fig. 1a).

*Remarks.*—The ilium of *Rana sylvatica* is quite distinct from those of many other *Rana* species in having a very distinct dorsal protuberance on the
anterodorsal part of its lateral surface near the acetabular fossa. In fact, this prominence is rounded and somewhat similar to those of tree toads of the genus Hyla. It is noteworthy that several authors have commented on the toad-like gait and short-leggedness of Rana sylvatica, especially in northern populations. Moreover, the ilia of Rana sylvatica, although of small size, do not show the perforate condition of the acetabular area as do immature individuals of larger species of Rana. Rana sylvatica is not found in Kansas today, but mainly occurs to the northeast (Fig. 11). The nearest population today is an isolated one in the Ozark Region of south-west Missouri and north-west Arkansas. Today, the wood frog occurs in wooded areas (Wright and Wright, 1949). The significance of this record will be detailed in the Discussion section.

**Rana pipiens** complex Schreber, 1782  
*Material.*—Locality 1, left and right ilia FHSVP 2865 and 2860, 2862, sacral vertebra FHSVP 2847; Locality 2, right ilia FHSVP 2898, 2861; Locality 4, left ilia FHSVP 2910, 2911; Locality 5, left ilium FHSVP 2924, sacral vertebra FHSVP 2919.

**Remarks.**—Holman (1971) discusses characters that distinguish the ilia of the *Rana pipiens* complex from other species of *Rana*. Collins (1974:78) states that *R. pipiens* is found in every aquatic situation in the state today. Taphonomically it is noted that the fossil *R. pipiens* was found in both high energy (Localities 1 and 2) and low energy (Localities 4 and 5) sedimentary situations. Collins (1974: map p. 77) shows that *R. pipiens* occurs in Ellis County, Kansas, today, although he realizes that some workers refer these populations to a distinct species, *Rana blairi*.

- **Lampropeltis calligaster** (Harlan, 1827)  
  *Material.*—Locality 1, trunk vertebra FHSVP 2822.

**Remarks.**—This species has a very well-defined hemal keel and subcentral ridge, but these processes are not as well-defined as in *Lampropeltis getulus*. *Lampropeltis calligaster* may be distinguished from *L. triangulum* in that it has a more vaulted neural arch and a more distinct hemal keel. Today, this species is found slightly to the east and south of Ellis County in Barton County, Kansas (Collins, 1974: map p. 183). This snake inhabits a variety of areas in Kansas today from rocky hillsides with open woods to prairie grasslands and often retreats into the burrows of other animals (Collins, 1974: 185).

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**THE WILLIAMS LOCAL FAUNA**

The Williams local fauna of the Great Bend Prairie Area, Rice County, Kansas (north-east corner of south-east 1/4 section 21, T 18 S, R 7 W) was previously studied by Hall (1972), mollusks: McMullen (1975), shrews; Lundberg (1975), catfishes; Preston (1979), turtles. It is considered to represent the Illinoian age of the Pleistocene based on its fauna and stratigraphy. The fauna was recovered from a borrow pit by field workers and friends of the late C. W. Hibbard. This is one of the largest fossil herpetofaunas known from the central plains, and is the largest Illinoian herpetofauna known. The mode of accumulation of the fossils in the Williams fauna does not appear to be unlike that of the Duck Creek fauna.

- **Ambystoma tigrinum** (Green, 1825)  
  *Material.*—Partial right maxilla and distal left humerus UM81731.

**Remarks.**—This species, also recorded and discussed in the previous fauna, has not been recorded from Rice County, Kansas, today, but according to Collins (1974: map p. 26) should occur there.

- **Acris crepitans** Baird, 1854  
  *Material.*—One left and two right ilia UM 81732 (Fig. 1b).

**Remarks.**—These ilia have the dorsal protuberances anterior to the anterior edge of the acetabular cup, and two of them are complete enough to have an ilial shaft ridge. These characters in combination are diagnostic for the genus *Acris*. The above fossils are indistinguishable from those of modern *Acris*.

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**Class Reptilia Laurenti, 1768**  
- Order Squamata Oppel, 1811  
  - Family Colubridae Oppel, 1811  
    - Subfamily Colubrinae Cope, 1893  

**Lampropeltis calligaster** (Harlan, 1827)  
*Material.*—Locality 1, trunk vertebra FHSVP 2822.

**Remarks.**—This species has a very well-defined hemal keel and subcentral ridge, but these processes are not as well-defined as in *Lampropeltis getulus*. *Lampropeltis calligaster* may be distinguished from *L. triangulum* in that it has a more vaulted neural arch and a more distinct hemal keel. Today, this species is found slightly to the east and south of Ellis County in Barton County, Kansas (Collins, 1974: map p. 183). This snake inhabits a variety of areas in Kansas today from rocky hillsides with open woods to prairie grasslands and often retreats into the burrows of other animals (Collins, 1974: 185).
crepitans, a species that occurs in Rice County, Kansas, today (Collins, 1974: map p. 57). The preferred habitat is said to be the muddy beach-like edges of small, shallow streams and ponds in Kansas today (Collins, 1974:58).

Family Bufonidae Fitzinger, 1826

*Bufo woodhousei woodhousei* Girard, 1854

*Material.*—Right cranial crest and one left and three right ilia UM 81733 (Fig. 1c, d).

*Remarks.*—The comments on the identification and habitat of this subspecies that were made in the Duck Creek fauna section apply here. *Bufo w. woodhousei* has been recorded from Rice County, Kansas, today (Collins, 1974:55).

Family Ranidae Bonaparte, 1831

*Rana catesbeiana* Shaw, 1802

*Material.*—One left and three right ilia UM 81734 (Fig. 2a).

*Remarks.*—The ilia of *Rana catesbeiana* are distinguishable from those of other species of *Rana* in the middle United States on the basis of (1) the steeper slope of the posterior part of the ilial blade into the dorsal acetabular expansion, (2) its large size, and (3) the very porous area of the bone near the acetabular border. Condition 3 is particularly marked in small individuals. The bullfrog is restricted to permanent lakes, rivers, streams, and swamps today where deep water is available (Collins, 1974:71). This species occurs in Rice County, Kansas, today (Collins, 1974:71).

*Rana pipsiens* complex Schreber, 1782

*Material.*—Sixteen left and 15 right ilia UM 81735 (Fig. 2b, c).

*Remarks.*—The comments that were made on the identification and habitat of this form in the Duck Creek fauna section apply here. Collins (1974: map p. 77) has recorded *R. pipsiens* from counties surrounding Rice County, Kansas, but there are no actual records from Rice County. Certainly this form occurs in the area today.

Class Reptilia Laurentii, 1768

Order Testudines Batsch, 1788

Family Chelydridae Swainson, 1839

*Chelydra serpentina* (Linnaeus, 1758)

*Material.*—Right femur, head of left femur, left ilium, left pubic fragment, nuchal fragment UM 60084.

*Remarks.*—This material was previously reported by Preston (1979:28). The snapping turtle is not listed as occurring in Rice County, Kansas, today, but according to the distribution shown in Collins (1974: map p. 87) should occur in the area. This
species is said to occur in every aquatic situation, but to prefer water with a soft mud bottom, abundant pond-edge vegetation, and numerous sunken logs and branches (Collins, 1974:87).

Family Testudinidae Gray, 1825

_Emydoidea blandingii_ (Holbrook, 1838)

**Material.**—Right 8th and left 11th peripherals and additional fragments UM 60089.

**Remarks.**—This species was previously identified and reported from the Williams local fauna by Preston (1979:31). _Emydoidea blandingii_ does not occur in Kansas today, the closest records being in south-central Nebraska (Fig. 12). The significance of this occurrence in the Kansas fossil record will be detailed in the Discussion Section of this paper.

_Chrysemys picta_ Schneider, 1783

**Material.**—Nuchals and epiplastra UM 60085, carapace parts UM 60086, plastral parts UM 60087, and 7th cervical vertebra UM 60577.

**Remarks.**—This material was previously identified and reported by Preston (1979:37). Although it is not listed as occurring in Rice County, Kansas, today, the subspecies _Chrysemys picta bellii_ undoubtedly is present there (Collins, 1974: map p. 107). The painted turtle lives in slow-moving, shallow streams and rivers, and shallow ponds and lakes with soft bottoms in Kansas today (Collins, 1974: 107–108).

_Pseudemys scripta_ Schoepff, 1792

**Material.**—Peripheral fragments and an epiplastron UM 60088.

**Remarks.**—This material was previously identified and reported by Preston (1979:35). This species is not recorded from Rice County, Kansas, today, but according to Collins (1974: map p. 110) the subspecies _Pseudemys scripta elegans_ should occur in the area. This turtle is said to occur in about every permanent body of water throughout its range in Kansas today (Collins, 1974:110).

Order Squamata Oppel, 1811

Family Colubridae Oppel, 1811

Subfamily Xenodontidae Cope, 1893

_Heterodon_ cf. _Heterodon platyrhinos_ Latreille, 1802

**Material.**—Four anterior trunk vertebrae and one fragmental middle trunk vertebra UM 81736.

**Remarks.**—Most discussion about the identification of _Heterodon_ on the basis of vertebral remains has been on the basis of middle trunk vertebrae. Unfortunately, the relatively complete _Heterodon_ vertebrae from the Williams fauna are anterior trunk vertebrae and do not appear to be specifically diagnostic. Nevertheless, these vertebrae are quite similar in size to those of a modern _Heterodon platyrhinos_ with a total length of 70 cm (27.55 inches), thus I am tentatively referring the vertebrae to this species. Conant (1975) lists the typical ranges in total length as 16–25 inches for _Heterodon nasicus_ and 20–33 inches in _H. platyrhinos_. _Heterodon platyrhinos_ has not been recorded from Rice County, Kansas, today, but according to Collins (1974: map p. 163) it should occur there. This snake is said to be common along valleys of major rivers in the Great Bend Prairie Area of Kansas today and it is said to prefer sandy areas (Collins, 1974:163).

Subfamily Colubrinae Cope, 1895

Compared to vertebrae of the Subfamily Natricinae in the Williams fauna, vertebrae of the Subfamily Colubrinae were rare (Table 1). Two fragmentary vertebrae UM 81737 are assigned to _Colubrinae_ gen. et sp. indet.

_Coluber constrictor_ Linnaeus, 1758

**Material.**—Trunk vertebra UM 60256 (Fig. 3).

**Remarks.**—Several authors (see summary in Holman, 1981) have been unable to distinguish the vertebrae of _Coluber_ and _Masticophis_. Nevertheless, based on the smaller size of the specimen and the relatively small size of the neural canal, and based on the modern geographic ranges of the two genera (Collins, 1974: maps pp. 169 and 173) I am cautiously referring this specimen to _Coluber constrictor_. The subspecies _Coluber constrictor flaviventris_ occurs in Rice County, Kansas, today (Collins, 1974: map p. 169). This snake occurs in open grassland and prairies in Kansas today (Collins, 1974: map p. 170).

_Elaphe vulpina_ (Baird and Girard, 1853)

**Material.**—An associated partial skeleton (Fig. 4) consisting of a cervical vertebra, 55 trunk vertebrae, 5 caudal vertebrae, and 5 ribs UM 60231; also 3 trunk vertebrae from another individual or individuals UM 81738.

**Remarks.**—The associated skeleton was collected by the late C. W. Hibbard and his field party on 8 June 1969. Holman (1982) provided an osteological definition of _Elaphe vulpina_. Diagnostic characters
of the trunk vertebrae are as follows: neural spine usually slightly longer than high, neural arch vaulted; condyle not enlarged; ventral processes of centrum gracile. Holman (1982:40, Table 2) indicates the height of neural spines of the trunk vertebrae of *Elaphe vulpina* compared with related colubrid species.

*Elaphe vulpina* is well out of its present day range in the Williams fauna. Today, the species gets no closer to Rice County, Kansas, than the northwestern part of Missouri and southeastern part of Nebraska (Fig. 13). Collins (1974:241) states “It is quite possible that the western fox snake will be found in extreme northeast Kansas.” The fox snake had a wider distribution in the Pleistocene than it does today (Holman, 1981: map p. 292). The significance of this extralimital species will be detailed in the Discussion section of this paper. The fox snake is a grassland and woodland edge species today (personal observation).

**Lampropeltis triangulum** (Lacepede, 1788)

*Material.*—Three trunk vertebrae UM 81739 (Fig. 5).

*Remarks.*—This is one of the easiest snakes of eastern and central North America to identify on the basis of vertebral characters. It has a low neural spine, a depressed neural arch, and only a moderately distinct hemal keel. The species occurs in Rice County, Kansas, today (Collins, 1974: map p. 188). This snake is said to occur in rocky ledges of prairie canyons today (Collins, 1974:189).

**Pituophis melanoleucus** (Daudin, 1803)

*Material.*—Trunk vertebra UM 60255 (Fig. 6).
Fig. 3.—*Coluber constrictor*, trunk vertebra UM 60256 from Williams local fauna. Upper left, dorsal; right, ventral; middle left, anterior; right, posterior; lower, lateral. The line equals 2 mm and applies to all views.

Remarks.—Aufenberg (1963:183–184) and Van Devender and Mead (1978:472) give vertebral characters of *Pituophis melanoleucus*. *Pituophis melanoleucus sayi*, the subspecies found in Rice County, Kansas, today (Collins, 1974: map p. 182) has lower neural spines than the southeastern subspecies *P. m. mugitus*. The Williams fauna vertebra appears identical to *P. m. sayi* in neural spine height (Fig. 6). This snake is said to live in open grassland as well as open woodland and woodland edge today in Kansas (Collins, 1974:182).

*Sonora episcopa* (Kennicott, 1859)

*Material.*—Trunk vertebra UM 81740.

Remarks.—The tiny vertebrae of *Sonora* may be distinguished from those of *Diadophis* and *Tantilla* on the basis of their more prominent neural spines, thinner hemal keels, and shorter vertebral form. Van Devender et al. (1977:55–56) state that *S. semiannulata* vertebrae cannot be distinguished from those of *S. episcopa*. The nearest *S. semiannulata* occurs to the area today is in southern New Mexico (Conant, 1975: map 157). Conant (1975: map 158), indicates *S. episcopa* occurs in Rice County, Kansas, today, but the more detailed map of Collins (1974:163) does not record it from Rice County, although there are records to the north and to the south of Rice County. The subspecies found in Kansas today
is *S. e. episcopa*. This snake is said to occupy dry, rocky, prairie hillsides (Collins, 1974:194).

**Tantilla** sp. indet.

*Material.*—Three trunk vertebrae UM 81741.

*Remarks.*—This tiny snake has trunk vertebrae with obsolete neural spines. The species of *Tantilla* appear to be difficult or impossible to distinguish from one another on the basis of vertebral characters. Two species of *Tantilla* occur in Kansas today (Collins, 1974: maps pp. 195 and 197). *Tantilla gracilis* occurs only in the eastern one-third of Kansas, whereas *Tantilla nigriceps nigriceps* occurs rather extensively in the western three-fourths of the state, although it has never been specifically recorded from Rice County. *Tantilla gracilis* is said to occupy rocky hillsides of open prairies and woodlands in Kansas today, whereas *T. nigriceps* is said to be found on rocky hillsides of grassland prairies (Collins, 1974: 195, 197).

Subfamily Natricinae Bonaparte, 1840

Many more natricine than colubrine vertebrae occur in the Williams fauna (Table 1) and this undoubtedly reflects the fact that these snakes lived nearer the site of deposition than the more terrestrial colubrines. One hundred and thirty-one vertebrae

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**Fig. 4.—** *Elaphe vulpina*, trunk vertebra from an associated partial skeleton UM 60231 from Williams local fauna. Upper left, dorsal, right, ventral; middle left, anterior, right, posterior; lower, lateral. The line equals 2 mm and applies to all views.
with diagnostic processes missing and caudal vertebrae are identified as Natricinae gen. et sp. indet. UMV.

*Nerodia sipedon* (Linnaeus, 1758)

*Material.*—Twenty-one trunk vertebrae UM 81742 (Fig. 7).

*Remarks.*—Holman (1967) has given vertebral characters that enable one to distinguish this species from related forms in eastern and central North America. *Nerodia sipedon sipedon* has not been recorded from Rice County, Kansas, today, but according to Collins (1974: map p. 227) should occur there. According to Collins (1974:227) the northern water snake is found in almost every aquatic situation in Kansas today, with both high and low energy bodies of water being frequented.

*Regina grahami* Baird and Girard, 1853

*Material.*—A trunk vertebra UM 81743 (Fig. 8).

*Remarks.*—Holman (1972) gives vertebral characters that separate *R. grahami* from other related species. This species is found in Rice County, Kansas, today (Collins, 1974: map p. 219). This snake lives near ponds and sluggish streams of prairie meadows and river valleys in Kansas today (Collins, 1974:219-220).

*Storeria* cf. *Storeria dekayi* (Holbrook, 1842)

*Material.*—Four trunk vertebrae UM 81744.
Fig. 6.—Pituophis melanoleucus, trunk vertebra UM 60255 from Williams local fauna. Upper left, dorsal, right, ventral; middle left, anterior, right posterior; lower, lateral. The line equals 2 mm and applies to all views.

Remarks.—Auffenberg (1963:192) and Holman (1962:258-259) discuss the identification of Storeria dekayi on the basis of vertebrae. Storeria occipitomaculata is a woodland species that occurs in the eastern two tiers of counties in Kansas today (Collins, 1974: map p. 217). Storeria dekayi texana is not recorded from Rice County, Kansas, today, but has been reported from Ellsworth County just to the north (Collins, 1974: map p. 215). This snake generally lives near moist situations in woodland and along woodland edges (Collins, 1974:215).

Thamnophis radix (Baird and Girard, 1853)

Material.—Twenty-one trunk vertebrae UM 81745 (Fig. 9).
Fig. 7.—*Nerodia sipedon*, trunk vertebra UM 81742 from Williams local fauna. Upper left, dorsal; right, ventral; middle left, anterior; right, posterior; lower, lateral. The line equals 2 mm and applies to all views.

Remarks.—This is only the second published record of this species as a fossil as Rogers (1982) has listed it from an early Kansan site in Kansas. Vertebrae of species of *Thamnophis* are difficult to identify. Nevertheless, trunk vertebrae of modern skeletons of *T. radix* (11) and *T. marciatus* (5) are definitely shorter and also less gracile than those of modern *T. sirtalis* (10) and *T. proximus* (4). Moreover, the neural spines of *T. radix* and *T. marciatus* have more anterior and posterior overhang than in most *T. sirtalis* and *T. proximus*. The neural spines of available modern *T. radix* are somewhat higher than those of *T. marciatus*. The Williams local fauna vertebrae appear identical to those of *T. radix*. The subspecies *T. radix haydeni* is found in Rice County, Kansas, today (Collins, 1974: map p. 205). These snakes are said to prefer open grassy prairies, particularly along the edges of streams, marshes, and lakes in Kansas today (Collins, 1974:206).

*Thamnophis sirtalis* (Linnaeus, 1758) or *Thamnophis proximus* (Say, 1823)

Material.—Twenty-six vertebrae, UM 81746 (Fig. 10).

Remarks.—I cannot distinguish whether these more elongate *Thamnophis* vertebrae represent *Thamnophis sirtalis* or *T. proximus*. *Thamnophis sirtalis parietalis* (Say) is listed as occurring in Rice County, Kansas, today (Collins, 1974: map p. 207), and although *Thamnophis sauritus* occurs in neigh-
Fig. 8.—Regina grahami, trunk vertebra UM 81743 from Williams local fauna. Upper left, dorsal; right, ventral; middle left, posterior; right, anterior; lower, lateral. The line equals 2 mm and applies to all views.

boring Stafford County to the southwest (Collins, 1974: map p. 203) it has not been reported from Rice County, Kansas. Thamnophis sirtalis is found in a wide number of habitats such as marshes, wet meadows, pond-margins, woodlands, and woodland edges and floodplains in Kansas today (Collins, 1974:208). It is said to prefer moist situations. *Thamnophis proximus* frequents the edges of swampy marshes, lakes, streams, and rivers (Collins, 1974:204).

*Tropidoclonion lineatum* (Hallowell, 1856)

*Material.*—Three trunk vertebrae UM 81747.

*Remarks.*—This is only the third record of this genus and species as a fossil. It has previously been reported from the Pleistocene of Texas (Holman, 1965) and from the Pleistocene (Illinoian) of central Kansas (Holman, 1971). Holman (1965) gives vertebral characters for this form, which has a distinctive vertebral type. *Tropidoclonion lineatum* is not recorded from Rice County, Kansas, today, but according to Collins (1974: map p. 209) should be expected to occur there. This snake is said to inhabit the hillsides of open prairies and woodland edges in Kansas today (Collins, 1974:209).
Vertebrate faunas bear on several compelling Pleistocene problems such as (1) the time of its onset, (2) proper divisional terms, (3) “disharmonious” assemblages, (4) paleoclimates, (5) megafaunal extinction, and recently (6) why no C\(^{14}\) ages for extinct Pleistocene genera are younger than 10,000 yrs B.P. (Meltzer and Mead, 1983). The Illinoian herpetofaunas reported herein relate directly to questions 3 and 4 and thus indirectly to questions 5 and 6.

One of the most discussed aspects of North American Pleistocene vertebrate faunas is that many are considered to be “disharmonious” assemblages (Lundelius et al., 1983). The term “disharmonious” is used to describe faunas containing animals that would be “ecologically incompatible” today (term used by Holman, 1976). In such faunas one is unable to find an area on the map where all of the species identified from that fauna could be found living together today (“area of sympatry” of McMullen, 1975, and others). Holman (1980) uses the term “extralimital” to refer to Pleistocene herpetological
species that occur outside of their present ranges. The degree of "disharmoniety" in Pleistocene faunas varies; some faunas having only one or two extralimital forms, and other faunas having Boreal and Tropical animals occurring together. Disharmonious faunas may be found in both glacial and interglacial deposits (Holman, 1980).

On the other hand in the British Isles (Stuart, 1982), glacial and interglacial faunas appear to contain more "harmonious" and "ecologically compatible" assemblages, and also to reflect more extreme climatic changes in glacial and interglacial times than in North America. For instance, interglacial faunas may contain macaque monkeys, spotted hyaenas, African lions, African rhinos, and African hippos, whereas glacial faunas may contain tundra voles, arctic foxes, woolly mammoths, woolly rhinos, reindeer, and musk oxen.

Explanations for disharmonious faunas in the North American Pleistocene vary. A common hypothesis (Hibbard, 1960) repeated by numerous other workers has been called "The Pleistocene Climatic Equability Model" where cooler summers supposedly account for the presence of northern ex-
extralimital species in the fauna, and warmer winters supposedly account for the presence of southern extralimital species in the fauna. Other workers (Lundelius et al., 1983) point out that disharmonious faunas may be associated with mixed vegetational associations. The classic concept that glaciers pushed northern forms down into southern communities may be partially true, but this concept does not explain the presence of southern extralimital forms satisfactorily.

Herpetological species are important in reconstructing fossil communities especially because (1) they are ectothermic and quite sensitive to ecological changes, (2) are probably less vagile than mammalian species, and (3) because most herpetological species of the Pleistocene represent extant ones whose ecological tolerances and habitat preferences are known. It is noteworthy here that all species of amphibians and reptiles from all Illinoian localities studied in Kansas are indistinguishable from living species.

Duck Creek Local Fauna

Based on the study of the sedimentary environment and on the molluscan fauna, Kolb et al. (1975) state: “The presence of Pisidium compressum and Sphaerium stratum within cross-bedded sands indicates a perennial stream with some current action, while the abundance of Valvata tricarinata suggests the stream was lake-like in places. The abundance of several strictly woodland species such as Cionella lubrica suggests that a continuous strand of trees bordered the stream, while valley slopes were possibly covered with grasses and scattered trees. Like-

Fig. 11.—Modern range of Rana sylvatica (stippling) and record of Rana sylvatica from the Duck Creek local fauna, Pleistocene, Illinoian (circled dot).
wise, cooler summers and winters than at present are indicated for Ellis County at the time these taxa lived by the predominance of species with northern distribution.

Based on the mammalian fauna of the Duck Creek locality McMullen (1978) states “In summary, the Duck Creek local fauna lived near a stream which supplied the area with permanent water. Occurring in the moist lowlands and probably bordering the stream in places was a riparian forest. Whether the interspersed trees were coniferous or deciduous is unknown because forest dwelling species in the fauna might have inhabited either situation and palynological data are lacking. The adjacent lowlands area probably was covered with mixed tall and short grasses.”

The small herpetofauna of the Duck Creek site appears mainly to fit in with the above interpretations (Table 1). The only extralimital species is the wood frog, *Rana sylvatica*, which occurs mainly to the north and east of Kansas today (Fig. 11). As is the case with the woodland mammalian species discussed by McMullen (1978), *Rana sylvatica* occurs in both deciduous and coniferous forests. Nevertheless, based on the *R. sylvatica* record, one might suggest the possibility of at least cooler, perhaps moister summers, and at least the presence of some kind of woodland cover near the major aquatic habitat. But it should be pointed out that other herpetological elements of the Duck Creek fauna (*Ambystoma tigrinum*, *Bufo w. woodhousei*, *Rana pипiens*, and *Lampropeltis calligaster*) occur in the area today, and do not indicate a climate indicative of northeastern South Dakota as inferred by McMullen’s (1975) discussion of the area of sympatry for Duck Creek fauna shrews.
Williams Local Fauna

The Williams fauna has not been interpreted as thoroughly as has the Duck Creek fauna. Hall (1972) gave an abstracted paper at the Michigan Academy of Science, Arts, and Letters on the mollusks of the Williams local fauna. McMullen (1975) discussed a new species of shrew that also occurred in the Duck Creek fauna. Lundberg (1975) listed catfishes, and Preston (1979) listed turtles from the Williams fauna. Based on species in these papers, the paleoecology appears to have been generally similar in both the Duck Creek and Williams fauna; that is a permanent body of water with woodland bordering the water, at least in places.

The larger herpetofauna of the Williams fauna indicates (based on habitats of modern Kansas forms, Collins, 1974) some rather specific situations (Table 1). The main habitat appears to have been a pond or the low energy part of a stream and its bank. Thirteen of the 21 species identified from the Williams fauna occur frequently or seasonally near this main habitat. On the other hand, 11 of 21 species are typical of prairie flats or prairie hillside habitats; and six of 21 animals would be found in prairie-woodland edge habitats. One animal is entirely a woodland species.

Two extralimital species, Emystoidea blandingii and Elaphe vulpina, occur in the Williams fauna. The nearest Emystoidea blandingii occurs to Rice County, Kansas, today is southeastern Nebraska (Fig. 12). The nearest Elaphe vulpina occurs to Rice County today is southeastern Nebraska and northeastern Missouri (Fig. 13). These occurrences may indicate somewhat cooler, moister climate for
the area in the Pleistocene. On the other hand the rest of the herpetological species in the Williams fauna do not indicate a climate that is different from the area today; in fact all of them are typical animals of the region. Certainly a "full glacial" climate or dominant coniferous forest situation is not indicated by the Williams fauna amphibian and reptile species. Animals of the fauna that occur consistently south of coniferous forest situations today include: Pseudemys scripta, Coluber constrictor, Sonora episcopa, Tantilla sp., Regina grahami, and Tropidoelion lineatum.

**Comment**

The statement made (Holman, 1980) that herpetological evidence from the Sandahl local fauna (Illinoian) did not support the classical idea of a cooler, moister climate for the Illinoian age in Kansas should be somewhat modified based on Illinoian herpetological species in both the Duck Creek and Williams faunas. The Sandahl fauna had two turtles, a salamander, five anurans, three lizards, and six snakes (17 forms), all of which are extant and occur in the area today. But the presence of the wood frog (Rana sylvatica) in the Duck Creek fauna and Blanding's turtle (Emydidae blandingii) and the fox snake (Elaphe vulpina) in the Williams fauna possibly indicates a somewhat cooler, moister climate, and the presence of more woodland than occurs in the area today. But, as previously stated, it is emphatically clear that a "full glacial" or Boreal climate, or a dominant coniferous forest association is not indicated by the other herpetological species.

In the past, Pleistocene mammalian faunas have sometimes been interpreted as indicating Boreal or even Tundra situations when the herpetofaunas from the same localities have been similar or identical to those found in the areas today. Certainly a problem of interpretation exists here. Moreover, as Stuart (1979) indicates in his study of Pleistocene occurrences of the European pond turtle (Emys orbicularis) in Great Britain, a certain minimum mean summer temperature is needed in order for the turtles to breed. In the future, it would seem that studies on critical temperatures for egg-hatching of turtles and other reptilian species would provide exceedingly important information about Pleistocene summer climates in North America.

Perhaps, rather than indicating the presence of full Boreal or Tundral vegetation and climate, the presence of northern extralimital mammals might best be explained by southward glacial displacement of both mammalian and plant species. This would form a mosaic Pleistocene community of both animals and plants. Such a mosaic community could survive as long as the climate remained equable.

**Literature Cited**


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