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SMALL MAMMALS OF THE PRAIRIE CREEK SITE, DAVIESS COUNTY, INDIANA

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ABSTRACT: Twenty-nine species of small mammals, including six extralimital species (*Condylura cristata,* the star-nosed mole; *Martes pennanti,* the fisher; *Tamiasciurus hudsonicus,* the red squirrel; *Clethrionomys gapperi,* the southern red-backed vole; *Microtus xanthognathus,* the yellow-cheeked vole; and *Lepus* cf. *L. americanus,* the snowshoe hare), were recovered from the Prairie Creek Site in Daviess County Indiana. Both Late Pleistocene (Zone D, 14,010 B.P.) and Holocene (Zone B, 2,880 - 4,140 B.P.) zones were distinguished along with an area of mixture (Zone C). The Late Pleistocene zone included several small mammals, whose presence provides support for the pollen and plant macrofossil interpretation that a spruce-dominated boreal forest surrounded Lake Prairie Creek and its associated marshes and wet meadows. The fauna includes a mixture of species (e.g., yellow-cheeked vole and star-nosed mole) that co-existed in the Late Pleistocene but have segregated distributions today. The Holocene zone included the remains of small mammals characteristic of an aquatic and marsh/meadow habitat with nearby deciduous woodlands, not unlike similar habitats in parts of Indiana today. Two Holocene extralimital species (the star-nosed mole and the fisher) appear not to have been as pressed for northern migration at the end of the Late Pleistocene as were some of the more boreal species.

INTRODUCTION

The preservation of small mammal remains at the Prairie Creek Site, Daviess County, Indiana presents a unique opportunity to examine an aspect of lacustrine deposits not normally available, because of either low faunal diversity (Richards, Whitehead, and Cochran, 1988) or the lack of sampling for microfaunal remains. Most Indiana lacustrine deposits occur in "kettle" lakes in northern (Blatchley and Ashley, 1901) or in valleys tributary to former glacial sluiceways in southern Indiana (Gray, 1971). Recovery (or salvage) of vertebrate remains in the past usually involved large mammals such as the American mastodont, *Mammut americanum* (e.g., Hay, 1912, 1923; Kintner, 1930; Simpson, 1934; Sanford, 1935; Lyon, 1939). Only in more recent years have there been attempts to recover microfauna from lacustrine deposits, and the results have, until now, been sparse. The Kolarik mastodont locality, Starke County, Indiana produced remains of only the meadow vole (*Microtus pennsylvanicus*) and muskrat (*Ondatra zibethicus*) among the bones of fishes, frogs, mastodont, and caribou (*Rangifer tarandus*) (Richards and Ellis, in prep.). The Christensen Mastodont locality, Hancock County, Indiana yielded bones of the muskrat in Late Pleistocene levels and remains of the raccoon (*Procyon lotor*) and mink (*Mustela vison*) in Holocene sediments (Graham, Holman, and Parmalee, 1983). Extensive washing of the sediments at the Dollens mastodont locality, Madison County, Indiana, produced only remains of muskrat and an indet. mouse sp., though the remains occurred in marsh (peat) rather than lake sediments (Richards, Whitehead, and Cochran, 1988). Lacustrine and marsh deposits have been studied largely for their vegetational histories as provided by pollen and plant macrofossils (e.g., Englehardt, 1965; Gooding and Ogden, 1965; Whitehead, Jackson, Sheehan, and Leyden, 1982; Jackson, Whitehead, and Ellis, 1986; Richards, Whitehead, and Cochran, 1988). Because of this

dearth of small mammal remains from lacustrine and marsh deposits, where vegetational histories are readily available, the 29 species of small mammals (including 6 extralimital species) recovered from the Prairie Creek Site are unique and important.

The caves of southern Indiana have produced extensive Quaternary microfaunas, including over 15 extralimital small mammals and reptiles (e.g., Richards, 1972, 1982, 1983, 1986). However, few of these cave deposits have been radiometrically dated, and none have associated pollen profiles as does the Prairie Creek Site.

In the summers of 1974 and 1975, the Department of Anthropology field school, Indiana University, and the Glenn A. Black Laboratory of Archaeology excavated biotic remains and archaeological materials from Quaternary-aged deposits of the Prairie Creek Site, Daviess County. Materials were recovered by trowling, with all matrix dry screened through 1/4" hardware mesh. Approximately 10% of the matrix was water screened through ca 1 mm hardware mesh (P.J. Munson, pers. comm.). The recovered vertebrate materials currently under study include the fishes (W.C. Dickinson), amphibians and reptiles (J.A. Holman and R.L. Richards, in prep.), birds (P.W. Parmalee, in prep.), small mammals (this paper), and large mammals (P.J. Munson, in prep). Pollen and plant macrofossils have been reported upon (S.T. Jackson and D.R. Whitehead, unpublished ms.), and the excavation method and overview of the site is in preparation (P.S. Munson). The geology and sedimentology of the Prairie Creek lake basin has been treated by Fraser and Gray (in press). Their study reveals that from approximately 21,000 B.P. to 16,000 B.P., the West Fork of White River served as a glacial sliceway with outwash sediments damming the mouth of tributary Prairie Creek, resulting in the formation of a large lake. The lake accumulated up to 6 feet of organic mucks and biotic remains until about 13,000 B.P., when the valley train sediments in White River were eroded, the dam was breached, and the lake drained. Sediments and biotic remains were redeposited a mile or so downstream into the bed of Prairie Creek, the present fossil locality. A radiocarbon date of 14,010 ± 140 B.P. (DIC-234) on a spruce log indicates the time of faunal accumulation in the sample of sediments excavated (P.J. Munson, pers. comm.). Just before 10,000 B.P., perhaps as the result of dune formation at the mouth of Prairie Creek, a marsh formed in the basin, and by 4,200 B.P. (P.J. Munson, pers. comm.), a shallow stream meandered through the basin into the East Fork White River.

Zone D includes remains of Late Pleistocene vertebrates that inhabited the waters, shores, and region surrounding Lake Prairie Creek approximately 14,000 B.P., in addition to river margin vertebrates incorporated into the deposit during lake draining (P.J. Munson, pers. comm.). Zone B includes the Holocene (4,140- 2,880 B.P.) remains of vertebrates living in and about Prairie Creek and marshlands of the former lake as well as the surrounding region accumulated in the alluvial sediments of Prairie Creek. These included the food refuse of aboriginal meals that may have involved a wider diversity of exploited habitats than might be expected in the "natural" accumulations. Zone C consists of vertebrates primarily from Holocene sediments, with inclusions of Late Pleistocene remains scoured from the underlying Zone D deposits (P.J. Munson, per. comm.). Occasional Late Pleistocene elements (Zone D) have been redeposited in Holocene (Zone B) strata.

CHECKLIST OF SMALL MAMMALS FROM THE PRAIRIE CREEK SITE, DAVIESS COUNTY, INDIANA

The Late Pleistocene (Zone D)

Blarina brevicauda	Northern short-tailed shrew
Cryptotis parva	Least shrew
Sorex cinereus	Masked shrew
Condylura cristata#	Star-nosed mole
Scalopus aquaticus	Eastern mole
*Martes pennanti**	Fisher
Mustela frenata	Long-tailed weasel
Mustela vison	Mink
Marmota monax	Woodchuck
Tamias striatus	Eastern chipmunk
Tamiasciurus hudsonicus#	Red squirrel
Peromyscus sp.	Deer and white-footed mice
Clethrionomys gapperi#	Southern red-backed vole
Microtus pennsylvanicus	Meadow vole
Microtus xanthognathus#	Yellow-cheeked vole
Ondatra zibethicus	Muskrat
Synaptomys sp.	Bog lemmings
Zapus hudsonius	Meadow jumping mouse
Sylvilagus cf. *S. floridanus*	Eastern cottontail
Leporidae, sp. indet.	Cottontails and hares

The Late Pleistocene - Holocene Mixture (Zone C)

Blarina brevicauda	Northern short-tailed shrew
Sorex cinereus	Masked shrew
Condylura cristata#	Star-nosed mole
Procyon lotor	Raccoon
*Martes pennanti**	Fisher
Mustela vison	Mink
Sciurus carolinensis	Gray squirrel
Sciurus cf. *S. niger*	Fox squirrel
Clethrionomys gapperi#	Southern red-backed vole
Microtus pennsylvanicus	Meadow vole
Microtus pinetorum	Pine vole
Ondatra zibethicus	Muskrat
Synaptomys sp.	Bog Lemmings
Lepus cf. *L. americanus*#	Snowshoe hare
Leporidae, sp. indet.	Cottontails and hares

The Holocene (Zone B)

Didelphis virginiana	Virginia opossum
Blarina brevicauda	Northern short-tailed shrew
Condylura cristata[#]	Star-nosed mole
Scalopus aquaticus	Eastern mole
Urocyon cinereoargenteus	Gray fox
Procyon lotor	Raccoon
Martes pennanti[*]	Fisher
Mustela vison	Mink
Mephitis mephitis	Striped skunk
Glaucomys cf. *G. volans*	Southern flying squirrel
Marmota monax	Woodchuck
Sciurus carolinensis	Gray squirrel
Sciurus niger	Fox squirrel
Peromyscus sp.	Deer and white-footed mice
Microtus pennsylvanicus	Meadow vole
Microtus cf. *M. pinetorum*	Pine vole
Leporidae cf. *Sylvilagus* sp.	Cottontail
Leporidae, sp. indet.	Cottontails and hares

[#] Extralimital.
[*] Extirpated in historic times.

SYSTEMATIC PALEOZOOLOGY

The minimum number of individuals (MNI) and number of identified skeletal pieces (NISP) of small mammals for each zone are presented in Table 1. Species accounts follow the nomenclature and order of presentation of Banks, *et al.* (1987). Modern species distributions are from Hall (1981) and Mumford and Whitaker (1982) with habitat and species associations from the latter, unless otherwise noted. Measurements (mm) were made by ocular micrometer at 15X or by dial calipers. The following abbreviations are used: I, C, P, and M for the upper incisor, canine, premolar, and molar, respectively; i, c, p, and m for the lower teeth; $\bar{x}$ for the arithmetic mean; S.D. for the standard deviation; O.R. for the observed range of measurements; C.V. for the coefficient of variation; N for the number of specimens; L for left; R for right; prox. for proximal; dist. for distal; frag. for fragment; and B.P. for before present (A.D. 1950). Catalogue numbers (in parenthesis) are marked on the specimens. The remains are housed at the Glenn A. Black Laboratory of Archaeology, Indiana University, Bloomington.

Class MAMMALIA: Mammals
Order MARSUPIALIA: Marsupials
Family DIDELPHIDAE: Large American opossums
Didelphis virginiana Kerr, 1792; Virginia opossum

Material. Zone B: R dentary, ant. portion (453/1); Rp2 (1237/4); thoracic vertebra (453/4); and L radius, prox. end (766/6).

Taxon	Zone D		Zone C		Zone B	
	MNI[1]	NISP[2]	MNI	NISP	MNI	NISP
Didelphis virginiana	—	—	—	—	1	4
Blarina brevicauda	2	10	1	1	2	2
Cryptotis parva	1	1	—	—	—	—
Sorex cinereus	2	2	1	1	—	—
Sorex cf. *S. cinereus*	1	3	—	—	—	—
Sorex sp. indet.	—	1	—	—	—	—
Condylura cristata[#]	3	5	1	1	1	1
Scalopus aquaticus	1	3	—	—	8	13
Urocyon cinereoargenteus	—	—	—	—	1	1
Procyon lotor	—	—	1	4	2	12
Carnivore cf. *Procyon lotor*	—	—	—	—	—	3
Martes pennanti[*]	3	5	1	2	1	3
Carnivore cf. *Martes pennanti*[*]	—	2	—	1	1	3
Mustela frenata	1	1	—	—	—	—
Mustela vison	2	5	1	4	4	10
Carnivore cf. *Mustela vison*	—	1	—	—	—	3
Mephitis mephitis	—	—	—	—	1	1
Carnivore spp. indet.	—	4	—	2	—	6
Glaucomys cf. *G. volans*	—	—	—	—	1	1
Marmota monax	1	1	—	—	1	1
Rodent cf. *Marmota monax*	—	1	—	—	—	1
Sciurus carolinensis	—	—	1	1	2	4
Sciurus cf. *S. carolinensis*	—	—	—	—	1	10
Sciurus niger	—	—	—	—	1	1
Sciurus cf. *S. niger*	—	—	1	1	—	1
Sciurus sp.	—	—	—	6	—	11
Tamias striatus	2	5	—	—	—	—

Taxon	Zone D		Zone C		Zone B	
	MNI[1]	NISP[2]	MNI	NISP	MNI	NISP
Rodent cf. *Tamias striatus*	—	1	—	—	—	—
Tamiasciurus hudsonicus[#]	1	3	—	—	—	—
Sciuridae, spp. indet.	1	1	—	2	—	2
Peromyscus sp.	2	3	—	—	2	3
Clethrionomys gapperi[#]	1	1	4	5	—	—
Microtus pennsylvanicus	1	1	1	1	—	—
Microtus cf. *M. pennsylvanicus*	3	7	—	2	1	2
Microtus pinetorum	—	—	1	1	—	—
Microtus cf. *M. pinetorum*	—	—	—	—	1	1
Microtus pinetorum/ochrogaster	—	—	—	—	—	1
Microtus xanthognathus[#]	2	3	—	—	—	—
Microtus cf. *M. xanthognathus*[#]	—	5	—	—	—	—
Microtus sp. indet.	2	7	—	4	—	4
Ondatra zibethicus	38	702	14	291	56	903
Synaptomys sp.	1	2	1	2	—	—
Arvicolinae, spp. indet.	2	16	—	—	—	—
Zapus hudsonius	1	1	—	—	—	—
Mouse spp. indet.	—	53	—	15	—	24
Rodent sp. indet.	—	1	—	—	—	—
Lepus cf. *L. americanus*[#]	—	—	1	1	—	—
Sylvilagus cf. *S. floridanus*	1	1	—	—	—	—
Sylvilagus sp.	—	—	—	—	1	1
Leporid spp. indet.	—	13	—	6	—	11
Mammal spp. indet.	—	162	—	43	—	106
Totals	75	1033	30	397	89	1150

[1] MNI = Minimum number of individuals.
[2] NISP = Number of identified skeletal pieces.
[#] Extralimital.
[*] Extirpated in historic times.

Remarks. The opossum is unknown from Late Pleistocene faunas north of Missouri, Kentucky, and Virginia (Kurtén and Anderson, 1980). It has apparently spread Table 1. Zonal distribution of the identified small mammal skeletal pieces at the Prairie Creek Site, Daviess County, Indiana. into more northern States in the past several thousand years (Guilday, 1958), being known from archaeological context in the early Holocene of east-central Illinois (Purdue and Styles, 1986). Opossum bones were recovered from only the Holocene zone at Prairie Creek. Although favoring wooded areas, the opossum also inhabits brushy and semi- open country and can spend considerable time along watercourses.

Order INSECTIVORA: Insectivores
Family SORICIDAE: Shrews
Blarina brevicauda (Say, 1823); Northern short-tailed shrew

Material. Zone D: L maxilla frag. (2460); RP3 (2693); L dentary frag. with i (2463); L dentary with ml (2686); L, R i (2460, 2693); Rm3 (2464); 2 L humeri (2335, 2460); and sacrum (2460). Zone C: RI (2597). Zone B: Frag. L dentary with m2 (2652); and L dentary portion, edentulous (2529).

Remarks. Dentaries were too fragmented for metric determination of subspecies (Graham and Semken, 1976; Jones, *et al.,* 1984). Two dentary fragments (2463 from Zone D and 2652 from Zone B) were measured for depth of ramus at m2, reading 2.31 mm and 2.02 mm, respectively. They appear no different in size than 15 modern Indiana *Blarina brevicauda kirtlandi* from the Indiana State University collection ($\bar{x}$ = 2.28 mm; O.R. = 2.09 - 2.60 mm). The short-tailed shrew occurs in most Indiana habitats and is presently one of the most abundant mammals in the State.

Cryptotis parva (Say, 1823); Least shrew

Material. Zone D: LP3 in maxilla frag. with 3 empty unicuspid alveoli (2335).

Remarks. The least shrew is found throughout Indiana in old fields, especially drier ones. Few have been recovered from woodlands.

Sorex cinereus Kerr, 1792; Masked shrew

Material. Zone D: L dentary with ml (2460); and L dentary, edentulous (2463). Zone C: R dentary with p4-m3 (2459).

Sorex cf. *S. cinereus*

Material. Zone D: L dentary, edentulous (2335); Lml (2335); and R dentary with p4-m2 (2335).

Remarks. Dentaries of *Sorex cinereus* and *S. longirostris* are very similar, and there is a general opinion that except for the slightly smaller size of the latter, the two are indistinguishable (Guilday, 1962; Guilday, Hamilton, and McCrady, 1966; Ray, 1967; Guilday, Hamilton, and McCrady, 1969; Guilday, Parmalee, and Hamilton, 1977; Guilday, Hamilton, Anderson, and Parmalee, 1978). *Sorex longirostris* has been reported only from Holocene localities in the Midwest (Parmalee, 1967; Richards, 1983) and the Pleistocene (Sangamonian) of Florida (Kurtén and Anderson, 1980). Richards (1983)

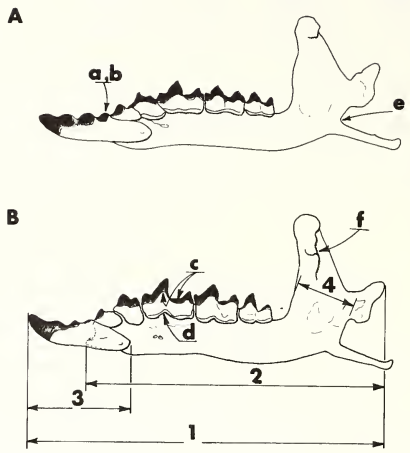

Figure 1. The left dentaries of *Sorex cinereus* and *S. longirostris* illustrating distinguishing measurements and morphological features. **A.** *Sorex cinereus*: a and b illustrate the size and pigmentation of the 3rd accessory tine of the incisor; and e refers to the shape of the lower portion of the sigmoid notch. **B.** *Sorex longirostris*: c points out the lower extent of the pigmentation on m1 and m2; d points out the development of the "notch" in the labial cingulum of m1 and m2; and f refers to the rugosity of sculpturing of the labial surface of the vertical ramus. One represents the total length of the mandible; 2, the total length of the dentary; 3, the length of the incisor; and 4, the width of the vertical ramus.

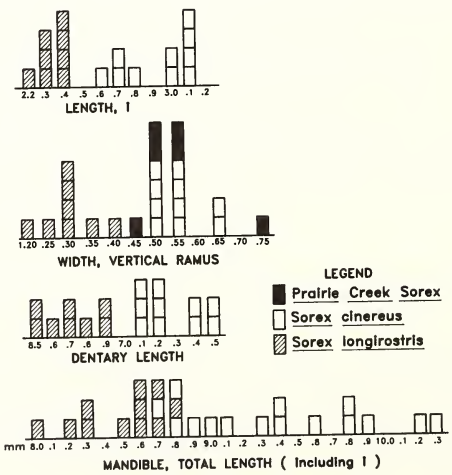

Figure 2. Four dimensions that have discriminated between *Sorex cinereus* and *S. longirostris* in a small sample. Figure 1 illustrates the actual measurements.

Table 2. Selected dentary/tooth measurements (mm) of *Sorex cinereus* from the Prairie Creek Site, Daviess County, Indiana.

Unit	Element	Length p4-m3	Length m1-m3	Length m1	Length m2	Length m3	Depth at m2	Condyle width	Ht. Vert. ramus	Wth.Vert. ramus
Zone D										
2335	R dentary	—	—	1.19	1.10	—	.89	1.47	3.06	1.48
2335	L dentary	—	—	—	—	—	.89	1.40	3.08	1.55
2335	Lm1	—	—	1.20	—	—	—	—	—	—
2460	L dentary	—	—	1.25	—	—	.89	1.44	—	1.47
2463	L dentary	—	—	1.25	—	—	.98	—	3.11	1.73
Zone C										
2459	R dentary	3.70	3.10	1.22	1.09	.93	.88	1.47	2.96	1.49

suggested that the two species could be separated by the total length of the mandible (including incisor), total length of the dentary, length of the incisor, and width of the vertical ramus (Figures 1 and 2). Many of the other commonly presented measurements (e.g., toothrow lengths, tooth dimensions, and condyle width) segregate the two species only at the extremes or not at all (condyle width). All measurements are useful, however, in quantifying geographic variation in size, such as that displayed by *Sorex cinereus* (Guilday, Martin, and McCrady, 1964). The two can also be separated by a cluster of morphological traits (Figure 1) that includes the following: the greater size and heavier pigmentation of the 3rd accessory tine of the lower incisor in *S. cinereus* (Figure 1A, a, b; that of *S. longirostris* is smaller and scarcely pigmented, if at all); the lower extent of pigmentation especially on the m1 and m2 in *S. cinereus* (Figure 1B, c; the lower line of pigmentation on the labial surface of the protoconid is at approximately the same level as the labial ridge of the hypoconid in *S. cinereus* (it is above the level of the labial ridge in *S. longirostris*)); the weaker development of the small "notch" in the labial cingulum of m1 and m2 in *S. cinereus* (Figure 1B, d; the "notch" is stronger and more distinct in *S. longirostris*); the shape of the lower portion of the sigmoid notch (Figure 1A, e; the anteromost concavity tends to be in the lower portion of the notch in *S. cinereus* and is variable in position in *S. longirostris*); the lesser rugosity of sculpturing on the labial surface of the vertical ramus (including coronoid spicule and external temporal fossa) in *S. cinereus* (Figure 1B, f); and the tendency of the teeth of *S. cinereus* to be reddish, when pigmentation is preserved (more orangish in *S. longirostris*). These distinctions are based upon limited material with a narrow geographic range and should be pursued further.

The Prairie Creek materials are assigned to *S. cinereus* on a combination of metric and morphological characters. Measurements are presented in Table 2. The jaws were too fragmented for the measurements of toothrow and overall length commonly used to interpret geographic variation in size. However, the jaws did appear to be similar in size to the modern comparative material from Indiana.

Sorex cinereus ranks second only to *Blarina brevicauda* as the most abundant shrew in eastern Late Pleistocene cave deposits (Richards, 1983). Today, the masked shrew

Figure 3. The left humeri (posterior view) of the moles found at the Prairie Creek Site, Daviess County, Indiana: **a**, *Condylura cristata* (Zone D: 2693); and **b**, *Scalopus aquaticus* (Zone B: L- 236/1). Note the more gracile form of *C. cristata*. Scale in millimeters.

inhabits moist environments with dense ground cover. Its common associates in northern Indiana, where it is common, are the meadow vole (*Microtus pennsylvanicus*), the northern short-tailed shrew (*Blarina brevicauda*), the white-footed mouse (*Peromyscus leucopus*), and the meadow jumping mouse (*Zapus hudsonius*), all of which were recovered from the Late Pleistocene zone at Prairie Creek. Neither the masked shrew nor the meadow jumping mouse were recovered from the Holocene zone.

Sorex sp. indet.; Red-toothed shrews

Material. Zone D: L humerus (2464).
Remarks. The humerus compares favorably with that of *Sorex cinereus.*

Family Talpidae: Moles
Condylura cristata (Linnaeus, 1758); Star-nosed mole

Material. Zone D: L humerus (2693; Fig. 3); L humerus, prox. condyle (2464); L humerus (2335, pathological); ulna, prox. end (2335); and frag. tibiofibula (2335). Zone C: frag. ulna (2437). Zone B: frag. L humerus (222/4).

Remarks. The materials are shown in Fig. 3. This is the first report of the star-nosed mole as a fossil in Indiana. The star-nosed mole presently inhabits marshes, swampy areas, and stream banks in northeastern Indiana. The Prairie Creek Site is some 190 miles southwest of the nearest (Allen County) specimen-based record of the star-nosed mole. Interestingly, remains of this mole were recovered from both Late Pleistocene and Holocene zones at Prairie Creek. Extralimital star-nosed mole remains are also known from Crankshaft Cave, Missouri (Parmalee, Oesch, and Guilday, 1969). The hairy-tailed mole (*Parascalops breweri*) is likewise known as an extralimital fossil from a Late Pleistocene

and Holocene context in Indiana (Parmalee, Munson, and Guilday, 1978; Richards, 1982). Perhaps moles in general, with their own "individualistic" environmental tolerances, were not as pressed for northern migration at the end of the Late Pleistocene as were some of the more boreal species.

Scalopus aquaticus (Linnaeus, 1758); Eastern mole

Material. Zone D: Frag. L humerus (2703); ulna (1664/1); and tibiofibula, prox. end (2464). Zone B: Scapula (222/3); 7 L humeri (236/1 (Figure 3), 453/3, 859/1, 1061/1, 1387/1, 1387/2, 2529: bone #1); frag. L humerus (1238/7); 3 R humeri (453/2, 766/4, 2529: bone #2); and ulna (1238/3).

Remarks. The eastern mole is found today throughout Indiana in most terrestrial habitats. Although it is generally a temperate species, it did apparently co-exist with the more northern star-nosed mole (*Condylura cristata*) in all zones at Prairie Creek. Temperate climate and less water saturated soils in the Prairie Creek environment (as opposed to the marshes and meadows of the earlier Lake Prairie Creek) probably account for the relative abundance of the eastern mole in the Holocene zones.

Order CARNIVORA: Carnivores
Family CANIDAE: Wolves, coyotes, foxes
Urocyon cinereoargenteus (Schreber, 1775); Gray fox

Material. Zone B: L radius, prox. shaft portion (766/5).

Remarks. Today, the gray fox is found throughout Indiana, although it is more common in the south, prefering brushy and wooded habitats.

Family PROCYONIDAE: Raccoons
Procyon lotor (Linnaeus, 1758); Raccoon

Material. Zone C: L maxilla frag. with P4, M1, M2 (2197/1); RM1 (529/1); Lm1 (2330/1); and baculum (274/1). Zone B: L maxilla frag. with P4 (2199/1); R premaxilla with I2, I3 (453/9); cranial and palatal frags. (859/14); RC (222/2); RP4 (1239/1); RP4 (Unit IV W85-90, N10, B2); RM1 (1237/2); RM1 (Unit IV, W85-90, N10, B2); LM2 (1237/3); L dentary, post. portion (211/2); Rc (453/23); and Lm2 (1238/2).

Carnivore cf. *Procyon lotor*

Material. Zone C: RP2 (2597). Zone B: C root (453/24); L dentary portion with c and p1, p2 alveoli (1082/1); and L ulna, prox. end (211/4).

Remarks. The raccoon is presently common throughout Indiana, frequenting wooded areas near water as well as more open country. It may originally have been confined to forested areas, including swamps. Interestingly, raccoon remains are not present in the Late Pleistocene zone at Prairie Creek, though they are well represented in the Holocene. The modern parapatric distribution of the temperate raccoon and the more boreal fisher (*Martes pennanti*) suggests that the absence of raccoon (and the presence of the fisher) in the Late Pleistocene zone is a reflection of the boreal climate and possibly of competition between the two species.

Table 3. Selected measurements (mm) of the remains of *Martes pennanti* (the fisher) from the Prairie Creek Site, Daviess County, Indiana.

Element	Measurement	Zone	Catalog Number	L-R	Value	Sex
I3	Anteroposterior length of crown	D	513/1	L	4.57	M
I3	Transverse width of crown	D	513/1	L	2.80	M
C	Greatest anteroposterior diameter of root	D	513/4	R	6.93	M
C	Greatest transverse diameter of root	D	513/4	R	6.07	M
P2	Length of crown	D	794/1	L	5.72	M
		D	513/1	L	6.17	M
P2	Width of crown	D	794/1	L	2.87	M
		D	513/1	L	2.87	M
P3	Length of crown	D	794/1	L	7.51	M
P3	Width of crown	D	794/1	L	3.54	M
P4	Length of crown	D	794/1	L	12.14	M
P4	Anterior width of crown (across protocone, normal to labial surface)	D	794/1	L	6.98	M
		D	513/1	L	8.12	M
P4	Posterior width of crown (heel)	D	794/1	L	4.14	M
P2-P4	Crown length	D	794/1	L	26.09	M
M1	Greatest anteroposterior length of lingual lobe	C	218/1	L	7.26	?
M1	Greatest transverse width of crown	C	218/1	L	10.21	?
c	Greatest anteroposterior diameter of root	C	237/1	L	ca. 7.18	M
c	Greatest transverse diameter of root	C	237/1	L	4.22	M
Femur	Least anteroposterior diameter of shaft	D	513/2	L	6.82	M
Femur	Least transverse diameter of shaft	D	513/2	L	7.5	M
Humerus	Length from caput to medial condyle	D	1497/1	R	81.05	F
Humerus	Length from caput to medial sulcus of distal articulation	D	1497/1	R	78.95	F
Humerus	Anteroposterior depth of proximal end	D	1497/1	R	15.08	F
		B	211/3	L	18.26	M
Humerus	Least transverse diameter of shaft	D	1497/1	R	5.50	F
Calcaneum	Greatest length	B	229/1	R	27.15	M

Family MUSTELIDAE: Mustelids
Martes pennanti (Erxleben, 1777); Fisher

Material. Zone D: L maxilla with P2, P3, and P4, male (794/1); L maxilla + premaxilla with I3, P2, and P4, male (513/1); RC, male (513/4); R humerus, female (1497/1); and L femur, male (513/2). Zone C: LM1 (218/1); and Lc, male (237/1). Zone B: L dentary, condyle area, male (214/2); L humerus, prox. end, male (211/3); and R calcaneum, male (229/1).

Carnivore cf. *Martes pennanti*

Material. Zone D: cervical vertebra (794/4); and thoracic vertebra, neural arch (794/5). Zone C: cervical vertebra (274/2). Zone B: Occipital with L condyle, male (230/2); R humerus, distal end, female (211/6); and ? radius shaft frag. (230/3).

Remarks. The fisher remains have previously been recorded and illustrated (Richards, 1993a). Measurements are presented in Table 3. The fisher does not presently inhabit Indiana, but there are several references to its historic occurrence (Mumford, 1969). Fisher remains have been recovered from two other Late Pleistocene localities (King Leo Cave, Harrison County and Megenity Peccary Cave, Crawford County; Richards, 1993a), from two archaeological sites (Ohio County (Kirkpatrick and Conaway, 1948) and Fort Ouiatenon, Tippecanoe County (Martin, 1986)), and from the Lake Michigan dunes (Rand and Rand, 1951). Tomak (1975) identified *Martes* remains from the original Prairie Creek investigation but did not conclude as to the species. (*Martes americana*, the marten, is known from several eastern Late Pleistocene localities (Kurtén and Anderson, 1980) but has not yet been found in Indiana). In the Late Pleistocene, the fisher was found as far south as Georgia, Arkansas, throughout the Appalachians, and west to Missouri (Kurtén and Anderson, 1980). The fisher inhabits extensive mixed hardwood forests (Burt and Grossenheider, 1952). It is among the few mammals that feed upon the porcupine (*Erethizon dorsatum*) (Kurtén and Anderson, 1980). Porcupine remains were not present in the Prairie Creek faunal sample.

Mustela frenata Lichtenstein, 1831; Long-tailed weasel

Material. Zone D: LP3 (2672).

Remarks. The long-tailed weasel is found throughout Indiana today in most habitats and often near water.

Mustela vison Schreber, 1777; Mink

Material. Zone D: 2 L humeri, dist. halves (200/2; 354/2); L radius, dist. end (2464); R radius, male (2463: bone #1); and L femur, female (354/1). Zone C: LM1 (217/2); L dentary with p4 and m1 (217/1); R dentary, post. portion, edentulous (374/1); and R humerus, lacking head (1465/1). Zone B: L dentary with p2, p3, m1, and m2 (214/1); L dentary with p3, m1, male (222/1); L dentary with m1 (453/5); L dentary with p3 and ml (453/6); frag. R dentary with p3 (453/7); L humerus, dist. 1/2, male (204/3); L ulna (766/2); R radius, distal 2/3 (859/5); L femur, prox. 1/2 (453/14); and R tibia, female (211/1).

Carnivore cf. *Mustela vison*

Material. Zone D: Rc (2464). Zone B: L humerus, dist. 1/2 (204/4); frag. L dentary (453/8); and L astragalus (453/17).

Remarks. Remains of the mink were the most abundant of the carnivore bones at the Prairie Creek Site. This result is to be expected, as the mink occurs throughout Indiana today, frequenting the borders of lakes and marshes as well as the banks of rivers and creeks in both wooded and open environments. The mink is closely associated with the presence of muskrat (*Ondatra zibethicus*) today, just as it was throughout the Prairie Creek sequence.

Mephitis mephitis (Schreber, 1776); Striped skunk

Material. Zone B: L ulna, prox. end (236/3).

Remarks. The striped skunk presently occurs throughout Indiana in a variety of habitats, including woods, brushy and weedy fields, and along streams and dry ravines.

Order RODENTIA: Rodents
Family SCIURIDAE: Squirrels
Glaucomys cf. *G. volans* (Linnaeus, 1758); Southern flying squirrel

Material. Zone B: L tibia, lacking distal end (204/2).

Remarks. The tibia compares closely with that of *Glaucomys volans,* rather than the slightly larger (and boreal) *G. sabrinus.* The southern flying squirrel is found throughout Indiana in mature woods. Throughout its range, it occurs in deciduous or mixed deciduous-coniferous stands, while *G. sabrinus* inhabits the more northern conifer and mixed forests (Burt and Grossenheider, 1952). The presence of *G. volans* indicates more modern, Holocene vegetation during Zone B accumulation.

Marmota monax (Linnaeus, 1758); Woodchuck

Material. Zone D: LI (1188/1). Zone B: R femur, prox. 1/2 (859/2).

RODENT cf. *Marmota monax*

Material. Zone D: L dentary, angle area (496/1). Zone B: L humerus, dist. 1/2 (204/5).

Remarks. The woodchuck may originally have been an animal of the forest (Lyon, 1936). Today, however, the woodchuck is common throughout Indiana and is most abundant in more open areas, preferring brushy, uneven land, interspersed with cultivated fields.

Sciurus carolinensis Gmelin, 1788; Gray squirrel

Material. Zone C: R humerus, prox. end (2597). Zone B: R scapula, glenoid cavity area (1086/2); L humerus shaft (453/22); and L humerus, distal end (859/7).

Sciurus cf. *S. carolinensis*

Material. Zone B: R dentary with incisor (229/2); Rm3 (2538); L humerus, dist.

end (211/5); L femur, lacking dist. end (453/12); L femur, prox. end (453/21); L femur, prox. ½ (766/1); R femur, prox. end (2529); R tibia, dist. end (236/2); R tibia, lacking dist. end (453/10); and R calcaneum (453/11).

Remarks. The gray squirrel is found throughout Indiana, most abundantly in extensive, mature, mixed deciduous woodlands with a well developed understory. Its closest single associate is the fox squirrel (*Sciurus niger*). Both occurred only in the Holocene zone at Prairie Creek.

Sciurus niger Linnaeus, 1758; Fox squirrel

Material. Zone B: R femur (461/1).

Sciurus cf. *S. niger*

Material. Zone C: R dentary, edentulous (217/4). Zone B: R tibia, dist. end (204/1).

Remarks. The fox squirrel presently occurs throughout Indiana in less dense woodlands with less understory than its most common associate, the gray squirrel (*Sciurus carolinensis*). Both were recovered only from the Holocene zone at Prairie Creek.

Sciurus sp. indet.; Tree squirrel

Material. Zone C: LI (311/2); R ulna, prox. end (217/5); frag. R femur (217/6); L tibia, dist. end (2597); R tibia (1477/1); and R calcaneum (311/1). Zone B: 3 LI (222/5, 453/13, 1238/6); 2 RI (859/10, 1238/5); Li (859/11); Li frag. (VIIB, N2-4, W25-30+, Lev B5); R ischium (1238/4); R femur shaft (453/18); R tibia shaft (1237/1); and metatarsal (859/12).

Tamias striatus (Linnaeus, 1758); Eastern chipmunk

Material. Zone D: frag. L dentary with m2 (2460); Ri (2460); R humerus (2462); R tibia, prox. 2/3 (2335); and R tibia, prox. end (2461).

RODENT cf. *Tamias striatus*

Material. Zone D: Li, juvenile (1412/1).

Remarks. The chipmunk is common throughout Indiana, except in the southwestern part of the State and along the Ohio River, where it is of sporadic occurrence. It inhabits woodlands and woodland border habitats such as brushy fields and the borders of lakes. Suprisingly, it was recovered from only the Late Pleistocene zone at Prairie Creek.

Tamiasciurus hudsonicus (Erxleben, 1777); Red squirrel

Material. Zone D: R femur (1497/2); L tibia, lacking prox. end (849/2); and R tibia, dist. end (2703).

Remarks. The Prairie Creek femur is larger than several comparative Indiana specimens (total length from caput, 42.26 mm; total length from greater trochanter, 42.34 mm; and breadth of distal end, 7.25 mm). Today, the red squirrel is found in the north-

ern two-thirds of Indiana, though there are a few sporadic records from the south-central and southwestern part of the State. It is generally found in pine and spruce forests, mixed hardwood forests, and swamps (Burt and Grossenheider, 1952). In Indiana, the red squirrel is known from hardwood forest (especially where conifers are present), isolated woodlots, and wooded stream borders and adjoining swamps. It is the most northern of the tree squirrels and was recovered only from the Late Pleistocene zone at Prairie Creek.

Family Muridae: Rats, mice, voles
Subfamily Sigmodontinae: New World rats and mice
Peromyscus Gloger, 1841, sp. indet.; Deer and white-footed mice

Material. Zone D: L, R dentaries with i (2335); and L dentary with i (2464). Zone B: R dentary with i (766/8); R dentary, edentulous (2652); and Rm1 (2535).

Remarks. Relatively unworn m1's of eastern *Peromyscus* can sometimes be identified to species (Guilday, *et al.,* 1977; Ray, 1967). Unfortunately, the Prairie Creek dentaries lack molars. Today, both the white-footed (*Peromyscus leucopus*) and deer (*P. maniculatus*) mice occur throughout Indiana, occupying a variety of habitats from woodlands to dry, open fields.

Subfamily Arvicolinae: Arvicoline rodents
Clethrionomys gapperi (Vigors, 1830); Southern red-backed vole

Material. Zone D: L dentary, edentulous (2463). Zone C: LM3 (2654); Lm1 (2597); and 3 Lm1 (2654).

Remarks. The southern red-backed vole is not historically known from Indiana. The present material has previously been noted, as well as other Late Pleistocene material, from cave deposits in Lawrence, Harrison, and Jennings Counties, Indiana (Richards, 1986). The red-backed vole has been recovered extralimitally from over 20 Quaternary localities in Colorado, Nebraska, Kansas, Iowa, Missouri, Arkansas, Illinois, Kentucky, Tennessee, and Georgia (Richards, 1986). Some of the Illinois, Missouri, and Iowa sites are of Holocene age. *Clethrionomys* possesses rooted molars (as adults) and a characteristic occulusal enamel pattern (Semken, 1984). Today, the southern red-backed vole is most common in mixed conifer/deciduous forests, especially where the floor is littered with logs and stumps, though it can also be found in the brushy understory of forest edges (Semken, 1984). It was recovered with certainty only from the Late Pleistocene zone at Prairie Creek.

Microtus pennsylvanicus (Ord, 1815); Meadow vole

Material. Zone D: LM3 (2460). Zone C: RM3 (2654).

Microtus cf. *M. pennsylvanicus*

Material. Zone D: 2 L dentaries with m1 and m2 (2464, 2692); 2 R dentaries with m1 and m2 (2463, 2464); Lm1 (2463); and 2 Rm1 (2460, 2461). Zone C: Lm3 (2453); and Rm3 (2437). Zone B: R dentary with i, m1, and frag. m2 (859/13); and Lm2 (2652).

Remarks. The dentition of *Microtus pennsylvanicus* is generally inseparable from that of the rock vole, *M. chrotorrhinus,* except for the distinctive M3's (Semken, 1984).

The remaining molars with the "*pennsylvanicus*" pattern might include *M. chrotorrhinus* but, as suggested by the recovered M3's, are likely of *M. pennsylvanicus.* Fossil sites for *M. chrotorrhinus* have not yet been noted beyond the Appalachian area, where it has a sporadic occurrence today (Lundelius, *et al.,* 1983). Presently, the meadow vole is common to abundant in northern Indiana but relatively scarce in south-central and southwestern Indiana. It occurs in moist habitats such as low meadows, marshes, the grassy shores of lakes and streams, and grassy fields and has seldom been recovered from woodlands.

Microtus pinetorum (Le Conte, 1830); Pine vole

Material. Zone C: Lm1 (2597).

Microtus cf. *M. pinetorum*

Material. Zone B: Rm1 (2653).

Microtus pinetorum/M. ochrogaster (Wagner, 1842); Prairie vole

Material. Zone B: RM2 (2428).

Remarks. *Microtus pinetorum* and *M. ochrogaster* have very similar dentitions. Johnson (1972) separated the two species using two measurements (neck width/posterior length ratio) of the m1, a method duplicated by Richards and Munson (1988) on Indiana material. The m1 of *M. pinetorum* has a relatively narrow, posteriorly directed 3rd buccal reentrant angle and a relatively posteriorly directed triangle 6 (Martin, 1987; Martin, pers. comm., Oct. 1988). The two Prairie Creek m1's are assigned to *M. pinetorum* by these modern Indiana neck width/posterior length ratios (2597: neck width, 0.21 mm, posterior length, 1.44 mm; 2653: neck width only, 0.23 mm) and by the criteria of Martin. The RM2 contains four elements, the condition in *Microtus pinetorum, M. ochrogaster,* and *M. chrotorrhinus,* though the last is of unlikely occurrence in the Holocene zone at Prairie Creek. Both the pine and the prairie vole occur throughout Indiana today, more commonly in the south. The pine vole occurs primarily in deciduous forest with soft soil and a leaf mold that allows easy burrowing, though it also occurs in brushy or grassy fields. Its most common associates are the northern short-tailed shrew (*Blarina brevicauda*) and the white-footed mouse (*Peromyscus leucopus*). The prairie vole prefers relatively dry grassy or weedy fields.

Microtus xanthognathus (Leach, 1815); Yellow-cheeked vole

Material. Zone D: 2 LM1's, lacking ant. loops (2460, 2462); and LM3, lacking ant. loop (2460).

Microtus cf. *M. xanthognathus*

Material. Zone D: Rm2, ant. frag. (2693); L ulna (2464); R innominate, acetabular area (2461); R femur (2461); and R femur, lacking distal end (2464).

Remarks. The teeth were identified by occlusal pattern, size, and the distribution of cement (Hallberg, Semken, and Davis, 1974). Postcranial material was referred by

large size. These materials have been previously recorded (Richards, 1993b). Today, the yellow-cheeked vole occurs in northwestern Canada and Alaska. The nearest populations (northeast Manitoba) are about 2093 km (1300 miles) north of the Prairie Creek Site. It is known from one other Indiana Late Pleistocene locality (Megenity Peccary Cave, Crawford County; Richards, 1989) and over 20 others in Quebec, Pennsylvania, West Virginia, Virginia, Tennessee, Kentucky, Illinois, Missouri, Arkansas, Wisconsin, Iowa, and Wyoming (Hallberg, Semken, and Davis, 1974; Richards, 1993a). Today, the yellow-cheeked vole inhabits spruce forests and the bordering tundra (Burt and Grossenheider, 1952). Guilday (1971) related that it occurred in the open coniferous parklands at the forest fringe, rather than in the dense boreal forest. Yellow-cheeked vole remains were recovered only in the Late Pleistocene zone at Prairie Creek.

Ondatra zibethicus (Linnaeus, 1766); Muskrat

Material. Zone D: 9 frontals; 3L, 3R temporals; 11L, 8R maxillae; 7L, 5R zygomatic processes of maxilla; 2L, 3R premaxillae; 4 palates; 17 cranial frags.; 6L, 5RI; 4 I frags.; 13L, 6RMI; 3L, 5RM2; 21L, 29R dentaries; 1L, 1R dentary tips; 2 articular processes of L dentaries; 19L, 24Ri; 21L, 21Rm1; 13L, 23Rm2; 7L, 4Rm3; 5 atlases; 2 cervical, 2 thoracic, 12 lumbar, 54 caudal vertebrae; 2 sacrabrae; 7 vertebrae frags.; 14 vertebrae centra epiphyses; 1 clavicle; 8 molar frags.; 1 rib; 2L, 4R scapulae; 18L, 16R humeri; L humerus, prox. end; L humerus, dist. end; 3L, 10R ulnae; 1L, 2R radii; 17L, 25R innominates; L ischium; 1L, 3R ilia; 30L, 37R femora; R femur, prox. end; 2 femur heads; 4 femur head epiphyses; distal femur epiphysis; 28L, 36R tibiofibulae; L tibiofibula, shaft frag. and distal epiphysis; L tibia, shaft frag. and distal end; R tibiofibula, distal end; R tibia, prox. epiphysis; 5L, 8R calcanea; 1L, 2R astragali; 18 metatarsals and fragments; 3 metapodials; and 4 proximal, 2 distal phalanges. Zone C: 4 frontals; 1L, 3R temporals; 2R maxillae; maxilla frag.; 2L, 1R zygomatic processes of maxilla; 4 cranial frags; 1 palate; 1L, 3RI; 4 I frags.; 7L, 4RM1; 2L, 2RM2; 2L, 2RM3; 11L, 9R dentaries; L dentary tip; 2L, 4R dentary frags.; R condyle frag.; 13L, 14Ri; 11L, 14Rm1; 8L, 7Rm2; 1L, 3Rm3; 2 i frags; 7 molar frags.; 4 lumbar, 13 caudal vertebrae; sacrum; 3 vertebrae centra epiphyses; 1 rib; R scapula; 4L, 5R humeri; 2 humeri head epiphyses; 12L, 12R femora; 1 femur head epiphysis; 3 femora distal epiphyses; 3L, 1R ulnae; 1L, 1R radii; 12L, 6R innominates; R innominate, acetabular area; 10L, 11R tibiofibulae; L tibia, distal end; tibiofibula, prox. epiphysis; R calcaneum; L astragalus; 20 metatarsals; and 6 phalanges. Zone B: 12L, 10R maxillae; maxilla frag.; 2L, 3R zygomatic processes of maxillae; 4 palates; palate frag.; 16 frontals; 2L temporals; 2L premaxillae; 4 cranial frags.; 5L, 6RI; 7 I frags.; 23L, 20RM1; 9L, 17RM2; 1L, 3RM3; 28L, 34R dentaries; 3L, 1R dentary frags.; 27L, 23Ri; 29L, 43Rm1; 17L, 18Rm2; 7L, 7Rm3; i frag.; 20 molar frags.; atlas; 2 cervical, 3 thoracic, 12 lumbar, 56 caudal vertebrae; 2 vertebrae frags.; 2 sacrabrae; 10 vertebrae centra epiphyses; clavicle; rib; 2R scapulae; 21L, 16R humeri; 3 humeri head epiphyses; 13L, 5R ulnae; ulna, dist. end; ulna shaft frag.; 6L, 4R radii; 2 R radii, distal ends; 23L, 24R innominates; R ischium frag.; 56L, 42R femora; femur head epiphysis; 4 femora distal epiphyses; 40L, 36R tibiofibulae; L tibiofibula frag.; tibia frag.; 8 tibiae proximal epiphyses; tibia, distal epiphysis; 4L, 6R calcanea; 3L, 3R astragali; 60 metatarsals, 1 frag.; and 18 phalanges.

Remarks. The muskrat was the most abundant mammal in all zones at Prairie Creek. Muskrat m1's from interglacial deposits and modern southern regions display significantly lower length/width ratios than those from glacial strata and modern northern re-

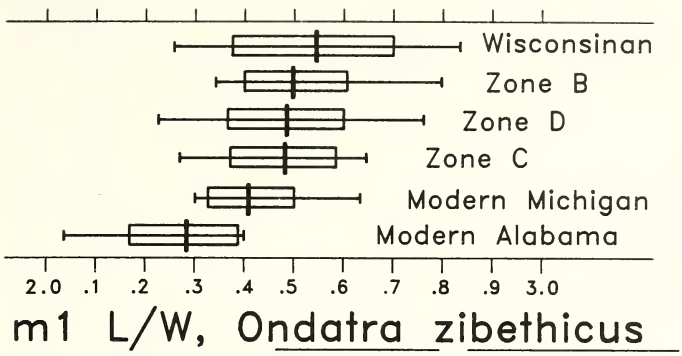

Figure 4. Length/width ratios for the first lower molar of *Ondatra zibethicus*. Zones B-D refer to the Prairie Creek Site. The arithmetic mean (vertical bar), one standard deviation (box), and the observed range (horizontal lines) are illustrated. Michigan, Alabama, and Wisconsinan-aged specimen data are from Nelson and Semken (1970).

gions (Semken, 1966; Nelson and Semken, 1970). Analysis of 103 m1's from Prairie Creek[1] shows high length/width ratios for all three zones, higher than a modern Michigan ratio, and nearest that of Wisconsinan-aged specimens from the Nelson-Semken study (Figure 4). Ratios of the Prairie Creek Late Pleistocene (Zone D, $\bar{x}$ = 2.48 mm) and Holocene (Zone B, $\bar{x}$ = 2.50 mm) m1's are quite similar (Table 4), and individual ratios overlap so greatly that there is little stratigraphic distinction on a bivariant plot. Although the differences are not statistically significant, it is interesting that the Holocene ratio is slightly more "northern" than that of the Late Pleistocene at Prairie Creek. Only two long bones displayed a tendency for completion of epiphyseal union (2 L femora have minor points of fusion between the diaphyses and loose epiphyses; L-513 from Zone D and L-1465 from Zone C). None of the other major limb bones display initial union of more than one end of the bone (e.g., there was no union of: humerus, prox. end; radius, dist. end; femur, dist. end; or tibiofibula, prox. end). Many of the muskrat teeth, however, display the heavy wear of old adults. This suggests that few muskrats reach full growth, even as adults, and adds a growth-related bias to postcranial measurement comparisons. It also masks temporal and geographic size variation in postcranial skeletal remains. Munyer (1964) also found a lack of epiphyseal union of postcranial elements in otherwise osteologicaly mature modern Illinois muskrats.

Measurements of the Prairie Creek muskrat materials are presented in Table 4. None of the mean ($\bar{x}$) values between Prairie Creek Zones B and D and modern samples of select measurements displayed any differences that were statistically significant. An age

[1] M1's were measured at their "girth" to reduce the variability produced by different degrees of wear. The girth is measured from the enamel convexity ("bow") at the anterior margin of the tooth to the posterior enamel margin of the tooth in a plane parallel to the occlusal wear surface (pers. comm., H.A. Semken, Jr., 25 May 1988).

Table 4. Selected measurements (mm) and ratios for *Ondatra zibethicus*.

Element	Measurement	Zone	$\bar{x}$ [1]	O.R.[2]	S.D.[3]	C.V.[4]	N[5]
ml	Length/width ratio	Mod[6]	2.43	2.35 - 2.60	.092	3.79	7
		B	2.50	2.34 - 2.80	.104	4.17	47
		C	2.48	2.27 - 2.65	.098	3.97	21
		D	2.48	2.23 - 2.77	.117	4.72	35
ml	First labial cement tract height	Mod	5.19	1.53 - 7.04	2.391	46.10	7
		B	5.57	0.00 - 9.80	2.864	51.41	65
		C	6.18	1.70 - 9.90	2.398	38.83	23
		D	5.22	0.10 - 9.50	2.674	51.21	40
Dentary	Least depth from coronoid notch to base of horizontal ramus	Mod	14.58	14.0 - 15.5	0.71	4.88	6
		B	14.35	13.4 - 14.9	0.62	4.34	6
		C	14.24	12.8 - 15.4	1.06	7.44	5
		D	14.76	13.1 - 16.5	1.13	7.68	9
Dentary	Depth from angle at junction of vertical and horizontal ramus to base of dentary	Mod	11.33	10.7 - 11.9	0.45	3.97	8
		B	11.44	10.1 - 12.6	0.69	6.04	19
		C	11.51	10.6 - 12.6	0.81	7.08	8
		D	11.48	10.5 - 12.4	0.57	4.92	18
Dentary	Angular "notch" to anterior edge of ml alveolus	Mod	25.91	25.6- 26.4	0.32	1.23	7
		B	26.97	25.2 - 28.6	1.02	3.77	15
		C	25.72	24.5 - 27.5	1.19	4.62	6
		D	26.79	23.5 - 28.7	1.26	4.70	17
Dentary	Angular "notch" to tip of dentary	Mod	39.57	37.5 - 41.2	1.35	3.40	7
		B	40.10	39.6 - 40.5	—	—	2
		C	37.0	35.6 - 39.1	1.71	4.63	4
		D	38.53	34.2 - 40.7	1.94	5.04	12
Scapula	Least antero-posterior diameter of "neck"	Mod	5.37	5.0 - 5.7	0.26	4.77	7
		B	—	——	—	—	—
		C	—	——	—	—	—
		D	4.84	4.5 - 5.2	0.33	6.79	5
Scapula	Transverse width across glenoid cavity	Mod	4.5	4.3 - 4.8	0.22	4.80	7
		B	4.6	4.6	—	—	1
		C	—	——	—	—	—
		D	4.64	4.6 - 4.8	0.09	1.93	5
Humerus	Total length	Mod	36.04	34.0 - 38.7	1.79	4.97	7
		B	39.15	37.1 - 42.5	2.09	5.33	6
		C	38.67	36.7 - 40.7	2.00	5.17	3
		D	35.89	34.2 - 38.5	1.63	4.54	7

Element	Measurement	Zone	$\bar{x}$ [1]	O.R.[2]	S.D.[3]	C.V.[4]	N[5]
Humerus	Greatest width of shaft across deltoid "flange"	Mod[6]	9.97	8.7 - 10.9	0.76	7.65	7
		B	9.51	7.9 - 10.6	1.13	11.93	8
		C	10.13	10.1 - 10.2	0.05	0.49	4
		D	9.51	7.7 - 11.1	0.94	9.87	10
Humerus	Least oblique width of shaft ("flange" area)	Mod	4.16	3.7-4.5	0.28	6.64	7
		B	3.94	3.4-4.9	0.34	8.75	22
		C	3.93	3.7-4.0	0.13	3.19	7
		D	3.86	2.8-4.6	0.50	13.01	26
Humerus	Transverse width of distal end from medial process to lateral articular margin	Mod	11.43	10.9 - 11.7	0.27	2.35	7
		B	11.49	9.6 - 13.1	0.88	7.62	15
		C	11.24	10.8 - 11.5	0.29	2.56	5
		D	11.31	10.1 - 12.2	0.60	5.35	15
Ulna	Total length	Mod	50.13	48.5 - 53.4	1.98	3.95	7
		B	—	———	—	—	—
		C	49.8	49.8	—	—	1
		D	52.0	52.0	—	—	1
Ulna	Greatest antero-posterior width through semilunar notch	Mod	5.3	4.8 - 6.0	0.39	7.39	7
		B	5.5	4.9 - 6.3	0.46	8.29	6
		C	5.73	5.1 - 6.3	0.60	10.52	3
		D	5.58	4.7 - 6.3	0.59	10.53	8
Ulna	Greatest antero-posterior diameter of shaft (ca. 10 mm below semilunar notch)	Mod	4.77	4.2 - 5.2	0.40	8.45	7
		B	5.05	4.8 - 5.3	—	—	2
		C	4.75	4.7 - 4.8	—	—	2
		D	4.68	4.2 - 5.1	0.41	8.73	5
Ulna	Least transverse diameter of shaft below semilunar notch	Mod	2.64	2.5 - 2.9	0.15	5.73	7
		B	2.59	2.3 - 2.8	0.20	7.54	7
		C	2.75	2.7 - 2.8	—	—	2
		D	2.56	2.3 - 2.9	0.26	10.19	5
Radius	Total length	Mod	38.06	36.8 - 41.4	1.69	4.43	7
		B	41.7	41.7	—	—	1
		C	—	———	—	—	
		D	36.3	34.5 - 38.5	2.03	5.59	3
Radius	Greatest diameter, proximal end	Mod	4.81	4.6 - 5.3	0.24	5.01	7
		B	5.1	4.8 - 5.4	—	—	2
		C	—	———	—	—	—
		D	4.78	4.5 - 5.1	0.26	5.42	5

Element	Measurement	Zone	$\bar{x}$ [1]	O.R.[2]	S.D.[3]	C.V.[4]	N[5]
Radius	Least diameter, proximal end	Mod[6]	2.9	2.6 - 3.1	0.18	6.30	7
		B	3.17	3.0 - 3.4	0.21	6.57	3
		C	—	——	—	—	—
		D	2.88	2.6 - 3.4	0.31	10.81	5
Radius	Greatest diameter, distal end	Mod	5.34	5.1 - 5.7	0.21	4.02	7
		B	5.18	4.6 - 5.7	0.41	7.89	5
		C	5.2	5.2	—	—	1
		D	4.8	4.4 - 5.5	0.61	12.67	3
Radius	Least diameter, distal end	Mod	3.81	3.7 - 4.0	0.11	2.81	7
		B	3.68	3.2 - 3.9	0.32	8.70	4
		C	4.1	4.1	—	—	1
		D	3.4	3.0 - 3.8	0.40	11.76	3
Innominate	Least vertical width, "neck" of ilium	Mod	5.5	5.1 - 6.2	0.47	8.61	6
		B	5.35	4.4 - 6.5	0.57	10.66	31
		C	5.24	3.8 - 6.2	0.69	13.21	13
		D	5.32	3.5 - 6.2	0.51	9.63	39
Innominate	Least vertical width, "neck" of ischium	Mod	7.37	7.0 - 7.6	0.21	2.80	6
		B	7.01	5.9 - 8.0	0.61	8.70	17
		C	6.50	5.2 - 7.4	0.85	13.11	8
		D	7.18	6.6 - 7.9	0.40	5.58	14
Innominate	Anteroposterior diameter of acetabulum (align with groove below postero-superior facet)	Mod	8.1	7.6 - 8.6	0.41	5.06	6
		B	7.98	7.5 - 8.5	0.38	4.77	8
		C	7.95	7.5 - 8.6	0.47	5.86	4
		D	8.1	7.6 - 9.0	0.45	5.55	10
Femur	Total length, from greater trochanter	Mod	44.76	42.6 - 47.5	1.91	4.27	7
		B	44.65	28.3 - 49.4	5.26	11.79	14
		C	47.03	43.1 - 50.3	3.13	6.66	4
		D	45.56	28.9 - 49.7	4.29	9.41	19
Femur	Total length, from head	Mod	43.29	40.8 - 46.1	1.90	4.40	7
		B	43.23	26.8 - 48.5	6.15	14.22	10
		C	45.87	41.6 - 49.6	4.03	8.78	3
		D	44.9	42.7 - 48.6	1.56	3.48	13
Femur	Head, greatest diameter	Mod	7.07	6.8 - 7.4	0.26	3.63	7
		B	7.26	6.4 - 7.7	0.40	5.53	19
		C	7.4	6.7 - 8.0	0.66	8.86	3
		D	7.16	6.3 - 7.9	0.37	5.19	23

Element	Measurement	Zone	$\bar{x}$ [1]	O.R.[2]	S.D.[3]	C.V.[4]	N[5]
Femur	Transverse width of shaft across "flange"	Mod[6]	10.53	8.9 - 12.2	1.26	11.98	7
		B	9.66	6.3 - 12.6	1.30	13.42	44
		C	10.16	8.4 - 11.6	0.89	8.80	9
		D	10.34	6.4 - 12.5	1.29	12.44	43
Femur	Least antero-posterior width of shaft ("flange" area)	Mod	5.24	4.6 - 5.7	0.36	6.87	7
		B	4.81	3.7 - 6.0	0.42	8.66	65
		C	4.83	4.2 - 5.5	0.41	8.49	20
		D	5.03	3.8 - 5.8	0.40	7.98	58
Femur	Greatest transverse width, distal end (oblique)	Mod	10.6	9.5 - 11.8	0.86	8.13	7
		B	10.31	8.4 - 11.4	0.98	9.52	13
		C	10.98	9.6 - 11.9	0.98	8.90	4
		D	10.84	8.5 - 12.5	1.00	9.24	22
Femur	Width from tips of greater to lesser trochanters	Mod	16.81	15.9 - 17.2	0.44	2.63	7
		B	16.97	15.8 - 18.7	0.83	4.88	16
		C	17.15	16.8 - 17.5	0.40	2.36	4
		D	16.78	14.1 - 18.5	0.95	5.69	26
Tibio-fibula	Total length	Mod	63.94	60.5 - 65.7	2.07	3.24	5
		B	72.2	72.2	—	—	1
		C	64.5	62.2 - 67.5	2.72	4.21	3
		D	66.07	61.0 - 69.1	2.95	4.47	6
Tibio-fibula	Greatest transverse width, proximal end	Mod	10.87	9.9 - 11.6	0.67	6.12	6
		B	10.37	10.0 - 10.7	0.35	3.39	3
		C	11.17	10.7 - 11.8	0.57	5.09	3
		D	11.39	10.1 - 12.6	1.04	9.17	8
Tibio-fibula	Greatest transverse width of shaft at tibiofibula junction	Mod	4.55	3.5 - 5.2	0.59	13.02	6
		B	4.21	3.1 - 5.5	0.47	11.08	49
		C	4.42	3.7 - 5.1	0.40	9.10	17
		D	4.33	3.4 - 5.3	0.36	8.26	53
Tibio-fibula	Greatest antero-posterior width of distal end	Mod	6.5	6.3 - 6.8	0.23	3.61	5
		B	6.4	5.0 - 7.3	0.55	8.56	16
		C	6.5	6.0 - 6.8	0.32	4.87	5
		D	6.5	5.6 - 7.0	0.37	5.63	22
Tibio-fibula	Greatest transverse width, distal end	Mod	11.26	10.7 - 11.7	0.44	3.90	5
		B	10.85	8.1 - 11.8	0.97	8.90	13
		C	11.37	10.2 - 12.2	0.66	5.83	6
		D	11.07	10.0 - 12.1	0.58	5.22	23

[1] $\bar{x}$ = Arithmetic mean.
[2] O.R. = Observed range of measurements.
[3] S.D. = Standard deviation.
[4] C.V. = Coefficient of variation.
[5] N = Number of specimens.
[6] Mod = Modern skeltons, south-central Indiana caves (Richards' collection).

profile was constucted for each Prairie Creek zone by measuring the height of the first labial dentine tract (and thus amount of unworn tooth), a measurement previously used in taxonomic studies (Figure 5; Semken, 1966; Nelson and Semken, 1970). This profile indicated a generally similar age distribution for muskrats in all Prairie Creek zones. In an attempt to assess the non age-related size of postcranial elements from the three zones at Prairie Creek, histograms of measurements of an abundant element ("flange" width, femur) were matched to ten age classes (one for each mm of tooth wear) for empirical comparison (Figure 5). By tooth wear, Zone D displays a slightly older average muskrat age (i.e., lower values for the median (6.5 mm) and mean ($\bar{x}$ = 5.22 mm) of m1 tract height) than in Zone B (7.0 mm for the median and 5.57 mm for the mean). Zone D also has a correspondingly larger femur "flange" width (for Zone D, the median was 10.5 mm and the mean was 10.34 mm; for Zone B, the median was 9.5 mm and the mean was 9.66 mm). This suggests that the postcranial measurement summaries (Table 4) do incur some age class (and thus size) bias between the various zones.

Three postcranial elements displayed pathology (Figure 6). The proximal 1/2 of a L femur (L-354 from Zone D; Figure 6b) reveals an apparently fractured and healed (with anteroposterior thickening) shaft. A second L femur (L-236 from Zone B; Figure 6c) suggests disease. It displays a smooth-edged, circular pit (approximately 5.3 mm in diameter and 3.1 mm deep) surrounded by degenerating bone on the anterior face of the proximal end. There is some remodeling of the muscle scars and a general roughening of the bone surface on the proximal 1/2 of the shaft. A R tibiofibula (L-236 from Zone B; Figure 6a) displays a remodeled puncture, piercing anteroposteriorily through the distal diaphysis/epiphysis plate interface. The adjacent distal fibula end has been remodeled to a swollen mass of bone.

Today, the muskrat is found throughout Indiana along streams and around lakes and ponds, but it is especially abundant in marshes and other waters that have abundant emergent vegetation. Its most common associates are the mink, raccoon, opossum, beaver, meadow vole, and star-nosed mole, and in drier situations around the marshes, the northern short-tailed shrew, masked shrew, and meadow jumping mouse (*Zapus hudsonius*).

Synaptomys Baird, 1858 sp. indet.; Bog lemming

Material. Zone D: I frag. (2460); and R dentary, edentulous (2335). Zone C: LM1 (2654); and LM1 or M2, posterior 3 triangles (2654).

Remarks. Remains of *Synaptomys cooperi,* the southern bog lemming, and/or those of *S. borealis,* the northern bog lemming, could be represented in the Late Pleistocene zone. Fossils of the two are effectively distinguished only by lower molars (Semken, 1984), none of which were recovered at Prairie Creek. The southern bog lemming is presently found in grassy fields and occasionally woodlands throughout much of Indiana. The northern bog lemming is a Canadian species of wet alpine and subalpine meadows, muskeg, heaths, and sedges (Burt and Grossenheider, 1952). It has been recovered extralimitally at one Indiana Late Pleistocene locality (Megenity Peccary Cave, Crawford County; Richards, 1993b) and more than 21 others in Pennsylvania, Maryland, West Virginia, Virginia, Tennessee, Arkansas, Missouri, Wisconsin, Iowa, Wyoming, and Mon-

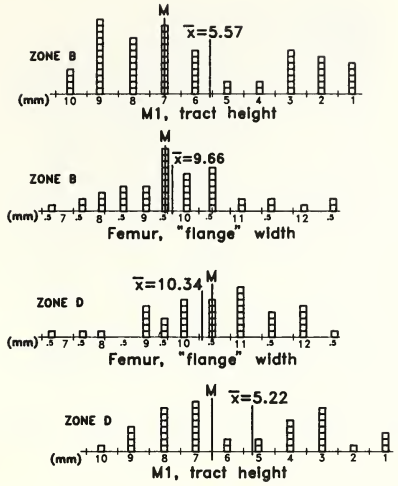

Figure 5. Age distribution (m1 tract height) correlated with femur "flange" width in *Ondatra zibethicus* from Zones B and D at the Prairie Creek Site. $\bar{x}$ is the arithmetic mean, and M is the median. Each box represents one measurement. Calibrated in millimeters.

Figure 6. Muskrat (*Ondatra zibethicus*) pathology as evident at the Prairie Creek Site in Daviess County, Indiana: **a**, the right tibiofibula displaying a remodeled puncture of the distal end (Zone B: L-236); **b**, the proximal 1/2, left femur, showing a fractured shaft along with the remodeled thickening of the shaft (Zone D: L-354); and **c**, the left femur displaying a smooth-edged, circular pit and bone resorption suggestive of disease (Zone B: L-236). Smallest scale in millimeters.

Figure 7. The right femora of *Lepus americanus* and *Sylvilagus floridanus* from several different localities: **a**, *Lepus* cf. *L. americanus* from the Prairie Creek Site (Zone C: 328/1); **b-c**, *Lepus americanus* from Megenity Peccary Cave (Late Pleistocene) in Crawford County, Indiana (b was found in the Batroom crevice, and c was found in Unit M16Q); and **d-e**, *Sylvilagus floridanus* from the Holocene of southern Indiana (R.L. Richards' collection: Lep 11; Lep 24-27.2). Scale in millimeters.

tana (Lundelius, *et al.,* 1983; Richards, 1993b).

Family DIPODIAE: Birch mice, jumping mice, jeroboas
Subfamily ZAPODINAE: Jumping mice
Zapus hudsonius (Zimmermann, 1780); Meadow jumping mouse

Material. Zone D: LI (2460).

Remarks. The meadow jumping mouse occurs sporadically, though often abundantly, throughout most of Indiana. It occurs were there is heavy herbaceous ground cover, usually in old fields (sometimes damp) though also in woodlands. Its most common associates in the fields are the meadow vole (*Microtus pennsylvanicus*) and the masked shrew (*Sorex cinereus*) and in the woodlands are the northern short-tailed shrew (*Blarina brevicauda*) and the white-footed mouse (*Peromyscus leucopus*), all recovered in the Late Pleistocene zone at Prairie Creek.

Order LAGOMORPHA: Lagomorphs
Family LEPORIDAE: Hares and rabbits
Lepus cf. *L. americanus* Erxleben, 1777; Snowshoe hare

Material. Zone C: R femur (328/1; Figure 7a).

Remarks. *Lepus* material was separated from that of *Sylvilagus* primarily by the slender proportions of the shafts of the humerus, femur, and tibia (Guilday, Parmalee, and Hamilton, 1977) as well as the ulna, radius, and metapodials of *Lepus.* The Prairie Creek femur is larger than that of *Sylvilagus transitionalis, S. floridanus,* and *S. palustris* and smaller than the femora of *Lepus townsendii* and *L. californicus,* falling within the size range of *Lepus americanus* (Table 5). Modern *L. americanus* displays a negative

Table 5. Selected femur measurements of relevant eastern North American Leporids (mm).

Taxa	Locality	Age	$\bar{x}$ [6]	O.R.[7]	N[8]
		Distal Width of Femur			
Sylvilagus transitionalis[1]	Massachusetts	Recent	12.0	11.7 - 12.3	2
Sylvilagus floridanus[3]	North Florida	Recent	10.9	10.4 - 11.3	9
Sylvilagus floridanus[3]	North Carolina	Recent	12.9	12.8 - 12.9	2
Sylvilagus floridanus[2]	Indiana	Recent	13.2	12.6 - 14.2	15
Sylvilagus floridanus[1]	Pennsylvania	Recent	13.4	12.8 - 13.8	10
Sylvilagus palustris[3]	North Florida	Recent	13.0	11.6 - 14.0	9
Sylvilagus palustris[3]	North Carolina	Recent	13.3	13.0 - 13.6	3
Lepus americanus[4]	unspecified	Recent	12.7	11.7 - 13.9	5
Lepus americanus[1]	New Paris #4, Pennsylvannia	Late Pleistocene	13.2	12.4 - 14.3	20
Lepus americanus[1]	Clark's Cave, Virginia	Late Pleistocene	13.4	12.3 - 14.5	11
Lepus americanus[5]	Megenity Peccary Cave, Indiana	Late Pleistocene	13.5	13.2 - 13.7	3
Lepus cf. *L. americanus*	Prairie Creek, Indiana	Uncertain	14.4	14.4	1
Lepus americanus[1]	Pennsylvania	Recent	15.4	14.8 - 16.4	7
Lepus californicus[4]	unspecified	Recent	16.1	15.2 - 16.8	9
Lepus townsendii[4]	unspecified	Recent	19.0	18.3 - 20.5	10
		Greatest Length of Femur from Greater Trochanter			
Sylvilagus floridanus[3]	North Florida	Recent	79.5	75.0 - 87.4	9
Sylvilagus floridanus[3]	North Carolina	Recent	81.8	81.0 - 82.6	2
Sylvilagus floridanus[2]	Indiana	Recent	84.2	79.3 - 88.5	14
Sylvilagus palustris[3]	North Florida	Recent	78.4	66.0 - 82.0	9

Taxa	Locality	Age	$\bar{x}$ [6]	O.R.[7]	N[8]
Sylvilagus palustris[3]	North Carolina	Recent	82.7	82.0 - 83.3	2
Lepus americanus[4]	unspecified	Recent	89.9	84.7 - 96.7	5
Lepus americanus[5]	Megenity Peccary Cave, Indiana	Late Pleistocene	93.4	92.8 - 94.0	2
Lepus cf. *L. americanus*	Prairie Creek, Indiana	Uncertain	est. 101.6	101.6	1
Lepus californicus[4]	unspecified	Recent	108.2	100.5 - 114.8	9
Lepus townsendii[4]	unspecified	Recent	123.1	117.7 - 129.0	10
	Greatest Length of Femur From Caput				
Sylvilagus floridanus[2]	Indiana	Recent	80.5	75.7 - 83.7	15
Lepus americanus[5]	Megenity Peccary Cave, Indiana	Late Pleistocene	90.3	89.4 - 91.3	2
Lepus cf. *L. americanus*	Prairie Creek, Indiana	Uncertain	98.8	98.8	1
	Least Anteroposterior Depth of Shaft				
Sylvilagus floridanus[2]	Indiana	Recent	5.0	4.4 - 5.7	15
Lepus americanus[5]	Megenity Peccary Cave, Indiana	Late Pleistocene	4.9	4.7 - 5.0	3
Lepus cf. *L. americanus*	Prairie Creek, Indiana	Uncertain	5.7	5.7	1

[1] Measurements from Guilday, Parmalee, and Hamilton (1977).
[2] Measurements from Richards' collection of modern and sub-recent skeletons from south-central Indiana caves.
[3] Measurements from Holman (1959).
[4] Measurements from Martin (1974); localities not stated.
[5] Measurements from specimens in the collections of the Indiana State Museum.
[6] $\bar{x}$ = Arithmetic mean.
[7] O.R. = Observed range of measurements.
[8] N = Number of specimens.

"Bergman's response" with the smallest average size in the northern part of its range (Guilday, Martin, and McCrady, 1964). *Lepus americanus* fossils from Clark's Cave, Virginia and New Paris #4, Pennsylvania display the smaller size of more northern populations. The Prairie Creek femur is slightly larger than the average size of femora from those two cave sites as well as femora from Megenity Peccary Cave, Indiana, but it is smaller than femora from modern Pennsylvania specimens. There are no modern documented occurrences of *Lepus* in Indiana, though there are some doubtful historical reports for the northwestern part of the State (Lyon, 1936). *Lepus americanus* occurs no nearer to Indiana than Wisconsin and Michigan to the north and the Appalachians to the east, where it inhabits swamps, forests, and thickets (Burt and Grossenheider, 1952). *Lepus americanus* is known from Late Pleistocene strata south (and/or west) of its modern range from Megenity Peccary Cave in Crawford County, Indiana (Richards, unpublished), Welsh Cave in Kentucky (Guilday, Hamilton, and McCrady, 1971), and Crankshaft (Parmalee, Oesch, and Guilday, 1969) and Bat (Hawksley, Reynolds, and Foley, 1973) caves in Missouri. A mixture of *Sylvilagus* and/or *Lepus* remains were identified at the Sangamonian-aged Harrodsburg Crevice in Monroe County, Indiana, but *Sylvilagus* was thought to be the species most likely represented (Parmalee, Munson, and Guilday, 1978). The Prairie Creek femur, of uncertain stratigraphic assignment, and the skeletons from Megenity Peccary Cave are the only records of *Lepus* for Indiana.

Sylvilagus cf. *S. floridanus* (J.A. Allen, 1890); Eastern cottontail

Material. Zone D: metatarsal (1408/1).

Leporidae cf. *Sylvilagus* sp.

Material. Zone B: R ulna, prox. end (859/6).

Leporidae, sp. indet.; cottontail and/or hare

Material. Zone D: R dentary with i, p1-m2 (large, 1497/3); L i frag. (D-2461); Lp2 (or m1, m2; D-2693); dens of axis (2335); L humerus, dist. condyle (2335); 2R ulnae, prox. ends (1190/1; 2463: bone #2); R ulna shaft frag. (354/3); frag. R innominate (849/5); R femur, prox. end (large, 1497/4); R tibia, distal end with separate epiphysis (930/1); and L calcaneum (1188/2). Zone C: LM (2597); R dentary with p1-m2 (394/1); lumbar vertebra #7 (374/2); R radius, prox. end (217/3); L astragalus (C-2453); and R calcaneum (subadult, 953/1). Zone B: L dentary frag. with i (1238/1); R dentary with p1-m1 (859/3); Ri (B-2652); Rp1 (453/20); Rp2 (or m1, m2, 859/15); L humerus, distal condyle (453/16); L radius, prox. end (859/4); R radius, prox. end (1086/1); R femur, dist. end (766/3); metatarsal, lacking dist. end (453/15); and podial (B-2615).

Remarks. Few elements were complete enough to be identified as those of cottontail. The eastern cottontail is often locally abundant in many habitats throughout Indiana but is most numerous in overgrown fields of weeds, briars, and brush. It can also be found in the heavy ground cover around swamps and in open woods. The larger swamp rabbit (*Sylvilagus aquaticus*) found today in the swamps, marshes, and wet bottomlands (Burt and Grossenheider, 1952) of extreme southwestern Indiana could not be identified among the Prairie Creek materials.

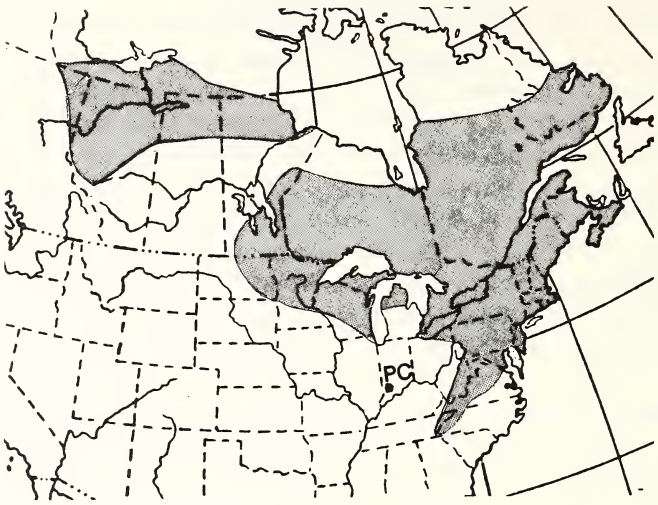

Figure 8. Areas of sympatry (shaded) of Zone D mammals based upon the modern ranges of the star-nosed mole (*Condylura cristata*), the southern red-backed vole (*Clethrionomys gapperi*), and the meadow vole (*Microtus pennsylvanicus*). PC represents the Prairie Creek Site in Daviess County, Indiana.

DISCUSSION

The Prairie Creek Site small mammal remains represent, for the most part, a natural accumulation in an aquatic environment. There are few, if any, indications of predation or scavenging (e.g., tooth punctures or gnawing) or, in the Holocene zone, of the activities of Native Americans (e.g., cut marks or burning). Stream transport is the likely source of fragmentation, though few elements were worn or notably abraded.

The Late Pleistocene sample (Zone D) represents accumulation in a lake, and the Holocene sample (Zone B) represents accumulation in a marsh and stream environment up to two miles downstream from the lake and more than 10,000 years later in time. Study of the small mammals, per se, did not suggest a selective accumulation of particular species in one environment over the other. Semiaquatic and marsh species such as the star-nosed mole, mink, meadow vole, and muskrat were well represented in both zones (61% in Zone D and 69% in Zone B, collectively by numbers of individuals (MNI)). Other species appear to be of more incidental occurrence. A comparison of the small mammal faunas between Zone D and Zone B reflects, for the most part, faunal associations separated in time by 10,000 years with similar modes of accumulation and conditions of preservation and recovery.

Of the twenty-nine species of small mammals recovered at the Prairie Creek Site, none is extinct, four do not now occur in Indiana (*Microtus xanthognathus,* the yellow-cheeked vole; *Clethrionomys gapperi,* the southern red-backed vole; *Lepus* cf. *L.*

americanus, the snowshoe hare; and *Martes pennanti,* the fisher, which occurred historically in Indiana), and two now occur in northern Indiana (*Condylura cristata,* the star-nosed mole, and *Tamiasciurus hudsonicus,* the red squirrel). These extralimital mammals occur primarily in the Late Pleistocene sediments (Zone D) with the star-nosed mole and fisher also occurring in the Holocene strata (Zone B).

The Late Pleistocene zone (Zone D) includes small mammals that support the interpretation (S.T. Jackson and D.R. Whitehead, in prep.) that a spruce-dominated, perhaps open boreal forest surrounded Lake Prairie Creek and its associated marshes and wet meadows. The present areas of sympatry of Zone D extralimital mammals includes centers in northwestern Canada and in the northeastern United States (including the Appalachians and the eastern half of Canada; Figure 8). The presence of *Microtus xanthognathus* suggests that the boreal forests were not particularly dense, and the presence of *M. pennsylvanicus* and *Sylvilagus* cf. *S. floridanus* indicate the occurrence of open areas associated with the lake. Caves in nearby south-central and southeastern Indiana (Richards, 1986) have produced Late Pleistocene associations of boreal voles (*Phenacomys* cf. *P. intermedius,* the heather vole, and *Clethrionomys gapperi,* the southern red-backed vole) with small mammals indicative of open environments (*Spermophilus tridecemlineatus,* the thirteen-lined ground squirrel, and *Geomys bursarius,* the plains pocket gopher). Similar associations from other Late Pleistocene localities suggest a widespread "boreal grassland", an environmental mosaic with patches of open vegetation in the boreal forest (Rhodes, 1984). Perhaps the better open area indicator species were "filtered" from the Prairie Creek deposit by the conifer forests surrounding the more mesic lake. The small mammals recovered at Prairie Creek do not include species indicative of extensive open areas, other than what might be expected in a fluctuating lake environment.

The extralimital yellow-cheeked vole (*Microtus xanthognathus*) and star-nosed mole (*Condylura cristata*) have exclusive (allopatric) distributions today but had areas of overlapping (sympatric) distribution in the Late Pleistocene. The yellow-cheeked vole is also disharmoniously associated with *Blarina brevicauda,* the northern short-tailed shrew, *Scalopus aquaticus,* the eastern mole, *Tamias striatus,* the eastern chipmunk, and *Sylvilagus* cf. *S. floridanus,* the eastern cottontail in the Prairie Creek Late Pleistocene zone. It appears that northern mammals, such as the yellow-cheeked and southern red-backed voles, star-nosed mole, red squirrel, and fisher, were displaced southward by glacial ice, intergrating with resident mammals as suggested by the equable climate model (Graham, 1976; Lundelius, *et al.,* 1983; Semken, 1984). The enhancement of shrew and microtine rodent diversity prevalent in Late Pleistocene cave sites (Graham, 1976) was not reflected in the Prairie Creek sample, suggesting that lacustrine environments in general are not as selective for the accumulation of those mammals as the cave environments are. Although northern fauna did integrate into the resident fauna, there is indication (lack of tree squirrels of the genus *Sciurus,* southern flying squirrel, raccoon, etc.) that some of the resident fauna had migrated away from the approaching glacial ice. This differential response of various species to changing environmental conditions supports current thought on the "individualistic" response of each species (Graham, 1979, 1984; King and Graham, 1981).

The Holocene fauna (Zone B) at the Prairie Creek Site suggests an aquatic or marsh environment in a temperate deciduous woodland. The red squirrel of the Late Pleistocene spruce forest has been replaced by the gray (*Sciurus carolinensis*) and fox (*S. niger*) squirrels, and such temperate woodland mammals as the opossum (*Didelphis virginiana*),

flying squirrel (*Glaucomys volans*), pine vole (*Microtus pinetorum*), and raccoon (*Procyon lotor*) are present. Although the star-nosed mole (*Condylura cristata*) and fisher (*Martes pennanti*) still occurred south of their modern range, apparently within their own "individualistic" environmental tolerances, the disharmonious nature of the Late Pleistocene fauna had been dissolved long before the deposition of the Zone B strata. In general, the Prairie Creek Holocene fauna is prevalent in similar environments in Indiana today. The Prairie Creek herpetofauna (Holman and Richards, in prep.) also suggests at least some "individualistic" response to changing environments but presents a dilemma in that several of the reptile species could not exist today in the cooler climates that are suggested by the Zone D pollen.

The lack of several species (e.g., *Lutra canadensis,* the river otter, and *Erethizon dorastum,* the porcupine) in the Prairie Creek strata is attributed to chance in the random sampling of the immense deposit.

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