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US ISSN 0027-4100

Bulletin OF THE
Museum of Comparative Zoology

Pleistocene Mustelidae (Mammalia, Carnivora) from Fairbanks, Alaska

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VOLUME 148, NUMBER 1
14 APRIL 1977

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OR DISTRIBUTED BY THE
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HARVARD UNIVERSITY

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PLEISTOCENE MUSTELIDAE (MAMMALIA, CARNIVORA) FROM FAIRBANKS, ALASKA

ELAINE ANDERSON[1]

ABSTRACT. Five species of mustelids, *Mustela* cf. *erminea*, *Mustela vison*, *Mustela eversmanni beringiae* ssp. nov., *Gulo gulo*, and *Taxidea taxus*, are reported from late Pleistocene deposits near Fairbanks, Alaska. This is the first record of the steppe ferret in the New World. It is closely related to, if not conspecific with, *Mustela nigripes*, the black-footed ferret. The northernmost occurrence of *Taxidea taxus* is reported. The wolverine, badger and ferret material is characterized by large size, and some of the specimens are the largest known for the species. The Fairbanks area was never glaciated, and the grassy steppes of this refugium supported a large assemblage of Pleistocene mammals.

INTRODUCTION

Remains of Pleistocene mammals are abundant in the frozen sediments of central Alaska, and at least 39 species are known. Many species of carnivores were associated with the large assemblage of herbivores that inhabited the Alaskan refugium in the late Pleistocene. Large carnivores, *Arctodus simus*, *Ursus arctos*, *Panthera leo atrox*, *Homotherium serum*, and *Canis lupus* dominated the scene, but the small carnivores—foxes, dhole, lynx, and the mustelids—were an important part of the fauna. Five species of mustelids, *Mustela* cf. *erminea*, *Mustela vison*, *Mustela eversmanni beringiae* ssp. nov., *Gulo gulo*, and *Taxidea taxus* are now known from the Fairbanks area.

Fossil collecting began in the Fairbanks area with the advent of gold mining in 1928. In 1929, the University of Alaska, under the presidency of C. E. Bunnell, initiated its well known program of collecting the fossils exposed during the mining operations. The university had little money for such ventures, but Childs Frick of the American Museum of Natural History agreed to finance the program, and his support continued until the middle 1950's (except during the war years when little mining was done). Otto W. Geist was in charge of collecting the fossils. Thousands of specimens were collected, but unfortunately, because of the methods of collection, stratigraphic information is almost entirely lacking. Since the University of Alaska had neither the space nor the comparative material, almost all of the specimens were shipped to the Frick Laboratory at the American Museum of Natural History. There, a few groups were studied, but most of the material was put in storage. The Mustelidae was one of the neglected groups, and until 1973, when Anderson reported the presence of ferret, only badger and wolverine were recorded in the faunal lists (Péwé, 1957).

The Fairbanks area, where the fossils were collected, lies between 64°45′ and 65°N latitude, and is situated on the north side of the broad Tanana River valley at the base of the hills that make up part of the Yukon-Tanana River upland (see Fig. 1). Rising 380 to 545 meters above the nearly flat floodplain of the Chena and Tanana rivers, are the low rounded hills of the uplands. Loess, derived from the floodplain and the glacial outwash plains, covers the ridges

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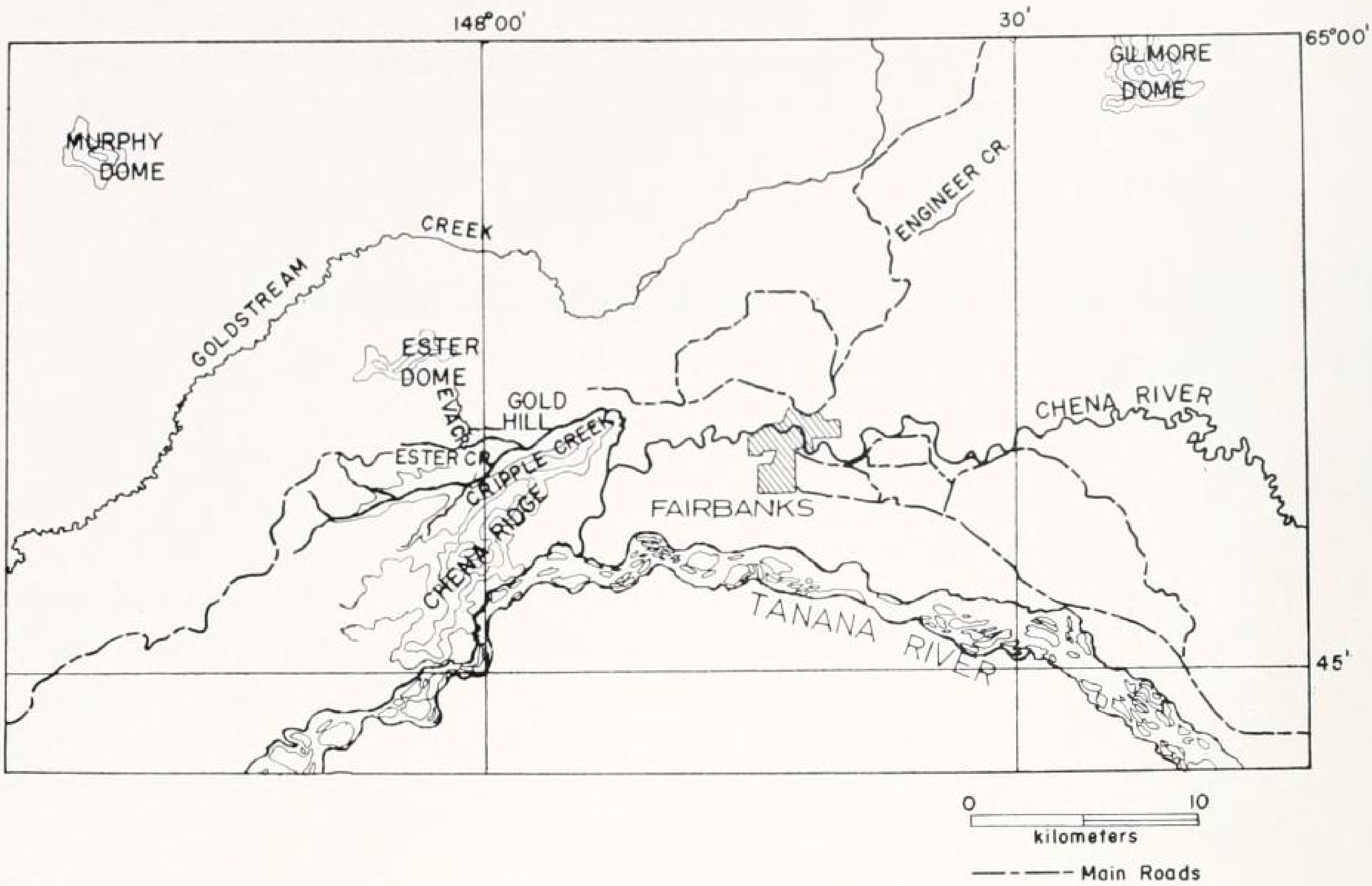

Figure 1. Map of the Fairbanks area.

from a depth of about a meter on the summits to about 30 meters on the middle slopes. The upland valleys are filled with from three to 30 meters of gravel overlaid by three to 90 meters of colluvial silt. The floodplain is underlaid by several hundred feet of interbedded lenses of silt, sand, and gravel (Péwé, 1957). The Fairbanks area was never glaciated, but glaciers from the Alaska Range to the south came within 80 kilometers of the present city of Fairbanks.

The Quaternary in central Alaska is characterized by alternating periods of deposition and erosion of gravel and silt, by warming and cooling of the climate, and by the formation and melting of the permafrost. Gold-bearing gravels were deposited in the creek valleys early in the Quaternary, and were later covered by loess and organic debris which became perennially frozen. Solifluction, the movement of moisture-saturated soil downhill during periods of thawing, was a major factor in the entombment of animal and plant remains. The fossil-laden silt eventually came to rest in the valleys, and was subsequently covered with more loess, and the entire mass became frozen. Today permafrost covers much of the Fairbanks area. Needless to say, mining and collecting fossils in this perennially frozen muck was, and still is, difficult. The fossils were exposed as the miners, using hydraulic methods, removed the frozen overburden from the gold-bearing gravels.

Since most of the bones were transported before burial, mummies and complete skeletons are rare, and most of the specimens are disarticulated. Although a few pre-Wisconsinan deposits are known (Péwé and Hopkins, 1967), the majority of specimens are late Wisconsinan in age.

The mustelid material is generally well preserved, although some of the teeth are broken. The bones vary in color from light to dark brown, and there is no trace of the blue mineral, vivianite, on any of the material I examined. The specimens consist entirely of skulls and mandibles. A femur of *Gulo* was listed in the field notes, but the specimen could not be found.

ACKNOWLEDGEMENTS

I wish to express my deep appreciation to Dr. Richard H. Tedford for letting me study the Alaskan mustelids in the Frick Collection. Beryl Taylor and George Krochak of the Frick Laboratory, American Museum of Natural History, assisted me in locating specimens and field data. Russell D. Guthrie, University of Alaska, showed me some of the collecting areas near Fairbanks, and I would like to thank him and his wife for their generous hospitality during my visit to Fairbanks. For permission to study collections in their care, I am indebted to John A. White, Idaho State University; Peter Robinson, University of Colorado Museum; Charles S. Churcher, University of Toronto; and C. R. Harington, National Museum of Canada. My sincere thanks go to Barbara Lawrence and Charles Mack, Museum of Comparative Zoology; John L. Paradiso and Clyde Jones, Bureau of Sport Fisheries and Wildlife, National Museum of Natural History; Richard G. Van Gelder, American Museum of Natural History; William H. Burt, University of Colorado Museum; and Robert S. Hoffmann, Museum of Natural History, University of Kansas, for making comparative material available to me. Björn Kurtén, University of Helsinki, permitted me to use some of his raw data on *Gulo gulo*. Erica Hansen, Idaho State University, made the illustrations for Figures 1–3; Ms. Dehlin, formerly of the Frick Laboratory, executed Figures 4 and 5 for Childs Frick some years ago. This research was supported by NSF Grant GB 31287 awarded to Professor Bryan Patterson, Harvard University, and is part of a study of Pleistocene mammals of North America.

ABBREVIATIONS

AMNH—American Museum of Natural History
F:AM—Frick Collection, American Museum of Natural History
ISUM—Idaho State University Museum
KU—Museum of Natural History, University of Kansas
MCZ—Museum of Comparative Zoology, Harvard University
NMC—National Museums of Canada
UA—University of Alaska
UCM—University of Colorado Museum
USNM—National Museum of Natural History
I—incisor, C—canine, P—premolar, M—molar: with superscript (upper) or subscript (lower) tooth
max.—maxillary
R—right
L—left
N—number in sample
O.R.—observed range
M—mean
S.D.—standard deviation

Mustela sp. cf. *M. erminea* Linnaeus
Short-tailed Weasel or Ermine
Figure 2 A

Material: Late Pleistocene, F:AM 49340 L ramus w/C–M_2; F:AM 49341 R ramus w/C–M_2; F:AM 49348 R ramus w/C–M_1; F:AM 49349 frag. L ramus w/$P_{3\text{-}4}$, Fairbanks area, Alaska.

Comparative Material: *Mustela erminea arctica*, Recent, Alaska AMNH 17939, 21917–19, 21921–22, 31369, 31379. KU 2975–76. *Mustela rixosa eskimo* Recent, Alaska AMNH 31383–84, 42811–13, 42815–18. Northwest Territory AMNH 29212.

Four small weasel mandibles were found in the collections from the Fairbanks area. Guthrie (personal communication) believes they were preserved in the nests of ground squirrels, *Spermophilus parryi*. The coronoid process is missing in all of the specimens. The teeth of three of the specimens are slightly worn, but F:AM 49348 shows moderately worn dentition. Comparison with Recent specimens of *Mustela erminea arctica* (Merriam) and *Mustela rixosa eskimo* (Stone), the two subspecies found in central Alaska today, shows that the Pleistocene specimens most closely resemble *Mustela erminea arctica*. Table 1 shows that measurements of tooth row length, length of M_1, length of trigonid of M_1, and width of the talonid of M_1 of the Pleistocene mandibles fall within the observed range of *Mustela erminea arctica* and exceed the observed range of *Mustela rixosa eskimo*.

In his monograph on American weasels, Hall (1951) noted that the basilar length of the skull of *Mustela erminea* measures

TABLE 1. MEASUREMENTS, IN MM, OF *MUSTELA ERMINEA* AND *MUSTELA RIXOSA* FROM ALASKA.

		N	O.R.	M
Depth of ramus below P_{3-4}				
F:AM, Late Pleistocene		4	3.0–3.2	3.05
M. e. arctica (Recent)	♂	7	3.3–4.3	4.02
	♀	3	2.6–3.5	2.96
M. r. eskimo (Recent)	♂	6	2.3–3.4	2.86
	♀	4	2.2–2.5	2.40
Depth of ramus below M_{1-2}				
F:AM, Late Pleistocene		3	2.5–3.3	3.03
M. e. arctica (Recent)	♂	7	3.5–4.8	4.40
	♀	3	2.9–3.7	3.26
M. r. eskimo (Recent)	♂	6	2.7–3.5	3.13
	♀	4	2.5–2.9	2.72
Length C–M_2				
F:AM, Late Pleistocene		3	11.9–12.0	11.93
M. e. arctica (Recent)	♂	7	12.0–15.8	14.52
	♀	3	11.4–12.7	11.90
M. r. eskimo (Recent)	♂	6	9.5–10.8	10.10
	♀	4	9.0–9.7	9.22
Length M_1				
F:AM, Late Pleistocene		3	4.3–4.6	4.46
M. e. arctica (Recent)	♂	7	4.5–5.6	5.01
	♀	3	4.1–4.7	4.33
M. r. eskimo (Recent)	♂	6	3.4–3.8	3.55
	♀	4	3.1–3.5	3.25
Length M_1 trigonid				
F:AM, Late Pleistocene		3	3.0–3.3	3.20
M. e. arctica (Recent)	♂	7	3.1–3.8	3.60
	♀	3	2.9–3.4	3.06
M. r. eskimo (Recent)	♂	6	2.4–2.6	2.50
	♀	4	2.2–2.5	2.30
Width M_1 talonid				
F:AM, Late Pleistocene		3	1.2–1.4	1.33
M. e. arctica (Recent)	♂	7	1.2–1.9	1.57
	♀	3	1.2–1.3	1.23
M. r. eskimo (Recent)	♂	6	1.0–1.2	1.08
	♀	4	0.9–1.0	0.92

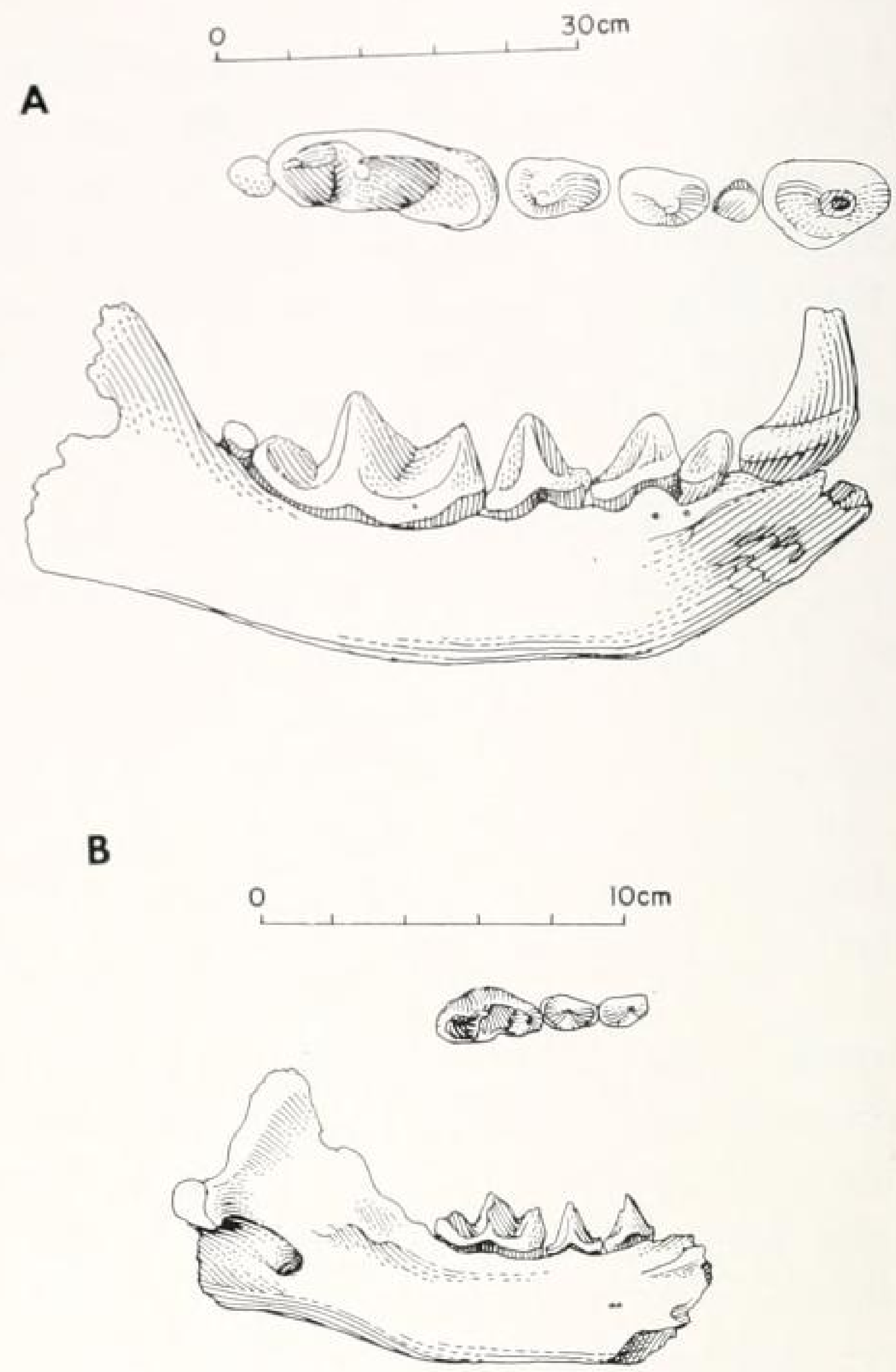

Figure 2. A. *Mustela* cf *erminea* (F:AM 49340); occlusal and lateral views of mandible. B. *Mustela vison* (F:AM 30821); occlusal and lateral views of mandible.

more than 32.5 mm in males and more than 31.0 mm in females; in *Mustela rixosa* the basilar length of the skull is less than 32.5 mm in males and 31.0 mm in females. Unfortunately, he did not include any measurements of weasel mandibles. Table 1 shows that there is overlap in measurements between the two species, and this, coupled with pronounced sexual dimorphism and geographic variation, can lead to uncertainty in the identification of cranial material.

The American ermine is considered to be only subspecifically distinct from the Old World animal. The taxonomic status of the least weasel is uncertain. Some workers (see Jones, 1964) regard *Mustela rixosa* as only subspecifically distinct from the Eurasian *Mustela nivalis*. But, in Sweden, the two species live side by side without interbreeding (Kurtén, personal communication). Until detailed comparative and statistical studies are done on both the Old and New World populations, I am recognizing *Mustela rixosa* as a distinct species.

The ancestry of *Mustela erminea* can be traced back to the late Pliocene in Europe, and the species probably reached North America in late Blancan or early Irvingtonian times. The earliest known North American occurrence is from the Cudahy

TABLE 2. MEASUREMENTS, IN MM, OF *MUSTELA VISON* FROM ALASKA.

	N	O.R.	M	S.D.
Depth of ramus below P_{3-4}				
F:AM 30821	1	7.8	—	—
M. v. ingens (Recent, Alaska)	16	6.1–8.3	7.45 ± .17	.71
Depth of ramus below M_{1-2}				
F:AM 30821	1	8.2	—	—
M. v. ingens (Recent, Alaska)	16	7.0–9.4	8.26 ± .19	.79
Length M_1				
F:AM 30821	1	7.8	—	—
M. v. ingens (Recent, Alaska)	16	7.4–9.0	8.14 ± .12	.49
Length M_1 trigonid				
F:AM 30821	1	5.3	—	—
M. v. ingens (Recent, Alaska)	16	5.1–6.1	5.75 ± .08	.32
Width M_1 talonid				
F:AM 30821	1	3.3	—	—
M. v. ingens (Recent, Alaska)	16	2.7–3.8	3.31 ± .08	.34

fauna, and ermines have been reported from several late Pleistocene and postglacial localities.

Mustela vison (Schreber) Mink Figure 2 B

Material: Late Pleistocene, F:AM 30821 fragment of left ramus with P_3–M_1, Fairbanks Creek, Alaska.

Comparative Material: *Mustela vison ingens*, Recent, Alaska, MCZ 34165. USNM 6531–32, 7115, 8646, 8696–99, 8702–06, 8708–09, 14463, 20814. Yukon Territory MCZ 34517–18.

A single mandible of *Mustela vison* is known from the Fairbanks area. The jaw is broken off anterior to the second premolar, and the coronoid process is eroded as is the labial side of the condyle. The sharply pointed cusps of the teeth show slight wear. Each tooth is surrounded by a well developed cingulum, and there is an incipient metaconid on M_1. Table 2 shows that measurements of the specimen fall within the observed range of *Mustela vison ingens* (Osgood), the extant subspecies found in the area today. It is the largest subspecies of *Mustela vison.* No morphological differences were observed between the specimen and the comparative material.

The specimen can be distinguished easily from the *Mustela eversmanni* mandibles by the incipient metaconid and wider talonid on M_1, and the longer and narrower P_4. Table 3 shows other differences separating mink from ferret.

Although records of *Mustela vison* extend back to the late Irvingtonian Cudahy fauna, Meade County, Kansas (Getz, 1960), mink are not common in Pleistocene deposits. Since they are found only along streams and lakes, the presence of mink in a fauna is a good indicator of nearby permanent water.

Mustela (*Putorius*) *eversmanni* Lesson Steppe Ferret

Material: Late Pleistocene, Fairbanks area, Alaska, F:AM 49336 anterior half skull w/R P^{2-4}, L I^3, C, P^{2-3}, P^4 broken, Ester Creek. F:AM 49337 L mandible w/C–M_2, Cripple Creek. F:AM 30827 frag. L ramus w/I_3, C, P_2, P_4–M_1, Cripple Creek. *Mustela eversmanni* Recent, MCZ 23705, 24737, 25333, 40939–40, 54604. USNM 22191, 188449, 259792. AMNH 57338, 60102, 85382. *Mustela eversmanni michnoi* USNM 38365, 172631, 175439, 175441. AMNH 45605–06, 84312. *Mustela putorius* Recent, MCZ 3702, 24665, 24738, 25352. USNM 792, 1851, 22394, 115213–214, 121248, 123629, 152668–670, 152673–676, 154158, 319222–223. AMNH 36631–32, 69520, 119621, 163437. *Mustela nigripes*, Late Pleistocene, Little Box Elder Cave, Converse County, Wyoming, UCM 21916–18, 21922–24, 21950–52, 21957, 21959, 21962, 21965–70, 21972, 21975, 21977–78, 21980, 21983, 21985, 21989–90, 22010–11, 22022–23, 22151. *Mustela nigripes*, Recent, MCZ 4184, 42723, 43727. KU 1487, 1593, 7146, 10177, 11077, 14411. AMNH 1203, 40078, 41994, 42567, 70590, 121610, 140397. UCM 59, 10658, 10660. USNM 14580, 21066, 21965, 21976, 22311, 22427, 22929, 30064–66, 32771, 34977, 35011, 35016–18, 35088, 35376, 65061, 83992–994, 110772, 122620, 155475, 168744, 188450–453, 188455–458, 199737, 201945, 211513, 224450, 228233, 228789, 232400, 234118, 234138,

TABLE 3. COMPARISON BETWEEN *MUSTELA EVERSMANNI-NIGRIPES* AND *MUSTELA VISON*, CRANIAL CHARACTERS.

Variate	*M. eversmanni-nigripes*	*M. vison*
Palate	Wide between canines	Narrow between canines
Basiocciput	Narrow	Wide
Basicranium	Well-defined tube extending from foramen ovale to anterior margin of auditory bullae	Area between foramen ovale and auditory bullae is flat
Auditory bullae	More inflated	Less inflated
Mastoid bullae	Inflated	Not inflated
Auditory meatus	External opening large	External opening small
Infraorbital foramen	Small	Large
Canines, upper and lower	Relatively large	Relatively small
P^3	Short, broad	Long, narrow
P^4	Relatively short protocone	Relatively long protocone
M^1	Inner lobe not expanded	Inner lobe expanded
Mandible	Relatively short and thick	Relatively long, slender
Inferior margin of jaw at angle	Broad, flattened	Pointed, less flattened
Premolars	Relatively short, broad	Relatively long, narrow
M_1	Metaconid absent, talonid narrow	Incipient metaconid, talonid wide
M_2	Relatively small	Relatively large

134970–971, 234973, 241014, 243799, 243818–820, 243909–910, 243990, 245641, 247073, 251453, 285877, 287321, 289498.

Anderson (1973) reported the presence of ferret in central Alaska. Additional studies show that the material is referable to *Mustela eversmanni*, the steppe ferret, an animal closely related to, if not conspecific with, *Mustela nigripes* the black-footed ferret. This is the first record of *Mustela eversmanni* in North America.

Mustela eversmanni beringiae[1] ssp. nov. Beringian Ferret
Figure 3

Type. F:AM 49336 anterior half of skull with right P^{2-4}, alveoli of I^{1-3}, C; left I^3, C–P^{2-3}, P^4 broken, alveoli of I^{1-2}, M^1, Ester Creek, T 1 S, R 2 W, about 16 km west of Fairbanks, Alaska 64° 50′N, 148°W. Fairbanks D–2, D–3 Quadrangles. Collected in 1938.

Hypodigm. Type plus F:AM 49337 left mandible with C–M_2, alveoli of I_{1-3}, Cripple Creek. F:AM 30827 fragment of left ramus with I_3, C, P_2, P_4–M_1, alveoli of I_{1-2}, P_3, Cripple Creek, T 1 S, R 2 W, west of Fairbanks, Alaska.

Distribution. Known only from late Pleistocene deposits near Fairbanks.

Diagnosis. Large ferret; facial region broader than *Mustela eversmanni michnoi*; massive postorbital processes; pronounced postorbital constriction; broad palate; tooth row crowded; enlarged canines.

A broad facial region characterizes the skull, and measurements of the breadth across the canines, carnassials, interorbital region, and postorbital processes exceed those of all the ferrets I have measured or have seen referred to in the literature. The skull belonged to an adult animal—the teeth are moderately worn, the nasal and palatine sutures are obliterated, and the sagittal crest is well developed. The nasal opening is large, and the opening of the small infraorbital foramen is an elongated oval. Extending from the tips of the broad postorbital processes are distinct ridges that unite in the region of the postorbital constriction to form the sagittal crest. The area between the postorbital processes and the constric-

[1] beringiae—from Beringia, the enormous unglaciated land mass extending from western Alaska to northeastern Siberia during the Pleistocene.

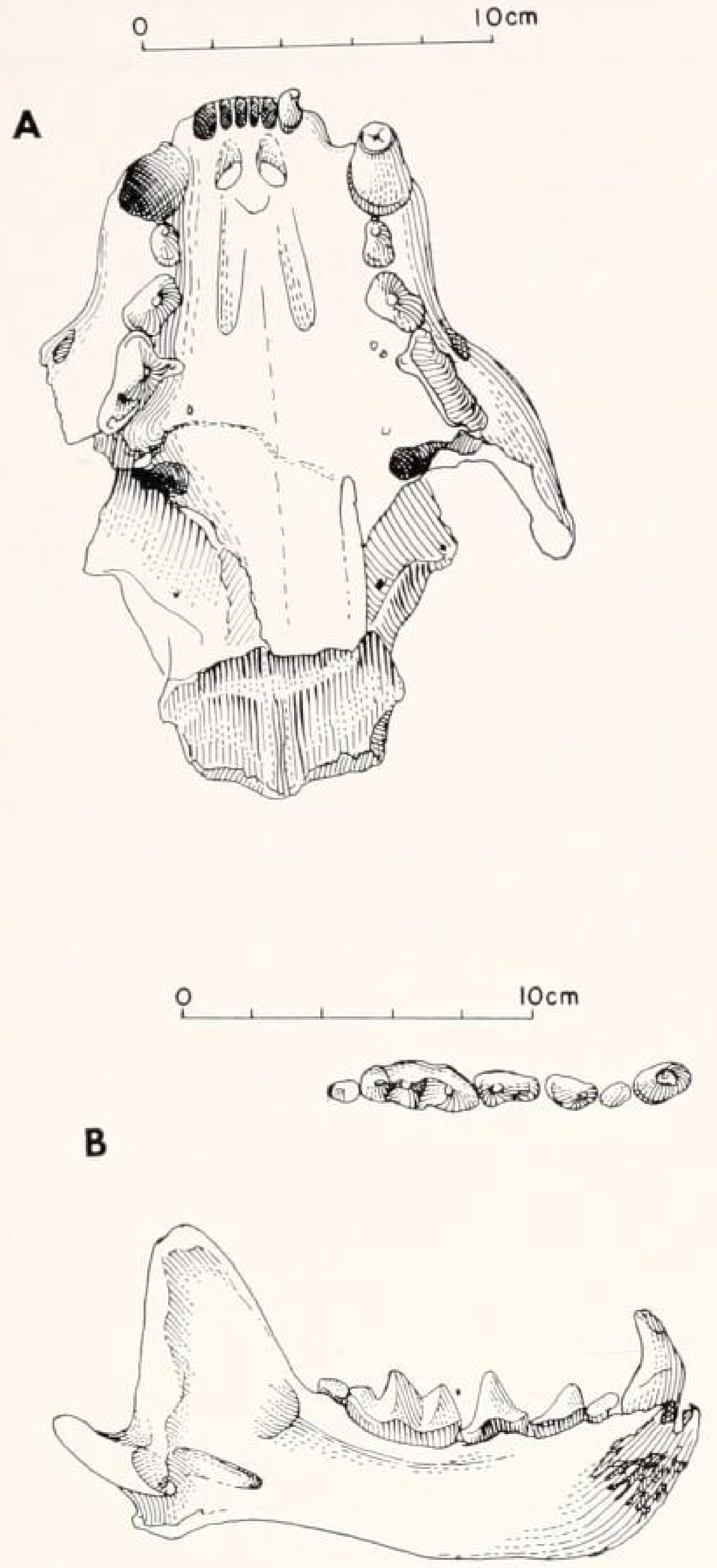

Figure 3. *Mustela eversmanni beringiae* ssp. nov. A. (F:AM 49336 Type) occlusal view of partial skull. B. (F:AM 49337) occlusal and lateral views of mandible.

tion is long and straight. The skull is broken just posterior to the constriction.

The upper teeth are crowded; there is no diastema between the canine and P^2, and P^3 is set obliquely in the jaw with the talon slightly overlapping P^4. The incisor row is curved, and the width from the outer edge of the alveolus of the right I^3 to the outer edge of the alveolus of the left I^3 measures 8.9 mm; this compares with a mean of 6.79 mm (N 7, O.R. 5.8—7.6 mm) for Recent *Mustela eversmanni michnoi* and 6.40 mm (N 67, O.R. 5.4—7.2 mm) for Recent *Mustela nigripes*. The canine is relatively long and slender, and P^3 is relatively short and broad. Measurements of P^4 fall within the observed range of measurements taken on the steppe ferret, and do not show any proportional differences. Only the alveolus of the left M^1 is preserved; it shows that the inner lobe of the tooth was narrow.

The left mandible, F:AM 49337, is perfectly preserved, only the incisors are missing (Fig 3B). The teeth are moderately worn and are close together. P_2 is set obliquely in the jaw and P_4 slightly overlaps M_1. As with the other species of ferrets, the lower premolars are relatively short and broad, M_1 shows no trace of a metaconid, the talonid of M_1 is ridged and relatively narrow, and M_2 is small. F:AM 30827, a partial left ramus broken off behind M_1, has more heavily worn teeth than F:AM 49337. The jaw is relatively massive in both specimens, the length of the tooth row exceeds those of *Mustela eversmanni michnoi* in my sample, but measurements of the teeth fall within the observed range of the other ferrets measured. (See Table 4.)

Comparison of the Alaskan material with both Pleistocene and Recent *Mustela (Putorius) nigripes* Audubon and Bachman, Recent *Mustela (Putorius) eversmanni* Lesson and Recent *Mustela (Putorius) putorius* Linnaeus showed that the specimens most closely resemble *Mustela (Putorius) eversmanni michnoi* Kashchenko, 1910, the South Transbaikalian Siberian Polecat. This is the largest subspecies and it inhabits the steppes south and west of Lake Baikal and neighboring areas of Mongolia (Stroganov, 1962). The skull of this subspecies shows a broad facial region, pronounced postorbital constriction, and a crowded tooth row.

Stroganov (1962) reports that *Mustela eversmanni* shows more geographic variation than other ferrets, and about 20 subspecies are recognized. For this reason, I used only specimens labeled *Mustela eversmanni michnoi* and *Mustela eversmanni larvatus*, a synonym of the former (see Ellerman and Morrison-Scott, 1966:265) in my statistical analysis.

TABLE 4. MEASUREMENTS, IN MM, OF *MUSTELA EVERSMANNI* AND *MUSTELA NIGRIPES*.

	N	O.R.	M	S.D.
Breadth across rostrum (C–C)				
F:AM 49336	1	21.8	—	—
M. eversmanni michnoi Recent	7	15.8–19.8	17.81 ± .53	1.40
M. nigripes Recent	75	15.1–19.6	16.80 ± .11	.91
Little Box Elder Cave Pleist.	1	16.8	—	—
Breadth across carnassials (P^4–P^4)				
F:AM 49336	1	28.4	—	—
M. eversmanni michnoi Recent	7	21.0–26.2	24.57 ± .60	1.61
M. nigripes Recent	75	21.2–25.8	23.63 ± .12	1.02
Little Box Elder Cave Pleist.	—	—	—	—
Interorbital breadth				
F:AM 49336	1	21.8	—	—
M. eversmanni michnoi Recent	7	16.4–19.3	17.64 ± .39	1.02
M. nigripes Recent	78	14.9–19.5	17.08 ± .11	1.05
Little Box Elder Cave Pleist.	2	18.0–21.4	19.70	—
Breadth across postorbital processes				
F:AM 49336	1	26.3	—	—
M. eversmanni michnoi Recent	7	20.0–23.6	21.84 ± .50	1.33
M. nigripes Recent	78	18.4–23.9	20.96 ± .16	1.42
Little Box Elder Cave Pleist.	2	21.8–25.4	23.60	—
Breadth across postorbital constriction				
F:AM 49336	1	14.9	—	—
M. eversmanni michnoi Recent	7	10.2–15.9	12.42 ± .67	1.78
M. nigripes Recent	77	9.8–16.0	12.41 ± .12	1.09
Little Box Elder Cave Pleist.	3	12.5–16.3	13.96	—
Length C–M^1				
F:AM 49336	1	22.1	—	—
M. eversmanni michnoi Recent	7	18.7–22.1	21.00 ± .43	1.15
M. nigripes Recent	77	17.5–21.9	19.74 ± .29	2.62
Little Box Elder Cave Pleist.	1	ca 21.4	—	—
Length P^3				
F:AM 49336	1	4.4	—	—
M. eversmanni michnoi Recent	7	3.8–4.6	4.28 ± .09	.26
M. nigripes Recent	70	3.5–4.2	3.86 ± .02	.17
Little Box Elder Cave Pleist.	2	3.8–4.4	4.1	—
Width P^3				
F:AM 49336	1	2.6	—	—
M. eversmanni michnoi Recent	7	2.0–2.7	2.31 ± .09	.25
M. nigripes Recent	70	1.9–2.5	2.18 ± .02	.16
Little Box Elder Cave Pleist.	2	2.2–2.3	2.25	—
Length P^4				
F:AM 49336	1	8.5	—	—
M. eversmanni michnoi Recent	7	7.0–8.5	8.10 ± .19	.52
M. nigripes Recent	79	6.7–8.0	7.41 ± .03	.28
Little Box Elder Cave Pleist.	7	7.3–8.1	7.71 ± .11	.30
Width P^4 protocone				
F:AM 49336	1	4.4	—	—
M. eversmanni michnoi Recent	7	3.4–4.3	3.80 ± .12	.31
M. nigripes Recent	79	3.2–4.0	3.67 ± .02	.18
Little Box Elder Cave Pleist.	7	3.5–4.1	3.77 ± .08	.21

TABLE 4. (CONTINUED)

	N	O.R.	M	S.D.
Length of mandible				
F:AM 49337	1	45.0	—	—
M. eversmanni michnoi Recent	7	38.5–46.6	43.25 ± 1.51	4.00
M. nigripes Recent	73	36.4–45.6	42.14 ± 0.24	2.09
Little Box Elder Cave Pleist.	6	35.8–42.2	38.91 ± 1.48	3.64
Height of mandible				
F:AM 49337	1	22.0	—	—
M. eversmanni michnoi Recent	7	20.0–23.1	21.41 ± .39	1.03
M. nigripes Recent	73	17.1–22.5	20.55 ± .13	1.17
Little Box Elder Cave Pleist.	6	18.4–21.8	19.75 ± .45	1.10
Depth of jaw below P_{3-4}				
F:AM 49337, 30827	2	9.2	—	—
M. eversmanni michnoi Recent	7	8.3–10.7	9.31 ± .21	.56
M. nigripes Recent	78	7.3–9.5	8.49 ± .07	.63
Little Box Elder Cave Pleist.	18	7.1–10.0	8.66 ± .21	.90
Depth of jaw below M_{1-2}				
F:AM 49337	1	9.8	—	—
M. eversmanni michnoi Recent	7	7.3–10.5	9.14 ± .23	.63
M. nigripes Recent	78	7.1–9.6	8.67 ± .07	.63
Little Box Elder Cave Pleist.	20	7.7–9.9	8.55 ± .16	.70
Length C–M_2				
F:AM 49337	1	26.4	—	—
M. eversmanni michnoi Recent	2	23.9–25.1	24.50	—
M. nigripes Recent	76	21.5–26.1	24.09 ± .11	1.03
Little Box Elder Cave Pleist.	10	21.5–25.3	23.37 ± .43	1.36
Length of M_1				
F:AM 49337, 30827	2	8.5–8.8	8.65	—
M. eversmanni michnoi Recent	7	7.6–9.6	8.94 ± .25	.65
M. nigripes Recent	77	7.3–9.1	8.27 ± .04	.40
Little Box Elder Cave Pleist.	24	7.3–9.0	8.24 ± .09	.45
Length of M_1 trigonid				
F:AM 49337, 30827	2	6.1–6.4	6.25	—
M. eversmanni michnoi Recent	7	5.5–6.8	6.35 ± .18	.48
M. nigripes Recent	77	5.2–6.4	5.85 ± .02	.25
Little Box Elder Cave Pleist.	23	5.3–6.4	5.92 ± .19	.91
Width M_1 talonid				
F:AM 49337, 30827	2	2.4–2.5	2.45	—
M. eversmanni michnoi Recent	7	2.1–2.6	2.45 ± .08	.23
M. nigripes Recent	79	2.1–2.6	2.34 ± .01	.13
Little Box Elder Cave Pleist.	23	2.0–2.5	2.26 ± .02	.12

Extant steppe or Siberian ferrets are found in steppe and forest-steppe zones of Eurasia, from Hungary and Yugoslavia to the Amur region of Siberia, south to the plains of central Asia, Mongolia and northeast China (Stroganov, 1962).

There is still disagreement as to the generic and specific status of Old World ferrets. Pocock (1936) and Ellerman and Morrison-Scott (1966) recognize a single species, *Mustela* (*Putorius*) *putorius*. However, Russian scientists (Ognev, 1931 and Stroganov, 1962), with larger samples to work with, recognize *Putorius putorius* and *Putorius eversmanni* as distinct species. Stroganov lists the following cranial characters as distinctive of *Mustela eversmanni*: a larger, bulkier skull, appreciable constriction of the postorbital region, and a longer facial region. In addition, the canines and carnassials are relatively larger than those of *Mustela putorius*. There are also pronounced differences in body size, coloration, and habitat of the two species. *Mustela putorius* inhabits forest biotopes and farmlands; *Mustela eversmanni* lives on the steppes and seldom enters forests. In areas where the ranges of the two species overlap, the two forms remain distinct.

Although postorbital constriction is correlated with increasing age in most mustelids, skulls of *Mustela putorius* do not show the pronounced constriction seen in the other species. The mean of the measurements of postorbital constriction of *Mustela putorius* in my sample is 16.31 mm (N 24, O.R. 12.6–18.2 mm); this compares with a mean of 12.41 mm for *Mustela eversmanni* and *Mustela nigripes* (see Table 4).

Pocock (1936:715) noted "the close similarity in all dimensions" of a male skull of *Mustela eversmanni* from the Altai, and a male skull of *Mustela nigripes* from Montana. I took 26 measurements on 19 skulls of *Mustela eversmanni* and on 79 skulls of *Mustela nigripes*; there were no significant differences in size between the two species (see Table 4). The only difference that appeared on scatter diagrams was a narrower basioccipital region in *Mustela nigripes*. Both species inhabit steppe regions, have a long sinuous body, and similar coloration. *Mustela nigripes* has never been abundant on the Great Plains, and today it is considered to be an endangered species. Unlike the steppe ferret, which feeds on a wide variety of small animals, the black-footed ferret feeds primarily on *Cynomys*. The geographic range of *Cynomys* and *Mustela nigripes* are nearly identical and the two species are associated in most Pleistocene localities except Old Crow River; *Cynomys* has not been reported from Fairbanks.

The Pleistocene history of *Mustela eversmanni* is poorly known, especially in Siberia. It is reported from late Pleistocene deposits in Europe; whether late middle Pleistocene ferrets are *Mustela putorius* or *Mustela eversmanni* is uncertain. Both species may be derived from the smaller early middle Pleistocene species, *Mustela* (*Putorius*) *stromeri* Kormos (Kurtén, 1968).

The earliest record of *Mustela nigripes* is from an upper Illinoian deposit in Clay County, Nebraska, and it is known from Sangamon deposits in Nebraska and at Medicine Hat, Alberta. Wisconsinan records include Old Crow River, Yukon Territory; Orr Cave, Montana; Jaguar Cave, Idaho; Little Box Elder Cave, Wyoming; Chimney Rock, Colorado; Isleta Cave, New Mexico; and Moore Pit, Texas. The specimen from Burnet Cave, New Mexico (see Schultz and Howard, 1935) is a juvenile with deciduous dentition; whether it is a mink or a ferret cannot be determined. The partial right ramus, NMC 16323, from Old Crow River, Locality 65, may be referable to *Mustela eversmanni beringiae*.

Ferrets entered the New World from Siberia, spread across Beringia, and then advanced southeastward to the Great Plains through ice-free corridors. Kalela (1940, in Kurtén, 1957) reported that during the period from 1880 to 1940, *Mustela putorius* extended its range in Finland from the Karelian Isthmus north to central Ostrobothnia and west to the Gulf of Bothnia. The rate of migration was 7.5 km annually or 750 km in a century. When climatic conditions permitted, this rate was probably applicable for ferrets spreading across Siberia and into the New World.

The question of conspecificity between *Mustela eversmanni* and *Mustela nigripes* is yet to be resolved. That the two species are closely related cannot be doubted, but until detailed comparative and statistical studies are made on the large collections of *Mustela eversmanni* in Soviet institutions; these data are compared with the information already compiled on *Mustela nigripes*; and behavioral and chromosomal studies are undertaken on both species, I regard them as distinct.

Gulo gulo (Linnaeus) Wolverine Figure 4

Material: Late Pleistocene, Fairbanks area, Alaska, F:AM 30795 skull with complete dentition, Goldstream. F:AM 30796 anterior ½ skull w/R I^{2-3}, P^1–M^1, L I^3, P^{1-4}, Ester Creek. F:AM 30797 L ramus w/C, P_2–M_1, top of gravel at 21 Goldstream, 40 feet below original surface. F:AM 30798 skull and associated jaw symphysis w/R C, P^2–M^1, L I^1, I^3–C, P^{2-4}; jaw symphysis w/R and L C, P_2–M_1, Old Eva Creek. F:AM 30799 partial anterior ½ skull w/R C, P^2–M^1, Cripple Creek. F:AM 30800 R max. w/P^4, Ester Creek. F:AM 30805 frag. R ramus w/P_3–M_1, Fairbanks Creek. F:AM 30806 L ramus w/P_2–M_1, No. 2 Goldstream stripping area. F:AM 30807 frag. R ramus w/P_3–M_2, No. 2 Goldstream stripping area. F:AM 30808 R ramus w/P_4–M_1, Cripple Creek. F:AM 30809 L ramus w/C, P_3–M_1, Cripple Creek. F:AM 30810 L ramus w/P_2–M_2, Engineer Creek. F:AM 30811 frag. R ramus w/P_4–M_1, Cripple Creek. F:AM 68003 R max w/C broken, P^{3-4}, M^1 and assoc. frag. R. ramus w/M_{1-2}, Gold Hill. F:AM 68005 frag. R ramus w/P_{3-4}, Gold Hill.

Comparative material: Postglacial, Moonshiner Cave, Bingham County, Idaho, ISUM 19585–19599, 19643, 19667, 17 skulls and skull fragments; ISUM 19601–19639, 39 mandibles.
Recent, Alaska, MCZ 47398–99, 48566–68, 50528. AMNH 137270. Yukon Territory MCZ 34516. Northwest Territory AMNH 3448–49, 3450, 34506–09, 37432–33. Measurements of 24 male and 13 female skulls from Alaska (data from Björn Kurtén).

The outstanding feature of the wolverine material from the Pleistocene of Alaska is the large size of the specimens. Comparisons with samples from postglacial Moonshiner Cave, Idaho, and the Recent of Alaska and northern Canada show that the Alaskan Pleistocene specimens exceed the others in all measurements except the inner lobe of M^1, the depth of the jaw below P_{3-4}, and the length of the lower tooth row (C–M_2) (see Table 5). No attempt was made to sex the fossil material. If I had, the size differences would have been even more pronounced.

The well preserved skull, F:AM 30795 (see Fig. 4A–B) from Goldstream, is the largest wolverine skull known to me. The condylobasal length measures 172 mm. The largest specimen in my sample has a condylobasal length of 151 mm, and the largest specimen in Ognev's sample from the U.S.S.R. measured 157.8 mm (1935:587). Hall and Kelson (1959) give an observed range of 127–140 mm for basal length for the extant animal in North America. Other cranial measurements of F:AM 30795 are equally large, especially the mastoid breadth, breadth across the carnassials, and the approximate zygomatic breadth. The well developed sagittal crest projects above the dorsal surface of the skull, but unfortunately, the overhanging projection is broken off at the occiput. The powerful mastoid processes point obliquely forward and downward. A partial skull, F:AM 30796, and a right maxilla, F:AM 30800, represent skulls nearly as large as F:AM 30795.

The dentition of F:AM 30795 is complete and shows moderate wear. The length of the upper tooth row (C–M^1) measures 62.8 mm compared with 53.0 mm for the largest specimen from Moonshiner Cave, and 55.6 mm for the maximum length in my Recent sample. Stroganov (1962:245) gives an observed range of 49–60 mm for the length of the upper tooth row for Siberian *Gulo gulo*. The incisors of F:AM 30795 are all worn down to the same level. The tips of both canines were broken off during the life of the animal, and the remaining portions of the fangs are worn smooth. The massive cheek teeth are crowded, but do not overlap, and the tooth row is dominated by the enormous carnassial with its small talon.

F:AM 30797 (Fig. 4C), a complete left mandible lacking only the incisors, first premolar and last molar, is the largest lower jaw from the Fairbanks region. Its total length, measured from the symphysis at the alveolus of I_1 to the most distant edge of the condyle, is 112.8 mm, a measurement larger than any in the postglacial or Recent sample. The teeth are only slightly worn, and are close together with P_2 sitting slightly obliquely in the jaw. The posterior

Table 5. Measurements, in mm, of *Gulo gulo*.

		N	O.R.	M	S.D.
Condylobasal length					
F:AM Collection		2	139.4–172.0	155.70	—
Moonshiner Cave, Id.		3	134.0–145.0	140.66	—
G. gulo, Recent	♂	29	140.0–151.0	146.05 ± .58	3.26
	♀	18	132.6–141.0	135.00 ± .65	2.61
Zygomatic breadth					
F:AM Collection		2	100.0–119.2	109.6	—
Moonshiner Cave, Id.		—	—	—	—
G. gulo, Recent	♂	29	98.3–113.2	105.0 ± .57	3.04
	♀	17	92.5–100.0	95.97 ± .42	1.69
Breadth across rostrum (C–C)					
F:AM Collection		4	41.4–48.6	44.92	—
Moonshiner Cave, Id.		7	36.1–42.3	38.92 ± .94	2.50
G. gulo, Recent	♂	9	40.0–43.9	42.51 ± .40	1.20
	♀	8	37.0–39.9	37.94 ± .35	.99
Breadth across carnassials (P^4–P^4)					
F:AM Collection		3	67.1–76.7	72.40	—
Moonshiner Cave, Id.		8	51.4–63.0	59.82 ± .73	2.07
G. gulo, Recent	♂	9	63.6–69.3	66.97 ± .59	1.77
	♀	8	59.7–63.8	61.47 ± .49	1.40
Interorbital breadth					
F:AM Collection		3	41.0–46.7	44.70	—
Moonshiner Cave, Id.		4	36.7–44.6	40.60	—
G. gulo, Recent	♂	9	39.1–45.4	41.38 ± .28	1.56
	♀	8	36.0–40.9	37.75 ± .15	.69
Breadth across postorbital processes					
F:AM Collection		2	48.2–56.8	52.50	—
Moonshiner Cave, Id.		4	44.0–53.5	48.37	—
G. gulo, Recent	♂	9	45.7–54.3	48.61 ± .94	2.83
	♀	7	42.4–49.5	45.50 ± 1.05	2.79
Mastoid breadth					
F:AM Collection		2	85.0–108.0	96.50	—
Moonshiner Cave, Id.		5	76.2–87.3	81.18	—
G. gulo, Recent	♂	9	83.1–94.6	90.05 ± 1.14	3.43
	♀	8	78.4–85.6	82.50 ± .82	2.19
Length C–M^1					
F:AM Collection		5	51.3–62.8	57.72	—
Moonshiner Cave, Id.		11	46.4–53.0	50.47 ± .69	2.29
G. gulo, Recent	♂	9	51.0–55.6	53.28 ± .42	1.28
	♀	8	43.4–51.3	48.63 ± 1.43	4.05
Length P^4					
F:AM Collection		6	21.6–23.4	22.70 ± .51	1.27
Moonshiner Cave, Id.		15	18.0–22.3	20.36 ± .28	1.06
G. gulo, Recent	♂	28	20.2–23.2	21.30 ± .13	.70
	♀	21	18.6–20.1	19.37 ± .09	.40
Width P^4 protocone					
F:AM Collection		6	12.6–13.5	12.96 ± .44	1.10
Moonshiner Cave, Id.		15	10.4–13.4	11.58 ± .22	.86
G. gulo, Recent	♂	28	11.4–13.1	12.31 ± .08	.47
	♀	18	10.6–12.1	11.15 ± .10	.43

TABLE 5. (CONTINUED)

		N	O.R.	M	S.D.
Width M^1					
F:AM Collection		5	13.5–15.8	14.80	—
Moonshiner Cave, Id.		18	12.0–14.2	13.39 ± .16	.72
G. gulo, Recent	♂	29	13.7–15.7	14.45 ± .09	.51
	♀	18	12.5–13.9	13.05 ± .09	.40
Length M^1 constriction					
F:AM Collection		5	6.3–6.6	6.46	—
Moonshiner Cave, Id.		18	5.1–6.2	5.72 ± .06	.29
G. gulo, Recent	♂	29	5.6–6.5	5.99 ± .04	.26
	♀	18	4.9–5.9	5.53 ± .06	.29
Length M^1 inner lobe					
F:AM Collection		5	7.1–9.0	8.06	—
Moonshiner Cave, Id.		18	6.6–8.5	7.56 ± .12	.51
G. gulo, Recent	♂	29	7.3–9.7	8.20 ± .06	.34
	♀	18	6.8–8.1	7.22 ± .08	.35
Length mandible					
F:AM Collection		5	96.0–112.8	105.82	—
Moonshiner Cave, Id.		16	89.2–107.0	95.41 ± .82	3.28
G. gulo, Recent	♂	9	99.5–107.2	103.76 ± 1.28	3.85
	♀	8	94.2–99.4	95.86 ± .66	1.89
Depth of jaw below P_{3-4}					
F:AM Collection		9	18.4–22.2	20.62 ± .44	1.33
Moonshiner Cave, Id.		26	16.0–21.4	18.64 ± .32	1.67
G. gulo, Recent	♂	9	19.3–22.6	20.82 ± .94	2.83
	♀	8	17.9–19.0	18.42 ± .42	1.19
Depth of jaw below M_{1-2}					
F:AM Collection		9	22.0–29.6	25.70 ± .55	1.66
Moonshiner Cave, Id.		26	20.0–26.1	22.21 ± .32	1.67
G. gulo, Recent	♂	9	23.2–25.7	24.52 ± .58	1.76
	♀	8	19.6–22.3	21.35 ± .55	1.56
Length C–M_2					
F:AM Collection		7	59.7–70.1	63.14 ± .74	1.97
Moonshiner Cave, Id.		26	54.7–64.6	58.82 ± .20	1.02
G. gulo, Recent	♂	9	61.3–66.4	64.70 ± .54	1.64
	♀	8	57.5–62.1	59.86 ± .55	1.56
Length M_1					
F:AM Collection		10	22.0–24.6	23.15 ± .57	1.81
Moonshiner Cave, Id.		38	18.5–23.1	20.80 ± .09	1.29
G. gulo, Recent	♂	29	21.6–25.2	22.80 ± .32	1.74
	♀	18	19.5–22.0	20.85 ± .48	2.05
Length M_1 trigonid					
F:AM Collection		9	16.9–19.3	18.15 ± .27	.83
Moonshiner Cave, Id.		38	14.2–17.6	15.87 ± .15	.97
G. gulo, Recent	♂	9	16.2–19.0	17.93 ± .28	.80
	♀	8	15.6–17.1	16.43 ± .17	.49
Width M_1 talonid					
F:AM Collection		9	7.0–8.1	7.62 ± .13	.41
Moonshiner Cave, Id.		38	5.8–8.4	6.83 ± .29	.55
G. gulo, Recent	♂	9	7.1–7.9	7.40 ± .09	.27
	♀	8	6.0–7.3	6.70 ± .18	.52

A

B

C

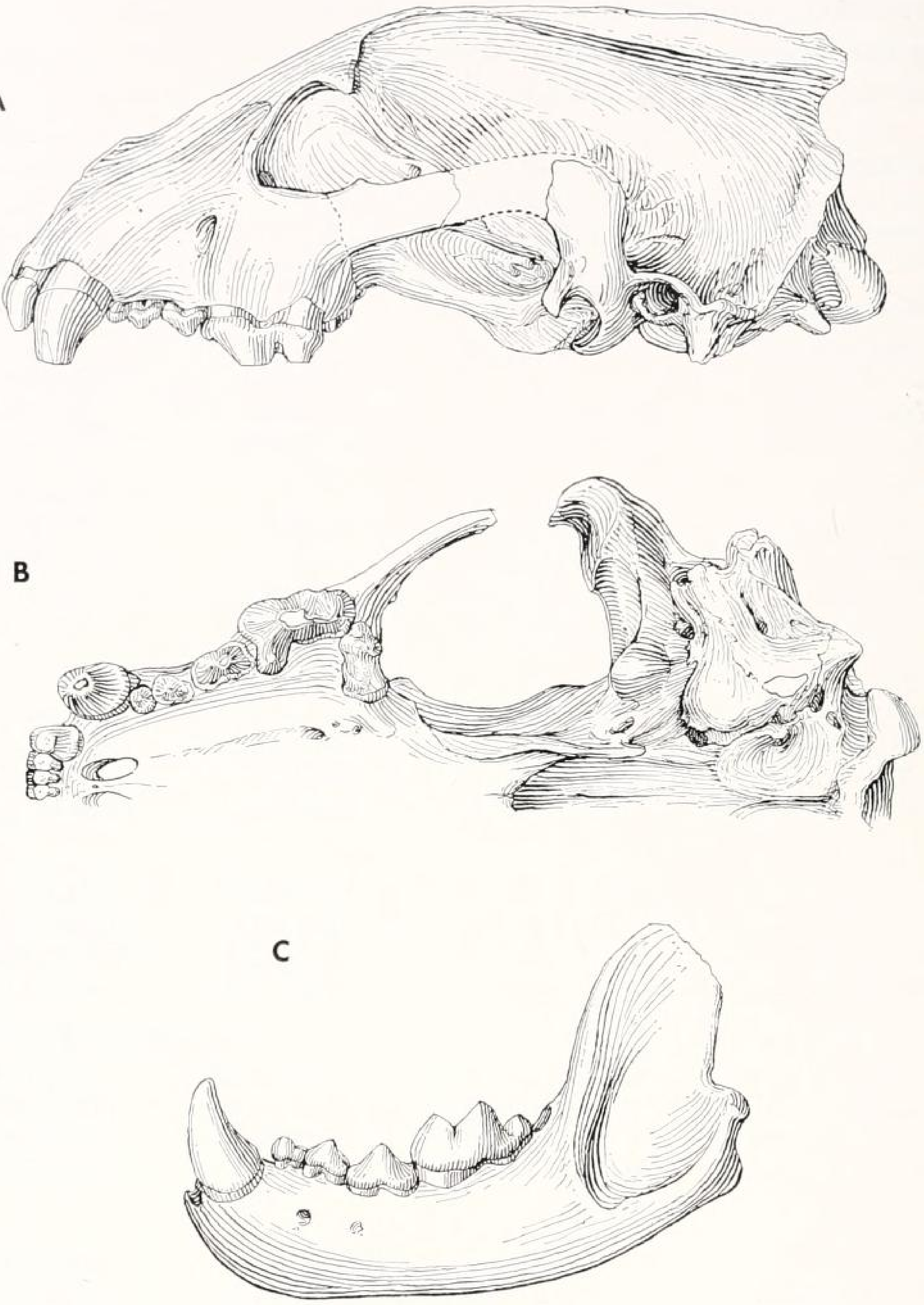

Figure 4. *Gulo gulo* (F:AM 30795) A. lateral and B. ventral views of skull; C. (F:AM 30797) lateral view of mandible. Scale 1/1.

part of P_4 is expanded. M_1 is a massive tooth with a powerful trigonid and reduced talonid; there is no trace of a metaconid. F:AM 30797 was also found at Goldstream, but it did not belong to the same individual as F:AM 30795. Except for larger size, the mandibles from the Pleistocene of Alaska do not differ from the extant *Gulo* living in the area today.

Kurtén and Rausch (1959) in their study of Alaskan and Fennoscandian wolverines noted that a significant difference was found between the two populations in the length of M^1 measured at the constriction. They found that the Recent specimens from Alaska had a more strongly constricted M^1 than those from Scandinavia. This is not the case with the late Pleistocene Alaskan specimens—the M^1 shows less constriction than those from Scandinavia. One of their fossil specimens from Europe also showed this reduced constriction of M^1. On a scattergram the specimens from Moonshiner Cave show nearly the same proportions as the sample from Fennoscandia. Comparisons with other late Pleistocene samples of *Gulo* are now being made.

Circumboreal in distribution, wolverines inhabit tundra and taiga regions, and today in America are found primarily in Alaska and northern Canada. Wolverines are rare in Pleistocene deposits. The earliest American records are late Irvingtonian from Port Kennedy Cave, Pennsylvania and Cumberland Cave, Maryland. Wisconsinan deposits containing *Gulo* include Old Crow River, Yukon Territory; Little Box Elder Cave, Wyoming; Chimney Rock Animal Trap, Colorado; Jaguar Cave, Idaho; and Fairbanks. Wolverines show a gradual increase in size during Rancholabrean times; postglacial and extant animals are smaller.

Gulo is descended from *Plesiogulo*, a large Pliocene form with a less specialized dentition that inhabited Eurasia and North America. *Gulo* makes its first appearance in early middle Pleistocene deposits in Europe as a slightly smaller form called *Gulo schlosseri* Kormos. It gave rise to *Gulo gulo* which appears during the Mindel glaciation in Europe and China. *Gulo* probably reached America in the Kansan. American wolverines were formerly considered to be a distinct species, *Gulo luscus* (Linnaeus); Kurtén and Rausch (1959) showed that the American population is only subspecifically distinct from the Eurasian.

Taxidea taxus (Schreber) Badger
Figure 5

Material: Late Pleistocene, Fairbanks area, Alaska. F:AM 30786 skull and associated mandible w/R I^{1-2}, C–M^1, L complete upper dentition, R I_{1-3}, C, P_3–M_2, L I_{1-3}, ½ P_2, P_3–M_2, Goldstream. F:AM 30787 skull w/L C, P^4–M^1, Goldstream. F:AM 30788 R ramus w/C, P_4–M_1, head of Goldstream. F:AM 30789 L ramus w/M_1 broken, Cleary. F:AM 30790 frag. L jaw, toothless, Goldstream. F:AM 30826 L ramus w/M_{1-2}, Cripple Creek. F:AM 30827 R ramus w/P_3–M_1, Ester Creek. F:AM 30828 R ramus w/P_2, M_2, frag. M_1, Cripple Creek. F:AM 30829 L ramus, toothless, Ester Creek. F:AM 30830 frag. R ramus w/P_{2-4}, M_1 broken, Cripple Creek. F:AM 30831 L ramus w/C, Cripple Creek. F:AM 30832 L ramus w/C, P_2–M_1, all broken, Cripple Creek. F:AM 30833 L max. w/P^3–M^1, Cripple Creek. F:AM 30834 L max. w/P^{3-4}, Cripple Creek. F:AM 30835 anterior half skull w/R C, P^3, L ½P^3, Lower Goldstream. F:AM 30836 anterior half skull w/R C, P^3–M^1, L ½P^3, Cripple Creek. F:AM 30837 skull w/R I^{1-2}, C–M^1, L I^{2-3}, C, ½P^2, P^3, Ester Creek. F:AM 30837A frag. R ramus w/P_2–M_2, Ester Creek. F:AM 30838 partial skull w/R and L P^4–M^1, Ester Creek. F:AM 30839 L ramus w/C, P_3–M_1, Fairbanks Creek. F:AM 30840 frag. R ramus w/M_1, Cripple Creek. Field numbers: F:AM 4493 L max. w/P^3–M^1, Gold Hill. F:AM 4717 R max. w/C, P^2 broken, P^{3-4}, Gold Hill. F:AM 4737 L ramus w/P_{2-3}, P_4–M_1 broken, Gold Hill. F:AM 6135 L ramus w/M_{1-2}, C–P_4 broken off at roots, Engineer Creek. F:AM 6411 jaw symphysis w/R C–M_2, L P_{3-4}, all broken, Cripple Creek. F:AM 68004 frag. R ramus w/P_4, Gold Hill. U.A. acc. no. 552 (on loan to Frick Laboratory) skull w/R and L P^3–M^1, Cripple Creek.
Late Pleistocene, Little Box Elder Cave, Converse County, Wyoming, UCM 21928. Postglacial, Moonshiner Cave, Bingham County, Idaho, ISUM 19650, 19671–79, 19682–85, 19687, 19701–04, 19705, (36 specimens), 19706 (31 specimens), 19731–32, 19735–49, 19752, 19761–64, 19766, 19769, 19771, 19773–75, 19777, 19780–81, 19795, 19799–19806, 19814–834.
Recent. *Taxidea taxus jeffersonii* MCZ 8517, 9223, 12402, 41389–90. UCM 5150, 5237, 5284, 5882, 6678, 10682–84, 10687. E.R. Warren collection, not cataloged 2635, 9135. *Taxidea taxus berlandieri* UCM 11548–550. UCM 3698, no data.

Badgers are not found in Alaska today. Their closest occurrence is along the Peace River, lat. 58°N, in northern Alberta (Preble, 1908), about 1800 km southeast of the Fairbanks area. During the late Pleistocene, badgers inhabited the unglaciated, grassy steppes of central Alaska and northern Yukon (Gold Run Creek, Harington, 1970, and Dominion Creek, Harington, personal communication). Remains of *Taxidea* outnumber the other Alaskan mustelids in the Frick collection.

The Alaskan badgers are characterized by large size. The condylobasal length of U.A. acc. no. 552 is 144.6 mm, a measurement that exceeds all other Pleistocene, postglacial, and Recent records. The condylobasal length of the large skull from Little Box Elder Cave, UCM 21928, (see Anderson,

TABLE 6. MEASUREMENTS, IN MM, OF *TAXIDEA TAXUS*

	N	O.R.	M	S.D.
Condylobasal length				
F:AM Collection	3	137.7–144.6	140.60	—
Moonshiner Cave, Id.	11	118.0–129.2	124.55 ± .61	2.04
Taxidea taxus, Recent	16	114.0–132.0	122.47 ± 1.22	4.89
Zygomatic breadth				
F:AM Collection	2	90.6–100.1	95.35	—
Moonshiner Cave, Id.	9	72.4–80.1	76.96 ± 1.31	3.95
Taxidea taxus, Recent	16	72.4–87.7	77.91 ± 1.18	4.74
Breadth across rostrum (C–C)				
F:AM Collection	6	38.4–46.2	41.96 ± 1.20	2.94
Moonshiner Cave, Id.	18	32.1–37.8	35.00 ± .36	1.53
Taxidea taxus, Recent	20	30.5–37.9	34.15 ± .46	2.06
Breadth across carnassials (P^4–P^4)				
F:AM Collection	3	45.2–49.6	47.40	—
Moonshiner Cave, Id.	18	38.5–44.6	40.94 ± .41	1.74
Taxidea taxus, Recent	20	37.7–44.4	40.85 ± .38	1.68
Interorbital breadth				
F:AM Collection	6	32.9–39.7	36.91 ± 1.07	2.61
Moonshiner Cave, Id.	21	25.6–35.0	29.90 ± .53	2.47
Taxidea taxus, Recent	19	24.6–31.4	27.50 ± .37	1.64
Breadth across postorbital processes				
F:AM Collection	6	39.9–44.6	42.28 ± .65	1.60
Moonshiner Cave, Id.	22	31.8–37.0	35.03 ± .28	1.32
Taxidea taxus, Recent	20	30.8–40.3	35.25 ± .53	2.40
Mastoid breadth				
F:AM Collection	3	90.0–91.4	90.80	—
Moonshiner Cave, Id.	12	66.0–83.3	73.89 ± .64	2.22
Taxidea taxus, Recent	19	70.2–86.8	76.39 ± 1.09	4.64
Length C–M^1				
F:AM Collection	9	40.7–47.3	44.74 ± .68	2.04
Moonshiner Cave, Id.	34	36.1–44.3	40.32 ± .33	1.93
Taxidea taxus, Recent	20	35.3–43.0	39.87 ± .38	1.73
Length P^3				
F:AM Collection	9	7.3–8.6	7.87 ± .13	.39
Moonshiner Cave, Id.	4	6.5–7.3	6.90	—
Taxidea taxus, Recent	14	6.2–7.5	6.64 ± .10	.40
Length P^4				
F:AM Collection	10	11.5–13.9	12.88 ± .24	.75
Moonshiner Cave, Id.	40	10.8–13.5	11.86 ± .08	.53
Taxidea taxus, Recent	19	10.3–13.5	11.73 ± .18	.80
Width P^4 protocone				
F:AM Collection	10	10.2–12.1	11.15 ± .20	.63
Moonshiner Cave, Id.	40	9.0–11.9	9.91 ± .09	.57
Taxidea taxus, Recent	19	9.0–11.3	10.05 ± .14	.61
Width M^1				
F:AM Collection	8	10.1–12.0	10.93 ± .19	.56
Moonshiner Cave, Id.	44	9.1–11.8	10.07 ± .09	.63
Taxidea taxus, Recent	19	9.3–11.6	10.28 ± .15	.67

TABLE 6. (CONTINUED)

	N	O.R.	M	S.D.
Length M^1 inner				
F:AM Collection	8	9.5–12.6	10.95 ± .39	1.09
Moonshiner Cave, Id.	44	9.7–12.5	10.90 ± .11	.70
Taxidea taxus, Recent	19	9.6–12.9	11.16 ± .21	.93
Length mandible				
F:AM Collection	8	95.2–109.0	99.01 ± 1.70	4.81
Moonshiner Cave, Id.	48	73.7–98.3	85.63 ± .65	4.56
Taxidea taxus, Recent	20	78.8–93.5	86.18 ± .99	4.32
Depth of jaw below P_{3-4}				
F:AM Collection	18	15.1–21.3	17.85 ± .41	1.73
Moonshiner Cave, Id.	74	12.0–18.1	14.42 ± .13	1.08
Taxidea taxus, Recent	20	12.0–16.3	14.35 ± .27	1.23
Depth of jaw below M_{1-2}				
F:AM Collection	17	19.5–26.0	22.58 ± .37	1.56
Moonshiner Cave, Id.	74	16.2–21.5	18.54 ± .14	1.18
Taxidea taxus, Recent	20	15.6–22.0	18.28 ± .35	1.58
Thickness of jaw below M_1				
F:AM Collection	17	8.1–12.0	10.23 ± .27	1.14
Moonshiner Cave, Id.	28	7.0–9.4	8.18 ± .13	.71
Taxidea taxus, Recent	20	6.5–8.6	7.65 ± .18	.71
Length C–M_2				
F:AM Collection	9	51.2–59.3	54.64 ± .71	2.15
Moonshiner Cave, Id.	48	43.4–53.6	49.14 ± .33	2.33
Taxidea taxus, Recent	19	44.6–52.0	48.79 ± .48	2.09
Length P_4				
F:AM Collection	9	8.2–9.8	9.14 ± .19	.57
Moonshiner Cave, Id.	7	7.2–8.6	7.88 ± .20	.53
Taxidea taxus, Recent	15	7.3–8.7	8.15 ± .12	.48
Length M_1				
F:AM Collection	12	13.1–15.2	14.38 ± .21	.73
Moonshiner Cave, Id.	20	11.6–14.9	13.20 ± .20	.89
Taxidea taxus, Recent	16	12.3–14.6	13.55 ± .17	.66
Length M_1 trigonid				
F:AM Collection	7	7.7–10.5	9.48 ± .37	.99
Moonshiner Cave, Id.	20	7.7–9.9	8.70 ± .15	.66
Taxidea taxus, Recent	16	8.3–9.9	8.87 ± .11	.45
Width M_1 talonid				
F:AM Collection	11	5.6–7.2	6.34 ± .14	.47
Moonshiner Cave, Id.	22	4.9–6.5	5.80 ± .09	.43
Taxidea taxus, Recent	18	5.3–7.0	6.03 ± .12	.51

1968) measures 142.2 mm. Table 6 shows that the largest specimen from Moonshiner Cave has a condylobasal length of 129.2 mm, and the largest Recent skull in my sample measures 132.0 mm. Long (1972) gives an observed range of 121.5–139.9 mm for the greatest length of the skull of *Taxidea taxus jeffersonii*, the largest extant subspecies. Other big late Pleistocene badgers are known from Dominion Creek, Yukon Territory, Rancho La Brea, McKittrick, and Maricopa, California, Burnet Cave and Sandia Cave, New Mexico (personal observations). I am presently reviewing all of the

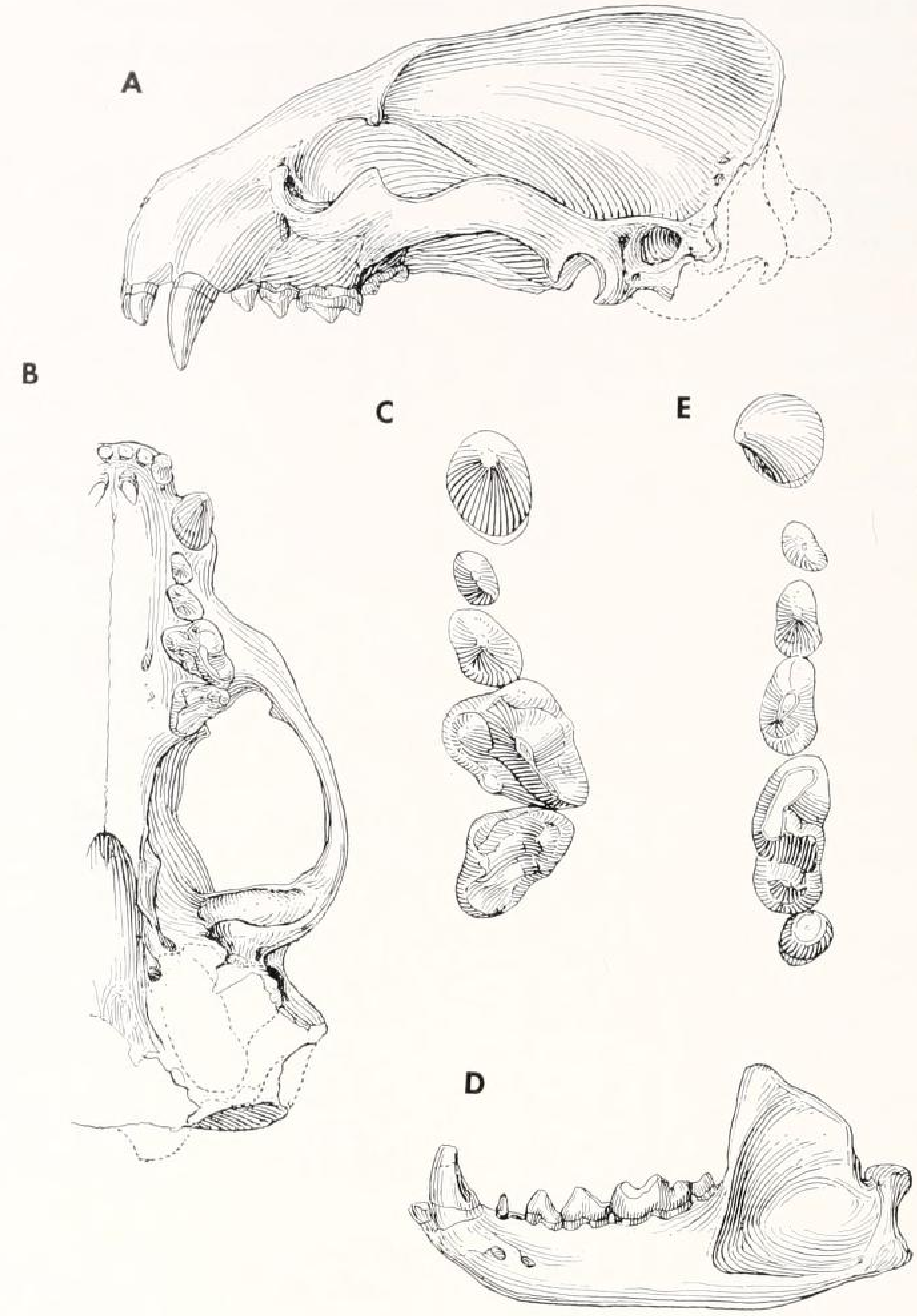

Figure 5. *Taxidea taxus* (F:AM 30786) A. lateral and B. ventral views of skull; C. occlusal view of upper dentition; D. lateral view of mandible; E. occlusal view of lower dentition. Scale 1/1.

Pleistocene *Taxidea* material. Preliminary studies indicate that all of the material is referable to *Taxidea taxus*, but subspecific designation of the Blancan and late Rancholabrean material seems warranted. A trend in the evolution of *Taxidea* during the Pleistocene is a gradual increase in size culminating in the huge Rancholabrean forms; there was a slight decrease in size during postglacial times, and this was followed by a slight increase in size in Recent times. The largest extant badgers are found in the northern parts of their range.

All of the measurements taken on the Alaskan material, except the length of M^1, which is quite variable, exceed those in my postglacial and Recent sample. Pronounced size differences are noticed in zygomatic breadth, mastoid breadth, and length of mandible (see Table 6).

The well preserved skull, U.A. acc. no. 552, belonged to an adult animal. The low broad skull is characterized by strong zygomatic arches, well developed sagittal and lambdoidal crests, a wide occiput with highly inflated tympanic bullae, and separate paraoccipital processes. The incisors, canines, and P^2's are missing; P^3–M^1 are moderately worn and close together. Three other complete skulls, three partial skulls, and four maxillary fragments are known from the Fairbanks area. Large size is characteristic of all of them. F:AM 30837 and 30787 have condylobasal lengths of 139.5 mm and 137.7 mm respectively; F:AM 30836 has a rostrum breadth of 46.2 mm compared to 43.6 mm for U.A. acc. no. 552.

Eighteen badger mandibles were found in the Fairbanks area. Of these, F:AM 30832 is the largest, the total length of this massive jaw measures 109 mm; this compares with a measurement of 98.3 mm for the largest specimen from Moonshiner Cave and 93.5 mm in my Recent sample. The teeth of F:AM 30832 are heavily worn, and this plus the great size indicate advanced age. The teeth of several of the specimens are broken. Morphologically, the specimens do not differ from the Recent sample. As Hall (1944) noted, the number of accessory cusps on the talonid of M_1 is extremely variable in Recent badgers; this is also true in the Alaskan population.

Geographic variability, sexual dimorphism, and individual variation are pronounced in badgers. Most fossorial of the Mustelidae, badgers inhabit plains and open forests where friable soil is available for digging. Their diet consists of insects and small vertebrates, especially rodents. Although badgers are inactive during cold spells, they are not true hibernators. The presence of badgers in Alaska during the late Pleistocene indicates a milder climate then, for today their northern distribution is limited by subarctic conditions. Hall (1944) cites the vicissitudes of the boreal climate as the major factor preventing intercontinental exchange of Old and New World badgers, and he postulated that if this exchange had occurred, the genus *Meles* would be found in North America as well as Eurasia, and *Taxidea* would be restricted to the southern latitudes of the New World. At the time Hall wrote this (1944), the Alaskan badgers were unknown. Why they did not spread farther West across Beringia is unknown.

Badgers are common in Pleistocene deposits in western United States, and a few have been recovered from sites in the East including Cumberland Cave, Maryland; Welsh Cave, Kentucky; Baker Bluff, Tennessee; and Peccary Cave, Arkansas. The probable ancestor of *Taxidea* is *Pliotaxidea nevadensis* (Butterfield) known from Hemphillian faunas in Nevada and Oregon. It was smaller and had larger tympanic bullae than *Taxidea*. Today *Taxidea taxus* is found from southern Canada to southern Mexico and from the Pacific Coast east to Michigan and Ohio.

CONCLUSIONS

During the late Pleistocene at least five species of mustelids inhabited an ice-free refugium in interior Alaska. Although stratigraphic information is lacking, all of the mustelid material is believed to be Wisconsinan in age. Péwé and Hopkins (1967) do not list any species of mustelids from pre-Wisconsinan age deposits in the Fairbanks region, and carbon-14 dates obtained on bison, musk ox, and mammoth material from the same area fall between 12,460 and >40,000 years B.P. (B. Taylor, personal communication).

The mammalian fauna of Alaska and northeastern Siberia was similar during the Wisconsinan, since biogeographically, it was one vast area. At the height of the glaciation, many species of animals ranged across the Beringian refugium unable to move onward because of the ice. Some of them, for example, *Saiga*, *Bos* (yak), *Taxidea*, and *Megalonyx*, did not extend their range, but many others, mainly the Eurasian immigrants, moved southward when the ice-free corridors were open. Hopkins (1967) postulated that an ice-free corridor probably existed in the Yukon Territory, northern British Columbia, and northern Alberta during the mid-Wisconsinan, a period of mild climatic conditions between

35,000 and 25,000 years ago; the corridor was closed from about 22,000 years to at least 14,000 years ago; and then it reopened again after the Bering land bridge had been drowned by rising sea levels. Thus, movements of animals to and from the Beringian refugium took place in mid-Wisconsinan and very late Wisconsinan/postglacial times.

As Hopkins (1967) and Guthrie (1968) postulated, grasslands must have been more extensive in the refugium during the late Pleistocene in order to have supported the enormous numbers of herbivores that lived there. The remains of three obligatory grazers, *Bison*, *Equus*, and *Mammuthus*, make up more than 85 per cent of the fossils collected in the Fairbanks area, and the presence of many plains dwellers including *Taxidea taxus* and *Mustela eversmanni* further supports this hypothesis.

Large size was characteristic of many species during the Pleistocene, and remains of *Gulo gulo* and *Taxidea taxus* from the Fairbanks deposits are the largest recorded. This may be an example of Bergmann's principle—that the same species of warm-blooded animal tends to be larger in the colder parts of its range—but an abundant food supply and few enemies may also have been factors.

The extinction or extirpation of many members of the Beringian fauna about 10,000 years ago was probably due to multiple factors including abrupt changes in the climate which resulted in changes in the vegetation (for example, an increase in the tundra-taiga and bogs at the expense of grasslands). This affected the large mammals more than it did the small ones. Of the mustelids, *Taxidea taxus* and *Mustela eversmanni* disappeared from Alaska, but survived in areas much farther south; *Gulo gulo*, *Mustela vison* and *Mustela erminea* still inhabit the area today. Man was undoubtedly a factor in the extinction of some species, but it is doubtful that he had anything to do with the disappearance of two of the Alaskan mustelids.

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