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OLIGOCENE (ORELLAN-WHITNEYAN) CRICETID RODENTS (MAMMALIA, RODENTIA) FROM SIOUX COUNTY, NEBRASKA

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ABSTRACT

A large collection of cricetid rodents from the Brule Formation, Sioux County, Nebraska from both Orellan and Whitneyan horizons was examined as the basis of this study. In all, three species were identified from the Orellan: *Eumys elegans* Leidy, 1856, *E. cricetodontoides* White, 1954, and *Willeumys viduus* (Korth, 1981), and two from the Whitneyan: *Eumys brachyodus* Wood, 1937,and *Scottimus exiguus* (Wood, 1937). The large sample of *Eumys* from the Orellan has allowed for the synonymy of *E. parvidens* Wood, 1937, with the type species *E. elegans*, separated previously only by size. Based on the small sample of *Willeumys*, it appears that the type species, *W. korthi* Wahlert, 2009, is a junior synonym of *W. viduus* (Korth, 1981).

INTRODUCTION

Well over 300 specimens of fossil cricetid rodents from a limited area of Sioux County, northwestern Nebraska are present in the collections of the Field Museum of Natural History in Chicago (FMNH). All were surface collected. The detailed stratigraphy of this area was described by Schultz and Stout (1955). The bulk of this material was collected by P. O. McGrew for FMNH in 1935 in the area northeast of Harrison and northwest of Crawford, Nebraska. The dominant geographical feature in the area used for locality purposes is a prominent butte called Round Top. Additional material was collected by several other collectors during the 1960s. The largest collection, other than that of McGrew was by P. C. Miller, Walker Museum of the University of Chicago in 1922 (later accessioned by FMNH). The bulk of these latter specimens were recovered from the Orella Member of the Brule Formation, sometimes referred to as the "Lower Brule" in the museum records (=Orellan North American Land Mammal Age [NALMA]; early Oligocene; see Prothero and Emry, 2004). However, the horizons of many of the specimens collected by Miller were referred to the Orellan without horizon (in museum records as "?Orellan", in age). Within the area of Round Top, the section contains both members of the Brule Formation (Orella and Whitney; Schultz and Stout [1955: fig. 3]). Based on the identification of the cricetids from this sample it appears to be more likely Whitneyan in age (see below discussions of *Eumys brachyodus* and *Scotimus exiguus*). Finally, a small collection made by G. Mead (date not recorded) was from the Whitney Member of the Brule Formation (White River Group) in this area (=Whitneyan NALMA; middle Oligocene). All of these specimens are the basis of this study.

Dental terminology follows that of Wood and Wilson (1936); maxillary teeth are represented by capital letters, lower teeth by lower-case letters (e.g., M1, m1). All measurements presented in tables are in mm, to the nearest 0.01 mm. Abbreviations for institutions: **FAM**, Frick collections, American Museum of Natural History; **FMNH**, Field Museum of Natural History; **UC**, University of Chicago; **UNSM**, University of Nebraska State Museum.

SYSTEMATIC PALEONTOLOGY

Order Rodentia Bowdich, 1821
Family Cricetidae Fischer de Waldheim, 1817
Subfamily Eumyinae Simpson, 1945
Eumys Leidy, 1856
Eumys elegans Leidy, 1856
(Figures 1A-C)

Eumys obliquidens Wood, 1937
Cricetodon nebraskensis Wood, 1937
Eumys parvidens Wood, 1937
Eumys pristinus Russell, 1972
Coloradoeumys galbreathi Martin, 1980
Eumys nebraskensis (Wood); Lindsay, 2008

Referred Specimens.—Partial cranium with left and right M1-M3—FMNH PM 3237, 3480; partial cranium with left M1-M3 and right M1-M2—FMNH UM 22; maxilla with left and right M1—FMNH P 25876; maxilla with M1-M3—FMNH PM 3266, 3267, 3268, 3282-3288, 3448, 3509, 3510, 36702; maxilla with M1-M2—FMNH PM 3245, 3269-3271, 3273, 3276, 3289-3291, 3449, 3451, 3452; maxilla with M2-

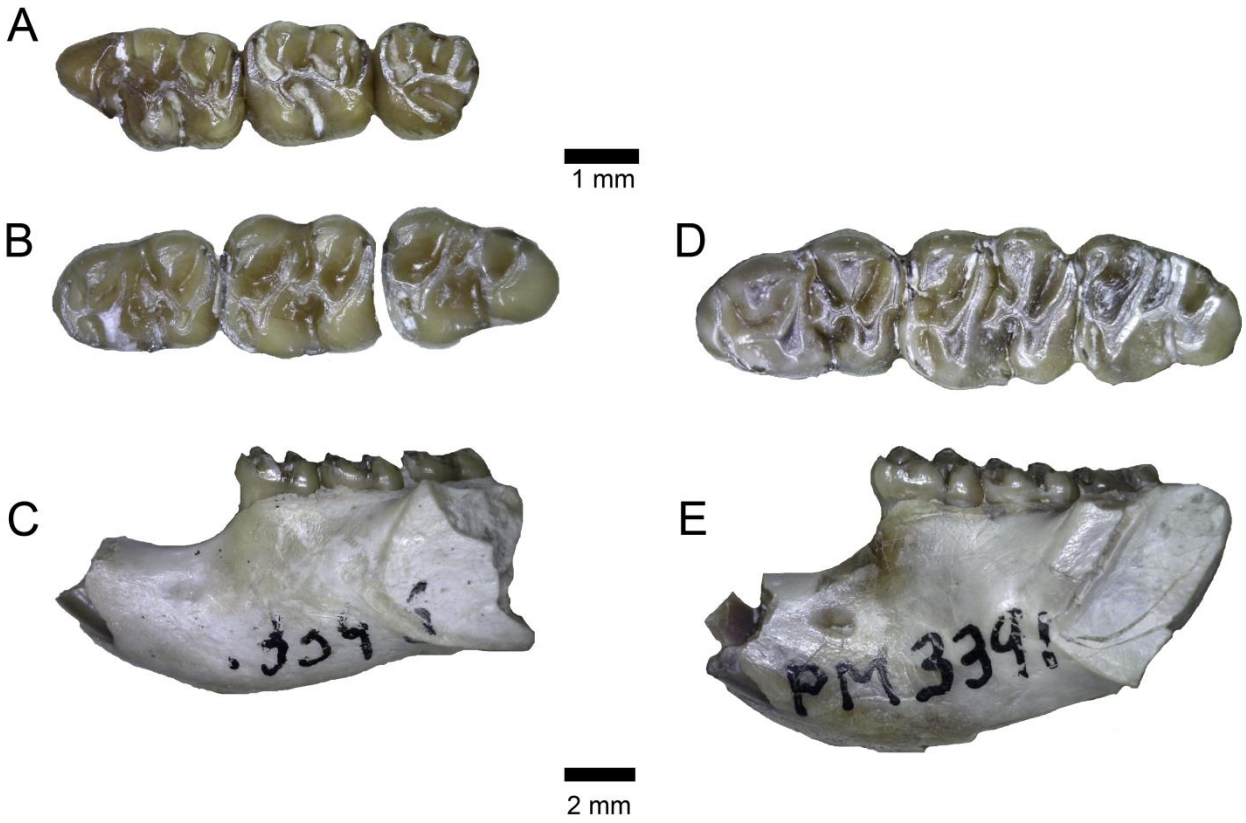

FIGURE 1. Cheek teeth and dentaries of *Eumys elegans* and *E. cricetodontoides* from the Orella Member, Brule Formation, Sioux County, Nebraska. A-C, *E. elegans*. A, FMNH PM 3286, occlusal view left M1-M3. B-C, FMNH PM 3396. B, occlusal view left m1-m3. C, lateral view of dentary. D-E, *E. cricetodontoides* FMNH 3391. D, occlusal view m1-m3. E, lateral view of dentary. Figures A, B, D to same scale (above); and C and E to same scale (below).

M3—FMNH PM 3274, 3275, 3277, 3278, 3292-3297, 3453; maxilla with M1—FMNH PM 3279, 3281, 3450; dentary with m1-m3—FMNH UM 21, 23-26, FMNH PM 3238-3241, 3298, 3299, 3303-3306, 3308-3318, 3322-3330, 3339-3341, 3343, 3345, 3346, 3357-3361, 3363, 3376, 3380, 3389, 3390, 3392-3397, 3408-3430, 3432, 3433, 3435, 3438, 3440, 3442-3444, 3446, 3447, 3454-3457, 3459, 3460, 3462, 3464-3478, 3482, 3483, 3485-3488, 3492, 3493, 3413, 3515-3519, 3522, 3523, 3533, 8379; dentary with m1-m2—FMNH PM 3244, 3319, 3331, 3332, 3334, 3344, 3347, 3348, 3350, 3351, 3362, 3363, 3377, 3378, 3398, 3399, 3439, 3441, 3466, 3467, 3479, 3484, 3489, 3519, 3531; dentary with m2-m3—FMNH PM 3243, 3301, 3302, 3307, 3320, 3321, 3333, 3335-3338, 3352-3356, 3364-3367, 3381-3388, 3400-3407, 3412, 3431, 3435, 3437, 3445, 3458, 3463, 3468-3475, 3490, 3491, 3524-3527, 3532, FMNH P 25847.

Horizon.—All specimens from Orella Member, Brule Formation, Sioux County, Nebraska (Orellan NALMA).

Discussion.—Detailed descriptions of the skull and dentition of *Eumys elegans* have been presented elsewhere, including detailed descriptions of variations in the dentition (Wood, 1937; Galbreath, 1953; Rosser, 1978; Martin, 1980; Wahlert, 2004; Korth, 2010a). No additional description is necessary.

Specimens of *Eumys* are extremely common in the Oligocene White River Group (or Formation) throughout the Great Plains of North America, ranging from Orellan to Whitneyan in age (Prothero and Emry, 2004: fig. 5.1). As many as 13 species of *Eumys* have been previously named from these beds (Rosser, 1978), mainly from the Orellan NALMA (=early Oligocene). In the last review of the Tertiary Cricetidae of North America, Lindsay (2008) listed 10 different species of *Eumys.* Most recently, in a review of the genus, Korth (2010a) recognized three Orellan species (*E. parvidens* Wood, 1937, *E. elegans* Leidy, 1856, *E. cricetontoides* White, 1954), two Whitneyan species (*E. brachyodus* Wood, 1937, *E. euryodus* Korth, 2010a), and one Arikareean (=latest Oligocene) species, *E. eliensis* Black, 1961. The large sample of *Eumys* in the FMNH

TABLE 1. Dental measurements of *Eumys elegans* from Orellan of Sioux County, Nebraska. Abbreviations: L, anteroposterior length; W, transverse width; N, number of specimens; M, mean; Min, minimum measurement; Max, maximum measurement; SD, standard deviation; CV, coefficient of variation. Measurements in mm. Data for UNSM sample from Korth (2010a: appendix).

FMNH sample

	M1L	M1W	M2L	M2W	M3L	M3W	M1-M3	M1W/L	M3W/L
N	36	40	46	45	33	33	22	36	33
M	2.71	1.78	1.87	1.75	1.48	1.66	6.27	0.66	1.12
Min	2.02	1.45	1.59	1.38	1.30	1.41	5.63	0.60	0.92
Max	3.06	1.98	2.10	2.10	1.85	1.93	7.07	0.81	1.23
SD	0.21	0.12	0.12	0.14	0.12	0.12	0.30	0.04	0.06
CV	7.81	6.89	6.43	8.17	7.92	7.01	4.86	5.89	5.73

	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3	m1W/L	m2W/L	m3W/L
N	146	153	213	212	183	184	169	101	211	152
M	2.28	1.62	2.00	1.81	2.06	1.75	6.48	0.71	0.91	0.85
MIN	1.84	1.33	1.74	1.46	1.52	1.25	5.54	0.64	0.78	0.73
MAX	2.60	1.88	2.28	2.14	2.43	2.18	7.27	0.80	1.05	1.01
SD	0.14	0.11	0.10	0.12	0.14	0.13	0.35	0.04	0.05	0.05
CV	6.22	6.58	5.17	6.69	6.93	7.47	5.33	5.45	5.47	5.87

FMNH & UNSM samples

	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3	m1W/L	m2W/L	m3W/L
N	228	237	307	303	266	268	246	226	303	263
M	2.29	1.65	2.03	1.83	2.10	1.78	6.53	0.72	0.91	0.85
Min	1.84	1.30	1.60	1.46	1.52	1.25	5.54	0.63	0.78	0.73
Max	2.75	2.10	2.55	2.25	2.50	2.18	7.55	0.85	1.05	1.01
SD	0.16	0.13	0.14	0.14	0.16	0.13	0.38	0.04	0.05	0.05
CV	7.01	7.68	6.71	7.38	7.41	7.60	5.88	5.62	5.35	5.87

collections has allowed for a more detailed study of the Orellan species of *Eumys*, and calls for the synonymy of *E. parvidens* with *E. elegans*.

In the original description of *Eumys parvidens*, Wood (1937: 251) did not provide an official diagnosis but characterized the species as: 1) smaller than the type species *E. elegans*; 2) M3/m3 large; and 3) the mesolophs(-ids) were "fairly well developed". Much later, Wood (1980: 53) eliminated the character of the mesolophs (-ids) but retained the smaller size and relative length of M3 (but not m3) as diagnostic. At the same time, Martin (1980: 11) provided an emended diagnosis that included: 1) smaller size; 2) mesolophs (-ids) poorly developed; 3) incisive foramina on skull "much anterior to M1"; and 4) palatine foramina small. Most recently, Korth (2010a) provided another emended diagnosis noting only: 1) smaller size (than *E. elegans*); 2) less lophate cheek teeth; and 3) m3 longer than m2. Both Martin (1980) and Korth (2010a) noted some differences between the skulls of *E. parvidens* and *E. elegans*, however, these were minor variances, mainly in the slightly different positioning of the cranial foramina and sutures of the skull that can be demonstrated as variable based on a large sample of crania of *E. elegans* from North Dakota described by Wahlert (2004). In all, it appears that size and relative length of m3 are the only characters that separate *E. parvidens* from the type species. The relative difference in crown-height of the cheek teeth can be attributed to the slightly smaller size of the *E. parvidens* specimens.

Wood's (1937) original sample of *E. parvidens* included the holotype from the Orellan of Sioux County, Nebraska, (partial skull with associated dentaries; UNSM 10036) and two additional dentaries; one from Colorado (Orellan Cedar Creek beds) and one from South Dakota (Orellan Big Badlands). Martin (1980) cited only the holotype in his review of early cricetids from North America. Korth (2010a) listed seven additional dentaries of *E. parvidens* from Sioux County, Nebraska. The only suggested occurrence of *E. parvidens* from another horizon was three isolated teeth from the early Whitneyan, also from Sioux County, Nebraska (Korth 2010b).

In a detailed study of the fauna from the Orellan Cedar Creek beds (=Cedar Creek Member, White River Formation), Galbreath (1953) did not recognize any specimens of *E. parvidens*, referring all specimens to *E. elegans*. Thus, all of the previously cited specimens of *E. parvidens* were limited to the Orellan of Nebraska other than the single specimen from the Orellan of South Dakota cited by Wood (1937) and the isolated teeth from the Whitneyan (Korth 2010b).

Rosser (1978) studied a large sample of *Eumys* from the Orellan Big Badlands, South Dakota (N=292) and was able to recognize only a single species, *E. elegans*, based on size and variations in the occlusal morphology of the molars. In an unpublished master's thesis, Chaille (1980) measured and coded morphologies for approximately 600 specimens of *Eumys* from Slim Buttes, South Dakota. He concluded that there were possibly three species based on size (*E. elegans, E. cricetodontoides, E. parvidens*), but only two based on morphology. He noted that there were distinct morphological differences, but he ignored 25 percent of the specimens that had "overlapping" morphologies (Chaille, 1980: 78). Also, the sample studied by Chaille (1980) was from both Orellan and Whitneyan horizons (levels B-F; see Lillegraven [1970]), which likely skewed his results as well.

In this study, a large sample of *Eumys* specimens from the Orella and Whitney Members of the White River Formation of Sioux County, Nebraska (N=362) was measured and analyzed for morphological differences. Two species are recognizable; one from the Orellan and one from the Whitneyan. The majority of the specimens are from the Orella Member and appear referable to *Eumys elegans*. The data for the Orellan sample was analyzed statistically (Table 1) and graphically, based on length and width measurements of the molars (Figure 2), and total length of the lower tooth row (Figure 3). Only one species is recognizable with the exception of two specimens (referred below to *E. cricetodontoides*). In addition, principal component analyses were run on these measurements (Figure 4). As with the raw measurements, one species is present. The metrics for the current sample from FMNH was

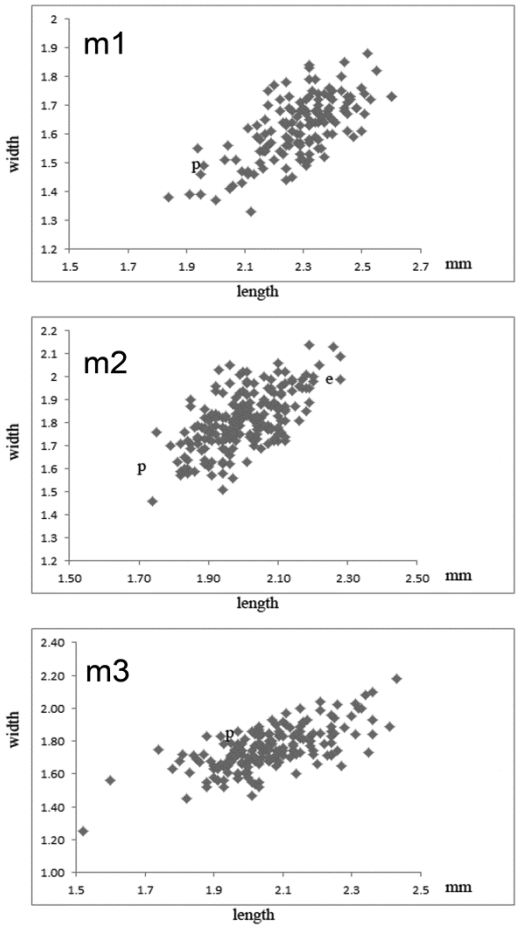

FIGURE 2. Scatter diagrams of length/width of lower molars of sample of *Eumys* from the Orella Member, Brule Formation, Sioux County, Nebraska. Abbreviations: p, holotype of *E. parvidens*; e, holotype of *E. elegans*.

combined with a previously reported sample also from Sioux County, Nebraska (Korth, 2010a: appendix) along with specimens previously referred to *E. parvidens* from Sioux County (Korth, 2010a: table 1). The results also suggests a single species, i.e. coefficients of variation <10 (Table 1). It appears that all previous specimens referred to *E. parvidens* are just the smaller specimens of *E. elegans* that have been artificially separated by size, due to small sample size of the former.

The length of m3 relative to m2 also appears not to be diagnostic. In the FMNH sample, 31 percent of the specimens had m3 longer than m2. In the smaller-sized specimens (within the previous size range of *E. parvidens*) only 25 percent had m3 as the longer tooth. The Whitneyan sample of *Eumys* from Sioux County can be separated from the Orellan sample of *E. elegans* based on relative proportions of the cheek teeth and

occlusal morphology of m1 (see below discussion of *E. brachyodus*).

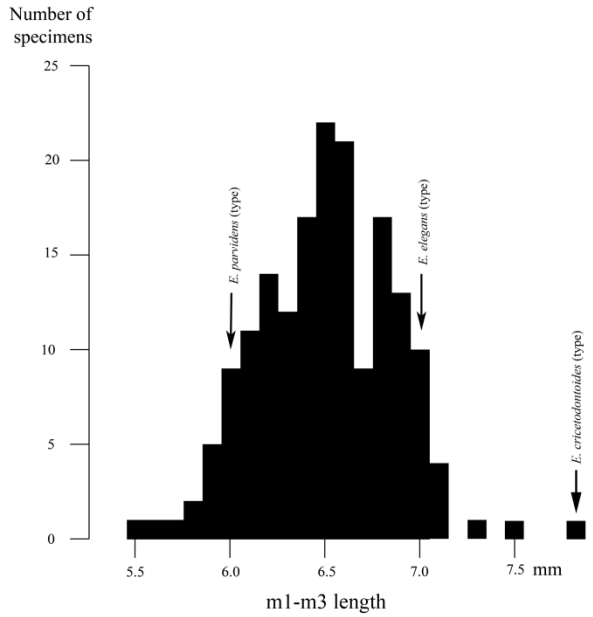

FIGURE 3. Length of m1-m3 from FMNH sample of *Eumys* from the Orella Member, Brule Formation, Sioux County, Nebraska.

Eumys cricetodontoides White, 1954
(Figure 1D, E)

(see Korth, 2010a: 85, for list of synonymies)

Referred Specimens.—FMNH 3391 and FMNH 3424, left dentaries with m1-m3.

Horizon.—Orellan, Orella Member, White River Formation, Sioux County, Nebraska.

Discussion.—The two specimens referred here to *E. cricetodontoides* are markedly larger than any of those of *E. elegans* in the sample, exceeding the maximum measurements of m1 and m1-m3 of the latter by approximately seven percent and the mean measurements by nearly 20 percent, and well within the previously reported size range for *E. cricetodontoides* (Table 2; White, 1954: 412-414; Korth, 2010a: table 3). It has been shown that the difference in size between *E. elegans* and *E. cricetodontoides* is statistically significant (Korth, 2010a: 118). Although the most common morphology for m1 of *E. cricetodontoides* is a single connection between the protoconid and anteroconid, White (1954) reported that a few specimens had either a double connection with the anteroconid, or a connection between the metaconid and anteroconid only. The proportions of m1 are similar to that of *E. elegans*, not as relatively wide as in *E. brachyodus*. Previously, this species has only been reported from the Orellan of Montana (White, 1954; Lindsay, 2009; Korth, 2010a), and possibly the Orellan of South Dakota (Chaille, 1980).

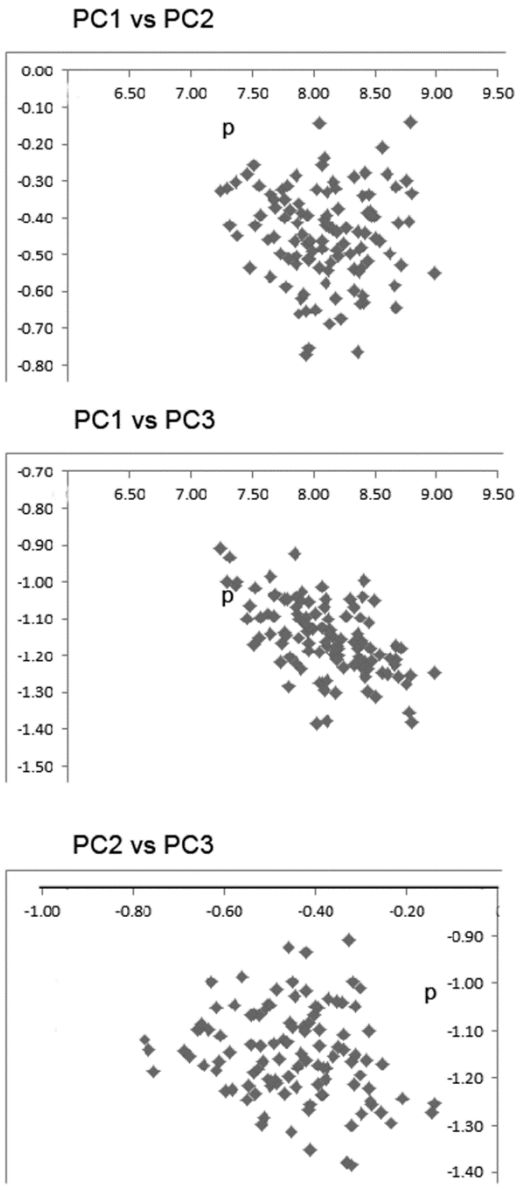

FIGURE 4. Principal component analyses for measurements of cheek teeth of *Eumys* from the Orella Member, Brule Formation, Sioux County, Nebraska. Abbreviation: p, holotype of *E. parvidens*.

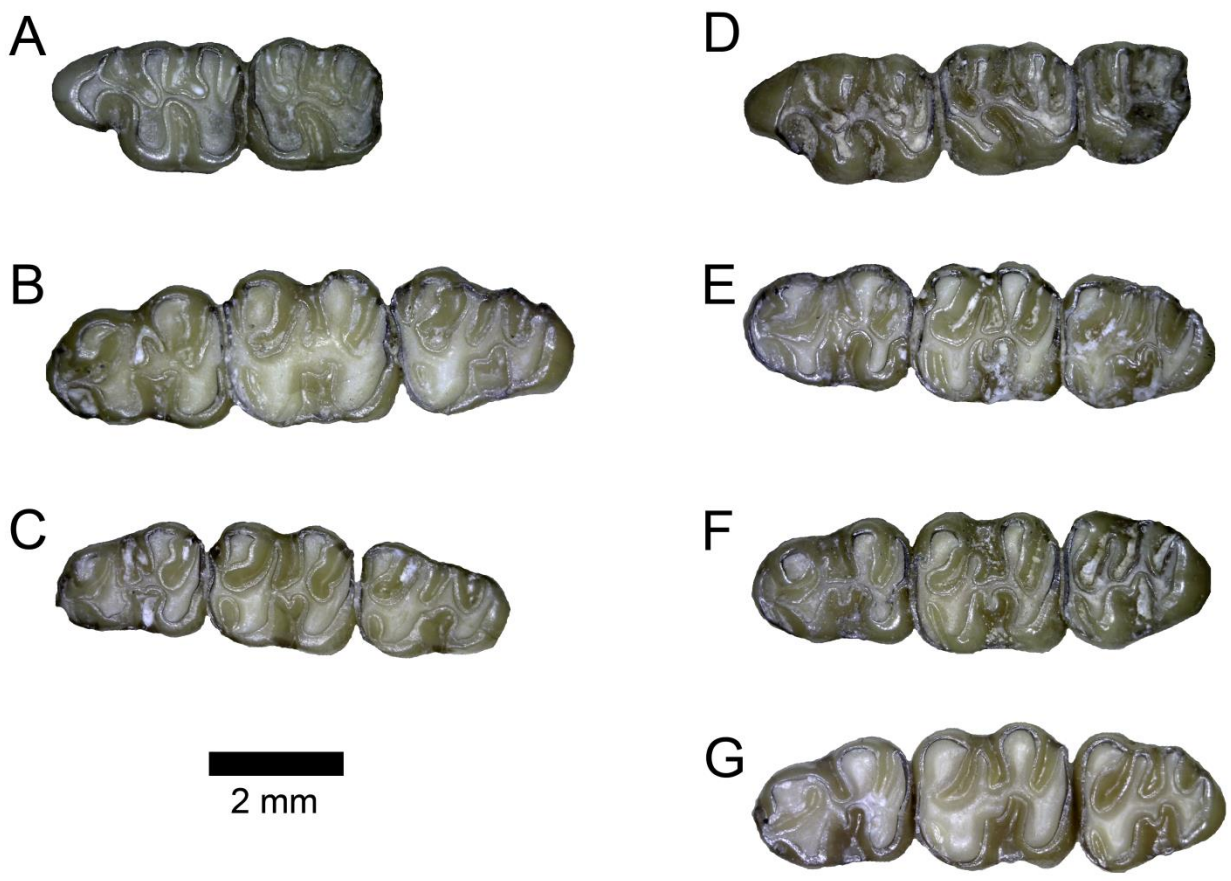

FIGURE 5. Occlusal view of cheek teeth of *Eumys brachyodus*. A-C, from Whitney Member, Brule Formation, Sioux County, Nebraska. D-G, from uncertain horizon (?Whitney Member), Brule Formation, Sioux County, Nebraska. A, FMNH UM 1521, left M1-M2. B, FMNH UM 1507, right m1-m3 (reversed). C, FMNH UM 1512, left m1-m3. D, FMNH 1535, left M1-M3. E, FMNH UM 1573, left m1-m3. F, FMNH UM 1574, left m1-m3. G, FMNH UM 1575, left m1-m3.

Eumys brachyodus Wood, 1937
(Figure 5)

Referred Specimens.—Whitney Member: maxilla with M1-M3—FMNH UM 1520; maxilla with M1-M2—FMNH UM 1521; maxilla with M2-M3—FMNH UM 1517; maxilla with M1—FMNH UM 1518, 1522; dentary with m1-m3—FMNH UM 1507, 1508, 1512, 1524; dentary with m1-m2—FMNH UM 1513; dentary with m2-m3—FMNH UM 1509-1511, 1514-1516, 1523, 1525; dentary with m2—FMNH UM 1548. ?Whitney Member (horizon uncertain): palate with right M1-M2 and left M1-M3—FMNH UM 1535; maxilla with M1-M3—FMNH UM 1536, 1537, 1540; maxilla with M1-M2—FMNH UM 1538, 1539; dentary with m1-m3—FMNH UM 65-69, 1436, 1502, 1526, 1528, 1541-1543, 1562-1565, 1573-1575, 1577-1580, 1583-1584; dentary with m1-m2—FMNH UM 70, 1547, 1560, 1566-1567; dentary with m2-m3—FMNH UM 1527, 1544-1546; 1549-1551, 1554-1556, 1558, 1559, 1561, 1568-1571, 1581, 1582, 1585-1588; dentary with m2—FMNH UM 1548.

Horizon.—Whitneyan NALMA, Whitney Member, Brule Formation and uncertain level (?Whitney Member) Brule Formation, Sioux County, Nebraska.

Discussion.—The specimens definitely known from the Whitney Member in the FMNH collections fall within the size range, proportions of m1, and morphology of m1 of previously described specimens of *E. brachyodus* (Figure 5A-C, Table 3; Wood, 1937; Korth, 2010a; Korth et al., 2019). The material in the FMNH collections from an uncertain horizon collected by the University of Chicago in the 1920s also appears

TABLE 2. Dental measurements for *Eumys cricetodontoides*, *Willeumys viduus*, and *Scottimus exiguus* from Sioux County, Nebraska. Measurements in mm.

Eumys cricetodontoides

Specimen #	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3
FMNH PM 3424	2.78	1.99	2.31	1.99	2.44	2.01	7.76
FMNH PM 3391	2.79	1.94	2.33	2.15	2.27	2.02	7.48

Willeumys viduus

Specimen #	M1L	M1W	M2L	M2W	M3L	M3W	M1-M3
FMNH PM 3247	2.29	1.38					
FMNH PM 3248	2.17	1.26	1.54	1.34	1.19	1.27	5.06
FMNH PM 3249	2.31	1.45	1.56	1.55			
FMNH PM 3250	2.02	1.28					
Mean	2.20	1.34	1.55	1.45	1.19	1.27	5.06

Specimen #	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3
FMNH PM 3465	2.12	1.33	1.74	1.46	1.52	1.25	5.54
FMNH PM 3476	2.17	1.38	1.89	1.53			
Mean	2.15	1.36	1.81	1.50	1.52	1.25	5.54

Scottimus exiguus

Specimen #	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3
FMNH UM 1552			2.02	1.53	1.94	1.46	6.10
FMNH UM 1553	2.11	1.36	1.70	1.42	1.54	1.29	5.58
FMNH UM 1554	2.29	1.44	1.90	1.49	1.94	1.45	6.40
Mean	2.20	1.40	1.87	1.48	1.81	1.40	6.03

ORELLAN						
E. elegans (FMNH sample, Sioux Co)	%	3	15	13	19	50	N (144)
WHITNEYAN							
E. brachyodus (FMNH sample, Sioux Co)		19	7	7	19	48	(29)
E brachyodus (North Dakota sample)		24	9	1	18	46	(167)
E. brachyodus (South Dakota sample)		38	0	5	10	50	(21)

FIGURE 6. Percentage occurrence of morphology of m1 in *Eumys* from different horizons. Orellan and Whitneyan (including ?Whitneyan) sample based on FMNH collections from Brule Formation, Sioux County, Nebraska; North Dakota sample from Korth et al. (2019); South Dakota sample from Korth (2010a). Abbreviation: N, number of specimens measured.

TABLE 3. Dental measurements of *Eumys brachyodus* from Sioux County, Nebraska, separated into definitely known level and uncertain level. Abbreviations as in Table 1. Measurements in mm.

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Sample definitely from the Whitney Member

	M1L	M1W	M2L	M2W	M3L	M3W	M1-M3
N	4	4	3	3	2	2	1
M	2.86	1.89	1.82	1.77	1.52	1.52	6.43
Min	2.56	1.73	1.81	1.69	1.41	1.44	
Max	3.16	2.06	1.84	1.86	1.63	1.59	
SD	0.25	0.16	0.02	0.09	0.16	0.11	
CV	8.57	8.36	0.95	4.80	10.23	7.00	

	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3	m1W/L
N	5	5	13	11	12	12	9	5
M	2.27	1.77	2.04	1.88	2.14	1.80	6.56	0.78
Min	2.02	1.61	1.88	1.68	2.00	1.56	6.24	0.73
Max	2.55	2.09	2.24	2.15	2.45	2.05	7.47	0.82
SD	0.21	0.19	0.13	0.14	0.13	0.14	0.39	0.04
CV	9.31	10.82	6.22	7.71	6.03	7.98	5.88	5.18

Sample from uncertain level (?Whitney Member)

	M1L	M1W	M2L	M2W	M3L	M3W	M1-M3
N	7	7	7	7	4	4	4
M	2.75	1.84	1.90	1.79	1.59	1.71	6.47
Min	2.69	1.71	1.74	1.65	1.50	1.62	6.37
Max	2.88	1.92	2.01	1.93	1.64	1.79	6.58
SD	0.07	0.07	0.09	0.09	0.06	0.07	0.09
CV	2.41	3.94	4.64	4.83	3.77	4.24	1.35

	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3	m1W/L
N	25	30	55	53	49	47	43	25
M	2.29	1.73	2.06	1.91	2.16	1.84	6.57	0.77
Min	2.02	1.44	1.82	1.58	1.69	1.51	5.78	0.69
Max	2.51	1.98	2.31	2.17	2.51	2.07	7.37	0.84
SD	0.14	0.12	0.11	0.11	0.15	0.13	0.35	0.05
CV	6.04	6.91	5.48	5.79	6.88	6.93	5.36	6.45

to be referable to *E. brachyodus* (Figure 5D-G; Tables 3, 4). In proportions, the m1 of *E. brachyodus* is wider relative to length than is that of *E. elegans*; this is true for the UC sample as well (Table 5). Also, the frequency of the morphology of m1 (more frequent double connection in *E. brachyodus*) is also consistent with the UC sample (Fig. 6), making it likely referable to *E. brachyodus*.

Willeumys Wahlert, 2009
Willeumys viduus (Korth, 1981)
(Figure 7A, B)

Paracricetodon exiguus (Wood); Alker, 1968
Eoeumys exiguus (Wood); Martin, 1980 (in part)
Eumys cf. *parvidens* Wood, 1980
Scottimus viduus Korth, 1981
Willeumys korthi Wahlert, 2009
Willeumys viduus (Korth); Korth and Tabrum, 2017

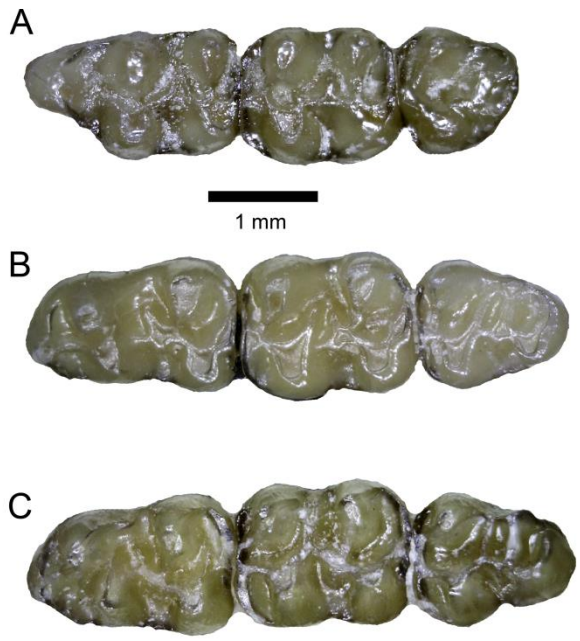

FIGURE 7. Dentitions of *Willeumys viduus* and *Scottimus exiguus* from Brule Formation, Sioux County, Nebraska. A-B, *W. viduus*. A, FMNH PM 3248, left M1-M3. B, FMNH PM 3465, right m1-m3 (reversed). C, *S. exiguus*, FMNH 1553, left m1-m3.

Referred Specimens.—FMNH PM 3248, left maxilla with M1-M3; FMNH PM 3249, left maxilla with M1-M2; FMNH PM 3247 and 3250, maxillary fragments with M1; FMNH PM 3465, right dentary with m1-m3; FMNH PM 3476, right dentary with m1-m2.

Horizon.—All specimens from Orella Member, Brule Formation, Sioux County, Nebraska.

Discussion.—These specimens do not differ from the sample previously described from Sioux County, Nebraska in size or morphology (Figure 7A, B; Table 2; also see Korth, 1981: figs. 6, 7; table 2).

Korth and Tabrum (2017) noted that there were only two minor differences between specimens of *W. viduus* and the type and only specimen of *W. korthi* Wahert, 2009 (FAM 97815): the lack of a loph extending posteriorly from the anterocone or a loph extending anteriorly from the protocone on M1 of *W. korthi*, and the lack of a posteriorly directed lophid from the metaconid on m1 of *W. korthi*; both of these features being present in specimens of *W. viduus*. However, in the small sample from the FMNH collections, it appears that in two of the M1s (FMNH PM 3247, FMNH PM 3249) there is no loph present between the anterocone and protoloph as in *W. korthi*, whereas the other two specimens have these lophs. Similarly, both of the referred specimens of lower dentitions cited here lack the buccal lophid posterior to the metaconid on m1 as in *W. korthi*. This demonstrates that the morphology of the cheek teeth of the holotype of *W. korthi* is within the range of variation of *W. viduus*, thus indicating a synonymy of the two species. The genus *Willeumys* remains valid; however, the trivial name *korthi* should be subsumed into the earlier named species *W. viduus*.

Scottimus Wood, 1937
Scottimus exiguus (Wood, 1937)
(Figure 7C)

Eumys exiguus Wood, 1937
Scottimus exiguus (Wood); Black, 1961
Eoeumys vetus (Wood); Martin, 1980 (in part)
Eoeumys exiguus (Wood); Martin, 1980 (in part)

Referred Specimens.—FMNH UM 1552, right dentary with m2-m3; FMNH UM 1553 and FMNH 1554, left dentaries with m1-m3.

Horizon.—All of the specimens referred here were collected by the University of Chicago in the 1920s and listed as occurring in the "Orellan?". If the reference of the *Eumys brachyodus* specimens with the same collection data to the Whitneyan is correct (see above), these specimens are also Whitneyan in age.

Discussion.—Although the specimens referred here to *S. exiguus* are similar in size to those identified as *Willeumys viduus* (Figure 7C, Table 2), they can be distinguished from the latter based on morphology of the lower molars (Korth and Tabrum, 2017): 1) pronounced anteroposterior lophs on lingual and buccal sides of major cusps (weak or missing in *Willeumys*); 2) mesolophid lacking on m2, and posterior arm of protoconid reaches posterolingual corner of metaconid (posterior arm of protoconid shorter and mesolophid present on *Willeumys*); 3) anterior arms of protoconid and metaconid reach anterior cingulid separately on m2 and m3 (fuse together before joining anterior cingulid in *Willeumys*); 4) posterior cingulid on m2 prominent (weak or missing in *Willeumys*); 5) anteroconid in m1 attached to metaconid (variable in *Willeumys*, often connected to protoconid or not at all).

Korth (1994: 235) listed the occurrence of *S. exiguus* as Orellan in age. However, Lindsay (2008) listed the holotype of *S. exiguus* as being from the Whitneyan Poleslide Member of the White River Formation, South Dakota. According to the original description by Wood (1937: 255) the holotype was from the "Middle *Oreodon* Beds." Emry et al. (1987: fig. 5.1) equated these beds to the lower part of the Poleslide Member of the Brule Formation. Evanoff et al. (2010: fig. 6) noted that the lower part of the Poleslide Member was Orellan in age, suggesting that "Middle *Oreodon*" beds at the base of the Poleslide

TABLE 4. Combined measurements of *Eumys brachyodus* from definite and indefinite Whitneyan levels, Sioux County, Nebraska. Abbreviations as in Table 1. Measurements in mm.

	M1L	M1W	M2L	M2W	M3L	M3W	M1-M3
N	11	11	10	10	6	6	5
M	2.79	1.86	1.88	1.79	1.56	1.64	6.46
Min	2.56	1.71	1.74	1.65	1.41	1.44	6.37
Max	3.16	2.06	2.01	1.93	1.64	1.79	6.58
SD	0.15	0.11	0.08	0.08	0.09	0.12	0.08
CV	5.54	5.70	4.38	4.57	5.76	7.46	1.20

	m1L	m1W	m2L	m2W	m3L	m3W	m1-m3	m1W/L
N	30	35	68	64	61	59	52	30
M	2.28	1.74	2.05	1.90	2.15	1.83	6.57	0.77
Min	2.02	1.44	1.82	1.58	1.69	1.51	5.78	0.69
Max	2.55	2.09	2.31	2.17	2.51	2.07	7.47	0.84
SD	0.15	0.13	0.11	0.12	0.14	0.13	0.35	0.05
CV	6.50	7.43	5.59	6.12	6.68	7.13	5.40	6.20

TABLE 5. Proportions of m1 (width/length) in *Eumys*. Abbreviations: M, mean; OR, observed range; N, number of specimens.

	M	OR	N	Reference
E. elegans (Orellan)				
Sioux Co., NE	0.71	0.64-0.83	145	FMNH sample
Sioux Co., NE	0.73	0.64-0.83	66	Korth (2010a: appendix)
E. brachyodus (Whitneyan)				
Sioux Co., NE	0.77	0.69-0.84	29	FMNH sample
Blue Ash, SD	0.76	0.71-0.83	21	Korth (2010a: table 2)
Cedar Pass, SD	0.81	0.74-0.90	13	Korth (2014: table 12)
Fitterer Ranch, ND	0.78	0.64-0.96	167	Korth et al. (2019: table A13)

Member were Orellan in age, rather than Whitneyan, establishing the occurrence of the type of *S. exiguus* as Orellan.

All of the specimens in the FMNH collections of *S. exiguus* were part of the UC collections that were only questionably Orellan, but suggested above as likely Whitneyan in age (see discussion of *E. brachyodus*). The occurrence of *S. exiguus* from this same horizon as the typically Whitneyan *E. brachyodus* supports the suggested Whitneyan age of the UC sample.

CONCLUSIONS

The large sample of historical cricetid material in the collections of the FMNH demonstrate that there is a distinct change in the cricetid fauna from the Orellan to the Whitneyan in western Nebraska; the Orellan being dominated by *Eumys elegans* along with rarer occurrences of *E. cricetodontoides* and *Willeumys viduus*, and the Whitneyan being characterized by the presence of *E. brachyodus* and rare occurrence of *Scottimus exiguus*. This is a characteristic style of turnover in most rodent species at the Orellan-Whitneyan boundary (see Korth, 1994: table 17), and in turn, echoes the general faunal change at the onset of the Whitneyan (Prothero and Emry, 1996).

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