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MAMMALS FROM THE BLUE ASH LOCAL FAUNA (WHITNEYAN, OLIGOCENE), SOUTH DAKOTA. RODENTIA PART 7: ADDITIONAL EUTYPOMYIDAE AND CASTORIDAE

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ABSTRACT

Previously, one eutypomyid, *Eutypomys wilsoni*, and one castorid, *Agnotocastor* sp. indet., were cited from the Blue Ash anthill fauna based on only three specimens (Korth, 2007, 2010). Recently, a much larger sample of isolated teeth has been recovered, including 12 specimens of *Eutypomys* and 35 specimens of *Agnotocastor*. This larger sample has allowed for a more complete description of *E. wilsoni* (previously known only from two teeth), recognition of a new species of *Eutypomys*, *E. productus*, and allowed for a specific identification of the *Agnotocastor* species as *A. praetereadens* Stirton, 1935.

INTRODUCTION

Forty different species of rodents have been identified previously from the Blue Ash anthill fauna of South Dakota (Korth, 2010, 2014), based on over 870 specimens. However, only three isolated teeth were referred to the Castoroidea (Korth, 2007, 2010, 2014); two of *Eutypomys* Matthew, 1905, and one of *Agnotocastor* Stirton, 1935. The recent discovery of a number of additional specimens in the collections of the Carnegie Museum from the Blue Ash anthills, has allowed for a more complete understanding of the morphology of the previously identified species as well as the recognition of a new species of *Eutypomys*.

Dental terminology for *Eutypomys* follows that of Wood and Wilson (1936) and for *Agnotocastor* follows that of Stirton (1935). Maxillary teeth are designated by capital letters, and lower teeth by lower-case letters (e.g. M1 or m1). Dental measurements were taken on an optical micrometer to the nearest 0.01 mm. Abbreviations for institutions: CM, Carnegie Museum of Natural History (Pittsburgh); SDSM, South Dakota School of Mines and Technology, Museum of Geology.

SYSTEMATIC PALEONTOLOGY

Order Rodentia Bowdich, 1821
Fmaily Eutypomyidae Miller and Gidley, 1919
Eutypomys Matthew, 1905
Eutypomys wilsoni Korth, 2007
(Figure 1A-D; Tables 1-3)
Type Specimen—CM 76293, left M1 or M2.

Additional Referred Specimens—CM 89331, 89332, 89334, 89335, M1 or M2; CM 89333, left p4; CM 89360, left m1 or m2; CM 89336, left m3.

Description—Previously, only P4 and M1 or M2 of this species has been described (Korth, 2007). The assignment of the lower cheek teeth to this species is done based on their size and crown-height similar to the upper teeth. The upper molars do not differ from the previous description of the holotype (Korth, 2007). Based on the holotype, the crown-height index (height of protocone divided by transverse width of tooth) of the M1 or M2 was reported as 0.90. In contrast, the four additional specimens of M1 or M2 have crown-height indices that range from 0.66 to 0.76, with an average of 0.71 (Table 2).

The p4, CM 86333, is heavily worn (Figure 1B). There are no recognizable cusps in the trigonid, but it is narrower than the talonid. The center of the occlusal surface is filled with five minute enamel fossetteids. The mesoconid is circular in outline and connected posteriorly to the hypoconid, otherwise isolated from any other features. The lingual re-entrant valley wraps around the anterior and lingual sides of the mesoconid. The posterior cingulid is a broad wear facet that makes up most of the talonid, connecting the entoconid to the hypoconid.

The only m1 or m2, CM 89360 (Fig. 1C), is only the enamel cap of the tooth with no wear on the occlusal surface, suggesting that it had not yet erupted. It has a crown-height (height of entoconid divided by transverse width) of 0.53, as high as *E. hibernodus* (Table 2), and is longer than wide (Table 3). The four major cusps are present (metaconid, protoconid, hypoconid, entoconid) but greatly reduced in size. As in all species of *Eutypomys* the cross-lophids are thin

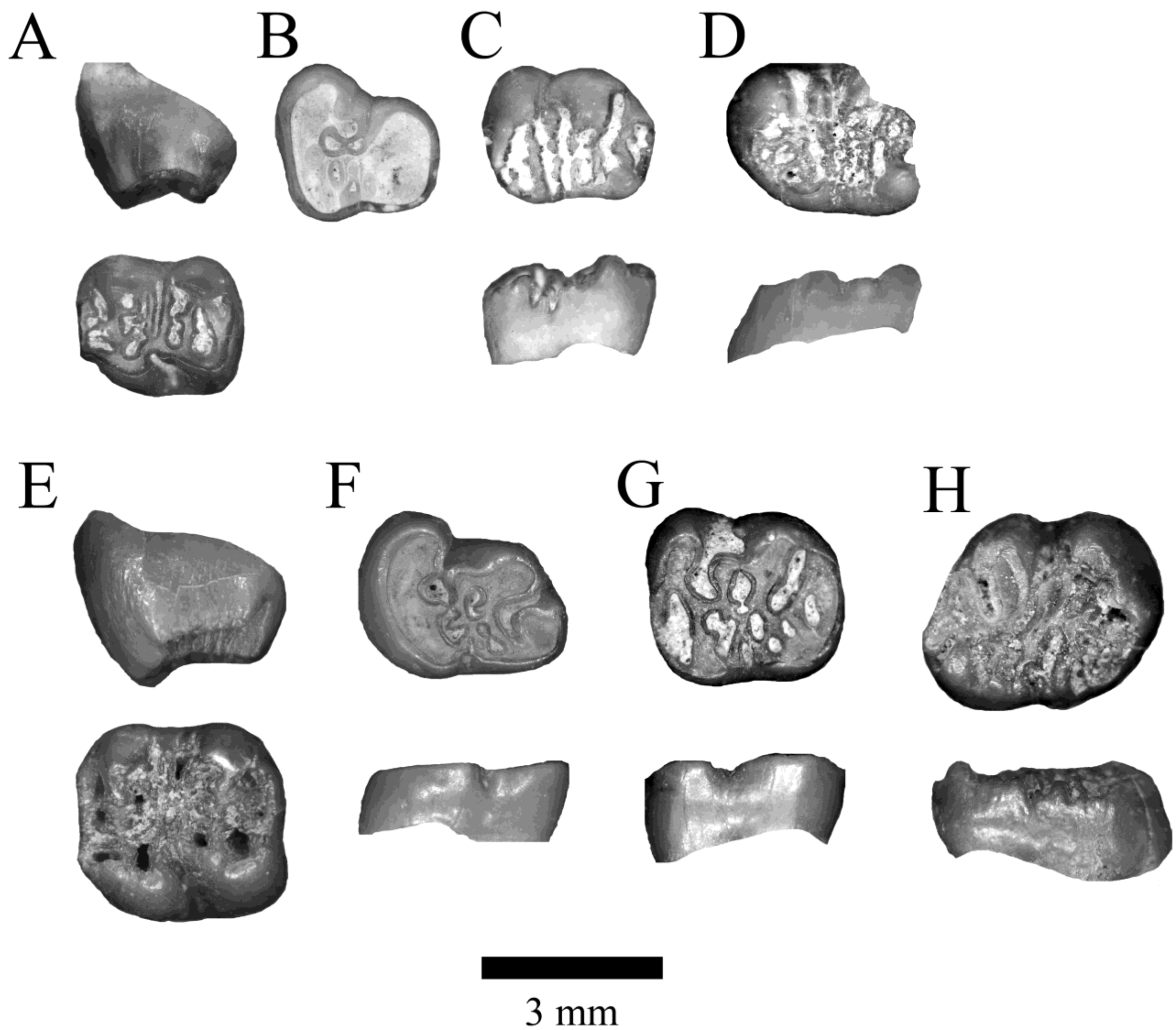

FIGURE 1. Dentition of *Eutypomys* from the Blue Ash fauna. A-D, *E. wilsoni*. A, CM 89335, left M1 or M2. B, CM 89333, right p4. C. CM 89360, left m1 or m2. D, CM 89336, left m3 (partial). E-G, *E. productus*. E, CM 89330, holotype. F, CM 89326, left p4. G, CM 89327, left m1 or m2. H, CM 89329, right m3. Anterior view above, occlusal view below for upper teeth (A, E); occlusal view above, lingual view below for lower teeth (B-D and F-H).

and interrupted by numerous lophulids. The metaconid is connected to the anterior cingulid that ends anterior to the protoconid, is continuous with a (?)metalophid that extends lingually, from the metaconid, and isolating a small basin. The protoconid is separated from the anterior cingulid by a valley that extends nearly to the lingual edge of the tooth. Two thin, irregular lophids extend lingually from the protoconid to the lingual edge of the tooth. A small mesoconid is separated from the protoconid, but in contact with the hypoconid. A thin lophid, similar to those connected to the protoconid, extends from the mesoconid to the lingual edge of the tooth. The entoconid and hypoconid are connected by a similar transverse lophid. The posterior cingulid wraps around the posterior margin of the tooth connecting the entoconid and hypoconid and enclosing a transversely elongated basin between them.

The only m3, CM 89336 (Figure 1D), is partially broken on the anterior end. It is longer than the m1 or m2 (Table 1) and extended posteriorly. However, the occlusal pattern of the tooth is very similar to that of the m1 or m2 except that the entoconid is more reduced in size. The degree of complexity of the occlusal pattern is the same as in the m1 or m2.

TABLE 1. Measurements of cheek teeth of *Eutypomys* from the Blue Ash anthill fauna. Abbreviations: L, anteroposterior length; W, transverse width. Measurements in mm.

CM#	p4L	p4W	m1 or m2 L	m1 or m2W	m3L	m3W	M1 or M2L	M1 or M2W
E. wilsoni								
89333	2.58	2.59						
89360			2.73	2.33				
89336					3.05	2.45		
89331							2.51	2.51
89332							2.81	2.7
89334							2.53	2.61
89335							2.64	2.45
76293 (type)							2.52	2.55
Mean							2.60	2.56
E. productus								
89326	3.28	2.92						
89327			3.12	2.99				
89329					3.76	3.27		
89328							3.5	3.26
89330 (type)							3.32	3.31
Mean							3.41	3.29

Discussion—The lower dentition assigned here to *E. wilsoni* is comparable in size and crown-height to the upper cheek teeth previously described (Korth, 2007:32-33; Tables 1, 2). The crown-height is higher than that reported for most other species (Table 2). The proportions of the upper cheek teeth of *E. wilsoni* are unique among species of the genus (except the new species described below) in being longer than wide. In all other previously described species, the M1 and M2 are wider than long (Table 3). In the original description of this species (Korth, 2007), the length of P4 relative to the upper molar was short (85% length of upper molar) and considered diagnostic. However, the length of the p4 is not appreciably less than that of the lower molar (95%).

Eutypomys productus n. sp.
(Figure 1E-H; Tables 1-3)

Type Specimen—CM 89330 left M1 or M2.

Referred Specimens—CM 89328, M1 or M2; CM 89326, left p4; CM 89327, left m1 or m2; CM 89329, right m3.

Diagnosis—Intermediate in size, larger than *E. wilsoni* and Duchesnean species, smaller than all other species; crown height of cheek teeth similar to that of *E. hibernodus*, higher-crowned than other species; upper molars longer relative to width than other species (as in *E. wilsoni*).

Etymology—Latin, *productus*, lengthened; in reference to the elongation of the molars.

Description—The two upper molars, CM 89328, CM 89330, (M1 or M2) have a typical occlusal pattern for *Eutypomys* (Figure 1E). They are squared in occlusal outline, being slightly longer (anteroposteriorly) than wide (transversely). The major cusps (paracone, metacone, protocone, hypocone) are of equal size and greatly reduced. The paracone and metacone are anteroposteriorly compressed and the hypocone and protocone are obliquely compressed. The only recognizable cross-lophs are the anterior and posterior cingula and the protoloph and metaloph, all of which are thin ridges that are parallel and oriented transversely across the occlusal surface. The remainder of the occlusal surface is filled with lophules that are nearly as high as the major lophs, and mainly oriented anteroposteriorly or obliquely across the valleys between the transverse lophs. The crown-height ratio (height of protocone divided by maximum transverse width) is 0.86 and 0.87 for the two upper molars, higher than any other species (Table 2).

The specimen of p4, CM 89326 (Figure 1F), is heavily worn. It is narrower anteriorly than posteriorly. The trigonid consists of a protoconid and metaconid that are equal in size, but the metaconid is more anteriorly placed. These cusps are separated by a deep valley that is open anteriorly, and extends posteriorly, curving lingually around the posterior side of the metaconid in a J-shape. The lingual re-entrant valley between the protoconid and hypoconid is shallow. The center of the tooth is filled with numerous enamel fossettids. The entoconid is smaller and more anteriorly placed than the hypoconid. They are united by a broad lophid along the posterior margin of the tooth may represent a fused hypolphid and posterior cingulid.

TABLE 2. Crown-height indices of molars of species of *Eutypomys* and *Microeutypomys* arranged in order of age of occurrence. Height index for lower molars = height of entoconid/ maximum transverse width; for upper molars = height of protocone/ maximum transverse width. Measurements for *E. wilsoni* and *E. productus* from Table 1; for *E. thompsoni* from Wood (1937:232); for *E. inexpectatus* from Wood (1974:tables 17, 18); for *E. acares*, *E. obliquidens* and *M. tilliei* from Storer (1988:tables 7, 8, 9); and for *E. hiberondus* from Korth (2000:table 2).

	m1 or m2	m3	M1 or M2	NALMA
E. productus	0.53	0.54	0.86-0.87	Whitneyan
E. wilsoni	0.53	0.49	0.66-0.75	Whitneyan
E. hibernodus	0.53-0.54	0.52	—	Orellan
E. thompsoni	0.41-0.50	0.47	—	Orellan
E. inexpectatus	0.41-0.48	0.36	0.61-0.65	Chadronian
E. acares	0.65	—	0.62	Duchesnean
E. obliquidens	—	—	0.65	Duchesnean
M. tilliei	—	—	0.65	Duchesnean

The m1 or m2, CM 89327 (Figure 1G), is approximately rectangular in occlusal outline (longer than wide). The trigonid is slightly narrower than the talonid. The anterior cingulid is continuous with the metaconid, but separated from the protoconid by a deep valley that extends from the buccal edge of the tooth to near its center. The mesoconid is nearly as large as the hypoconid, but separated from it, only connecting anteriorly with the protoconid. The only recognizable cross-loph is the hypolophid that runs from the entoconid to the hypoconid and is angled slightly posterobuccally. The talonid basin is filled with multiple fossettids created by numerous lophulids.

The m3, CM 89329 (Figure 1H), is similar in occlusal morphology to the m1 or m2, but is more elongated, and the entoconid is completely lacking while the hypoconid is reduced to a thin lophid. The mesoconid is isolated from the protoconid and hypoconid. The entire occlusal surface is covered with a complex pattern of lophules that are as high as the major cross-lophs.

Discussion—In morphology and proportions of the cheek teeth, *E. productus* is most similar to *E. wilsoni* from the same fauna. However, the sizes of the two species are quite distinct, *E. productus* being approximately 25-30% larger in all dimensions with no overlap in size range (Table 1). The height of the crowns of the molars of *E. productus* is also greater than in *E. wilsoni* (Table 2). The crown-height of *E. productus* is greater than that of any other species except *E. hibernodus*; both species having the same crown-height index for the lower molars. *E. productus* differs from *E. hibernodus* in having lower molars that are smaller and narrower relative to length than those of *E. hibernodus* (Tables 1, 3; Korth 2000:table 1).

As in *E. wilsoni*, the upper molars of *E. productus* are longer than wide (Table 3), a feature unique to these two species. However, this is not true for the lower molars where the Arikareean *E. montanensis* and all of the Uintan to Chadronian eutypomyids have proportions similar to that of the Blue Ash species (length/width > 1.00).

Macdonald (1970:fig. 25) described a partial cranium of *Eutypomys* with associated dentaries (SDSM 6227) from the Arikareean Wounded Knee fauna of South Dakota. He referred the specimen with question to "*Eutypomys* cf. *montanus*." The upper molars of this specimen average longer than wide, as in *E. productus* (Table 3), and are only slightly larger than the Blue Ash specimens of the latter (Macdonald, 1970:table 31). It is possible that this specimen is referable to *E. productus*, but additional measurements of crown-height are necessary to confirm this.

TABLE 3. Relative proportions of molar dimensions (length/ width) in species of *Eutypomys* and *Microeutypomys*, arranged in order of age of occurrence. Measurements for *E. wilsoni* and *E. productus* from Table 1; for *E. thompsoni* from Wood (1937:232); for *E. montanensis* from Wood and Konizeski (1965:table 2); for *E. inexpectatus* from Wood (1974:tables 17, 18); for *E. acares*, *E. obliquidens* and *M. tilliei* from Storer (1988:tables 7, 8, 9); for *M. karenae* from Walton (1993:table 1); and for *E. hibernodus* from Korth (2000:table 1).

	M1 or M2		m1 or m2		NALMA
	Mean	Range	Mean	Range	
E. montanensis	—	—	1.04	1.00-1.07	Arikareean
E. cf. *montanus*	1.03	0.97-1.06	1.07	1.03-1.12	Arikareean
E. productus	1.04	1.00-1.07	1.04	1.00-1.07	Whitneyan
E. wilsoni	1.02	0.97-1.08	1.17	—	Whitneyan
E. thompsoni	0.79	0.75-0.81	0.93	0.86-1.08	Orellan
E. hibernodus	—	—	0.97	0.92-1.00	Orellan
E. inexpectatus	0.93	0.90-0.99	1.08	0.98-1.13	Chadronian
E. acares	0.97	—	1.09	—	Duchesnean
E. obliquidens	—	—	1.06	—	Duchesnean
M. tilliei	0.93	—	1.13	—	Duchesnean
M. karenae	0.97	—	1.12	—	Uintan

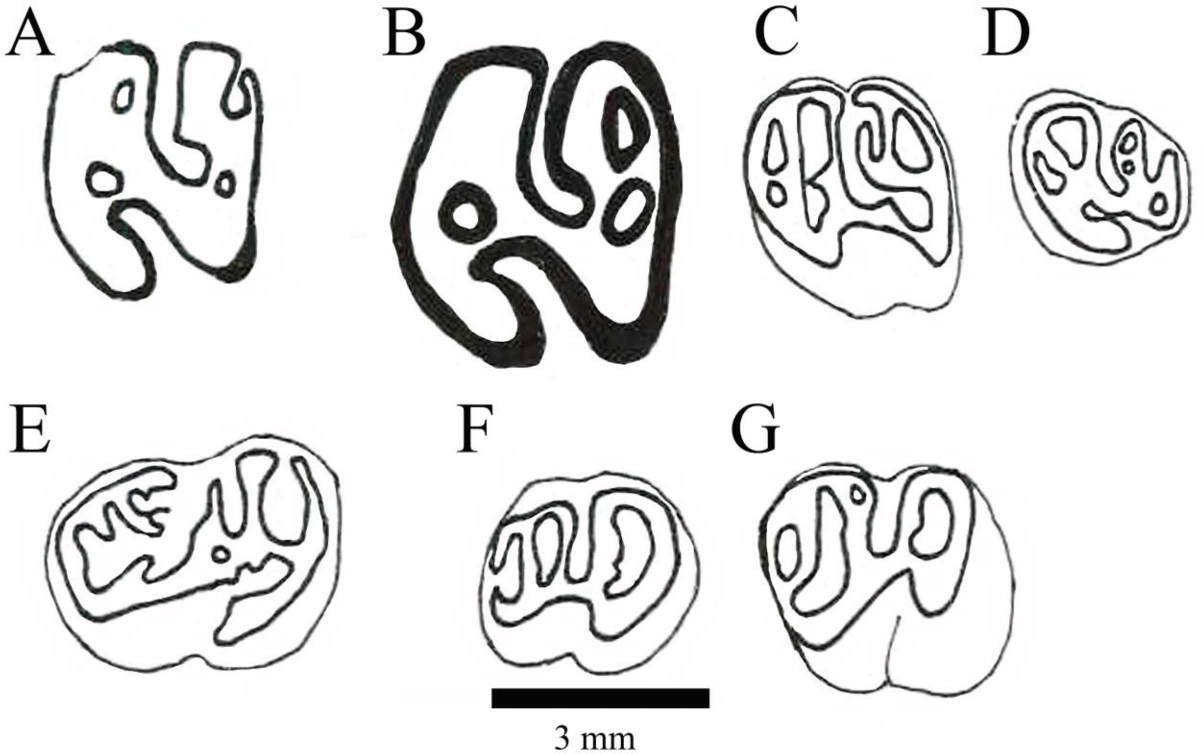

FIGURE 2. Dentiton of *Agnotocastor praetereadens* from the Blue Ash fauna. A, CM 91606, left dP4. B, CM 89363, left P4. C, CM 89367, right M1 or M2 (reversed). D, CM 89374, left M3. E, CM 89348, right dp4 (reversed). F, CM 89352, left m1 or m2. G, CM 89356, right m3 (reversed). Anterior to left on all figures.

Family Castoridae Hemprich, 1820
Agnotocastor Stirton, 1935
Agnotocastor praetereadens Stirton, 1935
(Figure 2; Table 4)

Agnotocastor sp. indet. Korth, 2010

Referred Specimens—CM 89347-89350, dp4; CM 89351-89353, m1 or m2; 89354-89356, m3; CM 89360 2 dp4s; CM 89357, 89365, P4; CM 89361, 89358, 89363, 89364, 89366-89368, M1 or M2; 89369-89375, 94600-92602, M3; CM 91604-91606, dP4.

Description and Discussion—Previously, only a single M3 of a castorid was reported from the Blue Ash fauna (Korth, 2010). It was referred to *Agnotocastor* but not definitely to a species because it was slightly smaller than any reported species. However, with a larger sample of isolated teeth, the size range includes specimens of the typically Whitneyan *A. praetereadens* (Korth 2001:table 2; Korth 2014:table 8).

In morphology, the lower molars have a relatively simple occlusal pattern (dominated by two larger transverse fossettids) as in *A. praetereadens* and *A. readingi* (Korth, 1988, 1996, 2001). In size, the cheek teeth of the Whitneyan *A. praetereadens* and Orellan *A. readingi* are similar, with a great deal of overlap (Korth, 1996:table 1, 1996:table 1, 2001:table 2, 2014:table 8). However, the relative size of the P4 to the molars is greater in *A. praetereadens* than in *A. readingi.* When the area of the molars (length x width) is compared to that of the premolars, in *A. praetereadens*, the upper molars range from 66 to 70% the size of the P4 and in *A. readingi* they average nearly 80% the size of P4. Similarly, the lower molars of *A. praetereadens* are only 60% the size of p4, and in *A. readingi* they are 86% the size of p4. The proportionally large premolar also distinguishes it from other species of *Agnotocastor*. In *A. coloradensis* , as in *A. readingi*, the upper molars are 76% the size of P4 and the lower molars are over 90% the size of p4, and in the Chadronian *A. galushai* (Emry, 1972), the lower molars are also over 90% the size of p4. Clearly the last premolar is more enlarged relative to the molars in *A. praetereadens* compared to all other species. There are no p4s of *Agnotocastor* in the Blue Ash fauna, however, the average size of the upper molars is only 70% that of the single P4 (CM 89357), more similar to that of *A. praetereadens*.

TABLE 4. Dental measurements of *Agnodocastor praetereadens* from the Blue Ash anthill fauna. Abbreviations: L, anteroposterior length; W, transverse width; N, number of specimens; M, mean; OR, range of measurements; SD, standard deviation; CV, coefficient of variation. Measurements in mm.

	dp4L	dp4W	m1-2L	m1-2W	m3L	m3W		
N	2	3	3	2	4	4		
M	3.75	2.78	3.10	2.98	2.81	3.11		
OR	3.65-3.85	2.56-2.94	3.01-3.22	2.96-2.99	2.37-3.10	2.86-3.83		
SD	0.14	0.20	0.11	0.02	0.32	0.48		
CV	3.77	7.13	3.54	0.71	11.42	15.38		
	dP4L	dP4W	P4L	P4W	M1-2L	M1-2W	M3L	M3W
N	2	3	1	1	6	5	11	9
M	2.98	3.72	3.48	3.75	2.82	3.19	2.60	3.05
OR	2.95-3.01	3.68-3.75			2.53-3.12	2.97-3.37	2.27-2.82	2.68-3.51
SD	0.04	0.04			0.25	0.15	0.18	0.24
CV	1.42	0.97			8.90	4.60	6.89	7.96

CONCLUSIONS

The castoroids from Blue Ash support a late Whitneyan age for the fauna (see Korth, 2010, 2014). *Agnotocastor praetereadens* is elsewhere restricted to the Whitneyan (Flynn and Jacobs, 2008), and *Eutypomys wilsoni* is exclusive to the fauna. However, *E. productus* is possibly synonymous with the specimen identified as "*Eutypomys* cf. *montanus*" from the early Arikareean of South Dakota (Macdonald, 1970). An occurrence of an Arikareean species in the Blue Ash fauna would be consistent with several otherwise Arikareean rodents that have their first occurrences at this locality (Korth, 2010) and supports a late Whitneyan age.

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