



[http://app.pan.pl/SOM/app64-Kimura\\_etal\\_SOM.pdf](http://app.pan.pl/SOM/app64-Kimura_etal_SOM.pdf)

SUPPLEMENTARY ONLINE MATERIAL FOR

**A new endemic genus of eomyid rodents from the early  
Miocene of Japan**

Yuri Kimura, Yukimitsu Tomida, Daniela C. Kalthoff, Isaac Casanovas-Vilar,  
and Thomas Mörs

Published in *Acta Palaeontologica Polonica* 2019 64 (2): 303–312.  
<https://doi.org/10.4202/app.00558.2018>

**Supplementary Online Material**

**SOM 1.** Selection of species and description of dental characters used in this study.

**SOM 2.** Data matrix and description of dental characters in the format for TNT.

**SOM 3.** First and last occurrences of eomyid species used for time-scaling the most parsimonious trees.

**SOM 4.** Phylogenetic relationships of eomyid rodents used in this study. **(A)** Strict consensus tree. **(B)** 50% Majority-rule consensus tree obtained from eight most parsimonious trees.

## **SOM 1.** Selection of species and description of dental characters used in this study.

For *Asianeomys*, three out of six species were included. *Asianeomys fahlbuschi* and *A. asiaticus* were scored based on direct observation, and *A. dangheensis* was scored based on direct observation of Wang's (2002) specimens and SEM images and descriptions of Maridet et al. (2015). *Asianeomys yashini* and *A. bolligeri* were excluded because lower molars were not yet discovered. Specimens of *Asianeomys* cf. *A. bolligeri* (Maridet et al., 2015) were not included either because of its indecisive taxonomic assignment. *Asianeomys junggarensis* was not considered because only a single specimen of p4 is ever discovered for the species, and the number of tooth roots (two-rooted p4 and four-rooted m1/m2) differs from the typical condition (three rooted p4 and four-rooted m1/m2) of *Asianeomys*. For *Keramidomys*, both of Chinese species (*K. fahlbuschi* and *K. magnus*) were included and scored based on direct observation, and four European species were chosen for analysis based on the availability of illustration, SEM images, and detailed description from literature. Late Eocene *Metanoiamys paradoxus*, which is more basal than the studied genera at the subfamilial level (Flynn, 2008), was defined as the outgroup. The species was scored based on description and SEM images of Emry and Korth (2012) with supplemental information about the number of roots on lower molars from Chiment and Korth (1996).

### **Character 0:** Loph pattern

- 0: Bunodont
- 1: Bunolophodont (cusps are not submerged into lophs)
- 2: Lophodont (cusps are submerged into lophs)

### **Character 1:** The number of tooth roots on p4

- 0: Two
- 1: Three

### **Character 2:** The number of tooth roots on m1

- 0: Two
- 1: Three
- 2: Four

### **Character 3:** Anteroconid on p4

- 0: Round, isolated
- 1: Absent
- 2: Transversely long, connecting to protoconid
- 3: Transversely long, connecting to metaconid and protoconid

### **Character 4:** Anterolophid on m1

- 0: Separated from the protoconid, but it may weakly connect to the protoconid as worn
- 1: Completely isolated
- 2: Connecting to the metalophid or protoconid through a transverse crest, making a valley in front of the protoconid
- 3: Connecting to the protoconid, without a transverse crest. No deep valley in front of protoconid

**Character 5:** Anterior ectolophid on p4

- 0: Connecting to the posterior wall of the protoconid
- 1: Connecting to the occlusal surface of protoconid

**Character 6:** Metaconid and protoconid on p4

- 0: Connected through a short metalophid
- 1: Connected through metalophid, which is as long as or longer than hypolophid
- 2: Isolated

**Character 7:** Metalophid on m1

- 0: Connecting to the protoconid. A spur from the anterior arm of the protoconid (=metalophid I) present
- 1: Connecting to the protoconid. Metalophid I absent
- 2: Connecting to the anterior ectolophid (or the posterior arm of the protoconid)

**Character 8:** Hypolophid on m1 <uninformative>

- 0: Connecting to the base of the posterior ectolophid
- 1: Connecting to the occlusal surface of the posterior ectolophid (or hypoconid if the ectolophid is interrupted)
- 2: Connecting to the posterolophid (or the posterior arm of the hypoconid)

**Character 9:** Mesolophid on m1

- 0: Short, not reaching to the lingual side of the tooth
- 1: Long (more than 2/3 of the length between the intersection of the ectolophid and the lingual border of the tooth)

**Character 10:** Mesoconid on m1

- 0: Absent
- 1: Present

**Character 11:** Posterior ectolophid on m1

- 0: Present, thus sinusid closed
- 1: Partially or fully absent, thus sinusid open

**Character 12:** Synclinid II on m1 <uninformative>

- 0: Closed by cingulum or by mesoloph extending to the base of the metaconid, without forming an anterior ring
- 1: Closed by loph, forming an anterior ring
- 2: Open

**Character 13:** Posterior ring in weakly worn specimens

- 0: Absent
- 1: Present

**Character 14:** Protoconid on p4

- 0: Transversely aligned with the metaconid
- 1: displaced more anteriorly than the metaconid (so that the metalophid directed anterolabially)

**Character 15:** Anteroloph on P4

0: Present

1: Absent

**Character 16:** Mesoloph on M1 (if not distinguishable, M1 or M2)

0: Present, short, not reaching to the labial side of the tooth

1: Present, long, reaching the labial side of the tooth

**Character 17:** Entoloph on M1 (if not distinguishable, M1 or M2)

0: Closed by the presence of anterior entoloph (>50%), the labial tip of the sinus is at the midline of the tooth or more lingual to it

1: Open to the syncline II due to the lack of anterior entoloph (>50%)

**Character 18:** Sinus on M3

0: Present

1: Absent (closed)

**References**

- Chiment, J.J. and Korth., W.W. 1996. A new genus of eomyid rodent (Mammalia) from the Eocene (Uintan-Duchesnean) of southern California. *Journal of Vertebrate Paleontology* 16: 116–124.
- Emry, R.J. and Korth, W.W. 2012. Early Chadronian (late Eocene) rodents from the Flagstaff Rim area, central Wyoming. *Journal of Vertebrate Paleontology* 32 (2): 419–432.
- Flynn, L.J. 2008. Eomyidae. In: Janis, C.M., Gunnell, G.F. and Uhen, M.D. (eds.), *Evolution of Tertiary Mammals of North America: Volume 2, Small Mammals, Xenarthrans, and Marine Mammals*, 415–427. Cambridge University Press, New York.
- Maridet, O., Daxner-Höck, G., Badamgarav, D. and Göhlich, U.B. 2015. The eomyid rodents (Mammalia) from the Oligocene and Miocene of the Valley of Lakes (Central Mongolia). *Palaontologische Zeitschrift* 89 (2): 207–228.
- Wang, B.-Y. 2002. Discovery of late Oligocene Eomyodon (Rodentia, Mammalia) from the Danghe area, Gansu, China. *Vertebrata Palasiatica* 40: 139–145.

## SOM 2. Data matrix and description of dental characters in the format for TNT.

xread

19 14

Asianeomys_dangheensis	1121[0 1]0011100001010?
Asianeomys_asiaticus	1?210001111[0 1]0011[0 1]00
Asianeomys_fahlbuschi	1121000111100000[0 1]01
Keramidomys_fahlbuschi	202[1 2]0[0 1]111110000[0 1]111
Keramidomys_carpathicus	2?23310111001101111
Keramidomys_thaleri	2022011111001001111
Keramidomys_mohleri	202231111101110111?
Keramidomys_magnus	2023[0 3]11111[0 1]0[0 2]001110
Keramidomys_ermannorum	2023311[1 2]1100110[0 1]111
Japanese_eomyid	002100010110000????
Metanoiamys_paradoxus	000?[1 2]0002000000?00?
Eomys_molassicus	0??020012110000110?
Eomys_antiquus	001[0 1][1 2]0222000200[0 1]000
Eomys_orientalis	0010200120002?0000?

;

cnames

{0 loph\_pattern bunodont bunolophodont\_(cusps\_are\_not\_submerged\_into\_lophs)  
lophodont\_(cusps\_are\_submerged\_into\_lophs);  
{1 numer\_of\_roots\_on\_p4 two three;  
{2 numer\_of\_roots\_on\_m1 two three four;  
{3 anteroconid\_on\_p4 round,\_isolated absent transversely\_long,\_connecting\_to\_protoconid  
transversely\_long,\_connecting\_to\_metaconid\_and\_protoconid;  
{4 anterolophid\_on\_m1  
separated\_from\_protoconid,\_but\_it\_may\_weakly\_connect\_to\_the\_protoconid\_as\_wor  
n completely\_isolated  
connecting\_to\_the\_metalophid/protoconid\_through\_a\_transverse\_crest,\_making\_a\_val  
ley\_in\_front\_of\_the\_protoconid  
connecting\_to\_the\_protoconid,\_without\_a\_transverse\_crest,\_no\_deep\_valley\_in\_fro  
nt\_of\_protoconid;  
{5 anterior\_ectolophid\_on\_p4 connecting\_to\_the\_posterior\_wall\_of\_the\_protoconid  
connecting\_to\_the\_occlusal\_surface\_of\_protoconid\_;  
{6 metaconid\_and\_protoconid\_on\_p4 connected\_through\_short\_metalophid  
connected\_through\_metalophid,\_which\_is\_as\_long\_as\_or\_longer\_than\_hypolophid  
isolated;  
{7 metalophid\_on\_m1  
connecting\_to\_the\_protoconid,\_a\_spur\_from\_the\_anterior\_arm\_of\_the\_protoconid\_(=  
metalophid\_I)\_present connecting\_to\_the\_protoconid,\_metalophid\_I\_absent  
connecting\_to\_the\_anterior\_ectolophid/posterior\_arm\_of\_the\_protoconid;  
{8 hypolophid\_on\_m1 connecting\_to\_the\_base\_of\_the\_posterior\_ectolophid  
connecting\_to\_the\_occlusal\_surface\_of\_the\_posterior\_ectolophid\_or\_hypoconid\_if\_th  
e\_ectolophid\_is\_interrupted.  
connecting\_to\_the\_posterolophid\_or\_posterior\_arm\_of\_the\_hypoconid;  
{9 mesolophid\_on\_m1 short,\_not\_reaching\_to\_the\_lingual\_side\_of\_the\_tooth  
long,\_more\_than\_2\_over\_3\_of\_the\_length\_between\_the\_intersection\_of\_the\_ectoloph

```

    id_and_the_lingual_border_of_the_tooth;
{10 mesoconid_on_m1 absent present;
{11 posterior_ectolophid_on_m1 present,_sinusid_closed
    partially_or_fully_absent,_sinusid_open;
{12 synclinid_II_on_m1
    closed_by_cingulum_or_by_mesoloph_extending_to_the_base_of_the_metaconid,_wi
    thout_forming_an_anterior_ring closed_by_loph,_forming_an_anterior_ring open;
{13 posterior_ring_in_weakly_worn_specimens absent present;
{14 protoconid_on_p4 transversely_aligned_with_the_metaconid
    displaced_more_anteriorly_than_metaconid_(so_that_the_metalophid_directed_antero
    labially);
{15 anteroloph_on_upper_P4 present absent;
{16 mesoloph_on_upper_M1_(if_not_distinguishable,_M1_or_M2)
    present,_short,_not_reaching_to_the_labial_side_of_the_tooth
    present,_long,_reaching_the_labial_side_of_the_tooth;
{17 entoloph_on_upper_M1_(if_not_distinguishable,_M1_or_M2)
    closed_by_the_presence_of_anterior_entoloph_(>50%),_the_labial_tip_of_the_sinus_i
    s_at_the_midline_of_the_tooth_or_more_lingual_to_it
    open_to_the_second_syncline_due_to_the_lack_of_anterior_entoloph_(>50%);
{18 sinus_on_upper_M3 present absent_(closed);
;

```

outgroup *Metanoiamys paradoxus*;

```

proc /;
comments 0
;

```

**SOM 3.** First and last occurrences of eomyid species used for time-scaling the most parsimonious trees.

Species	FAD (median age)	LAD (median age)	Uncertainty in FAD		Uncertainty in LAD		Max age in a singleton species	Min age in a singleton species	References
			Max (Ma)	Min (Ma)	Max (Ma)	Min (Ma)			
<i>Asianeomys asiaticus</i>	26.7	24.7	NA	NA	NA	NA	28.4	23.0	PBDB; Wang and Emry (1991)
<i>Asianeomys dangheensis</i>	25.5	19.5	28.0	23.0	23.0	16.0	NA	NA	Maridet et al. (2015); Wang (2002)
<i>Asianeomys fahlbuschi</i>	21.8	18.5	21.9	21.7	20.0	16.9	NA	NA	Wu et al. (2006); Qiu and Li (2016)
<i>Eomys antiquus</i>	33.3	30.6	33.9	32.6	30.9	30.2	NA	NA	Maridet et al. (2010)
<i>Eomys molassicus</i>	27.6	25.6	NA	NA	NA	NA	27.6	25.6	Maridet et al. (2010)
<i>Eomys orientalis</i>	32.7	25.4	33.9	31.5	27.8	23.0	NA	NA	Wang and Emry (1991); Maridet et al. (2015)
<i>Japaneomys yasunoi</i>	19.4	17.4	NA	NA	NA	NA	19.8	16.9	This study
<i>Keramidomys carpathicus</i>	16.1	4.8	17.0	15.2	5.3	4.2	NA	NA	NOW database
<i>Keramidomys ermannorum</i>	10.4	5.6	11.1	9.7	7.0	4.2	NA	NA	Daxner-Höck and Höck (2009)
<i>Keramidomys fahlbuschi</i>	19.7	6.5	22.4	16.9	7.8	5.3	NA	NA	Qiu and Li (2016)
<i>Keramidomys magnus</i>	10.4	6.5	11.1	9.7	7.8	5.3	NA	NA	Qiu and Li (2016)
<i>Keramidomys mohleri</i>	13.9	4.8	15.2	12.5	5.3	4.2	NA	NA	NOW database
<i>Keramidomys thaleri</i>	17.5	10.4	18.0	17.0	11.2	9.5	NA	NA	NOW database
<i>Metanoiamys paradoxus</i>	36.6	34.6	NA	NA	NA	NA	37.2	33.9	PBDB

## References

- Daxner-Höck, G. and Höck, E. 2009. New data on Eomyidae and Gliridae ( Rodentia , Mammalia ) from the Late Miocene of Austria. *Annalen des Naturhistorischen Museum in Wien* 111A (April): 375–444.
- Maridet, O., Hugueney, M. and Heissig, K. 2010. New data about the diversity of Early Oligocene eomyids (Mammalia , Rodentia ) in Western Europe. *Geodiversitas* 32 (2): 221–254.
- Maridet, O., Daxner-Höck, G., Badamgarav, D. and Göhlich, U.B. 2015. The eomyid rodents (Mammalia) from the Oligocene and Miocene of the Valley of Lakes (Central Mongolia). *Palaontologische Zeitschrift* 89 (2): 207–228.
- Qiu, Z.-D. and Li, Q. 2016. Neogene rodents from central Nei Mongol, China. *Palaeontologia Sinica* 198 (New Series C): 1–676.
- Wang, B.-Y. 2002. Discovery of late Oligocene Eomyodon (Rodentia, Mammalia) from the Danghe area, Gansu, China. *Vertebrata Palasiatica* 40: 139–145.
- Wang, B.-Y. and Emry, R.J. 1991. Eomyidae (Rodentia: Mammalia) from the Oligocene of Nei Mongol, China. *Journal of Vertebrate Paleontology* 11 (3): 370–377.
- Wu, W.-Y., Meng, J., Ye, J. and Ni, X.-J. 2006. The first finds of eomyids (Rodentia) from the Late Oligocene – Early Miocene of the Northern Junggar Basin, China. *Beiträge zur Paläontologie* 30: 469–479.

**SOM 4.** Phylogenetic relationships of eomyid rodents used in this study. (A) Strict consensus tree; (B) 50% Majority-rule conce.

