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SUPPLEMENTARY ONLINE MATERIAL FOR

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

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Published in *Acta Palaeontologica Polonica* 2019 64 (X): xxx–xxx.
<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.

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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)

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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?

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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

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        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);
;

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outgroup *Metanoiamys paradoxus*;

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proc /;
comments 0
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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

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

