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First record of *Karydomys* (Rodentia, Mammalia) from the German part of the North Alpine Foreland Basin

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Abstract *Karydomys*, a rare genus of cricetid rodents from the Middle Miocene of central Europe, had previously been reported only from the Swiss part of the North Alpine Foreland basin; documented evidence from the German part was lacking. This paper describes several new specimens of *Karydomys* from the German localities Höll and Laimering 3. A correlation of both localities to the Bavarian local biostratigraphic scale OSM F is proposed. Taxonomically, the fossils are most probably linked to *K. wigharti* from Hambach 6C (north-west Germany), and thus assigned to *K.* cf. *wigharti*. In spite of the scarcity of *Karydomys* fossils in the Upper Freshwatermolasse, the taxon is an important biostratigraphical marker because of its short stratigraphical range.

Keywords Cricetid rodent · Vertebrate palaeontology · Upper Freshwatermolasse · Biostratigraphy · Middle Miocene

Abbreviations

BSPG	Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany
NRMZ	Naturkundemuseum und Römisches Museum im Zumsteinhaus in Kempten
NAFB	North Alpine Foreland Basin
OSM	Upper Freshwater molasse from the German OSM (Obere Süßwassermolasse), used herein for the local biostratigraphic units

1 Introduction

Documented evidence from Central Europe of the cricetid genus *Karydomys* is exceedingly rare. Although several hundred Miocene vertebrate fossil localities are known from the North Alpine Foreland Basin (NAFB; e.g. Kälin and Kempf 2009; Abdul Aziz et al. 2010), the published record of *Karydomys* is restricted to a few isolated teeth from Middle Miocene localities in Switzerland (e.g., Garapich and Kälin 1999; Bolliger 2000; Kälin and Kempf 2009). Moreover, the genus has been reported from several fissure fillings in the Franconian Alb, Germany (Garapich and Kälin 1999; Mörs and Kalthoff 2004; Prieto 2012). A large tooth sample from the Lower Rhine Embayment (Northwest Germany) was described as a new species by Mörs and Kalthoff (2004). However, the occurrence of *Karydomys* in the German part of the NAFB had not been demonstrated to date. In this paper, we describe remains of *Karydomys* from Höll and Laimering 3, Bavaria. These

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fossils represent the first documented evidence of the genus from the German part of the NAFB.

2 Geographical and geological setting

2.1 Höll

This locality was described in detail by Scholz (1986). Fossils were excavated from sediments of the southernmost part of the Upper Freshwater Molasse (see Scholz 1986: Fig. 1). The outcroup is exposed along the Argen stream, to the west of the Höll farm near Gestratz, southwest of Isny and close to the Alps (TK 25: Blatt 8325 Wangen in Allgäu Ost; R.357210, H.527905 and see Fig. 1). The vertebrate-bearing layer occurs at the basis of the Upper Freshwater molasse succession, 1 m below the top of a hard, silty marl-limestone, and is located below the river water level for most of the time. Above this layer, 5–6 m of a sandy and mica-enriched marlstone completes the succession. The upper part of the wall consists of Würm morainic rubbles (Scholz 1986: Fig. 3).

Apart from land snails (? *Papaeoglandina* sp., *Triptychia* sp. *Tropidomphalus* sp. and *Cepea* sp.), reptiles are represented by remains of undeterminable Ophidia and Lacertilia, and relatively abundant chelonian remains. Furthermore, the presence of bird fossils has been indicated (Scholz 1986). Large mammals are diverse and include artiodactyls (*Dicrocerus elegans*, *Micromeryx flourensianus*, *Lagomeryx parvulus*, *L. pumilio*, *Dorcatherium crassum*), a perissodactyl (?*Brachypotherium brachypus)*, and a proboscidean (Scholz 1986).

Small mammals documented from this locality include marsupials, Erinaceomorpha, Soricomorpha, three genera of pikas (*Prolagus*, *Lagopsis* and ? "*Amphilagus*"), at least two sciurid genera, as well as the cricetid rodents *Democricetodon* sp. and *Megacricetodon minor*.

The dating (MN 6) of the locality was initially based largely on the assignment of the large-sized cricetid rodent fossils to *Cricetodon sansaniensis*. However, preliminary analysis of the material revealed that the species from Höll is very similar to fossils from Gallenbach 2b. In the Swiss part of the NAFB, *Cricetodon* appears during the *Megacricetodon lappi-Democricetodon gracilis* interval zone, whereas *Cricetodon* and *Megacricetodon lappi* co-occur in the upper part of the OSM E in Germany (see Sect. 5, Biostratigrapic considerations). Because no remains of the large-sized *Megacricetodon lappi* have been discovered in Höll, a preliminary correlation of the fauna to the local scala OSM F is proposed.

2.2 Laimering 3

For information on this locality and its faunal content, the reader is referred to Heissig (2006). The locality correlates to the OSM F (Abdul Aziz et al. 2010), and the fossil-rich layer occurs approximately 20–30 cm below the Laimering bentonite.

3 Materials and methods

The fossils from Höll are deposited in the *Naturkundemuseum und Römisches Museum im Zumsteinhaus* in Kempten, while the material from Laimering is housed in the *Bayerische Staatssammlung für Paläontologie und Geologie* in Munich, Germany. All specimens have been photographed and re-drawn. The molars illustrated in this paper are presented in left orientation, and measurements are in mm. The nomenclature follows Maridet et al. (2009).

Note that the measurements given for *Karydomys symeonidisi* from Karydiá 1 and 2 figured by Prieto (2012: Fig. 1) are wrong, and are actually corresponding to the plotting of the length of Karydiá 1 and the length of Karydiá 2. These values have been corrected in this paper in Fig. 2.

4 Systematic paleontology

Order Rodentia Bowdich, 1821
Family Cricetidae Fisher von Waldheim, 1817
Genus *Karydomys* Theocharopoulos, 2000

Type species *Karydomys symeonidisi* Theocharopoulos, 2000.

Other species included in Karydomys. Karydomys zapfei (Mein and Freudenthal 1971); *K. boskosi* Theocharopoulos 2000; *K. dzerzhinskii* Kordikova and De Bruijn 2001; *K. wigharti* Mörs and Kalthoff 2004; *K. debruijni* Maridet et al. 2011.

For comments on the history of the genus see also Prieto (2012, and references therein).

Karydomys cf. *wigharti* Mörs and Kalthoff 2004
(Fig. 1a–c.)

Diagnosis. Mörs and Kalthoff 2004.

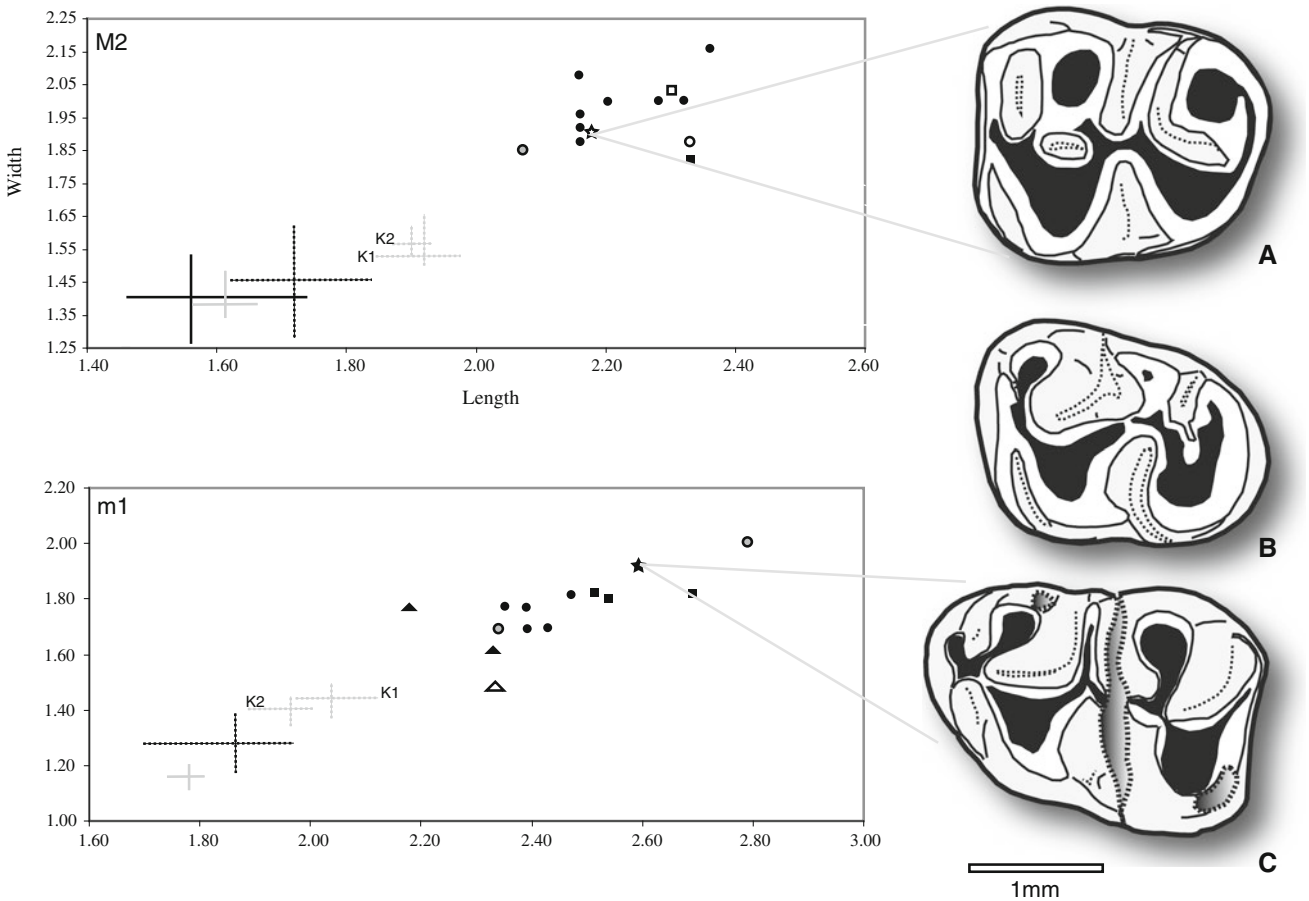
Differential diagnosis. Mörs and Kalthoff 2004.

Type locality. Hambach 6C, Lower Rhine Embayment, northwestern Germany, Middle Miocene.

Material and measurements. 1 M2 (2.18 × 1.91 mm) from Laimering 3. 1 m1 (~2.60 × 1.91 mm) and 1 m3 (2.17 × 1.62 mm) from Höll

Description. M2 from Laimering 3 differs from the single M2 from Petersbuch 6 (Prieto 2012) and Hambach 6C

Fig. 1 Geographic position of the studied localities



□ : **Petersbuch 6**, *Karydomys* cf. *wigharti*, Prieto 2012 ● : **Hambach 6C**, *Karydomys wigharti*, Mörs & Kalthoff 2004
○ : **Vieux-Collonges**, *Karydomys zapfei*, Mein & Freudenthal 1981 ○ : **Uzwil-Nutzenbüch**, *Karydomys wigharti*, Garapich & Kälin 1999
■ : **Devínska Nová Ves (=Neudorf)**, *Karydomys wigharti*, Fejfar 1974 — : **Locality XJ 200114 of the Junggar basin**, *Karydomys debruijni*, Maridet et al. 2011
– : **Karydiá 2**, *Karydomys boskosi*, Theocharopoulos 2000 ··· : **Karydiá 1+2**, *Karydomys symeonidisi*, Theocharopoulos 2000
··· : **Aktau I**, *Karydomys dzerzhinskii*, Kordikova & De Bruijn 2001 ☆: **Laimering 3,** *Karydomys* cf. *wigharti* this paper
▲ : **Belchatów B**, *Karydomys wigharti* Garapich & Kälin 1999 △: **Pontlevoy-Thenay**, *Karydomys zapfei,* Garapich & Kälin 1999
★: **´Höll,** *Karydomys* cf.*wigharti*, this paper

Fig. 2 *Karydomys* cf. *wigharti* Mörs and Kalthoff 2004 from Höll and Laimering 3. Size comparison with selected localities and specimens. **a** Left M2 from Laimering 3. **b** Right (reversed) m3 from Höll. **c** Right (reversed) m1 from Höll

(Mörs and Kalthoff 2004) in as far that the posterosinus, which is diagnostic of *Karydomys* (see details below), is missing. This difference, however, is probably an artefact resulting from the advanced wear stage of the molar. The two anterolophs are strong. While the labial anteroloph is curved and connects to the anterior wall of the paracone, the lingual one descends to the antero-lingual base of the protocone. Double protolophule. The mesoloph reaches the border of the crown, running along the entoconid. Sinus and mesosinus are transversal.

The m1 molar from Höll is broken into two pieces and has been glued. The strong mesolophid reaches the border of the m1. The metaconid spur connects to the anterolophulid that ends labially to the anteroconid. The hypolophulid ends at the anterior wall of the hypoconid. The labial cingulum closes the sinusid. On the m3 from Höll, only the labial anterolophid is developed; it is strong and reaches the basis of the labialo-anterior wall of the protoconid. The length of the short is approximately one-third of the width of the mesosinusid. The entoconid is crest-like. The posterolophid is relatively short but very strong.

Discussion. Mörs and Kalthoff (2004) recognize a striking correspondence in molar morphology between *K. wigharti* and *K. zapfei*. The separate status of the two species is based on numerous distinguishing characters. The upper molars of *K. wigharti* are generally larger than in *K. zapfei.* The M1 of *K. wigharti* has a broader, box-shaped antero-cone, which is somewhat split. In *K. wigharti,* M3 is more reduced and M2 has a shortened anterior part and the antero- and protosinus are narrower; posterior part characterized by a posterior metalophule and very small and deep posterosinus. Labial posterolophid are only weakly or not developed in m1 of *K. wigharti*.

Based on these characteristics, only the M2 and m1 can be used for comparison. In the first lower molar from Höll, a labial posterolophid is absent. The M2 from Laimering 3 lacks the posterosinus but this is probably due to the advanced wear of the specimen. Similarly, the posterior metalophule might have disappeared as a result of wear. The anterior part of the tooth is shortened, as stated by Mörs and Kalthoff (2004, p. 1399): the antero- and protosinus are narrow, and the anterolophule forms a distinct ridge. Assignment of the molar to *K. wigharti* appears therefore justified, but the lack of a larger sample set, together with the very few available molars of *K. zapfei* from Vieux-Collonges make an unambiguous identification and assignment difficult.

5 Biostratigraphic considerations

The genus *Karydomys* has been recorded for the *Megacricetodon lappi-Democricetodon gracilis* and *Democricetodon gracilis-Megacricetodon gersii* interval zones in the Swiss part of the NAFB. These zones have been correlated with the Bavarian OSM unit F by Kälin and Kempf (2009: Fig. 10). Van der Meulen et al. (2011; Figs. 1, 2), however, correlate the zones with OSM E' and OSM F, but without sufficient explanation, at least with regard to OSM E'. This OSM unit was introduced by Böhme et al. (2001) based on the locality Derching 1B, which just precedes the Ries impact. Although Derching 1b has not been studied in detail to date, it has been stated that the fauna lacks *Megacricetodon lappi*, but contains *Cricetodon* and a medium-sized *Megacricetodon* (*M.* aff. *gersii* in Böhme et al. 2001). As a result, without a more detailed study of the fauna from Derching, it remains difficult, if not impossible, to validate the correlation of OSM E' with the *M. lappi-D.gracilis* interval zone.

In the Swiss Molasse, remains of *Karydomys* are most often found together with fossils of the cricetid hamster *Cricetodon* (e.g., in Rümikon, Wielzholz, Uzwil-Nutzenbuech, Bolliger 2000; Kälin and Kempf 2009). For example, *Cricetodon* and *Karydomys* are associated in Strakonice (Czech Republic, Fejfar 1974) and Vieux-Collonges (France, Mein and Freudenthal 1971, 1981). Since *Cricetodon* is also present in the faunas Höll and Laimering 3, we find the same association of the two genera also in the German part of the NAFB.

On the other hand, the Swiss *Karydomys* locality Chatzloch lacks *Cricetodon*, but only shortly predates the first occurrence of this rodent (Kälin and Kempf 2009). According to Kälin (1997), Chatzloch is close in age to Devínská Nová Ves (=Neudorf)-fissure 1, a locality from the Slovak Republic that neither yielded *Cricetodon*. *Cricetodon* is also absent in Hambach 6C.

The first occurrence of *Cricetodon* in Germany has been reported from the top of the OSM C+D in Affalterbach (e.g., Heissig 1997). The cricetids rodents from this locality have not yet been published, but some measurements of the *Megacricetodon* and *Eumyarion* teeth from this site are given in Heissig (1990; Figs. 4, 5). As a result, this first occurrence is not satisfactorily demonstrated. Consequently, the first occurrence of *Cricetodon* from the German part of the NAFB is in Ebershausen, in the late part of the OSM E (correlated to the Swiss *Megacricetodon lappi* taxon range zone). The delay in the appearance of *Cricetodon* in Switzerland (post *Megacricetodon lappi*) and Germany (OSM E with *M. lappi*) is probably due to the fact that no fauna containing large-sized individuals (evolved) of *M. lappi* have been discovered in Switzerland to date, and thus the first occurrence of *Cricetodon* in Switzerland remains unknown. Devínská Nová Ves (=Neudorf)-fissure1 and Hambach 6 C are presently difficult to integrate in this biostratigraphic context.

Based on the new fossil data presented in this paper and the previous finds discussed above, we suggest that the first

occurrence of *Karydomys* in the NAFB, while shortly predating the migration of *Cricetodon* into Switzerland, at least post-dates, at present, this event in its German part. However, the general scarcity of the genus in the faunas renders a more sound temporal assessment difficult.

6 Conclusions

From the floodplain deposits at Höll and Laimering 3 several *Karydomys* teeth have been excavated. The teeth are rare and together with a relatively restricted stratigraphic range this may explain why until now the genus was not recorded in the German part of the North Alpine Foreland Basin. This is in accordance with the observed relative abundance of the genus (most often very rare) in Western and Central Europe, and does not contradict the palaeoecological preference of *Karydomys wigharti* and *K. zapfei* for extremely wet environments as proposed by Mörs and Kaltoff (2004).

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