Bayerische Staatssammlung
für Paläontologie und Geologie

- München, 01.07.2017
- Manuscript received 15.10.2016; revision accepted 20.12.2016
- ISSN 0373-9627
- ISBN 978-3-946705-00-0

Short Communication

New Miocene record of the suid *Listriodon* near Munich

Jérôme Prieto[1, 2*] & Christoph Mayr[2, 3]

[1]*SNSB-Bayerische Staatssammlung für Paläontologie und Geologie, Richard-Wagner-Str. 10, 80333 Munich, Germany*
[2]*Department of Earth- and Environmental Science, Palaeontology, Ludwig-Maximilians-University Munich, Richard-Wagner-Str. 10, 80333 Munich, Germany*
[3]*Institut für Geographie, Friedrich-Alexander-Universität Erlangen-Nürnberg,Wetterkreuz 15, 91058 Erlangen, Germany*

**Corresponding author; E-mail:* j.prieto@lrz.uni-muenchen.de

Zitteliana 89, 355–357.

Key words: Germany, Bavaria, Miocene, Suidae, Mammalia
Schüsselwörter: Deutschland, Bayern, Miozän, Suidae, Mammalia

Listriodontine pigs are characterized, among other morphological traits, by their highly enlarged incisors, strong sexual dimorphism in the canines, as well as the tendency to develop lophodont molars, remembering thus in some points those of tapirs (Van der Made 1996; see also Orliac 2006 and Pickford & Morales 2003). In particular, the species *Listriodon splendens* has an historical status. It has been defined as early as the middle of the 19th century based on fossils from the Swiss part of the North Alpine Foreland Basin (NAFB) (von Meyer 1846). In Germany, the suid found soon the interest of scholars, especially the very well-preserved lower jaws from Markt Rettenbach (Stromer 1930; Dehm 1934).

Listriodon splendens is also an important taxon for biostratigraphic purposes (e.g., De Bruijn et al. 1992; Mein 1999; Agusti et al. 2001). The transition from the biostratigraphic mammal zones MN5 to MN6 traditionally coincides with the disappearance of *Bunolistriodon* and the appearance of truly lophodont *Listriodon* (Mein 1999). Paradoxically, when Heißig (1997: 541) proposed a biostratigraphic scale for the German part of the NAFB (MN4 to MN6), he commented on the fully absence of *Listriodon* or *Bunolistriodon* before MN 8 (ca. 13.8 Ma after Kälin & Kempf 2009) in this area. This is in accordance with the observations made by Kälin & Kempf (2009) who correlated the first occurrence of *Listriodon* in Switzerland during the short MN7 (ca. 13.8-13.9 Ma after Kälin & Kempf 2009). Indeed, these discrepancies might derive from problems in the use of the MN zonation on a European scale that are beyond the scope of this short contribution (e.g., Van der Meulen et al. 2012).

Forms related to *Bunolistriodon lockharti/latidens* were documented from the base of the Upper Freshwater Molasse (lower Miocene) (e.g., Dehm 1934; Van der Made 1996; Eronen & Rößner 2007; Sach 2014). According to Böhme et al. (2012), *Listriodon splendens* first occurs in Central Europe at around 14.2 Ma in Klein-Hadersdorf (Austria). Seehuber (2009) considered the finds from Stätzling (Germany) as probably older than 14.4 Ma because they derived from sediments deposited under the post-Riesian bentonite (see Abdul-Aziz et al. 2010 for chronostratigraphic framework). A direct ancestor/descendant relationship between *Bunolistriodon lockarti* and *Listriodon splendens* is generally excluded (Van der Made 1996; Orliac 2009; Orliac et al. 2009; versus Pickford & Morales 2003), and the younger species is viewed as a migrant to the NAFB of Asiatic origin.

While the Miocene mammal record from Southern Germany is now seen such as one of the richest in Europe, findings of *Listriodon splendens* remain relatively rare (Fig. 1A), most probably because of the lack of deposits covering the stratigraphic range of the species. In this context, the discovery of a *Listriodon* tooth in a sand/clay pit 1 km east of Oberweikertshofen near Fürstenfeldbruck (Bavaria) deserves some attention. This fossil comes from a sandy layer that is interpreted as a channel filling cut into several meters of marly and clayey layers deposited below. The base of this channel filling contained abundant freshwater bivalve shells (Unionidae) in the south of the pit directly above the erosional contact (Fig. 1B, C). Most of the shells were abraded by fluvial transport, while a few valves were still attached to each other. The overlying sand deposits were at least

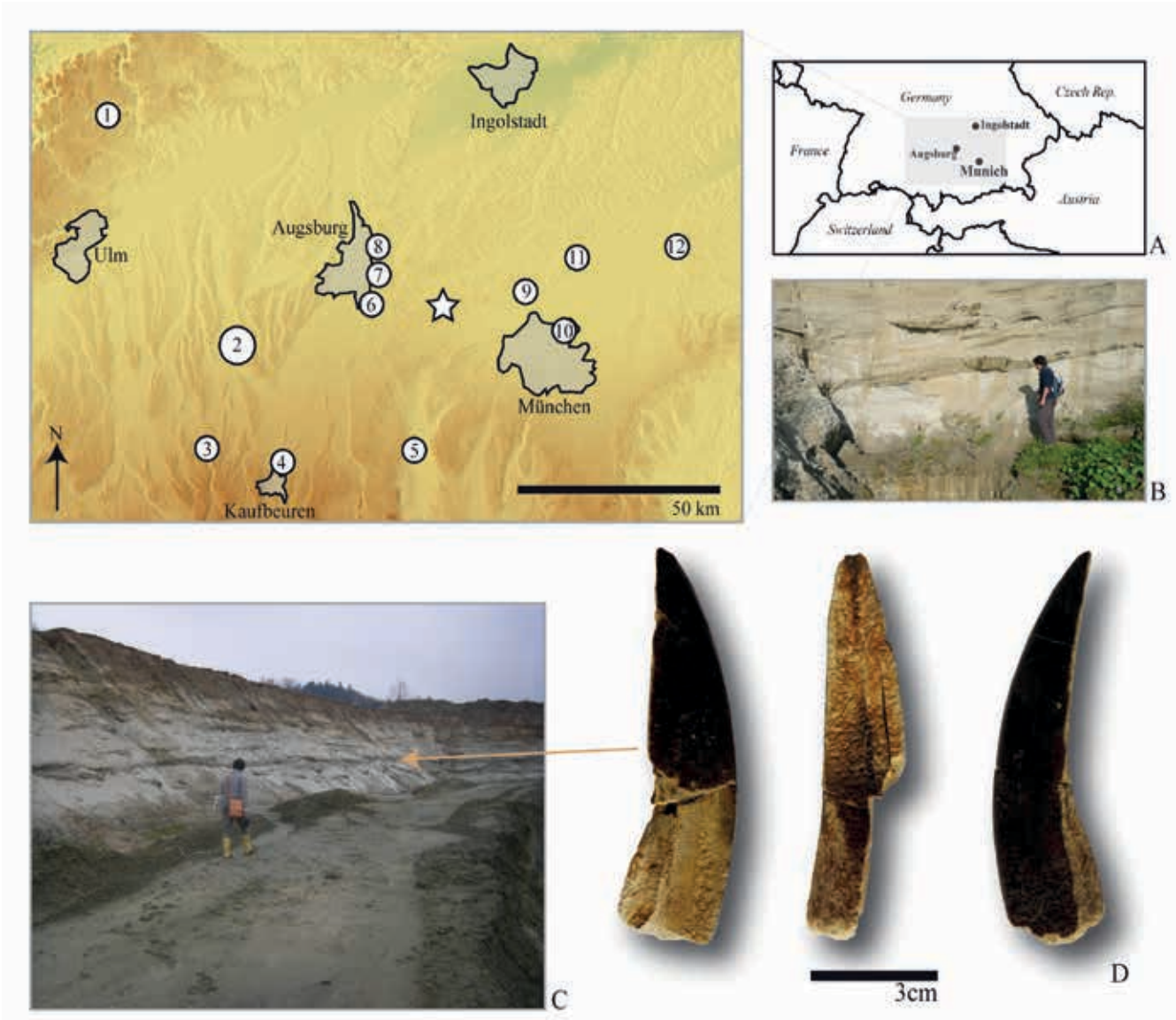

Figure 1: (A) Geographic situation of some *Listriodon* records from the North Alpine Foreland and the Steinheim basins; star: Oberweikertshofen; circles: 1. Steinheim 2. Derndorf, Mörgen, Tiefenried, Aspach 3. Markt Rettenbach 4. Hammerschmiede 5. St. Georgen near Dießen a. Ammersee 6. Mering 7. Friedberg 8. Stätzling 9. Prittlbach 10. Großlappen, Aumeister 11. Maßenhausen, Kleineisenbach 12. Wartenberg. **(B)** Oberweikertshofen, sandy layers containing unionids at the basis overlying marls (October 2008). **(C)** Oberweikertshofen, sandy channel fillings at the top of the section (January 2008). **(D)** Male canine of *Listriodon splendens*, and location of the finding in the pit (arrow). Data from Dehm (1934), Van der Made (1996), Seehuber (2009), Kirscher et al. (2016) and personal data of JP.

4 m thick and rarely contained mammal bones. The screen washing was not successful and even small vertebrates were not discovered.

The fossil considered herein is a right lower male canine of a juvenile *Listriodon* (Fig. 1D). It is broken on the lingual side at 8.42 cm from the unworn but slightly damaged tip. On the labial side the breakage occurs earlier, at 5.41 cm. The measurement method is following Van der Made (1996: figure 16. Labial side: 17.26 mm; lingual side: 19.22 mm; posterior side: 19.43 mm). Those are an underestimation because they are taken near to the tip of the canine, but the tooth was larger than that of any known *Bunolistriodon* compared to the value provided by Van der Made (1996: fig. 49). Following the previous reference, the size of the male canines is of good biostratigraphic value because it increases through time. While the present *Listriodon* tooth indicates a age not older than 14.4 Ma, it is too damaged to use it for a finer stratigraphy, and thus does not allow a more in deep evaluation of the age of the locality.

At around 14.2 Ma, major changes occurred in the faunal associations in relation to the Middle Miocene Climate Transition (MMCT; isotopic events Mi-3a, Mi-3). This stepwise and global event is characterized at its beginning by a sharp drop in temperature (Lewis et al. 2008). This cooling is evident in a gradual replacement of the evergreen forest by more deciduous and mesothermic plants (Jiménez-Moreno 2006). We speculate that vegetation changes may have played a role in the migration of *Listriodon splendens* into Central Europe. It has been interpreted as

a browser (Hunter & Fortelius 1994), not rooting (Van der Made 1996) but feeding on large quantities of herbs or other low vegetation (Van der Made et al. 2014). The assumed ecological preferences of the species may be in accordance with a more seasonal climate variability suggested for the period after 14.5–14.0 Ma (Böhme 2003; Eronen & Rößner 2007) possibly leading to a less dense vegetation. In addition, the great sexual dimorphism in the canines of *Listriodon splendens* is also seen as a morphological specific related to social behavior adapted to a more open landscape (Van der Made 2003; Van der Made et al. 2014).

Acknowledgment

This work is dedicated to Winfried Werner on the occasion of his 65th birthday and retirement. We thank Jan van der Made (Madrid) and Gertrud Rößner (Munich) for their appreciated reviews.

References

Abdul Aziz H, Böhme M, Rocholl A, Prieto J, Wijbrans JR, Bachtadse V, Ulbig A. 2010. Integrated stratigraphy and 40Ar/39Ar chonology of the early to middle Miocene Upper freshwater molasse in western Bavaria (Germany). International Journal of Earth Sciences (Geologische Rundschau) 99, 1859–1886.

Agustí J, Cabrera L, Garcés M, Krijgsman W, Oms O, Parés JM. 2001. A calibrated mammal scale for the Neogene of Western Europe. State of the art. Earth-Science Reviews 52, 247–260.

Böhme M. 2003. Miocene Climatic Optimum: evidence from Lower Vertebrates of Central Europe. Palaeogeography, Palaeoclimatologie, Palaeoecology 195, 389–401.

Böhme M, Aiglstorfer M, Uhl D, Kullmer O. 2012. The Antiquity of the Rhine River: Stratigraphic Coverage of the *Dinotheriensande* (Eppelsheim Formation) of the Mainz Basin (Germany). PloS ONE 7, e36817.

Bruijn dH, Daams R, Daxner-Höck G, Fahlbusch V, Ginsburg L, Mein P, Morales J. 1992. Report of the RCMNS working group on fossil mammals, Reisenburg 1990. Newsletters on Stratigraphy 36, 65–118.

Dehm R. 1934. *Listriodon* im Südbayrischen Flinz (Obermiocän). Centralblatt für Mineralogie, Geologie und Paläontologie, Abteilung B 12, 513–528.

Eronen JT, Rößner G. 2007. Wetland Paradise Lost: Miocene Community Dynamics in Large Herbivore Mammals from the German Molasse Basin. Ecology and Evolutionary Research 9, 471–494.

Heißig K. 1997. Mammal faunas intermediate between the reference faunas of MN4 and MN6 from the Upper freshwater Molasse of Bavaria. Actes du Congrès BiochroM'97, Mémoires et Travaux de l'Ecole pratique des Hautes Etudes, Institut de Montpellier 21, 537–546.

Hunter JP, Fortelius M. 1994. Comparative dental occlusal morphology, facet development, and microwear in two sympatric species *Listriodon* (Mammalia, Suidae) from the Middle Miocene of western Anatolia (Turkey). Journal of Vertebrate Palaeontology 14, 105–126.

Jiménez-Moreno G. 2006. Progressive substitution of a subtropical forest for a temperate one during the middle Miocene climate cooling in Central Europe according to palynological data from cores Tengelic-2 and Hidas-53 (Pannonian Basin, Hungary). Review of Palaeobotany and Palynology 142, 1–14.

Kälin D, Kempf O. 2009. High-resolution stratigraphy from the continental record of the Middle Miocene northern Alpine Foreland Basin of Switzerland. Neues Jahrbuch für Geologie und Palaeontologie, Abhandlungen 254, 177–235.

Kirscher U, Prieto J, Bachtadse V, Abdul-Aziz H, Doppler G, Hagmaier M, Böhme M. 2016. A biochronologic tie-point for the base of the Tortonian stage in European terrestrial settings: Magnetostratigraphy of the topmost Upper Freshwater Molasse sediments of the North Alpine Foreland Basin in Bavaria (Germany). Newsletters on Stratigraphy 49 (3), 445–467.

Lewis AR, Marchant DR, Ashworth AC, Hedenäs L, Hemming SR, Johnson JV, Leng MJ, Machlus ML, Newton AE, Raine JI. Willenbring JK, Williams M, Wolfe AP. 2008. Mid-Miocene cooling and the extinction of tundra in continental Antarctica. PNAS 105, 10676–10680.

Made Jvd. 1996. Listriodontinae (Suidae, Mammalia), their evolution, systematics and distribution in time and space. Contributions to Tertiary and Quaternary Geology 33, 3–254.

Made Jvd. 2003. Suoidea (pigs) from the hominoid locality of Çandir in Turkey. Courier Forschungsinstitut Senckenberg 240, 149–179.

Made Jvd, Prieto J, Aiglstorfer M, Böhme M, Gross M. 2014. Taxonomic study of the pigs (Suidae, Mammalia) from the late Middle Miocene of Gratkorn (Austria, Styria). Palaeobiodiversity and Palaeoenvironments 94, 595–617.

Mein P. 1999. European Miocene Mammal Biochronology. In: G Rößner, K Heißig (Eds), The Miocene land mammals of Europe. Munich, Verlag Dr. Friedrich Pfeil, 25–38.

Meulen, AJvd, Garciá-Paredes I, Àlvarez-Sierra MA, Hoek Ostende LWvd, Hordijk K, Oliver A, Peláez-Campomanes P. 2012. Updated Aragonian biostratigraphy: Small Mammal distribution and its implications for the Miocene European Chronology. Geologica Acta 10, 1–24.

Meyer H von. 1846. Über die fossilen von Wirbeltieren welche die Herren von Schlagintweit von ihren Reisen Indien und Hochasien mittgebracht haben. Palaeontographica 15, 1–40.

Orliac MJ. 2006. *Eurolistriodon tenarezensis*, sp. nov., from Montréal-du-Gers (France): implications for the systematics of the European Listriodontinae (Suidae, Mammalia). Journal of Vertebrate Palaeontology 26, 967–980.

Orliac MJ. 2009. The differentiation of bunodont Listriodontinae (Mammalia, Suidae) of Africa: new data from Kalodirr and Moruorot, Kenya. Zoological Journal of the Linnean Society 157, 653–678.

Orliac, MJ, Antoine P-O, Métais G, Marivaux L, Crochet J-Y, Welcomme J-L, Baqri SRH, Roohi G. 2009. *Listriodon guptai* Pilgrim, 1926 (Mammalia, Suidae) from the early Miocene of the Bugti Hills, Balochistan, Pakistan: new insights into early Listriodontinae evolution and biogeography. Naturwissenschaften 96, 911–920.

Pickford M, Morales J. 2003. New Listriodontinae (Mammalia, Suidae) from Europe and a review of *Listriodont* evolution, biostratigraphy and biogeography. Geodiversitas 25, 347–404.

Sach VJ. 2014. Fossilienkatalog der Oberen Süßwassermolasse (OSM), Brackwassermolasse (BM), Oberen Meeresmolasse (OMM) und der Unteren Süßwassermolasse (USM) in Südwestdeutschland. Documenta naturae Sonderband 70, 1–115.

Seehuber U. 2009. Litho- und biostratigraphische Untersuchungen in der Oberen Süßwassermolasse in der Umgebung von Kirschheim in Schwaben. Documenta naturae 175, 1–355.

Stromer R. 1930. Neue Funde fossiler Säugetiere im Obermiocän bayerisch Schwabens. Bericht Naturwissenschaftlichen Vereins für Schwaben und Neuburg 48, 29–31.