A New Talpid from the Late Eocene of North America

Authors: Karen J. Lloyd, and Jaelyn J. Eberle
Source: Acta Palaeontologica Polonica, 53(3) : 539-543
Published By: Institute of Paleobiology, Polish Academy of Sciences
URL: https://doi.org/10.4202/app.2008.0311
A new talpid from the late Eocene of North America

KAREN J. LLOYD and JAELYN J. EBERLE

The origin and early evolution of talpids (moles, shrew-moles, and desmans) is not well understood, in large part due to the poor fossil record of early talpids. Here we report the oldest known talpid from North America, Oreotalpa florissantensis gen. et sp. nov., based upon a tiny dentary with m1–m3 discovered in upper Eocene (Chadronian) strata of the Florissant Formation, Florissant Fossil Beds National Monument, Colorado. Oreotalpa extends the North American record of talpids back by some six Ma and appears temporally correlative with the oldest documented talpids from the late Eocene of Europe. While others have postulated an Asian origin for talpids, discovery of Oreotalpa suggests that the evolution of the group was underway in North America by late Eocene time and raises the possibility of a North American origin.

Introduction

The Talpidae (moles, shrew-moles, and desmans) comprise some 17 living genera and 42 species of small-bodied, semi-aquatic and subterranean burrowers that are widely distributed throughout temperate regions of Europe, Asia, and North America (Nowak 1991; Sánchez-Villagra et al. 2006). Given their small size and cryptic lifestyles, talpids have been challenging to study.

Most authors (e.g., Hutchison 1968; Yates and Moore 1990; Whidden 2000; Sánchez-Villagra et al. 2006) agree that talpids form a monophyletic group, although evolutionary affinities within the family are controversial and the few published phylogenetic studies focus on modern genera. While talpids traditionally were placed with hedgehogs, shrews, tenrecs, and solenodons in the Lipotyphla, this grouping appears to be paraphyletic. Based upon more recent molecular (e.g., Roca et al. 2004) and combined molecular-morphology (e.g., Asher 2007) studies, talpids have been allied only with shrews (soricids) and hedgehogs (erinaceids) in the Euailipotyphla (Waddell et al. 1999; Murphy et al. 2001; Douady and Douzery 2003). McKenna and Bell (1997) placed talpids in the order Erinaceomorpha within the Eulipotyphla, while Hutterer (2005) placed them within the Order Soricomorpha. The origin of talpids is poorly understood, due in large part to the sparseness and fragmentary nature of early talpid fossils.

Here we describe a new fossil talpid based upon a right dentary discovered in uppermost Eocene (Chadronian) strata of the Florissant Formation, central Colorado, USA. The Florissant fossil extends the North American record of Talpidae back by at least six Ma. Up until this discovery, the oldest documented North American talpids were late Oligocene in age (Macdonald 1970; McKenna and Bell 1997). The Florissant talpid appears to correlate in age with the oldest known talpid, Eotalpa, from latest Eocene (upper Ludian) strata of the London Basin on the Isle of Wight (Sigé et al. 1977). The Ludian is correlative to the Priabonian age (Savage and Russell 1983) and Headonian European Land Mammal Age, which, in turn, is correlated to the Chadronian North American Land Mammal Age (McKenna and Bell 1997). There is also an undetermined genus and species of Talpinae reported from the terminal Eocene of eastern Kazakhstan (Gabunia and Gabunia 1987; Lopatin 2002a).

The talpid reported here (FLFO 5813) was discovered at University of Colorado Museum of Natural History (UCM) locality 92179 in the Florissant Formation, Florissant Fossil Beds National Monument, central Colorado, USA (Fig. 1). Comprised of lake shales, volcanic sediments, and fluvial deposits, the Florissant Formation was defined by Evanno et al. (2001), who recognized six informal subdivisions. UCM locality 92179 is within the lower mudstone unit, directly below the famous petrified forest area of the National Monument at the 29-meter level of the stratigraphic section measured by Evanno et al. (2001: fig. 4). The lower mudstone unit is interpreted as representing stream deposits, and in its top few meters, a lahar deposit that buried the petrified forest (Evanno et al. 2001). Mammalian biostratigraphy (Worley-Georg and Eberle 2006), paleomagnetic analyses (Prothero and Sanchez 2004), and a weighted mean age of 34.07 ± 0.10 Ma from 40Ar/39Ar analyses of pumice (Evanno et al. 2001) indicate a latest Eocene (Chadronian) age for the Florissant Formation.

Institutional abbreviations.—CMNH, Carnegie Museum of Natural History, Pittsburgh, USA; FLFO, Florissant Fossil Beds National Monument, Florissant, USA; UCM, University of Colorado Museum of Natural History, Boulder, USA.

Other abbreviations.—Lowercase letters (e.g., m1) designate teeth from lower jaws; L, left tooth (e.g., Lm1); R, right tooth (e.g., Rm1); M/m, molar; A-P length, anteroposterior length; WTri, width of trigonid; WTal, width of talonid.

Material and methods

The Florissant talpid was recovered through dry-screening and sorting under magnification of loose sediment recovered from UCM locality 92179. The Florissant talpid is catalogued in the Fossil Vertebrate Collection at the UCM; consequently, it has a UCM catalog number as...
well. Detailed locality information is on file at FLFO and in the Paleontology Section at UCM. The fossil was compared with specimens and casts at the UCM, the American Museum of Natural History, the Field Museum of Natural History, and with descriptions in the literature. Measurements were done via a Spot\textsuperscript{TM} camera attached to a microscope and calibrated Spot\textsuperscript{TM} version 3.5.8 for Windows XP\textsuperscript{TM} software, and are in millimeters (mm). Cusp terminology and measurements follow Hutchison (1974: fig. 1). The classification follows McKenna and Bell (1997).

Systematic paleontology

Grandorder Lipotyphla Haeckel, 1866
Order Erinaceomorpha Gregory, 1910
Family Talpidae Fischer von Waldheim, 1817
Genus Oreotalpa nov.

*Etymology:* Ore (Greek): mountain, in reference to Colorado’s Rocky Mountains where the talpid was discovered; talpa (Latin): mole.

*Type species:* Oreotalpa florissantensis gen. et sp. nov., by monotypy.

*Diagnosis.*—As for the type species.

Oreotalpa florissantensis sp. nov.

Fig. 2, Table 1.

*Etymology:* Florissantensis, named for Florissant Fossil Beds National Monument.

*Holotype:* FLFO 5813 (UCM 99553), a right dentary fragment with m1–m3.

*Type locality:* UCM locality 92179, Florissant Fossil Beds National Monument, Florissant, Colorado, USA.

*Type horizon:* Florissant Formation, latest Eocene (Chadronian).

*Diagnosis.*—Small talpid with m2>m1>m3. Differs from most derived talpids, but similar to some Oligocene talpids, in having m1 with metaconid taller than entoconid. Similar in size and morphology to European Myxomygale (Oligocene–Miocene) and Asian Mongolopala (Oligocene). Differs from Oligocene Myxomygale antiqua and M. vauclusensis in more anteriorly-placed posterior mental foramen (under middle of m1). Differs from M. antiqua, but as in M. vauclusensis and Miocene M. gracilis, m1<m2. Differs from M. gracilis in more posteriorly-placed mental foramen and cristid obliqua does not join metastylid. Differs from M. vauclusensis and Asian Oligocene Mongoloscapter in absence of metastylid and more labial placement of cristid obliqua on posterior wall of metaconid. Differs from Asian Oligocene Mongolopala in m1-cm2 and absence of lingual cingulid below paraconid. Differs from late Oligocene North American Quadrudens wilsoni in its smaller size (~50%), discontinuous labial cingulid, and a smaller, narrower m1 that lacks a rectangular trigonid.

*Description.*—FLFO 5813 (UCM 99553) is a right dentary fragment with m1–m3 (Fig. 2). The posterior mental foramen is positioned under the middle of m1. The apices of several cusps on m1–m2 are broken, but the cusps on m3 are intact and unworn, and consequently we used this tooth as the basis for discussing relative cusp height differences below. The m2 is slightly longer than m1, which, in turn, is longer than m3, as is characteristic of most talpids (Sánchez-Villagra et al. 2006), although in some Oligocene talpids such as Myxomygale antiqua (Crochet 1974) and Mongolopala tathue (Ziegler et al. 2007), m1>m2. On m1, the trigonid is noticeably narrower than the talonid, while they are closer in width on m2 (Table 1). On m3, the trigonid is wider than the talonid, although they are similar...
in length. The protoconid is the tallest molar cusp, the paraconid is considerably smaller and lower than the proto- and metaconids, and the hypo- and entoconids are similar in height. The metaconid is taller than the entoconid. A postcristid runs between the hypoconid and entoconid, and the hypoconulid is separate. A long cristid obliqua extends from the hypoconid diagonally to the posterior wall of the trigonid lingual to the midline of the tooth and ascending the wall of the metaconid, although not to its apex. A V-shaped talonid notch occurs on m1–m2, as in most living talpids (Sánchez-Villagra et al. 2006), although the meta- and entocristids are high enough to lingually close off a relatively deep talonid basin. The m1 and m2 bear a tiny hypoconulid (= entostylid of Hutchison 1974) that is situated directly posterior to and below the entoconid. The m3 has an unreduced talonid that lacks a hypoconulid. The labial cingulid is not continuous around the hypoconid and protoconid. There is no lingual cingulid. An anterior cingulid is present on m1–m3. Although m1–m2 bear a posterior cingulid, m3 lacks one.

Discussion. — Oreotalpa appears morphologically most similar to Oligocene–Miocene Myxomygale from Europe and lower Oligocene Mongolopala from Asia. Incidentally, Ziegler et al. (2007) noted that Mongolopala is a morphologically most similar to Myxomygale. Oligocene Myxomygale antiqua and M. vauclusensis differ from Oreotalpa in having a more posteriorly-placed mental foramen (under posterior root of m1). Additionally, M. vauclusensis differs from Oreotalpa in bearing a metastylid and more lingually-placed cristid obliqua (Crochet 1995). Late Oligocene Mongoloscapter also bears a metastylid (Lopatin 2002a). Early Oligocene Mongolopala differs from Oreotalpa in having m1>m2 and a weak lingual cingulid on the paraconid (Ziegler et al. 2007).

Up until discovery of Oreotalpa, the earliest documented North American talpid was the late Oligocene (Arikareean) Quadrodonts wilsoni from the Sharps Formation, South Dakota, which was originally described as an erinaceid (Macdonald 1970). Q. wilsoni is about 50% larger than Oreotalpa and bears a relatively larger m1 that is wider than m2, with a broad, flattened, rectangular trigonid that comprises almost two-thirds of the tooth. Lower molars of Q. wilsoni have continuous labial cingulids (Macdonald 1970), unlike Oreotalpa, and appear to be more inflated, perhaps adapted to a more durophagous diet.

Because talpid molars are morphologically similar to those of soricids (shrews), chiropterans (bats), and proscalopids, a comparison of Oreotalpa to representatives of these groups is given below.

Soricidae was traditionally considered the sister group to talpids (e.g., Butler 1988). Dommina, the dominant North American soricid during Chadronian time, bears a mental foramen beneath m1 and molars that look superficially quite similar to Oreotalpa. However, soricids are more primitive than talpids in having m1>m2>m3 (Sánchez-Villagra et al. 2006). Soricid molars are differentiated from Oreotalpa by having an entoconid that is noticeably taller than the hypoconid and a shallow hypoflexid (Tejedor et al. 2005). Additionally, in soricids, the molar trigonid is longer due to an anteriorly-expanded paracristid and paraconid. More...
narrow talonids, especially on m3 where the talonid is consider-
ably narrower than the trigonid (Reed 1961; Barnosky 1981). In
contrast to Oreotalpa, Oligoscalops molars lack a distinct anterior
cingulid. Lower molars on the holotype of Oligoscalops whiting−
ensis (CMNH P25800) are worn and incomplete, and their
lengths could not be measured. However, in Proscalops, m1 is
longer than m2 (Reed 1961), in contrast to talpids where the oppo−
site occurs.

Discovery of Oreotalpa implies that the talpid lineage ex−
tends back at least to late Eocene time in North America, which
is consistent with some molecular estimates of divergence times
that suggest eulipotyphlan subfamilies originated during the
Eocene (Douady and Douzery 2003). Phylogenetic analysis
based primarily upon nuclear DNA (Roca et al. 2004) suggests
that soricids (shrews) and Erinaceids (hedgehogs) form a clade
that is the sister group to talpids. If correct, this implies that a
talpid ghost lineage extends back at least into the Paleocene,
based upon the earliest erinaceid, Litolestes, from North Amer−
ica (McKenna and Bell 1997).

From a biogeographic standpoint, appearance of three mor−
phologically similar talpids, Oreotalpa (latest Eocene, North Amer−
ica), Myxomygale (early Oligocene, Europe), and Mongo−
lopala (early Oligocene, Asia) suggests Holarctic intercontinental
dispersal of talpids prior to latest Eocene and raises the ques−
tion of talpids origins. To date, most workers have favored a Eur−
asian origin primarily because isolated teeth of the earliest Talpidae were found in the Upper Eocene of Europe and as−
signed to Eotalpa and Geotrypus (Sigé et al. 1977; McKenna
and Bell 1997; Whidden 2000), and an undetermined genus and
species of Talpinae is known from the latest Eocene of eastern
Kazakhstan (Gabunia and Gabunia 1987). Within the biostrati−
graphic resolution, all appear roughly coeval. Although Ore−
talpa does not preclude a Eurasian origin for the Talpidae, it
raises the possibility of a North American origin for the group.
Proscalopidae, which first appeared in the latest Eocene of
North America, has been tentatively considered the sister group
to Talpidae by some workers (e.g., Reed 1961; McKenna and
Bell 1997). In addition, soricids and erinaceids may form a clade
that is the sister group to talpids (Roca et al. 2004). In any event,
presence of talpids in the late Eocene of North America, when
considered alongside the assumption that sister taxa originate in
the same geographic area, provides support for a North Ameri−
can origin for talpids given the antiquity of proscalopids and
erinaceids in North America. Biogeography of the oldest soricids is more uncertain. While Dommina from the middle Eocene (Uinant) of North America was long considered the old−
est, basal soricid, recent discovery of an Asian middle Eocene soricid may predate Dommina (Lopatin 2002b). The age of these early soricids ultimately rests on refinement of biostratigraphic correlations between Asia and North America.

The Eocene talpid record is currently based upon Oreotalpa
from North America (this report), the European genera Eotalpa
and Geotrypus (Sigé et al. 1977; McKenna and Bell 1997; Whid−
den 2000), and an undetermined genus and species from eastern
Kazakhstan (Gabunia and Gabunia 1987). Eotalpa is known from
two isolated upper molars (RM1 and M2; Sigé et al. 1977) and the
holotype of Geotrypus includes a partial mandible with premolars
(Hugueney 1972), precluding their direct comparison with the
lower molars of Oreotalpa and making it challenging at best to in−
clude these taxa in recent talpid phylogenies based mostly on cra−
nial and postcranial characters (Sánchez−Villagra et al. 2006),
musculature (Whidden 2000), and molecular sequences (e.g.,
Shinohara et al. 2003). Our understanding of the geographic ori−
gins of talpids requires discovery of many more (and complete)
fossils combined with comprehensive phylogenetic analyses that
include both fossil and living talpid taxa. Nevertheless, discovery
of Oreotalpa indicates that talpids had dispersed between North
America and Eurasia by late Eocene time.

Acknowledgments.—Paleontological fieldwork was conducted in
2003−2005 within the boundaries of Florissant Fossil Beds National
Monument thanks to a permit issued to us by the National Park Service.
We thank Herbert Meyer (FLFO) for assistance with the permitting
process, and Emmett Evanoff (University of Northern Colorado, Gree−
ley, Colorado, USA) for sharing valuable information concerning the
fossil locality. Marie Worley−Georg (Chicago, Illinois, USA) recov−
ered the talpid specimen via sorting sedimentary matrix under magnifi−
cation. Peter Robinson (UCM) and the late Malcolm McKenna (Ameri−
can Museum of Natural History, New York, New York, USA and UCM) provided valuable advice concerning taxonomic identification. James Honey, Mariko Kageyama, and Toni Culver (UCM), Darrin Lunde (American Museum of Natural History, New York, New York, USA), and William Simpson (Field Museum of Natural History, Chi−
cago, Illinois, USA) loaned specimens and casts for comparative pur−
coses. Sara Olesiak (University of Colorado, Boulder, Colorado, USA)
produced SEM images of the talpid specimen. We benefited consider−
ably from the comments of anonymous reviewers on an earlier draft of
the manuscript. We especially thank Richard Cifelli (Oklahoma Mu−
seum of Natural History, Norman, Oklahoma, USA), Robert Asher
(Museum of Zoology, Cambridge University, Cambridge, UK), Alexei
Lopatin (Paleontological Institute, Russian Academy of Sciences, Mos−
cow, Russia), and Reinhard Ziegler (Staatliches Museum für Natur−
kunde Stuttgart, Stuttgart, Germany) for their constructive comments
and advice.

References

Asher, R.J. 2007. A web−database of mammalian morphology and a reanalysis
of Placental phylogeny. BMC Evolutionary Biology 7: 108.

Barnosky, A.D. 1981. A skeleton of Mesoscalops (Mammalia: Insectivora)
from the Miocene Deep River Formation, Montana, and a review of
proscalopid molars: Evolutionary, functional, and stratigraphic relation−

The Phylogeny and Classification of the Tetrapods, Vol. 2, Mammals,


Crochet, J.Y. 1995. Le Garouilles et les sites contemporains (Oilgocéne, MP
25) des Phosphorites du Quercy (Lot, Tarn−et−Garonne, France) et leurs
faunes de vertébrés. 4. Marsupiaux et Insectivores. Palaeontographica
A 236 (1−6): 39–75.

divergence times and the evolution of “Insectivora.” Molecular Phylo−

Evanoff, E., McIntosh, W.C., and Murphey, P.C. 2001. Stratigraphic summary
and 40Ar/39Ar geochronology of the Florissant Formation, Colorado. In: E.
Evanoff, K.M. Gregory−Wodzicki, and K.R. Johnson (eds.), Fossil Flora

Downloaded From: https://bioone.org/journals/Acta-Palaeontologica-Polonica on 02 Aug 2019
Terms of Use: https://bioone.org/terms-of-use


Lopatin, A.V. 2006. Early Paleogene insectivore mammals of Asia and establishment of the major groups of Insectivora. Paleontological Journal 40. (Supplement to No. 3), S205–S405.


