A New Species of Heterosminthus (Dipodidae, Rodentia, Mammalia) from the Miocene of the Baikal Region

1 author:

Alexey V. Lopatin
Russian Academy of Sciences
371 PUBLICATIONS   **1,654** CITATIONS

Some of the authors of this publication are also working on these related projects:

New genera of baleen whales (Cetacea, Mammalia) from the Miocene of the northern Caucasus and Ciscaucasia View project

Early evolution of mammals View project

A New Species of *Heterosminthus* (Dipodidae, Rodentia, Mammalia) from the Miocene of the Baikal Region

A. V. Lopatin

Paleontological Institute, Russian Academy of Sciences, ul. Profsoyuznaya 123, Moscow, 117868 Russia

Received April 15, 1999

Abstract—Based on fragmentary jaws from the Aya Cave (Baikal Region, Eastern Siberia; Middle Miocene) *Heterosminthus erbajevae* sp. nov. (Lophocricetinae, Dipodidae) is described. Based on the structure of the upper molars, the new species is closely related to the Central Asian lineage *H. mongoliensis–H. orientalis*, and is distinguished from the latter by the structure of M_1. As the specimens are well preserved, the jaw morphology of *Heterosminthus* has been examined in detail.

INTRODUCTION

The Aya Cave is one of the few localities for Miocene mammals in Eastern Siberia (Erbajeva and Alexeeva, 1997). It is located on the Priolkhonskoe Plateau in the Tazheran Steppe, at Aya Bay in the middle part of the western coast of Lake Baikal, 30 km southwest of Olkhon Island and 15 km east of the village of Yelantsy in the Irkutsk Region (Filippov *et al.*, 1995, fig. 1; Erbajeva and Filippov, 1997, fig. 1). The locality was discovered by Filippov in 1987 and examined repeatedly in 1988 to 1991 (Filippov *et al.*, 1995). A detailed stratigraphic description was performed by Erbajeva and Filippov (1997). Eight layers were distinguished, three of which (layers 3–5) contained Miocene vertebrates.

The fauna from the Aya locality includes fishes, amphibians, reptiles, and several species of small mammals. The latter comprise two uncertain taxa of insectivores; a lagomorph, *Amphilagus* cf. *fontannesi* (layers 3–5); rodents, *Cricetodon* cf. *sansaniensis* (layers 4 and 5), *Plesiosminthus* aff. *myarion* (layers 3 and 4), and Dipodidae gen. et sp. indet. (layer 5) (Erbajeva and Filippov, 1997). The remains belonging to the Lagomorpha and Rodentia were described in the paper cited. The layers considered were initially referred to as Middle–Upper Miocene (Filippov *et al.*, 1995). At present, the fauna is dated Early Miocene and compared to the European mammalian zones MN3–MN4 (Erbajeva and Alexeeva, 1997; Erbajeva and Filippov, 1997). In my opinion, the composition of small mammals most probably indicates the Middle Miocene Age of the Aya Fauna.

M.A. Erbajeva (Buryat Geological Institute of the Siberian Division of the Russian Academy of Sciences) kindly placed at my disposal specimens referred to as Dipodoidea from the Aya locality for reexamination (the material was transferred to, and is now housed at the Paleontological Institute of the Russian Academy of Sciences).

An isolated tooth originally determined as Dipodidae gen. et sp. indet. (Erbajeva and Filippov, 1997, figs. 5c–5g) is shown to be a lower premolar of a rodent belonging to the family Aplodontidae, registered in the Early–Middle Miocene of Central Asia and Kazakhstan as several species of the genus *Ansomys* (Qiu, 1987; Qiu and Sun, 1988; Qiu and Qiu, 1995; Lopatin, 1997; Zazhigin and Lopatin, 2000). Regarding the structure of P_4, this form is most similar to the morphotype of the Ansomyinae; however, large measurements, high crown, and fused roots exclude the possibility that it belongs to *Ansomys*. The most correct determination of this specimen (PIN, no. 4800/1) is Aplodontidae gen. indet.

The jerboa specimens referred to as *Plesiosminthus* aff. *myarion* Schaub, 1930 (Zapodidae, Sicistinae) are a fragmentary upper jaw containing M^1 and M^2 from layer 3 and an almost complete dentary containing M_1 from layer 4. Based on a preliminary description (figures were not given), I previously indicated that the morphology of the upper molars did not agree with the assignment of this specimen to the genus *Plesiosminthus* (Lopatin, 1999). Examination of the material allowed me to substantiate that the specimens under consideration belong to a new species of the genus *Heterosminthus* (Lophocricetinae, Dipodidae) that was widespread in the Miocene of Asia (Zazhigin and Lopatin, 2000).

In this study, these specimens are described as a new species; phylogenetic relationships of this form are discussed. The terminology for the elements of the occlusal surface of teeth follows Zazhigin and Lopatin (2000).

SYSTEMATIC PALEONTOLOGY

Family Dipodidae Fischer, 1817

Subfamily Lophocricetinae Savinov, 1970

Genus *Heterosminthus* Schaub, 1930

Heterosminthus erbajevae Lopatin, sp. nov.

E t y m o l o g y. The species is named in honor of M.A. Erbajeva.

H o l o t y p e. PIN, no. 4800/3, right dentary with M_1; Eastern Siberia, Baikal Region, Aya locality; Middle Miocene.
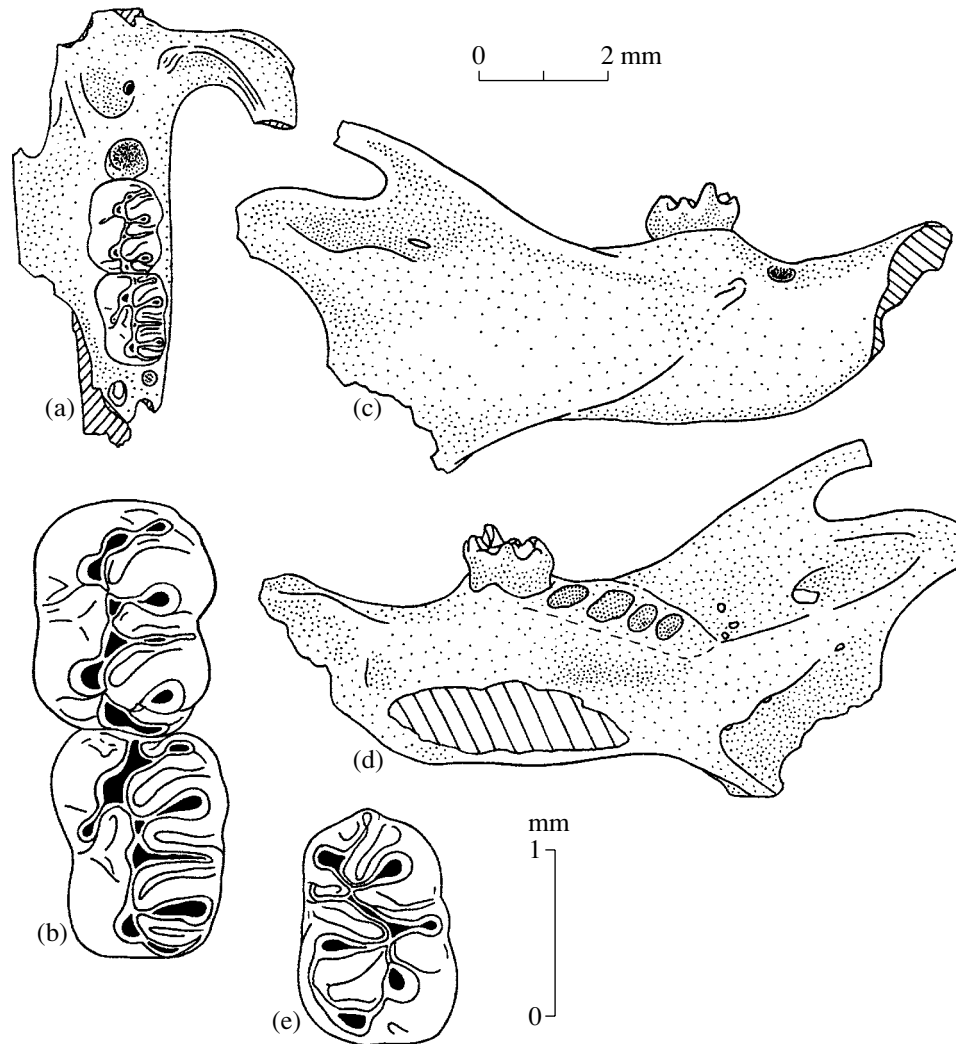
Fig. 1. *Heterosminthus erbajevae* sp. nov.: (a, b) PIN, no. 4800/2, fragmentary left maxilla containing M^1 and M^2: (a) complete specimen and (b) M^1 and M^2; (c–e) holotype PIN, no. 4800/3, right dentary containing M_1: (c) labial side, (d) lingual side, and (e) M_1.

Description (Fig. 1). A medium-sized member of the genus. The maxilla has a stout and broad zygomatic process, the posterior base of which is located ahead of the alveolus of P^4, at a distance approximately equal to the length of the latter. In the anterior part, the zygomatic process is substantially expanded ventrally and dorsally. The dorsal part of the external wall of the infraorbital canal is broken off; therefore, it is impossible to judge the extent to which it was closed (however, it is evident that the wall did not fuse completely with the body of the maxilla). A tubercle and a ridge on the masseteric area on the ventral side of the base of the zygomatic arch are weak, the masseteric groove is only slightly developed. A deep prealveolar fossa lies medial to the tubercle of the masseteric area, just ahead of the P^4 alveolus; the anterolateral part of the fossa bears a small foramen providing passage for a nerve or a blood

vessel. The posterior edge of the incisor foramen reaches the transverse level of the anterior edge of the P^4 alveolus.

The alveolus of P^4 is relatively large and round. M^1 and M^2 are four-rooted and rounded rectangular in outlines. In M^1, the posterior lobe is a little wider than the anterior lobe; in M^2, it is substantially narrower. The lingual cusps are massive and slanting medially, the labial cusps are weakly extended transversely.

The anterocone of M^1 is well developed, large, and clearly detached; it is connected to a well-pronounced anterostyle by a relatively high anteroloph II. The anteroloph I is only weakly developed and looks like a small ridge on the anterior edge of the occlusal surface; it is separated from the anteroloph II by a small valley and fused with the bases of the anterocone and anterostyle. The posterior arm of the protocone and the lin-

gual projection of the paracone are connected to the anterior end of the endoloph and together form the protoloph II. The protostyle is a well-pronounced but relatively narrow crest. The mesocone is well developed and connected labially to a long mesoloph. The medial part of the mesoloph is relatively high and broad, the lateral part is weak, narrow, and low. The hypocone and the metacone are connected by a relatively large metaconule (metaloph II). The labial arm of the posteroloph is well developed and long, the lingual arm is low and short.

On M^2, the anterocone is developed to a lesser extent than on M^1 and connected to a large anterostyle by the anteroloph II; anteriorly, it fused with a small double-armed anteroloph I. The pattern of contact between the protocone and the paracone is the same as on M^1. The protostyle is large and distinctly expanded posteriorly. The mesoloph is well developed and complete. The metacone adjoins the middle of the hypocone (metaloph I). The posteroloph is small, it frames the posterior edge of the occlusal surface.

M^3 is not preserved; judging from the alveolus, it was relatively small and three-rooted.

The horizontal ramus of the lower jaw is low, the ascending ramus is high. The tooth row is positioned at a relatively large angle to the longitudinal axis of the mandible. The mental foramen is located at the upper edge of the bone, in the posterior part of the diastema. The lower masseteric ridge is well-pronounced; the masseteric tubercle is small but distinct, located on a level with the anterior root of M_1. The upper boundary of the masseteric area is marked by a weak groove. The alveolar tubercle is large and moderately expanded. Dorsal to the latter, there is a fossa of temporal muscle looking like a large longitudinally extended depression containing a small foramen of the mandibular canal in the anterior part. The coronoid process is long, narrow, and curved posteriorly. An incisure between the coronoid process and the articular process is superficial. The articular process is only slightly extended and thin. The articular head is relatively short and narrow. A fossa on the medial side of the articular process (named the dipodid groove) is deep and wide, it contains a large mandibular foramen. In addition, three small foramina are located in the region adjoining posterolaterally the posterior edge of the alveolar part of the horizontal ramus. The angular process is large, long, and narrow; it bears a deep depression on the medial side. The dorsal wall of this depression contains three small foramina located one by one on an anteroposteriorly directed line. A piece of the angular process is broken off; therefore, it is impossible to determine whether or not it was fenestrated.

M_1 is extended. The anteroconid is extremely small and connected to the metaconid by a narrow crest. The protoconid and the metaconid are opposed and connected to each other by a well-pronounced metalophid II curving posteriorly. A well developed oblique endolophid adjoins the central part of the metalophid posteriorly, a narrow and weak transverse mesolophid deviates from the lingual end of the endolophid. Lingually, the mesolophid is connected to a weak cingulid-like element that is probably rudimentary mesostylid and metastylid fused with each other. A small mesoconid, a short and stout ectomesolophid, and a relatively large and high ectostylid are fused to form an integral transverse element, in which the mesoconid and the ectostylid are almost equal in size. The arms of the entoconid and hypoconid are connected to the posterolingual angle of the mesoconid at the same point. The hypoconulid is well-pronounced. The posterolophid is long, connects the hypoconulid to the entoconid, completely closes the posterofossettid, and becomes a sharp posterolingual rib of the entoconid. M_1 is double-rooted. M_2 and M_3 are not preserved. Judging from the alveoli, they were also double-rooted but substantially shorter than M_1.

M e a s u r e m e n t s, mm. Holotype: length × width of M_1, 1.45×0.975; length of the alveoli of M_2 and M_3, 1.3 and 1.05, respectively; mandibular length, 14; depth of the mandibular body at the mental foramen and under M_1, 2.2 and 2.9, respectively; and height of the ascending ramus, 5.7. Specimen PIN, no. 4800/2: length × width of the P^4 alveolus, 0.6×0.55; length of M^1–M^2, 2.825; and length × width of M^1 and M^2, 1.475×1.125 and 1.4×1.1, respectively.

C o m p a r i s o n. The new species is distinguished from *H. firmus* Zazhigin et Lopatin, 2000 and *H. honestus* Zazhigin et Lopatin, 2000 by the absence of protoloph I on M^2 and ectolophid on M_1; it is distinguished from *H. nanus* Zazhigin et Lopatin, 2000 and *H. jucundus* Zazhigin et Lopatin, 2000 by the shape of M^2, the absence of ectolophid on M_1, and by larger measurements; from *H. mongoliensis* Zazhigin et Lopatin, 2000 and *H. orientalis* Schaub, 1930, by the structure of the mesoconid, ectomesolophid, and ectostylid and by the pattern of connection between the posterior cusps and the mesoconid on M_1; from *H. gansus* Zheng, 1982, *H. mugodzharicus* Zazhigin et Lopatin, 2000, and *H. gabuniai* (Lungu, 1981), by a more primitive structure of M^1–M^2 (well-pronounced protoloph and complete mesoloph) and M_1 (the presence of the mesolophid and the absence of ectocingulid and posterostylid).

M a t e r i a l. In addition to the holotype, PIN, 4800/2, a fragmentary left maxilla containing the alveoli of P^4 and M^3 and complete M^1 and M^2 from the type locality.

DISCUSSION

The dental structure of *H. erbajevae* suggests that it belongs to the phylogenetic lineage *H. mongoliensis* (the end of the Early Miocene of Mongolia)—*H. orientalis* (Middle Miocene of China and Mongolia). This is indicated by the absence of the anterior protoloph on M^2 and ectolophid on M_1; the presence of these elements is characteristic of the lineage *H. firmus*—*H. honestus*—*H. jucundus* from Kazakhstan (Zazhigin and Lopatin, 2000). The new form is intermediate between

H. mongoliensis and *H. orientalis*. A large anterocone, weak protostyle, and long mesoloph on M^1 combined with a well developed mesolophid on M_1 show that *H. erbajevae* is closely related to *H. mongoliensis*, whereas the outlines of crowns and the shape of cusps are more similar to those of *H. orientalis*. However, the structure of the middle part of M_1 in *H. erbajevae* strongly distinguishes this form from the two above species and from all other species of the genus *Heterosminthus*. These distinctive features are small measurements of the mesoconid, a weak isolation of the latter from the ectomesolophid, relatively large measurements of the ectostylid, and the pattern of connection of the entoconid and hypoconid with the mesoconid. In the new species, the arms of the entoconid and hypoconid adjoin the mesoconid at the same point, whereas in other members of the genus *Heterosminthus*, the arms are isolated and usually located at a distance from each other. *Heterosminthus erbajevae* probably belongs to deviating branch within the phylogenetic lineage *H. mongoliensis*—*H. orientalis*. If the assumption is made that *H. erbajevae* originates directly from *H. mongoliensis*, it should be dated the Middle Miocene based on the evolutionary level of dental morphology. This dating is in agreement with the determination of other small mammals from the Aya locality (*Amphilagus* cf. *fontannesi* and *Cricetodon* cf. *sansaniensis*).

Regarding the taxonomic position of the Lophocricetinae, two different points of view have been proposed. The first is based on a large number of primitive characters in the jaw structure and presumes close relationships between this group and birch mice and jumping mice (Savinov, 1970), it implies the assignment of the Lophocricetinae to the Zapodidae (Qiu, 1985, 1996; Martin, 1994). McKenna and Bell (1997) regarded this group as a tribe belonging to the subfamily Sicistinae; however, the Lophocricetini are considered to include only the genus *Lophocricetus*, whereas *Heterosminthus* is placed in the Sicistini. The second hypothesis is based on phylogenetic interpretation of dental structure and implies the assignment of lophocricetines to the Dipodidae sensu stricto (Zazhigin and Lopatin, 1999, 2000; Lopatin and Zazhigin, 2000) or even to the Cardiocraniinae (Shenbrot *et al.*, 1995).

I believe that the dental structure suggests that the Lophocricetinae should be ranked a separate subfamily of the family Dipodidae.

ACKNOWLEDGMENTS

REFERENCES

Erbajeva, M.A. and Alexeeva, N.V., Neogene Mammalian Sequence of the Eastern Siberia, *Mém. Trav. EPHE, Inst. Montpellier*, 1997, no. 21, pp. 241–248.

Erbajeva, M.A. and Filippov, A.G., Miocene Small Mammalian Faunas of the Baikalian Region, *Mém. Trav. EPHE, Inst. Montpellier*, 1997, no. 21, pp. 249–259.

Filippov, A.G., Erbajeva, M.A., and Khenzykhenova, F.I., *Ispol'zovanie verkhnekainozoiskikh melkikh mlekopitayushchikh yuga Vostochnoi Sibiri v stratigrafii* (The Use of Upper Cenozoic Small Mammals from the South of Eastern Siberia in Stratigraphy), Irkutsk: VostSibNIIGGiMS, 1995.

Lopatin, A.V., The First Find of *Ansomys* (Aplodontidae, Rodentia, Mammalia) in the Miocene of Kazakhstan, *Paleontol. Zh.*, 1997, no. 6, pp. 102–105.

Lopatin, A.V., New Early Miocene Zapodidae (Rodentia, Mammalia) from the Aral Formation of the Altynshokysu Locality (North Aral Region), *Paleontol. Zh.*, 1999, no. 4, pp. 93–102.

Lopatin, A.V. and Zazhigin, V.S., The History of the Dipodoidea in the Miocene of Asia: 2. Zapodidae, *Paleontol. Zh.* (Moscow), 2000, no. 4, pp. 86–91.

Martin, R.A., A Preliminary Review of Dental Evolution and Paleogeography in the Zapodid Rodents, with Emphasis on Pliocene and Pleistocene Taxa, *Nat. Sci. Mus. Monogr.* (Tokyo), 1994, no. 8, pp. 99–113.

McKenna, M.C. and Bell, S.K., *Classification of Mammals above the Species Level*, New York: Columbia Univ. Press, 1997.

Qiu, Z., The Neogene Mammalian Faunas of Ertemte and Harr Obo in Inner Mongolia (Nei Mongol), China—3. Jumping Mice—Rodentia: Lophocricetinae, *Senckenberg. Lethaea*, 1985, vol. 66, no. 1/2, pp. 39–67.

Qiu, Z., The Aragonian Vertebrate Fauna of Xiacaowan, Jiangsu—7. Aplodontidae (Rodentia, Mammalia), *Vertebr. Palasiat.*, 1987, vol. 25, no. 4, pp. 283–296.

Qiu, Z., *Middle Miocene Micromammalian Fauna from Tunggur, Nei Mongol*, Beijing: Sci. Press, 1996.

Qiu, Z.X. and Qiu, Z.D., Chronological Sequence and Subdivision of Chinese Neogene Mammalian Faunas, *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, 1995, vol. 116, pp. 41–70.

Qiu, Z. and Sun, B., New Fossil Micromammals from Shanwang, Shandong, *Vertebr. Palasiat.*, 1988, vol. 26, no. 1, pp. 50–58.

Savinov, P.F., Dipodids (Rodentia, Mammalia) from the Neogene of Kazakhstan, in *Materialy po evolyutsii nazemnykh pozvonochnykh* (Materials on the Evolution of Terrestrial Vertebrates), Moscow: Nauka, 1970, pp. 91–134.

Shenbrot, A.G., Sokolov, V.E., Geptner, V.G., and Koval'skaya, Yu.M., *Mlekopitayushchie Rossii i sopredel'nykh regionov. Tushkanchikoobraznye* (Mammals of Russia and Adjacent Regions: Dipodoidea), Moscow: Nauka, 1995.

Zazhigin, V.S. and Lopatin, A.V., The Dipodoidea from the Miocene and Early Pliocene of Asia, *VI S"ezd Teriologicheskogo obshchestva: Tezisy dokladov* (VI Congr. Theriol. Soc.: Moscow, April 13–16, 1999), Moscow, 1999, p. 93.

Zazhigin, V.S. and Lopatin, A.V., The History of the Dipodoidea (Rodentia, Mammalia) in the Miocene of Asia: 1. *Heterosminthus* (Lophocricetinae), *Paleontol. Zh.*, 2000, no. 3, pp. 90–102.