NEW SPECIMENS OF *MERYCOPOTAMUS* (ARTIODACTYLA:
ANTHRACOTHERIIDAE) FROM MIDDLE MIOCENE OF POTWAR PLATEAU,
PAKISTAN

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ABSTRACT

The *Merycopotamus* remains are described from the Chinji Formation (middle Miocene) of the Lower Siwalik Subgroup of Pakistan. The material recovered from two fossiliferous localities of Chabbar Syedan and Dhok Bun Ameer Khatoun in Chakwal district, Punjab, Pakistan. The described specimens of *Merycopotamus nanus* add additional knowledge on Pakistani anthracotheriid diversity.

Keywords: Artiodactyls, Anthracotheriids, *Merycopotamus*, Chinji Formation, middle Miocene.

<https://doi.org/10.36899/JAPS.2020.6.0165>

Published online August 03, 2020

INTRODUCTION

The Potwar Plateau is the most fertile area in the Siwaliks that represents the extensive record of the vertebrate fossils (Pilbeam *et al.*, 1979; Badgley *et al.*, 2008; West *et al.*, 2010). Anthracotheriidae was very diversified in this region during Neogene (Pilgrim, 1913; Forster-Cooper, 1924; Black, 1978; Gaziry, 1987; Pickford, 1987). The described specimens of *Merycopotamus* are collected from two different localities of the Chinji Formation: Chabbar Syedan and Dhok Bun Ameer Khatoun. Both the sites have yielded many mammals remains that belong to the middle Miocene age. The newly found specimens document the poorly known anthracotheriid group from the Siwalik Group.

Chabbar Syedan: The studied outcrops (Lat. 33° 00' 16.1'' N; Long. 73° 13' 29.0'' E) are present nearby the Chabbar Syedan village, district Jhelum, Punjab, Pakistan (Fig. 1). The Formation is dominant in this area as the red claystone placed on subordinate hard grey sandstone with interbedding narrow beds of siliceous nodules (Aftab *et al.*, 2015, 2019; Abbas *et al.*, 2016). Chabbar Syedan denotes the middle stage of the Chinji Formation with approximate age of 13.2-12.2 Ma (Barry *et al.*, 2002; Nanda, 2002, 2008).

Dhok Bun Ameer Khatoun: The outcrops (Lat. 32° 47' N; Long. 72° 55' E) are located in the northeast of Choa Saidan Shah, Chakwal, Punjab, Pakistan (Fig. 1). The outcrops contain sandstones, siltstones and shales dumped in a riverine environment, mostly packed by uneroded igneous mineral sediments (Cheema, 2003;

Khan *et al.*, 2008, 2011). Dhok Bun Ameer Khatoun denotes the lower stage of Chinji Formation with age of almost 14.2-13.2 Ma (Barry *et al.*, 2002; Nanda, 2002, 2008).

MATERIALS AND METHODS

The material was collected from the middle Miocene localities of the Potwar Plateau, Northern Pakistan (Fig. 1). The specimens, collected from the surface, were transported to the laboratory and prepared for the taxonomic study. The specimens were catalogued, and their length and width (in mm) measured at occlusal level by a digital caliper. The dental terminology and measurements follow Lihoreau (2003). The fossils are kept in Dr. Abu Bakr Fossil Display and Research Centre, Department of Zoology, University of the Punjab, Lahore, Pakistan.

Abbreviations: BMNH-British Museum of Natural History; PUPC-Punjab University Paleontological Collection, University of the Punjab, Lahore, Pakistan; l-left; r-right; p-lower premolar; m-lower molar; M-upper molar, Ma-million years ago.

Systematic Palaeontology: Family Anthracotheriidae
Leidy, 1869

Genus *MERYCOPOTAMUS* Falconer and Cautley, 1847

Merycopotamus nanus Falconer, 1868

Holotype: BMNH, M40766, right M1 (Falconer, 1868).

Type locality: Khushalgarh, below Attock, the Punjab province, Pakistan (Falconer, 1868).

Diagnosis: As described by Lihoreau *et al.* (2007).

Stratigraphic level: Chinji Formation – middle Miocene (Falconer, 1868; Lihoreau *et al.*, 2007).

New material: PUPC 17/232, rp3 (Dhok Bun Ameer Khatoon); PUPC 18/251, lp3 (Chabbar Syedan); PUPC 15/440, lm1 (Dhok Bun Ameer Khatoon); PUPC 16/209, lm3 (Chabbar Syedan).

Description and comparison: PUPC 17/232 is a rp3 having coarse enamel and is triangular in shape (Fig. 2(1)). The anterior valley is broad and open. The anterior lobe includes the protoconid and paraconid, whereas the hypoconid covers most of the tooth posteriorly. A large cingulid covers the base of the tooth.

PUPC 18/251 is a well-worn and fragile lp3 (Fig. 2(2)), that preserves the hypoconid and entoconid only partially. The base of the tooth is completely covered by a thick cingulum throughout its length. The metaconid is higher than all the other conids. The roots are well preserved and the enamel is highly wrinkled.

PUPC 15/440 is a well-worn lm1 (Fig. 2(3)), in which the protoconid, hypoconid, and entoconid are partially broken. The mesostylid is preserved. The median valley is partially closed by a small tubercle. A thick cingulid is preserved at the base of the postprotocristid. The roots are well preserved.

PUPC 16/209 is mandibular fragment with lm3 (Fig. 2(4)). The preserved portion of the corpus is extremely weathered, fragile and cracked at various places. The anterior and posterior valleys show small tubercles. A thick cingulum is present at the base of the preprotocristid. The hypoconulid is massive and has a tubercle at its lingual side. A small cingulum is covered base of the hypoconulid.

The characteristics of this material is also the presence of an additional cusp on the mesiolingual apex of the premolars, the lack of premetacristid in the molar, access of prehypocristid and preentocristid to the lingual border of the molar and the position of the hypoconulid, in line with buccal cusps. All these characters belong to *Merycopotamus* (Lihoreau *et al.*, 2007). The Siwalik *Merycopotamus* is represented by three species: *M. nanus*, *M. medioximus* and *M. dissimilis* (Falconer, 1868; Falconer and Cautley, 1836, 1847; Lihoreau *et al.*, 2004). *Merycopotamus nanus* is different from *M. medioximus* by the smaller size of the lower molars (Fig. 3). It differs from the teeth of *M. dissimilis* by lacking the entoconid fold and by having loop-like hypoconulid in the m3 (Lihoreau *et al.*, 2007). The size of the described material clearly documents a species smaller than *M. medioximus* and *M. dissimilis*, their size falling within the range of *M. nanus* (Fig. 2, 3; Table 1). Furthermore, also the described lower molars present the occlusal pattern of *M. nanus* (Lihoreau *et al.*, 2007).

Table 1. The teeth measurements (in mm) of *Merycopotamus*. * represents the specimens described in the present study. Comparative material from Lihoreau *et al.* (2007), and Khan *et al.* (2013).

Taxa	Inventory No.	Nature & Position	Length	Width	W/L
<i>M. nanus</i>	PUPC17/232*	rp3	14.52	10.10	0.70
	PUPC 18/251*	lp3	16.5	12.0	0.73
	PUPC 15/440*	lm1	15.00	11.24	0.75
	PUPC16/209*	lm3	30.0	15.5	0.52
	Lihoreau <i>et al.</i> , 2007 (average values)	p3	15.7	10.1	0.68
		m1	19.7	12.4	0.63
		m3	33.2	15.9	0.48
<i>M. dissimilis</i>	PUPC 13/5	rm3	32.0	16.0	0.50
	Lihoreau <i>et al.</i> , 2007 (average values)	p3	18.0	10.0	0.56
		m1	20.7	14.0	0.68
		m3	39.2	20.1	0.51
	CCZ234	p3	21.2	13.5	0.64
<i>M. medioximus</i>	CCZ234	m1	21.7	14.6	0.67
	CCZ233	m3	40.7	19.5	0.48

DISCUSSION

Merycopotamus was documented from the Siwalik Hills of the Indian Subcontinent (Falconer and Cautley, 1836, 1847; Falconer, 1868; Colbert, 1938, 1943), as well as from Iraq (Brunet and Heintz, 1983),

Nepal (Munthe *et al.*, 1983), Indonesia (Königswald, 1933) and Thailand (Hanta *et al.*, 2005, 2008). In the Siwaliks, this genus was first described and discussed in detail by Falconer and Cautley (1847). *Merycopotamus* was recorded from the Chinji to Dhok Pathan formations of the Siwalik succession in the Potwar Plateau, Pakistan (Pilbeam *et al.*, 1977, 1979). The chronologically

Fig. 1. Map of Potwar Plateau in Pakistan showing the localities that yielded the specimens described in this paper.

Fig. 2. *Merycopotamus nanus*. Lower dentition: 1. PUPC 17/232, rp3; 2. PUPC 18/251, lp3; 3. PUPC 15/440, lm1; 4. PUPC 16/209, lm3. Views: a) occlusal, b) lingual, c) labial. Scale bar 10 mm.

Fig. 3. Scatter diagrams showing dental proportions of *Merycopotamus*. Comparative material from Lihoreau *et al.* (2007) and Khan *et al.* (2013).

Fig. 4. Temporal distribution of *Merycopotamus* from various Miocene to early Pleistocene localities of Asia, including Pakistan (taken from Hanta *et al.*, 2008).

youngest *Merycopotamus* in this region was found from Azad Kashmir (2.6-2.4 Ma; Steensma and Hussain, 1992). Temporally, the genus ranges from the middle Miocene to early Pleistocene of the Siwalik Group (Steensma and Hussain, 1992; Barry *et al.*, 2002; Lihoreau *et al.*, 2007). The Tatrot Formation yielded two species of *Merycopotamus* i.e. *M. minor* and *M. major*, both species being renamed as *M. nanus* by Falconer (1868) and *M. dissimilis* by Falconer and Cautley (1847) respectively. Later, Colbert (1935) synonymized *M. nanus* with *M. dissimilis*. Lihoreau (2003) studied the *Merycopotamus* specimens collected by the team of the Geological Survey of Pakistan and the Peabody Museum of Yale University, then he established a new additional species, *M. medioximus* (Lihoreau *et al.*, 2004).

M. nanus (basal species) was found in the Chinji Formation (13.9-11.3 Ma, middle Miocene) of the Siwalik Group (Pilbeam *et al.*, 1977, 1979; Barry *et al.*, 2002; Lihoreau, 2003; Hanta *et al.*, 2008). *M. medioximus* (slightly derived), described by Lihoreau *et al.*, (2004), is an intermediate form. It was found in the Nagri and lower Dhok Pathan formations (10.4-8.6 Ma, early Late Miocene) of the Siwalik Group (Lihoreau *et al.*, 2004). *M. dissimilis* (derived form) is the youngest species and present in the upper Dhok Pathan, Tatrot, and lower Pinjor formations (7.8-2.4 Ma, late Miocene to early Pleistocene) of the Siwalik Group (Barry *et al.*, 2002; Lihoreau *et al.*, 2007).

M. medioximus and *M. dissimilis* share a synapomorphic character (the mesostyle division) which clearly reflects that *M. nanus* is a stem group of the

genus. *M. nanus* is confined to the Indian subcontinent and is the oldest representative in the middle Miocene of Lower Siwalik Subgroup (Chinji Formation) (Fig. 4). If the morphology (division) of the mesostyle is regarded as the important character in *Merycopotamus* evolution, it is considered that *M. medioximus* (early Late Miocene) is the first slightly more derived species emigrated from Indian Subcontinent to Thailand and developed into a new form, Tha Chang *Merycopotamus* (Lihoreau *et al.*, 2007; Hanta *et al.*, 2008).

Conclusions: A rare species, *M. nanus* is reported from the outcrops of Potwar Plateau, Pakistan, based on additional specimens discovered recently. This material adds to the lower dentition of middle Miocene age of the Siwalik Group referred to *M. nanus*. The localities Chabbar Syedan and Dhok Bun Ameer Khatoon correspond to the upper part of the middle Miocene of the Siwalik Group, thus confirming the first appearance of *M. nanus* in the subcontinent.

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