Pakistan J. Zool., vol. 49(6), pp 2327-2330, 2017. **DOI**: http://dx.doi.org/10.17582/journal.pjz/2017.49.6.sc3

Short Communication

Fossils of *Boselaphus* (Bovini: Bovidae: Ruminantia) from Sardhok Pleistocene of Pakistan

Muhammad Khaled Siddiq[1], Ayesha Riaz[2], Muhammad Akbar Khan[1], Muhammad Adeeb Babar[1], Khalid Mahmood[1,*] and Muhammad Akhtar[1]

[1]Dr. Abu Bakr Fossil Display and Research Centre, Department of Zoology, University of the Punjab, Quid-e-Azam Campus, Lahore 54590, Pakistan

[2]Department of Zoology, GC Women University, Faisalabad, Pakistan

Article Information

Received 17 December 2016
Revised 02 March 2017
Accepted 25 March 2017
Available online 14 November 2017

Authors' Contributions

MAK provided concept and designed the study. MKS aquired the data. KM and MA analysed and interpreted the data. MAB and AR drafted the manuscript.

Key words

Pabbi Hills, Pinjor, Soan Formation, Boselaphus.

ABSTRACT

New *Boselaphus* (Mammalia, Bovidae) material is excavated from Pabbi Hills of Sardhok, northern Pakistan. Recently excavated bovid material in the Pleistocene locality of Sardhok (Punjab, Pakistan) includes dentition that provides a better knowledge of the taxon morphology, and this material expands our anatomical knowledge of this taxon. *Boselaphus namadicus* is spanning from about 3.4 to 0.6 Ma in the Siwalik Group. The Pleistocene species, *Boselaphus* cf. *namadicus,* was adapted to open and dry habitats of the Siwaliks.

Fossil mammals are common in the Pleistocene sediments of the Siwaliks (Dennell *et al*., 2006, 2008). The Pinjor fauna has shown that the very large mammals are abundant and the medium sized mammals are rare. The eustatic changes in sea level in Southeast Asia seem to have been an important factor for the extinction of the large sized mammalian species (Dennell *et al*., 2008). A faunal turnover is evident from the Sardhok outcrops, with the extinction of these taxa from Pakistan. Among those disappearing during this time are *Proamphibos kashmiricus, Hemibos triquetricornis, Kobus porrecticornis, Sivatragus bohlini, Hexaprotodon sivalensis, Rhinoceros sivalensis, Equus sivalensis, Stegodon bombifrons, Elephas planifrons,* and *Elephas namadicus* that are likely tied to both environmental changes as well as competition with new taxa, which had migrated southwards. The gradual reduction of *Stegodon* evidently supports from the Late Pliocene to Early Pleistocene, especially when the Upper Siwalik data are examined.

The Pinjor fauna is well known from Pakistan and India, and rare in Nepal and Myanmar (Colbert, 1935, 1943; Dennell *et al*., 2006). The presence of abundant Pinjor faunal element in India and Pakistan indicate that there was to- and fro- movement of fauna in these regions (Maglio, 1973; Sarwar, 1977; Dennell *et al*., 2008; Nanda, 2008). Many authors noted that the widespread of the Pinjor fauna in Pakistan, Kashmir, India, Nepal and Myanmar indicated its migration in the intermountain routes (Colbert, 1943; Valdiya, 1993; Tewari *et al*., 2002). Why these many species became extinct in the region, while some continued to survive to today, is not satisfactorily explained by human or climate-mediated models of extinction; it may be linked to differences in ecology and body size.

The Sardhok paleontological study area belonging to the Upper Siwaliks, located in the Potwar Plateau of Northern Pakistan, has yielded fossils of early Pleistocene (Supplementary Fig. 1). The Sardhok mammals are documented by outstandingly rich material. It increases knowledge of the dental morphometric characters of bovids, giraffids, cervids and proboscideans. On the other hand, it completes the picture of the faunal composition of the Siwalik early Pleistocene mammals. Despite the commonness of those species in the Siwalik early Pleistocene, earlier descriptions were hitherto only based mostly on the earlier material of unknown origin and the findings, enable to calibrate stratigraphic position of the species with the newly discovered material *in situ* (Supplementary Fig. 1).

Abbreviations: NHMUK, Natural History Museum, London; PUPC, Punjab University Palaeontological Collection, Lahore, Pakistan; SD, Sardhok locality; cf, confer; L, length; W, width; dp, deciduous premolar; M/m, molar.

* Corresponding author: khalidkasuri@gmail.com
0030-9923/2017/0006-2327 $ 9.00/0

Fig. 1. *Boselaphus* cf. *namadicus*: 1, PUPC 11/127, left mandible fragment with dp4-m1; 2, PUPC 69/207, ldp4; 3, PUPC 67/297, rm1; 4, PUPC 12/61, lm1; 5, PUPC 67/296, rm2; 6, PUPC 66/18, lm2; 7, PUPC 68/48, lm2. Views: a, occlusal; b, lingual; c, labial. Scale bar 10 mm.

Methodology

The specimens are recovered from the outcrops nearby Sardhok village by various field trips. Most of the fossils were collected by surface collection. Measurements are in mm. Upper teeth are in upper case (M3), lower teeth in lower case (m3). In descriptions, the teeth are characterized in detail.

Genus *Boselaphus* Blainville, 1816

Type species: Boselaphus tragocamelus (Pallas 1766).

Generic giagnosis: As in Pilgrim (1939)

***Boselaphus* cf. *namadicus* Rutimeyer, 1878**

Type specimen

NHMUK 36851, cranium and horn-cores; from the Pleistocene of the Narbada valley, India, described and figured by Rutimeyer (1878, p. 89, Pl. 6, figs 7-8) under the name of *Portax namadicus*.

Diagnosis

A *Boselaphus* larger size than *B. tragocamelus*; with horn-cores slightly closer to the orbits, with their inner keel situated farther inward and more to the front than in *B. tragocamelus*; temporal fossa relatively slightly shorter; occipital less convex transversely over the foramen magnum and less hollowed on either side of the median vertical line; occipital condyles much wider and projecting farther in rear of the occipital crest; foramen magnum much larger; paraoccipital process less compressed laterally" (Pilgrim, 1939).

Stratigraphic range: Upper Siwaliks.

Geographic distribution: South Asia (Pilgrim, 1939).

New material: Lower dentition: PUPC 11/127, left dp4-m1; PUPC 69/207, left dp4; PUPC 67/297, right m1; PUPC 12/61, left m1; PUPC 67/296, right m2; PUPC 66/18, left m2; PUPC 68/48, left m2.

Locality: Sardhok (SD9, SD19, SD24, SD25, SD26), Gujrat district, Punjab province, Pakistan.

Description

The lower deciduous premolar is trilobed tooth (Fig. 1-1). The lobes are well crescentic and the 1st lobe is shorter than the 2nd and 3rd lobes that are almost equal in size. The enamel is thin and rugose. The cingulum is present antero-labially. The two tubercles are present labially in the valleys between the first and second lobes as well as in the second and third lobes. The stylids are bulky and divergent comparatively (Fig. 1-1, 1-2). The antero-posterior length of the deciduous molar is considerably greater than the transverse diameter (Table I). The height of the lobes increases antero-posteriorly0. The ribs are highly projected. The rib of the third lobe is slightly tilted forward near the apex. The fossettid of the first lobe is simpler and wider than those of the second and the third lobes. The labial side of the third lobe is broad at the base, becoming abruptly narrow and pointed at the apex.

The lower molars are hypsodont and narrow crowned (Fig. 1-3 to 7). The stylids are well divergent. The molars represent pronounced crown neck. The enamel is finely rugose. The ectostylid is well developed lying towards the hypoconid with oval cross section (Fig. 1-3 to 7). The metaconid is spindle shaped with an inflated median part, which produces the moderately strong anterior median rib of the metaconid. The anterior transverse flange is very prominent in the molars. The hypoconid is more constricted than those of the protoconid.

Comparison

The molars show rugose enamel, strong ectostylids, prominent median ribs, constricted labial lobes, and strong and divergent stylids. The general contour of the studied specimens excludes the specimens from the tribe Bovini (*Proamphibos, Amphibos, Bos, Leptobos* etc.) and favor their inclusion to the tribe Boselaphini. The morphology of these specimens is typical of boselaphines, in general the divergent stylids and pronounced crown neck of the teeth make their inclusion in boselaphines (Pilgrim, 1937, 1939; Khan *et al*., 2008a, b, 2009, 2010). The specimens are large enough (Table I) to include them in the large Siwalik boselaphines of the Siwalik Pleistocene.

The dimensions and morphology of the studied material (Table I, Fig. 1) reveal all the features of the Pleistocene boselaphine species *Boselaphus namadicus,* a species recorded from the Upper Siwaliks of the subcontinent. The material is assigned to *Boselaphus* cf. *namadicus* owing to insufficient data.

Table I.- The measurements of the studied cheek teeth (mm) of *Boselaphus* cf. *namadicus.*

Specimen No.	Nature	Length	Width	W/L ratio
PUPC 11/127	dp4	29.0	12.0	0.41
	m1	26.2	13.8	0.52
PUPC 69/207	ldp4	31.7	11.4	0.35
PUPC 67/297	rm1	26.1	10.7	0.40
PUPC 12/61	lm1	31.4	13.7	0.43
PUPC 67/296	rm2	28.4	12.0	0.42
PUPC 66/18	lm2	32.0	14.7	0.45
PUPC 68/48	lm2	28.5	14.9	0.52

Discussion

The boselaphines are generally found abundantly in the Siwalik Group (Lydekker, 1878; Matthew, 1929; Colbert, 1935; Pilgrim, 1926, 1937, 1939; Akhtar, 1992; Khan and Farooq, 2006). Nevertheless, boselaphines are one of the dominant bovids found in the Late Miocene of Africa and Eurasia with a variety of morphs ranging small-medium to large size (Gentry, 1970, 1971, 1994; Vrba and Schaller, 2000; Khan *et al*., 2014). The small size species include *Elachistoceras* and *Eotragus*; the medium size species include *Miotragocerus, Tetracerus* and *Tragoportax*; the large size species include *Selenoportax, Pachyportax* and *Boselaphus*.

First record of *Boselaphus namadicus* from the Siwaliks was reported by Rutimeyer (1878) under the

name of the genus *Portax*. Later, Lydekker (1878) noticed the similarities of the sample with the living species of *Boselaphus tragocamelus* and renamed it *Boselaphus namadicus*. The tribe Boselaphini has wide distribution in the subcontinent Siwalik. But the group is now restricted to south Asia representing only two living species Nilegauy (*Boselaphus tragocamelus*) and Tetracere (*Tetracerus quadricornis*). *Boselaphus namadicus* is considered to be immediate ancestor of modern boselaphine *Boselaphus tragocamelus* or may close alley to the living species.

Conclusions

Boselaphus namadicus is recorded from the Sardhok Pleistocene of the Siwalik Group. The large mammalian faunal element indicates the important role of open landscapes throughout the Early Pleistocene of the region. The presence of wooded biotopes along a major river is indicated by the frequent occurrences of these large mammals. The predominance of large sized mammals in this sequence indicates the important role of open, steppe-like environment at that time.

Supplementary material

There is supplementary material associated with this article. Access the material online at: http://dx.doi.org/10.17582/journal.pjz/2017.49.6.sc3

Statement of conflict of interest

Authors have declared no conflict of interest.

References

Akhtar, M., 1992. *Taxonomy and Distribution of the Siwalik Bovids*. Ph. D. Diss., University of the Punjab, Lahore, Pakistan.

Colbert, E.H., 1935. *Am. Mus. Novit*. **799**: 1-24.

Colbert, E.H., 1943. *Trans. Am. phil. Soc., N. S.,* 32: 395-429.

Dennell, R., Coard, R. and Turner, A., 2006. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, **234**: 168-185. https://doi.org/10.1016/j.palaeo.2005.10.008

Dennell, R., Coard, R. and Turner, A., 2008. *Quat. Int.*, **192**: 78-88. https://doi.org/10.1016/j.quaint.2007.06.023

Gentry, A.W., 1970. In: *Fossil vertebrates of Africa* (eds. L.S.B. Leakey and R.J.G. Savage), Academic Press, London, **2**: 243-323

Gentry, A.W., 1971. *Bull. Br. Mus. (N.H.), G.S.,* **20**: 229-296.

Gentry, A.W., 1994. *Hist. Biol.*, **7**: 115-158. https://doi.org/10.1080/10292389409380449

Khan, M.A. and Farooq, U., 2006. *Int. J. zool. Res.,* **2**: 100-109.

Khan, M.A., Ahmad, Z. and Akhtar, M., 2008a. *Biologia (Pakistan),* **54**: 65-72.

Khan, M.A., Iqbal, M., Ghaffar, A., Khan, A.M. and Akhtar, M., 2008b. *Pakistan J. Zool.*, 40: 303-307.

Khan, M.A., Iliopoulos, G. and Akhtar, M., 2009. *Geobios*, **42**: 739-753. https://doi.org/10.1016/j.geobios.2009.04.003

Khan, M.A., Kostopoulos, D.S., Akhtar, M. and Nazir, M., 2010. *Neu. Jahrb. Geol. Paläont.*, **258**: 121-128.

Khan, M.A., Iqbal, J., Ali, S. and Akhtar, M., 2014. *Pakistan J. Zool.*, **46**: 463-470.

Lydekker, R., 1878. *Pal. Ind.*, **10**: 88-181.

Maglio, V.J., 1973. *Trans. Am. philos. Soc.,* **63**: 1-149. https://doi.org/10.2307/1006291

Matthew, W.D., 1929. *Bull. Am. Mus. Nat. Hist.*, **56**: 437-560.

Nanda, A.C., 2008. *Quat. Int.*, **192**: 6-13. https://doi.org/10.1016/j.quaint.2007.06.022

Pilgrim, G.E., 1926. *Proc. Pan-Pacific Sci. Congr.* Australia, pp. 896-931.

Pilgrim, G.E., 1937. *Bull. Am. Mus. N. H.*, **72**: 729-874.

Pilgrim, G.E., 1939. *Pal. Ind. N. S.,* **26**: 1-356.

Rutimeyer, L., 1878. *Abhandl. Schweiz. Paläontol. Gesell.,* **4**: 1-208.

Sarwar, M., 1977. *Bull. Deptt. Zool. Univ. Punjab Lahore*, **10**: 1-172.

Tewari, R., Pant, P.C., Singh, I.B., Sharma, S., Sharma, M., Srivastava, P., Singhvi, A.K., Mishra, P.K. and Tobschall, H.J., 2002. *Man Environ.*, **27**: 1-14.

Valdiya, K.S., 1993. *Curr. Sci.*, **64**: 873–885.

Vrba, E.S. and Schaller, G., 2000. In: *Antelopes, deer and relatives* (eds. E.S. Vrba and G. Schaller), Yale University Press, New Haven, pp. 203-222.