PACHYPORTAX (BOVIDAE: Ruminantia) FROM DHOK PATHAN FORMATION OF SIWALIKS

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ABSTRACT

Some new molars of Pachyporx are recovered from the Late Miocene-Early Pliocene of the Middle Siwalik Subgroup. The material allowed the identification of two species of Pachyporx: P. latidens and P. nagrii. Pachyporx nagrii is known with a rare fossil record. These findings enhance our knowledge on the anatomical characters of the described species.

Key words: Antelopes, Boselaphini, Hasnot, Miocene, Pliocene, Siwaliks.

INTRODUCTION

Boselaphines were abundant during the Eurasian and African Late Miocene (Thomas, 1984; Bibi, 2007; Khan et al., 2009, 2010). The evolutionary lineage of early boselaphines can be seen in the Siwalik deposits. The earliest member of boselaphines has been recorded from the Kamlial Formation (ca 16 Ma) of the Northern Pakistan (Solounias et al., 1995). The Chinji Formation (14.2-11.2 Ma) of the Siwaliks is represented by more than three species (Sivoreas gradiens, Miotragocerus gluten, Helicoportax tragelaphoides) of Boselaphini (Pilgrim, 1937, 1939; Thomas, 1984; Khan et al., 2011). The Nagri Formation (11.2-10 Ma) represents typically Sivoreas eremita, Elachistoceras khauristanensis, Selenoparx vexillarius (Thomas, 1977; Akhtar, 1992; Made and Hussain, 1994) and the Dhok Pathan Formation (10.3-4 Ma) represents Tragoportax punjabicus, Selenoparx vexillarius and Pachyporx latidens (Pilgrim, 1937, 1939; Akhtar, 1992; Khan et al., 2009).

The Siwalik Boselaphini have been studied by several researchers identifying many number of species (Pilgrim 1937, 1939; Thomas, 1977; Akhtar, 1992; Solounias et al., 1995; Khan et al., 2009, 2010, 2012). The boselaphes appear to decline in the Soan Formation (3.4-0.6 Ma) and only one extinct species Boselaphus namadicus is recorded. They probably became extinct in Africa at the end of the Miocene (Bibi, 2007) and today they are only restricted to Asia with two living species: large Boselaphus tragocamelus and small Tetracerus quadricornis.

The Siwalik outcrops are represented by two species of Pachyporx, P. latidens and P. nagrii. Pachyporx latidens is a gigantic species and restricted to the Late Miocene-Early Pliocene of the Siwaliks. Pachyporx nagrii is smaller than P. latidens (Akhtar et al., 2003). Gentry (1974) considered that P. nagrii was an invalid species, but later, Akhtar et al. (2003) ascribed P. nagrii from the Nagri type locality in Chakwal, Pakistan. Prior to this study, P. nagrii was only known from the outcrops belonging to the Nagri Formation of the Siwaliks (e.g. see Pilgrim, 1937, 1939; Akhtar, 1992; Akhtar et al., 2003).

The new findings of P. nagrii from the Dhok Pathan Formation of the Pakistani Siwaliks reconfirm the validity of this species and extend the stratigraphic range from the Nagri Formation to the Dhok Pathan Formation of the Siwaliks. Thus, the present paper deals with a taxonomic investigation of Pachyporx from the sediments of the Middle Siwalik Subgroup having age 10.2-3.4 Ma.

Geography and geology: The material comes from the fossil sites of the Dhok Pathan (Lat. 33° 07' N: Long. 72° 14' E), type locality in district Chakwal and the Hasnot (Lat. 32° 49' N: Long. 73° 18' E), village in district Jhelum northern Pakistan (Figure 1). The studied sites are rich in fossil remains (Barry et al., 2002; Khan et al., 2009, 2010, 2012, 2013). The outcrops consist of orange shale with less compacted gray sandstone bodies and red-brown mudstone with a few thin conglomerate interbeds (Quade and Cerling, 1995).

The studied outcrops belong to the Late Miocene-Early Pliocene (10.2-3.4 Ma) of the Siwaliks (Barry et al., 2002). The age of the Hasnot outcrops spans 7-3.5 Ma with youngest layers in Bhandar bed in North-East of the Hasnot (Pilbeam et al., 1977; Johnson, et al., 1982; Barry et al., 1982, 2002; Khan et al., 2009, 2010). The Dhok Pathan type locality outcrops are older than the Hasnot localities and ranging in age 10.2-8.4 Ma (Pilbeam et al., 1977; Barry et al., 2002; Khan et al., 2010).
Fig. 1. Map of the Potwar Plateau in northern Pakistan; reference localities of the Siwaliks encircled. Bars represent chronological distribution of the Siwalik _Pachyportax_ (modified from Behrensmeyer and Barry 2005 and the boundary dates are from Dennell 2008 and Nanda 2008).

**MATERIALS AND METHODS**

The studied material consists of upper and lower dental elements and part of the PhD thesis of the first author. The specimens were sampled by various means during campaign which took place in the 2004-2013 time range. A few already collected specimens are included in this study as well. The sampled material was transported to the Dr. Abu Bakr Fossil Display and Research Centre. The fossils were arranged for the morphometric studies. The inventory number consists of yearly catalogue number (nominator) and the serial number of the respective year (denominator) (e.g. 07/166, the upper figure denotes the collection year and the lower one the serial number of the respective year). The capital letter is used for upper dentition and the lower one for lower dentition. The measurements of the specimens were taken with the help of a metric Vernier caliper and mentioned in millimeters.

**Depository:** The studied specimens are housed in the Fossil Display and Research Centre, Zoology Department, University of the Punjab, Lahore, Pakistan.

**Terminology:** The terminology (Fig. 2) and protocol of measurements follow Gentry *et al.* (1999).
SYSTEMATIC PALAEOONTOLOGY:
Family Bovidae Gray, 1821
Subfamily Bovinae Gill, 1872
Tribe Boselaphini Knottnerus-Meyer, 1907
Genus Pachyportax Pilgrim, 1937

Pachyportax latidens (Lydekker) Pilgrim, 1937

Localities: Dhok Pathan, district Chakwal and Hasnot, district Jhelum, northern Pakistan.

Studied Material: PUPC 04/22, lM1; PUPC 04/31, IM2; PUPC 07/166, part of maxilla bearing M2-3; PUPC 13/304, rM3; PUPC 13/234, rm3; PUPC 13/233, partial lm3.

Description
Upper dentition: The enamel is wrinkled (Fig. 3). The wrinkling is equally evident labio-lingually. The labial cusps are higher than the inner lingual cusps. The protocone is slightly extended forward than the hypocone, so anterior side of the tooth is wider than the posterior one. The protocone is crescent with praeprotocrista and postprotocrista. The postprotocrista is united with the praehypocrista. The praeprotocrista is united with the praeparacrista. The posthypocrista is united with the postmetacrista. The paracone and metacone are sharp with their cristae running antero-posteriorly namely praeparacrista, postparacrista, praemetacrista and postmetacrista respectively. The anterior and posterior central cavities are well developed. The anterior one is broader than the posterior one. The parastyle, mesostyle and metastyles are present labially. The mesostyle is more developed than the other two styles. The median ribs are prominent. The entostyle is transversely extended in upper molars.

Lower dentition: The lower dentition includes third molars (Fig. 3). The crown is high and narrow. The ectostyloid lies towards the hypoconid. The hypoconid covers more area than the protoconid. The anterior transverse flange is present. The metastyloid and entostyloid are highly developed. The median ribs are bulky near the neck of the crown. The prefossette is shorter than postfossette.

Comparison: The cheek teeth differ from a giraffid in having fairly low rugosity (Pilgrim, 1911; Khan et al., 2009; Bhatti et al., 2012). The studied specimens seem to belong to boselaphine bovids and they are too large to be accommodated in Miotragocerus and Tragoportax (Gentry, 1990; Khan et al., 2009, 2010). The upper molars represent heavy entostyle. However, it is variable in some teeth. The studied specimens show all the basic features of Pachyportax that the upper molars are strongly hypsodont, quadrate, having entostyle extended transversely, relatively strong styles and ribs. The morphometric of the specimens are similar to that of P. latidens (Figs. 3, 4; Table 1).

Pachyportax nagrii Pilgrim, 1939

Localities: Hasnot, Jhelum district, the Punjab province, Pakistan.

Studied Material: PUPC 04/4, IM1; PUPC 04/3, IM2; PUPC 13/287, lM2; PUPC 69/206, rM2; PUPC 13/373, lM3; PUPC 67/187, rM3.

Description: The studied material includes only upper dental elements (Fig. 3). The labial cusps are higher vertically than the lingual ones. The postprotocrista is joining with the praehypocrista. The paracone and metacone with their sloping cristae are well preserved. The antero-posterior cavities are well developed and deep. The anterior cavity is wider than the posterior one. The parastyle is more strongly developed than the metastyle. Nevertheless, the metastyle is heavy in the M3. The transverse width slightly exceeds than the
anteroposterior length in some molars (Table 1). The anteroposterior median ribs are strong.

Comparison: The studied specimens reflect the morphology of the genus Pachyportax. However, they are of appropriate size to match that of P. nagrii (Figs. 3, 4; Table 1). The material represents autapomorphic characters of P. nagrii: small size, strong styles and median ribs, no constricted crown neck that is common in Selenoportax and Tragoportax and transversely extended entostyle. Pachyportax latidens is a large sized Pachyportax whereas P. nagrii is a small one (Table 1).

Table 1.—Comparative measurements (in mm) of the cheek teeth of the Dhok Pathan Formation Pachyportax.

*the studied specimens. Referred data are taken from Pilgrim (1937), Akhtar (1992) and Khan et al. (2009).

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<th>Number</th>
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<th>W</th>
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Fig. 3. Representative cheek teeth of Pachyportax: 1. PUPC 04/31, IM2. 2. PUPC 13/304 rM3. 3. PUPC 13/234, rm3. 4. PUPC 69/206, rM2. 5. PUPC 13/287, IM2. 6. PUPC 67/187, rM3. a = occlusal view, b = lingual view, c = labial view. Scale bar 10 mm.
DISCUSSION

Many species of the tribe Boselaphini are recorded from the Siwalik Group. The species are known with variation in size (Gentry, 1994; Vrba and Schaller, 2000; Khan et al., 2014). The Siwalik Boselaphini ranges from small-medium to large size (Akhtar, 1992; Khan et al., 2009). Most of the species are endemic to the Siwalik (Lydekker, 1876, 1884; Gentry, 1999). Pachyportax have been continuously present during the Late Miocene-Early Pliocene of the Siwaliks (Fig. 1), representing abundance in Hasnot (Lydekker 1876, 1884; Pilgrim, 1937, 1939; Akhtar, 1992, 1995, 1996; Khan et al., 2009, 2010).

Pachyportax nagrii is recovered here for the first time from the Hasnot outcrops (7-5 Ma) of the Middle Siwaliks (Fig. 1). The Hasnot succession has been dated 7 to 5 Ma (Pilbeam et al., 1977; Barry et al., 2002; Khan et al., 2009). The new findings of P. nagrii extend the stratigraphic range of P. nagrii from the Nagri Formation (11.2-10.2 Ma) to the Dhok Pathan Formation of the Middle Siwaliks (10.2 to 5.0 Ma). This documents the uncertain occurrence in the Pliocene of the Siwalik Group (Fig. 1), and more best preserved material (e.g. skull, horn-cores) is needed to establish the certain occurrence of the species.

Pachyportax nagrii suggests that the species may have confined in the isolated pockets of the Siwaliks during the Late Miocene, in competition with the large sized boselaphines i.e. P. latidens, Selenoportax vexillarius, S. lydekkeri. It is already noted that the shift to a drier and more seasonal climate in the Siwaliks caused the extinction of a number of medium-sized boselaphine species, and induced the establishment of high crowned large boselaphines such as Selenoportax and Pachyportax (Bibi, 2007; Bibi et al., 2009). Pachyportax has been restricted to Pliocene of the subcontinent owing to Himalayan Mountains (Barry et al., 1982; Bernor, 1984).
Conclusions: *Pachyportax latidens* and *P. nagrii* were recorded from the Late Miocene-Early Pliocene deposits of Pakistan. *Pachyportax latidens* is larger than that of *P. nagrii*. *Pachyportax* confines to the Miocene-Early Pliocene of the Siwaliks. The recovered *P. nagrii* demonstrates that the chronological age of the species is the Late Miocene-Early Pliocene (Nagri to Dhok Pathan formations), contrary to the previous findings that belong to the Nagri Formation (early Late Miocene).

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REFERENCES


