

## *Selenoportax vexillarius* (Mammalia, Boselaphini, Bovidae) from the Siwaliks

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**Abstract.** –*Selenoportax* is a large sized bovid only present in the Siwaliks and hitherto its four species have been identified. Three species (*Selenoportax vexillarius*, *S. lydekkeri*, *S. dhokpathanensis*) are described from the Middle Siwaliks and one (*S. tatrotensis*) from the Upper Siwaliks. No species has been still found from the Lower Siwaliks. The present study is based on 16 specimens collected from Hasnot, the Middle Siwaliks and all the collected specimens belong to the species, *S. vexillarius* and *S. lydekkeri* but in this paper only the species *S. vexillarius* are described, comprising the nine specimens. This crucial finding leaves the position of *S. tatrotensis* and *S. dhokpathanensis* in doubt. The identification of the species is based on the cranial material.

**Key words:** *S. vexillarius*, the Middle Siwaliks, Hasnot, molar.

### INTRODUCTION

*Selenoportax* comprises a tribe Boselaphini, family Bovidae of order artiodactyla that are the dominant mammalian herbivores in old world terrestrial communities (Solounias *et al.*, 1995). The bovid family is highly diverse, with numerous extant species, and has an extensive fossil record with species in Africa, Eurasia, and North America. Bovids appear to have had three adaptive radiations at 14, 7.5 and 2 Ma (Gentry, 1970, 1978, 1994; Solounias, 1982; Thomas, 1984; Ye, 1989) and *Selenoportax* appear in 7.5 Ma old sediments of the Siwaliks. Barry *et al.* (1982) use the term *Selenoportax lydekkeri* interval zone for the sediments. The genus *Selenoportax* is well known from the Nagri and the Dhok Pathan zones of the Middle Siwaliks (Pilgrim, 1937). Solounias (1981) refers a horn core specimen from Pikermi, described by Gaudry (1865) as *Selenoportax*. According to him the material is not diagnostic enough for a more specific determination. The recent collection from the Hasnot includes the cranial material of the species *S. vexillarius*. The Hasnot fossils are approximately 7 Ma old (Pilbeam *et al.*, 1977; Johnson *et al.*, 1982; Barry *et al.*, 1982). The upper

third molar (PUPC 87/199) of the species *S. vexillarius* is being described here for the first time.

### Abbreviations

PMNH, Pakistan Museum of Natural History; PUPC, Punjab University Palaeontological Collection, housed in the Department of Zoology, Punjab University, Lahore, Pakistan; AMNH, American Museum of Natural History, New York; Ma, Million years ago; H, Hasnot; M<sup>1</sup><sub>1</sub>, first upper and lower Molar; M<sup>2</sup><sub>2</sub>, second upper and lower molar; M<sup>3</sup><sub>3</sub>, third upper and lower molar; P, premolar.

### SYSTEMATIC PALAEOLOGY

Family: BOVIDAE Gray, 1821  
Subfamily: BOVINAE Gill, 1872  
Tribe: BOSELAPHINI Simpson, 1945

### Genus *SELENOPORTAX* Pilgrim, 1937

#### Type species

*Selenoportax vexillarius* Pilgrim, 1937.

#### Generic diagnosis

Moderate to large sized Siwalik bovid; with hypsodont to extremely hypsodont teeth, upper molars quadrate with strong divergent styles, median ribs well developed, entostyle strongly

developed and ectostylid moderately developed, enamel very rugose, crown narrow at the base and broad at the apex (Pilgrim, 1937).

*Included species*

*Selenoportax vexillarius* Pilgrim, 1937;  
*Selenoportax lydekkeri* Pilgrim, 1937; *Selenoportax*  
*tatrotensis* Akhtar, 1992; *Selenoportax*  
*dhokpathanensis* Akhtar, 1992.

*Distribution*

Middle to Upper Siwaliks.

***Selenoportax vexillarius* Pilgrim, 1937**

*Selenoportax tatrotensis* Akhtar, 1992

*Type specimen*

A skull lacking maxilla and dentition and most of the basicranium (AMNH 19748).

*Referred specimens*

Right M<sup>2</sup> (PUPC 00/53; PUPC 96/39), left M<sup>2</sup> (PUPC 01/23), left M<sup>3</sup> (PUPC 87/199), a fragment of left mandible with P<sub>4</sub> and M<sub>2,3</sub> (PUPC 04/1; Fig. 1), a fragment of left mandible with M<sub>2,3</sub> (PUPC 98/78; Fig. 2), left M<sub>1</sub> (PUPC 85/40), left M<sub>2</sub> (PUPC 04/12), left M<sub>3</sub> (PUPC 87/90).

*Localities*

Hasnot (H 1, H 8, H 11, H 12, H 5) Jhelum district, the Punjab province, Pakistan.

*Stratigraphic range*

Middle Siwaliks.

*Diagnosis*

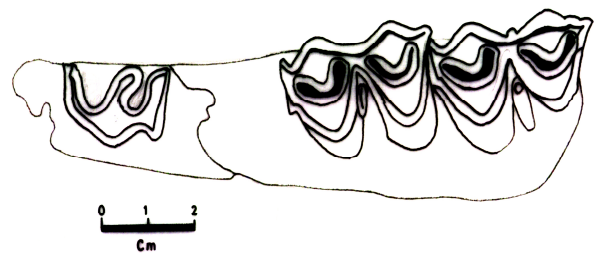
Cheek teeth large and strongly hypsodont, enamel very rugose. Upper molars quadrate with strong and divergent styles near the neck of crown, ribs quite large, entostyle/ectostylid strongly developed. Fossettes without indentations and simple in outline, transverse anterior goat folds poorly developed at front of lower molars.



a



b



c

Fig. 1. *S. vexillarius*; a fragment of left mandible with P<sub>4</sub> and M<sub>2,3</sub> (PUPC 2004/1), a) Buccal view; b) Crown view; c) Morphology of occlusal view.

*Description*

Nine cranial specimens are described here. The right M<sup>2</sup> (PUPC 2000/53) is a rather well preserved molar except from its protocone, which is missing, and the metacone, which is broken at the apex. The paracone is well developed and pointed in

the middle with two running cristae. The enamel is moderately thick and rugose. The rugosity is more distinct on the buccal side than on the lingual side of the tooth. The entostyle is missing in the transverse valley between the protocone and the hypocone whereas the other styles are generally well developed. The parastyle is very strong and prominent. The mesostyle and the metastyle are moderately developed and the anterior median rib is more prominent than the posterior rib. The fossettes are well defined and wide. The second right upper molar PUPC 1996/39 is in an excellent state of preservation and in an early stage of wear. The enamel is finely rugose and the rugosity is more evident on the lingual side than the buccal side. The entostyle is strongly developed and a large part of its anterior end is missing, exposing the dentine at the broken end. The principal cones are well developed and the buccal cusps are higher than the lingual ones, which at this stage of wear are not attached to each other at the transverse valley. The protocone is V-shaped. The styles and median ribs are well developed. The fossettes are wide and no spur of enamel seems to project into these fossettes. The left  $M^2$  (PUPC 2001/23) is a well-preserved tooth. The specimen is in an early stage of wear, it is extremely hypsodont and narrow crowned. The enamel rugosity is more prominent on the buccal side than on the lingual side. The entostyle is present in the transverse valley between the protocone and the hypocone. The major four cusps are well developed. The protocone is pointed in the middle and transversely it is narrower than the hypocone. The paracone and the metacone are well developed and pointed in the middle with two running cristae anteroposteriorly. The styles and the median ribs are well developed and prominent. The left  $M^3$  (1987/199) is generally a well preserved molar except from the missing hypocone and the entostyle, presenting an early stage of wear. The posterior median rib is more prominent than the anterior median rib while the fossettes are broad.

Specimen PUPC 2004/1 (Fig. 1) is a damaged left mandible fragment anteroposteriorly as well as vertically; found with  $P_4$ - $M_{2,3}$  preserved. The  $P_4$  is well developed, presenting an advanced stage of wear. Overall, it shows a W-shaped morphological structure. The enamel is finely wrinkled and the

wrinkles are more evident on the buccal side. This difference was caused by the action of weathering on the lingual side of the tooth. The protoconulid is well preserved and the metaconid is relatively higher than the protoconulid. The anterior valley is wider than the medial valley and U-shaped. The crown of  $M_1$  is broken and only the roots are preserved in the alveolar cavities of the mandible. The alveolar width of the preserved roots of  $M_1$  is 19.0 mm. In  $M_2$  the ectostylid is present but not completely developed. The median ribs are strongly developed. The transverse anterior goat fold is poorly developed but more prominent on the buccal side than the lingual side. The fossettes are broader and narrower with crescentic outlines. The 3<sup>rd</sup> lower molar is well preserved although its hypoconulid is broken. The molar presents a rather early stage of wear and the anterior lobe is just touched by wear whereas the posterior lobe is practically unworn. PUPC 1998/78 (Fig. 2) is a damaged mandible fragment, not only antero-posteriorly but also dorso-ventrally. Behind the 3<sup>rd</sup> molar, a small part of the ascending ramus is present, which is poorly preserved and fairly eroded along the ventral length. It is heavy, thick transversely and moderately deep vertically. The molars on the mandible are in an excellent state of preservation. The  $M_2$  is very well preserved, presenting a middle stage of wear. The worn condition of the molar indicates a high crowned and narrow tooth. The enamel is thick and shows fine plications all over the crown. These plications are more prominent and distinct on the buccal cusps than on the lingual ones. The goat fold is moderately developed on the anterior side of the tooth. The ectostylid is strongly developed. As it is commonly observed the lingual conids are higher than the buccal ones. The protoconid is crescentic in shape. The praeprotocristid is larger than the postprotocristid. The metaconid is slightly damaged in the middle with two slightly worn sloping cristids. The entoconid is slightly higher than the metaconid and pointed in the middle. The wear is more distinct to the center of the entoconid than to the sloping cristids. The hypoconid is more V-shaped than the protoconid. The metastylid and the entostylid are strongly developed while the mesostylid is not distinct. The median ribs are moderately developed but distinct to the base of the

crown. The specimen has a long and wide furrow between the anterior and posterior ribs. There is an ectostylid present in this furrow, which is not present in the other specimens. The fossettes are moderately wide and deep, having no indentation.

The 3<sup>rd</sup> molar of the mandible is also well preserved like the 2<sup>nd</sup> one. The tooth presents an early stage of wear although the dentine has been exposed everywhere on the surface of the crown. The enamel layer is finely plicated. These plications are more prominent on the buccal cusps than on the lingual cusps. The crown of the molar is high and is considered extremely hypsodont. The ectostylid is strongly developed. The major conids and the talonid are well developed. Overall, the protoconid is crescentic in shape, and the praeprotocristid is greater in length than the postprotocristid. The metaconid is high in the middle with anteriorly and posteriorly sloping cristids. The wear is confined to the middle portion of the metaconid. The entoconid is as high as the metaconid but narrower. The hypoconid is looking more crescentic in shape than the protoconid, while its anterior cristid is united with the posterior cristid of the protoconid and its posterior cristid is united with the anterior end of the hypoconulid due to the old age of the individual. The metastylid and the entostylid are moderately developed. The fossettes are moderately narrow and have no indentations. The posterior fossette is slightly longer than the anterior one. The hypoconulid is very well developed, long and narrow, with a wide and inflated central area, and two sloping cristids, comparatively close to each other and running downward lingually and anteriorly. The left lower 1<sup>st</sup> molar PUPC 1985/40 is well developed, in an early stage of wear with all major cusps fully developed. The enamel rugosity is more prominent and evident on the buccal side than on the lingual side of the tooth due to weathering. The principal cusps are well developed and are all pointed in the middle. The posterior and anterior fossettes are narrow. The 2<sup>nd</sup> left lower molar PUPC 2004/12 is well developed, in an early stage of wear with all the major cusps fully developed. The praeprotocristid is narrower than the postprotocristid. The ectostylid is missing and the anterior and posterior fossettes are narrower. Specimen PUPC 1987/90 is fairly preserved except

from the pointed ends of the protoconid, the metaconid and the hypoconid, which are slightly damaged, the ectostylid, which is missing and the broken hypoconulid. The goat fold is moderately developed anteriorly and the stylids are less developed in this specimen. All the comparative measurements are provided in Table I.

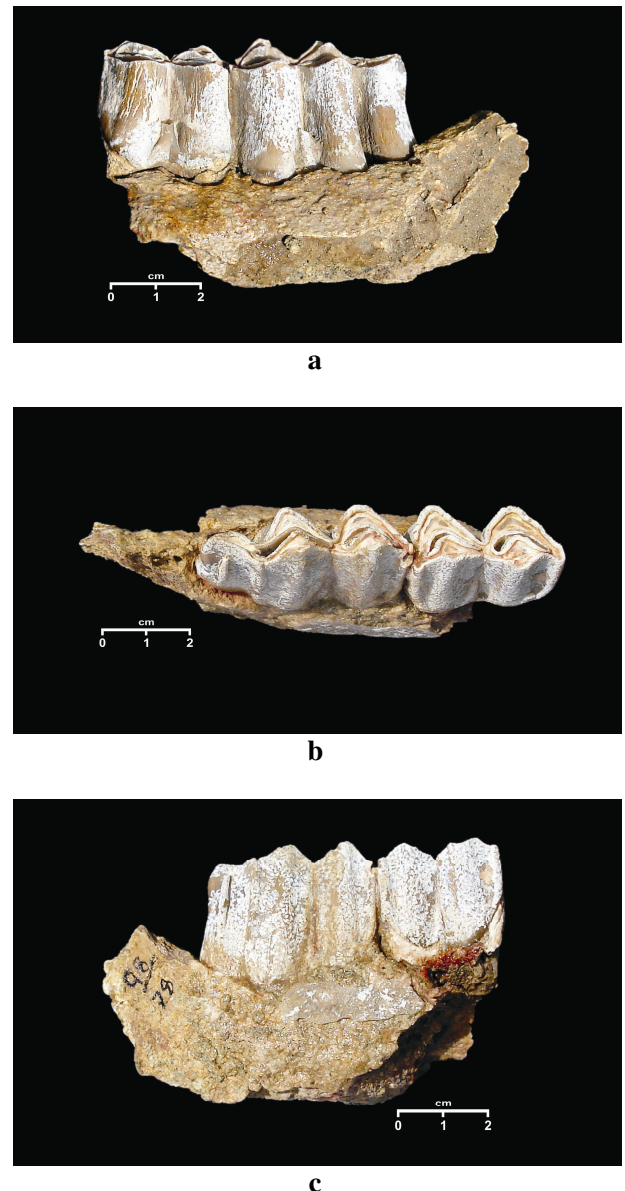


Fig. 2: *S. vexillarius*, a fragment of left mandible with M<sub>2-3</sub> (PUPC 1998/78), a) Buccal view; b) Crown view; c) Lingual view.

**Table I: Comparative measurements of the cheek teeth of *Selenoportax vexillarius* in mm (millimeters). \* The studied specimens. In parenthesis the locality code, from where the specimen was collected.**

Number	Nature	Position	Length	Width	W/L ratio
PUPC 00/53 (H1)*	right molar	M <sup>2</sup>	27.5	18.5	0.67
PUPC 96/39 (H8)*	right molar	M <sup>2</sup>	26.0	19.0	0.73
PUPC 01/23 (H11)*	left molar	M <sup>2</sup>	23.5	19.5	0.82
PUPC 87/199 (H8)*	left molar	M <sup>3</sup>	25.0	21.2	0.84
PUPC 04/1 (H12)*	a left fragmentary mandible having P <sub>4</sub> and M <sub>2,3</sub>	P <sub>4</sub> M <sub>2</sub> M <sub>3</sub>	20.0 27.9 31.4	12.4 16.1 16.0	0.62 0.57 0.50
PUPC 98/78 (H12)*	a left fragmentary mandible having M <sub>2,3</sub>	M <sub>2</sub> M <sub>3</sub>	25.0 36.0	16.0 15.0	0.64 0.41
PUPC 85/40 (H8)*	left molar	M <sub>1</sub>	19.7	12.5	0.63
PUPC 04/12 (H5)*	left molar	M <sub>2</sub>	20.0	12.5	0.62
PUPC 87/90 (H5)*	left molar	M <sub>3</sub>	38.0	16.5	0.43
AMNH 10514	left molar	M <sub>3</sub>	33.0	15.0	0.45
AMNH 29917	left molar	M <sub>1</sub>	18	13	0.72
AMNH 19844	right molar	M <sup>2</sup>	25.7	24.0	0.93
AMNH 29946	left premolar	P <sub>4</sub>	21.0	11.0	0.52
AMNH 29917	left premolar	P <sub>4</sub>	21.7	10.0	0.46
AMNH 19844	left molar	M <sub>2</sub>	25.9	16.5	0.63
AMNH 19514	left molar	M <sub>2</sub>	22.0	15.5	0.70
AMNH 29917	left molar	M <sub>2</sub>	21.0	15.0	0.71
AMNH 19514	left molar	M <sub>3</sub>	33.0	21.5	0.65
PMNH 87/19	a maxillary part of the skull having right P <sup>3</sup> -M <sup>3</sup> and left P <sup>4</sup> -M <sup>3</sup>	P <sup>3</sup> P <sup>4</sup> M <sup>1</sup> M <sup>2</sup> M <sup>3</sup>	19.5 19 24.2 29 28.7	16.5 17 21.5 21 18	0.84 0.89 0.88 0.72 0.62

## DISCUSSION

The large sized Siwalik Boselaphini include the genera *Selenoportax* and *Pachyportax*. The *Selenoportax* is a moderate to large sized Boselaphini, whereas *Pachyportax* is a gigantic sized form. The general contour of the studied specimens, the rugosity of the enamel, the strong entostyles/ectostylids, the prominent median ribs, the strong and divergent styles exclude the specimens from the genus *Pachyportax* and favor their inclusion in the genus *Selenoportax* (Akhtar, 1992, 1995, 1996). Pilgrim (1937) based this genus on a collection from the various Siwalik localities of Pakistan and India. Pilgrim referred all the collected specimens to the genus *Selenoportax* and added two species in it, *S. vexillarius* and *S. lydekkeri*. The dimensions (Table I; Figs. 3, 4) and the morphology of the studied material reveal all the features of the species *S. vexillarius* cited by Pilgrim in 1937.

Specimens PUPC 2000/53, PUPC 1996/39, and PUPC 2001/23 present the same morphological features of the type specimen AMNH 19844 (Pilgrim, 1937). The specimen is an extremely hypsodont and narrow crowned tooth as indicated by its measurements. The molar shows fine enamel corrugacy, which is relatively more prominent on the lingual side than on the buccal side. Specimen PUPC 2000/53 shows the same basic features of the species like the increased antero-posterior diameter near the summit of the crown and the strong development of the styles and ribs. The structure of specimen PUPC 2004/1 resembles in its antero-posterior length and transverse width with the specimens AMNH 29946 and AMNH 29917 (Pilgrim, 1937). The paraconid, the parastylid, the protoconid, the entoconid, and the development of the stylids are fairly similar. In P<sub>4</sub> the enamel is wrinkled buccally as well as lingually. However, the wrinkles are more conspicuous on the buccal side

than on the lingual side. The  $M_2$  in PUPC 1998/78 is narrow crowned, as indicated by its width and length ratio (Fig. 4). Specimen PUPC 1998/78 resembles with the specimens AMNH 19844, AMNH 19514 and AMNH 29917 as discussed by Pilgrim in 1937. In  $M_3$  the enamel layer is finely plicated and it compares very favorably with AMNH 19514 (Pilgrim, 1937). In left  $M_1$  (PUPC 1985/40), left  $M_2$  (PUPC 2004/12), and left  $M_3$  (PUPC 1987/90), the shape of the cristids and the roughness of the enamel are very evident and have similar morphology with AMNH 19514, AMNH 29917, AMNH 19844 (Pilgrim, 1937).

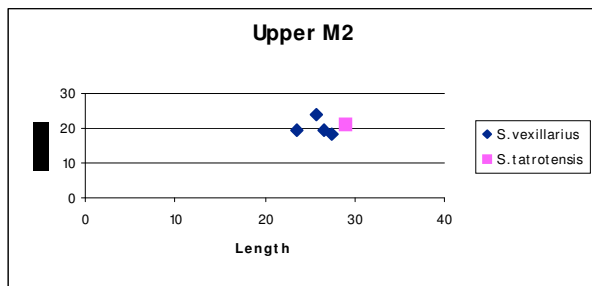


Fig. 3: Figure shows the size variation of 2<sup>nd</sup> upper molar of *S. vexillarius* and *S. tatrotensis* (Scale in millimeters).

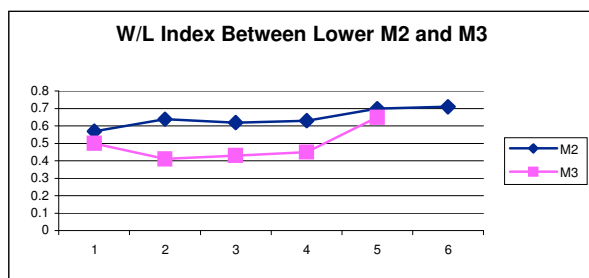


Fig. 4: Figure shows the width/length index of the cheek teeth of *S. vexillarius* (Values are taken from Table I and in millimeters).

## REFERENCES

- AKHTAR, M., 1992. *Taxonomy and distribution of the Siwalik Bovid*. Ph. D. dissertation, University of the Punjab, Pakistan, 1-381.
- AKHTAR, M., 1995. *Pachyportax giganteus*, new species (Mammalia, Artiodactyla, Bovidae) from the Dhok Pathan, district Chakwal, Punjab, Pakistan. *Pakistan J. Zool.*, **27**: 337-340.
- AKHTAR, M., 1996. A new species of the genus *Selenoportax* (Mammalia, Artiodactyla, Bovidae) from Dhok Pathan, district Chakwal, Punjab, Pakistan. *Proc. Pakistan Congr. Zool.*, **16**: 91-96.
- BARRY, J. C., LINDSAY, E. H., AND JACOBS, L. L., 1982. A biostratigraphic zonation of the middle and upper Siwaliks of the Potwar Plateau of northern Pakistan. *Palaeogeog. Palaeoclimat. Palaeoecol.*, **37**: 95-130.
- GAUDRY, A., 1865. *Animaux fossils at geologie de l. Attique*, Paris, pp. 264-308.
- GENTRY, A. W., 1970. The Bovidae (Mammalia) of the Fort Ternan fossil fauna. In: *Fossil vertebrates of Africa* (eds. L.S.B. Leakey and R.J.G. Savage), vol. 2. Academic Press, London.
- GENTRY, A. W., 1978. A new genus and species of Pliocene boselaphine (Bovidae, Mammalia) from South Africa. *Ann. S. Afr. Mus.*, **65**: 145-188.
- GENTRY, A. W. 1994. The Miocene differentiation of Old World Pecora (Mammalia). *Hist. Biol.*, **7**: 115-158.
- JOHNSON, N.M., OPDYKE, N.D., JOHNSON, G.D., LINDSAY, E. H. AND TAHIRKHELI, R.A.K., 1982. Magnetic polarity, stratigraphy and ages of Siwalik group rocks of the Potwar Plateau, Pakistan. *Palaeogeog. Palaeoclimat. Palaeoecol.*, **37**: 17-42.
- PILBEAM, D., BARRY, J., MEYER, G. E., SHAH, S. M. I., PICKFORD, M. H. L., BISHOP, W. W., THOMAS, H. & JACOBS, L. L., 1977. Geology and palaeontology of Neogene strata of Pakistan. *Nature*, London, **270**: 684-689.
- PILGRIM, G. E., 1937. Siwalik antelopes and oxen in the American Museum of Natural History. *Bull. Am. Mus. nat. Hist.*, **72**: 729-874.
- SOLOUNIAS, N., 1981. The turolian fauna from the Island of Samos, Greece. *Cont. Vert. Evol.*, **6**: 99-232.
- SOLOUNIAS, N., 1982. Evolutionary patterns of the Bovidae (Mammalia). *Proc. N. Am. Paleontol. Conv. III*, **2**: 495-499.
- SOLOUNIAS, N., BARRY, J.C., BERNOR, R.L., LINDSAY, E.H. AND RAZA, S.M., 1995. The oldest bovid from the Siwaliks, Pakistan. *J. Verteb. Palaeontol.*, **15**: 806-814.
- THOMAS, H., 1984. Un nouveau bovide dans les couches a Hominoidea du Nagri (Siwaliks moyens, Miocene superieur), Plateau du Potwar, Pakistan: *Elachistoceras khauristanensis*, gen. nov. sp. nov. (Bovidae, Artiodactyla, Mammalia). *Bull. Soc. Geol. France*, **19**: 375-383.
- YE, J., 1989. Middle Miocene artiodactyls from the northern Junggar Basin. *Verteb. Palasiat.*, **27**: 37-52.

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