

***Psammodyus boreoitalicus* sp. nov. (Coleoptera: Scarabaeidae: Aphodiinae: Psammodiini) from Italy**

Ladislav MENCL¹), David KRÁL²) & Miloslav RAKOVIČ³)

¹Masarykovo náměstí 5, CZ-281 26 Týnec nad Labem, Czech Republic
e-mail: l.mencl@centrum.cz

²Department of Zoology, Faculty of Science, Charles University,
Viničná 7, CZ-128 43, Praha 2, Czech Republic
e-mail: kral@natur.cuni.cz

³U Kruhářny 548, CZ-252 29 Dobřichovice, Czech Republic
e-mail: mrakovic@volny.cz

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Abstract. A new species of the genus *Psammodyus* Fallén, 1807, *Psammodyus boreoitalicus* sp. nov. from north-eastern Italy, is described, and compared with a species exerting most similar morphological characters, *Psammodyus asper* (Fabricius, 1775). External characters (the habitus and details), the epipharynx and aedeagus are illustrated. The differential diagnosis is summarised in a table.

INTRODUCTION

When studying numerous material of *Psammodyus* Fallén, 1807 specimens from Italy, the first author of the work presented here recognised a new species of the genus. The new species is described below under the name *Psammodyus boreoitalicus* sp. nov.

The most recent work dealing with a revision of *Psammodyus* was compiled by Pittino (2007). That revision comprises a key to species, in which the new species reliably keys out to point 11: *Psammodyus asper* (Fabricius, 1775).

The importance of particular characters for the definition of the new species is discussed below in the Part Taxonomy (Differential diagnosis) and particularly in Table 1.

MATERIAL AND METHODS

The specimens were observed by using the MBS-10 and SZP 1120-T stereoscopic microscopes. The photos published here were taken by the use of the Meopta laboratory microscope, CMOS 5 digital camera and Helicon Focus programme.

Measurements of lengths and widths were carried out with the help of an ocular micrometer.

Each *Psammodyus boreoitalicus* type specimen is equipped with printed labels as follows: a white label giving locality data; a pale green label specifying a number related to a photo-documentation system by the first author; and a red label indicating the identification

and type status, name of the new species, names of the present authors and year of the examination. Individual lines of every label are separated by a slash (/). Paratype numbers mentioned in figure legends are the numbers from the pale green labels.

For the explanation of terms concerning structures and sculptures of *Psammodiini* used in the present work see for example Rakovič et al (2016).

For morphological terms used in the description of epipharyngeal structures we follow Dellacasa et al. (2010).

The following acronyms stand for collections, in which the specimens studied here are kept:

- CNCW Cezary Nowak private collection, Włoszczowa, Poland;
- DSCP David Sommer private collection, Praha, Czech Republic;
- ŁMCN Łukasz Minkina private collection, deposited in Institute of Systematics and Evolution of Animals, Kraków, Poland;
- LMCT Ladislav Mencl private collection, Týnec nad Labem, Czech Republic;
- MRC D Miloslav Rakovič private collection, Dobřichovice, Czech Republic;
- NMPC National Museum Praha, Czech Republic (Jiří Hájek).

Psammodius asper specimens depicted in photos come from Central-Bohemia (surroundings of Brandýs nad Labem - Stará Boleslav and Kostomlaty nad Labem settlements) and are deposited in LMCT.

TAXONOMY

Psammodius boreoitalicus sp. nov.

(Figs. 1-4, 8, 10, 12, 14, 16, 18-20, 23-25, 27, 29)

Type locality. Italia, Friuli-Venezia Giulia, Tramonti di Soto, river Meduna, 46°16'59.680"N 12°47'14.580"E.

Type material. Holotype (♂) (NMPC) equipped with the following printed labels: 1) "ITALIA, Friuli-Venezia Giulia / Tramonti di Soto, riv. Meduna / N 46°16'59,68" E 12°47'14,58" / Lgt. L. Mencl, 26.7.2017, 325m"; 2) pale green label: "2686 / Dok. L. Mencl 2017"; 3) red label: "HOLOTYPE (♂) / *Psammodius boreoitalicus* sp. nov. / L. Mencl, D. Král & / M. Rakovič, det. 2021". Allotype (♀) (NMPC) equipped with the following printed labels: 1) "ITALIA, Friuli-Venezia Giulia / Tramonti di Soto, riv. Meduna / N 46°16'59,68" E 12°47'14,58" / Lgt. L. Mencl, 26.7.2017, 325m"; 2) pale green label (see above): "2841 / Dok. L. Mencl 2021"; 3) red label: "ALLOTYPE (♀) / *Psammodius boreoitalicus* sp. nov. / L. Mencl, D. Král & / M. Rakovič det. 2021". Paratypes: (9 spec.): from holotype locality (LMCT, MRC D, NMPC) labels 1) same as with holotype, but dated: 11. 7. 2014, label 2) red label: "PARATYPE / *Psammodius boreoitalicus* sp. nov. / L. Mencl, D. Král & / M. Rakovič, det. 2021"; (5 spec.): from holotype locality (LMCT, MRC D, NMPC), but dated: 28.5. 2016; (7 spec.): same as with holotype (LMCT, MRC D, NMPC), but dated: 29.5.2016; (81 spec.): same as with holotype (LMCT, MRC D, NMPC), but dated: 23.5.2017; (22 spec.): same as with holotype (LMCT, MRC D, NMPC), but dated: 25.5.2017; (55 spec.): same as with holotype (LMCT, MRC D, NMPC), but dated: 26.7.2017; (28 spec.): from holotype locality (LMCT, MRC D, NMPC), but dated: 27.7.2017; (4 spec.): (LMCT), "ITALIA, Friuli-Venezia Giulia / Moggio Udinese, riv. Fella / N 46°24'06,02" E 13°11'43,92" / Lgt. L. Mencl, 25. 5. 2017, 303 - 310m"; (4 spec.): (LMCT), "ITALIA, Friuli-Venezia Giulia / Montereale Valcellina, riv. Cellina, / N 46°09'53,76" E 12°39'58,73" / Lgt. L. Mencl, 25. 5. 2017, 280m"; (10 spec.): (CNCW), "ITALY / Friuli-Venezia Giulia / Montereale Valcellina ad Maniago / 1.06.2021 / Cezary Nowak leg. [printed]"; (5 spec.): (CNCW), "ITALY / Friuli-Venezia Giulia / Montereale Valcellina ad Maniago / 2.06.2021 / Cezary Nowak leg. [printed]"; (11 spec.): (CNCW), "ITALY / Friuli-Venezia Giulia / Montereale Valcellina ad Maniago / 4.06.2021 / Cezary Nowak leg. [printed]"; (7 spec.): (ŁMCN), "ITALY / Montereale Valcellina / sifted from roots of grass growing / on sandbanks of Cellina river / 01.06.2021 / leg. Ł. Minkina [printed]"; (7 spec.): (ŁMCN), "ITALY / Montereale Valcellina / sifted

from roots of grass growing / on sandbanks of Cellina river / 02.06.2021 / leg. L. Minkina [printed]"; (18 spec.): (LMCN), "ITALY / Montereale Valcellina / sifted from roots of grass growing / on sandbanks of Cellina river / 04.06.2021 / leg. L. Minkina [printed]"; (4 spec.): (NMPC), "ITALY / Montereale Valcellina / sifted from roots of grass growing / on sandbanks of Cellina river / 02.06.2021 / leg. L. Minkina [printed]"; (5 spec., 3 of them in pure alcohol): (NMPC) and (2 spec.): (DSCP), "NE Italia, 13.-14.ix.2021 / Tramonti di Sotto, ca330m / VALTRAMONTINA camp / MEDUNA river sands / 46°17'00"N 12°47'14"E / David Král & David Sommer lgt. [printed]"; (1 spec.) (NMPC): with the following printed labels: 1) "Istria [sic!] [1]913 / Cervignano [= Cervignano del Friuli] / F. Svoboda", 2) ex coll. David Král / National Museum / Prague, Czech Republic", 3) pale green label "2230 Dok. L. Mencl 2016".

See also Figs. 37-41 for the appearance of labels.

Description of holotype (♂). Small (body length of 2.40 mm), broader behind, maximum width of 1.15 mm (at about 0.55 elytra length), dorsal surfaces glabrous, moderately shining, reddish brown to brownish black head and pronotum usually darker than elytra; habitus in dorsal aspect as in Fig. 1.

Head (Fig. 8). Clypeus angularly rounded each side of anteromedian emargination, its lateral sides arcuate; genae not ciliate, considerably protruding and well differentiated from clypeus lateral margins anteriorly. Anterior area of head surface with relatively sparse granules varying in shape, size and orientation (except for narrow, non-granulate zones along anterior and lateral margins); middle protuberance only moderately elevated anteriorly and laterally. Head vertex with two pairs of oblique ridges.

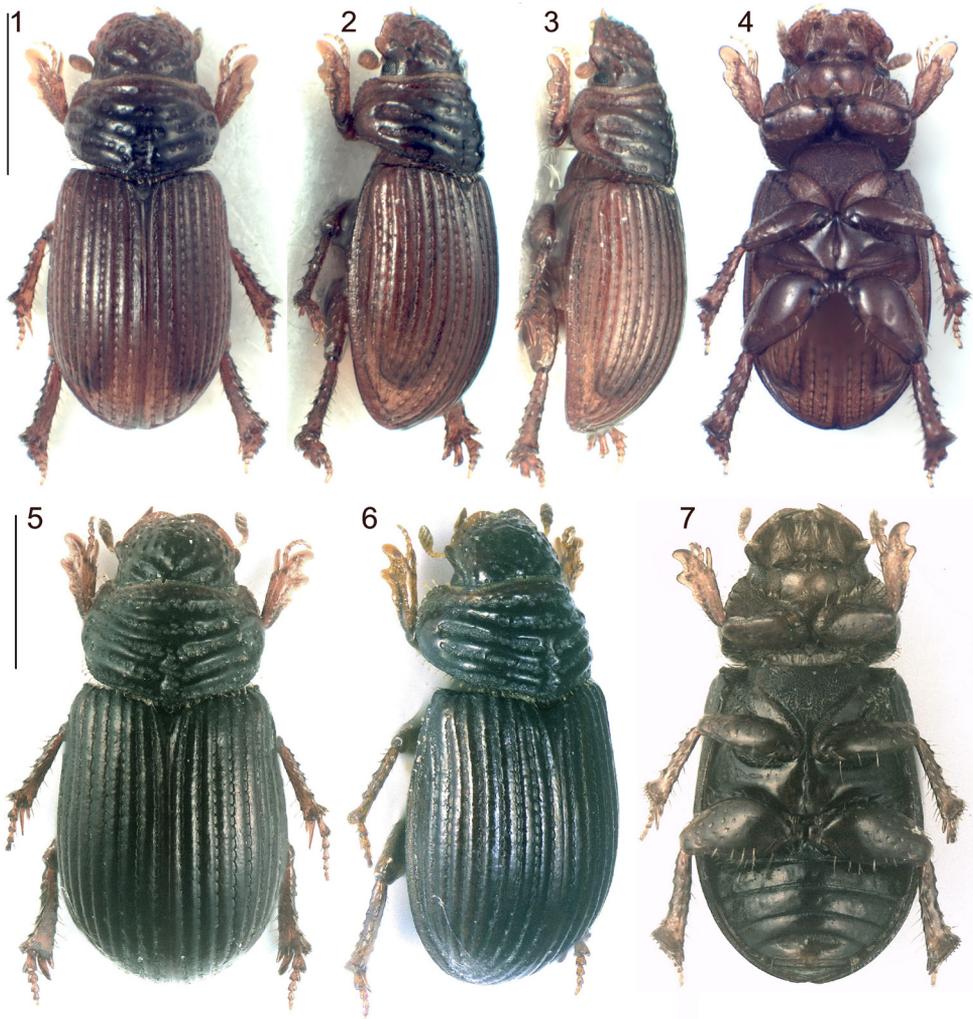
Epipharynx (Fig. 25) transversal, anterior outline shallowly emarginate, lateral outlines straight and divergent in approximately anterior half, regularly widely rounded posteriorly; tormae and nesium well sclerotised, approximately symmetrical, apotormae missing, mesophoba present; epitorma almost quadrate, weakly sclerotised; helus with several irregularly spaced sensilla and three longitudinal rows of robust sensilla anteriorly; corypha and zygum absent; phobae weakly sclerotised, glabrous; chaetoparia with row of 18 about same length, stout, closely spaced spines; area of prophobae well sclerotised, bearing longitudinal row of three short, stout, densely spaced spines.

Pronotum narrower than head, convex, transversal, broadest point at short distance behind half length, with five transversal ridges, five transversal furrows, and posterior longitudinal furrow interrupting transversal ridges 4-5; ridges relatively wider than furrows); ridges rather smooth, furrows with medium-sized to coarse punctures. Lateral margins arcuate, both anterior and posterior corners rounded; lateral margins crenulate (most distinctly anteriorly). Lateral and basal margins equipped with apically dilated macrosetae.

Scutellum (Fig. 10) small, triangular, finely microscopically punctate throughout.

Elytra broader behind, widest at about 0.5-0.6 elytra length, their length-to-width ratio of about 1.50, with ten striae and ten moderately convex intervals. Elytra wider than pronotum (ratio maximum pronotum width/maximum elytra width of 0.82. Punctures in elytral striae longitudinal, only moderately crenating intervals. Discal intervals considerably convex, lateral intervals quite distinct.

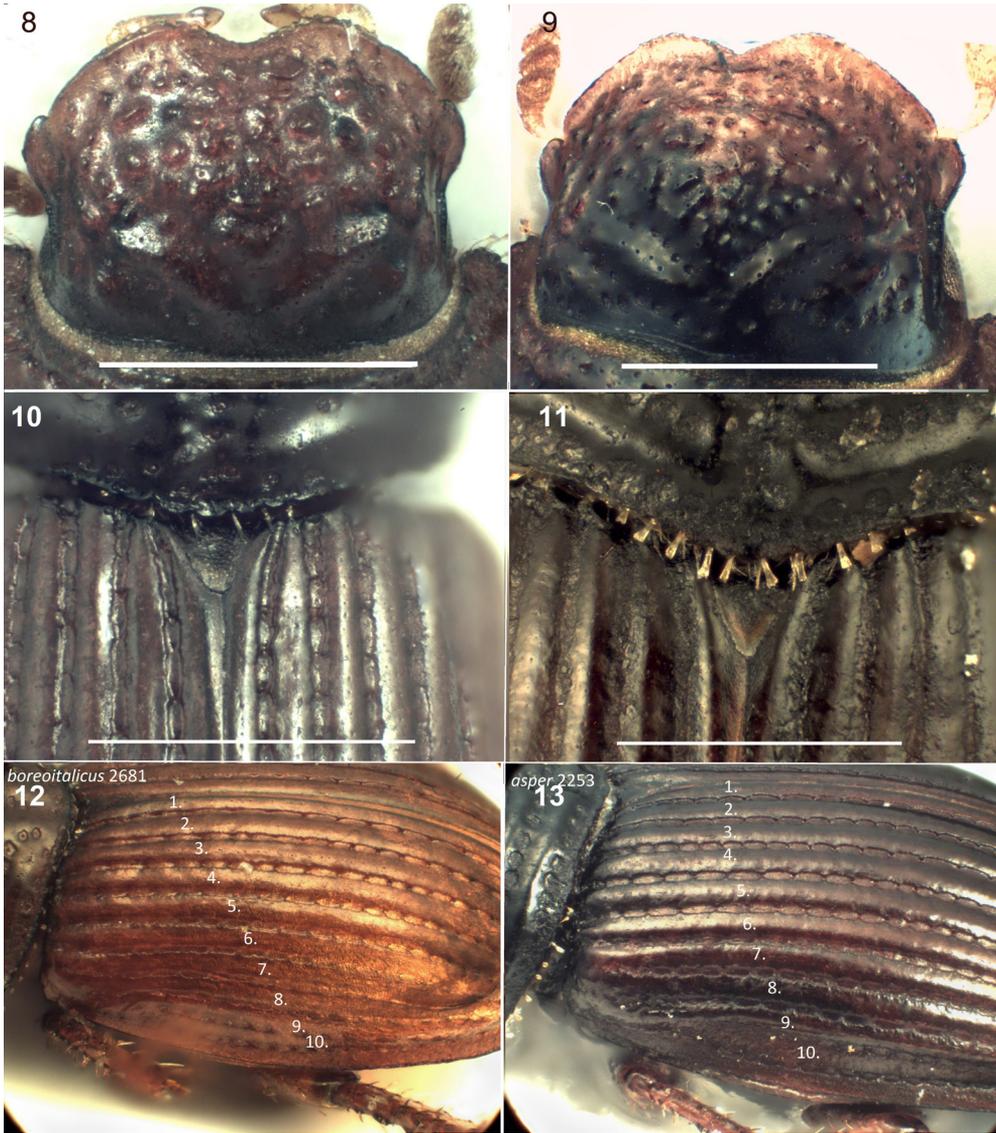
Legs and antennae yellowish brown to reddish brown, much paler than dorsal surfaces. Protibiae with 3 considerably rounded (not acute) external teeth. Mesotarsomeres 1-4 moderately widened apically, superior apical spurs of mesotibiae acute, slim, nearly straight, longer than mesotarsomeres 1-4 combined. Metatarsomeres 1-4 strongly triangularly widened, superior apical spurs of mesotibiae thick, about as long as mesotarsomeres 1-3 combined.



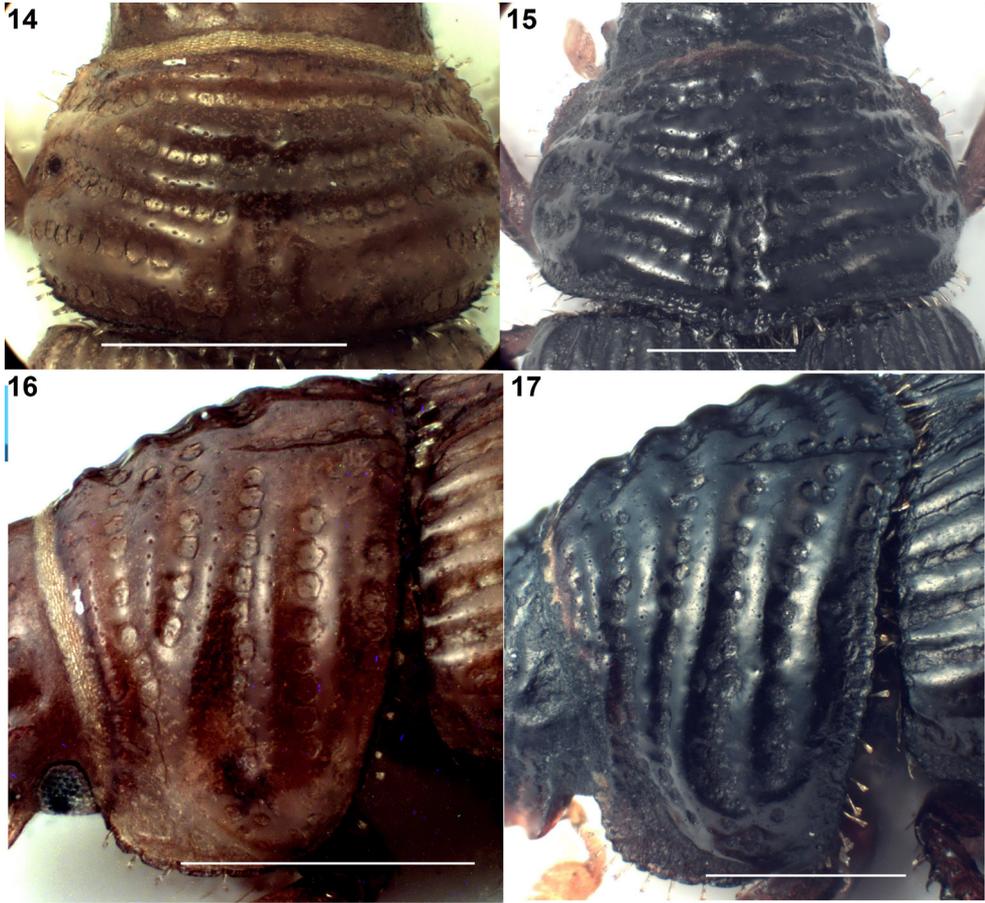
Figs. 1-7. Habitus of two *Psammodius* species: 1- *P. boreoitalicus* sp. nov., holotype, dorsal view; 2- *P. boreoitalicus* sp. nov., holotype, dorsolateral view; 3- *P. boreoitalicus* sp. nov., holotype, lateral view; 4- *P. boreoitalicus* sp. nov., holotype, ventral view; 5- *P. asper* (see Methods), dorsal view; 6- *P. asper* (see Methods), dorsolateral view; 7- *P. asper* (see Methods), ventral view. Scale lines: 1 mm. Photographs by L. Mencl.

Ventrum (Fig. 4) brown, femora sparsely macrosetaceous (with setigerous punctures). Mesometaventrum sparsely finely punctate, with few setigerous punctures present laterally, middle longitudinal furrow of mesometaventrum complete.

Sexual dimorphism. There are only slight differences between males and females. Males are smaller than females in average. Some differences are found on the mesometaventrum: the area adjacent to the longitudinal midline furrow is concave in males (Fig. 23), convex in females (Fig. 24); there are no differences as to the furrow depth and width.



Figs. 8-13. Head, areas adjacent to scutellum and elytra of two *Psammodius* species: 8- *P. boreoitalicus* sp. nov., holotype, head; 9- *P. asper* (see Methods), head; 10- *P. boreoitalicus* sp. nov., holotype, areas adjacent to scutellum; 11- *P. asper* (see Methods), areas adjacent to scutellum; 12- *P. boreoitalicus* sp. nov., paratype 2681, elytra; 13- *P. asper* (see Methods), elytra. Scale lines: 0.5 mm for Figs. 8-11, Figs. 12-13 are out of scale. Photographs by L. Mencl.

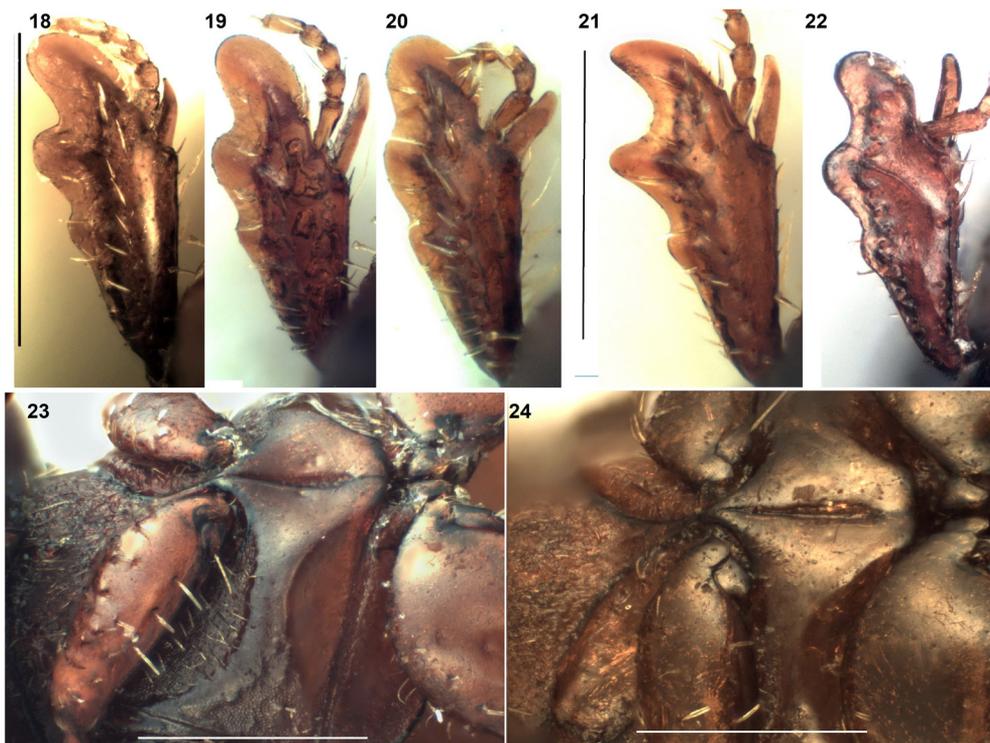


Figs. 14-17. Pronotum of two *Psammodius* species: 14- *P. boreoitalicus* sp. nov., paratype 2685, dorsal view; 15- *P. asper* (see Methods), dorsal view; 16- *P. boreoitalicus* sp. nov., paratype 2685, lateral view; 17- *P. asper* (see Methods), lateral view. Scale lines: 0.5 mm. Photographs by L. Mencl.

Variability. The body length varies between 2.3 and 3.1 mm within a group of specimens measured (156 individuals).

In the new species, there is no considerable colour variability. There are also no considerable individual differences as to the shapes of body parts.

On the other hand, the pronotum dorsal surface is rather variable, which is not surprising due to the rich pronotal structures and sculptures in *Psammodiini*. For example, Figs. 14 and 16 suggest that pronotal transversal furrow 2 is considerably reduced laterally. However, this interesting feature is not always present; there are also individuals having different arrangement of the pronotal furrows.



Figs. 18-24. Protibiae and details of mesometaventral plate of two *Psammodyus* species: 18- *P. boreoitalicus* sp. nov., paratype 2681; 19- *P. boreoitalicus* sp. nov., paratype 1832; 20- *P. boreoitalicus* sp. nov., paratype 2686; 21- *P. asper*, fresh specimen (see Methods); 22- *P. asper*, rather worn specimen (see Methods); 23- *P. boreoitalicus* sp. nov., male paratype 2271; 24- *P. boreoitalicus* sp. nov., female paratype 2682. Scale lines: 0.5 mm. Photographs by L. Mencl.

Differential diagnosis. Differences between characters of the new species and those of the most similar species are summarized in Table 1 presented below. The importance of particular characters will also be considered in the part Discussion.

Table 1. Differences between characters of two similar species *P. asper* and *P. boreoitalicus* sp. nov.

<i>Psammодиус asper</i> (Fabricius, 1775)	<i>Psammодиус boreoitalicus</i> sp. nov.
brownish black to black, immature specimens (about 10%) lighter	reddish brown to brownish black
body length 2.6-3.9 mm; 3.171 mm in average; number of individuals measured n = 678; Mean Standard Deviation MSD = 0.039	body length 2.3- 3.1 mm; 2.614 mm in average; number of individuals measured n = 156; Mean Standard Deviation MSD = 0.022
transversal pronotal ridges strongly convex; ridges mostly narrower than or comparable to respective furrows (Figs. 15, 17)	transversal pronotal ridges relatively less convex; ridges mostly wider than respective furrows (Figs. 14, 16)
punctures on scutellum moderately larger at base or in basal half (Fig. 11)	scutellum finely microscopically punctate throughout (Fig. 10)
elytral interval 10 flat (Fig. 13)	elytral interval 10 rather convex (Fig. 12)
three large teeth on outer margin of protibia angular, at most with moderately rounded apices (Figs. 21-22)	three large teeth on outer margin of protibia rounded (Figs. 18-20)
profemora more elongate (length-to-width ratio of 1.9) (Fig. 7)	profemora wider (length-to-width ratio of 1.7) (Fig. 4)
aedeagus distinctly longer (Fig. 28, 30)	aedeagus distinctly shorter (Figs. 27, 29)
epipharynx obviously wider (Fig. 26): width-to-length ratio of 2.39-2.65 (measured in n = 6 specimens)	epipharynx as in Fig. 25: width-to-length ratio of 2.11-2.27 (measured in n = 3 specimens)
chaetoparia with longer setae, their apices rather acute (Fig. 26)	chaetoparia with shorter, stronger setae, their apices rounded or subacute (Fig. 25)

Distribution. So far known only from north-eastern Italy, Venezia-Giulia region.

Collecting circumstances. Collected by rinsing gravel, sand and grass tufts with water. See Discussion for the type of localities.

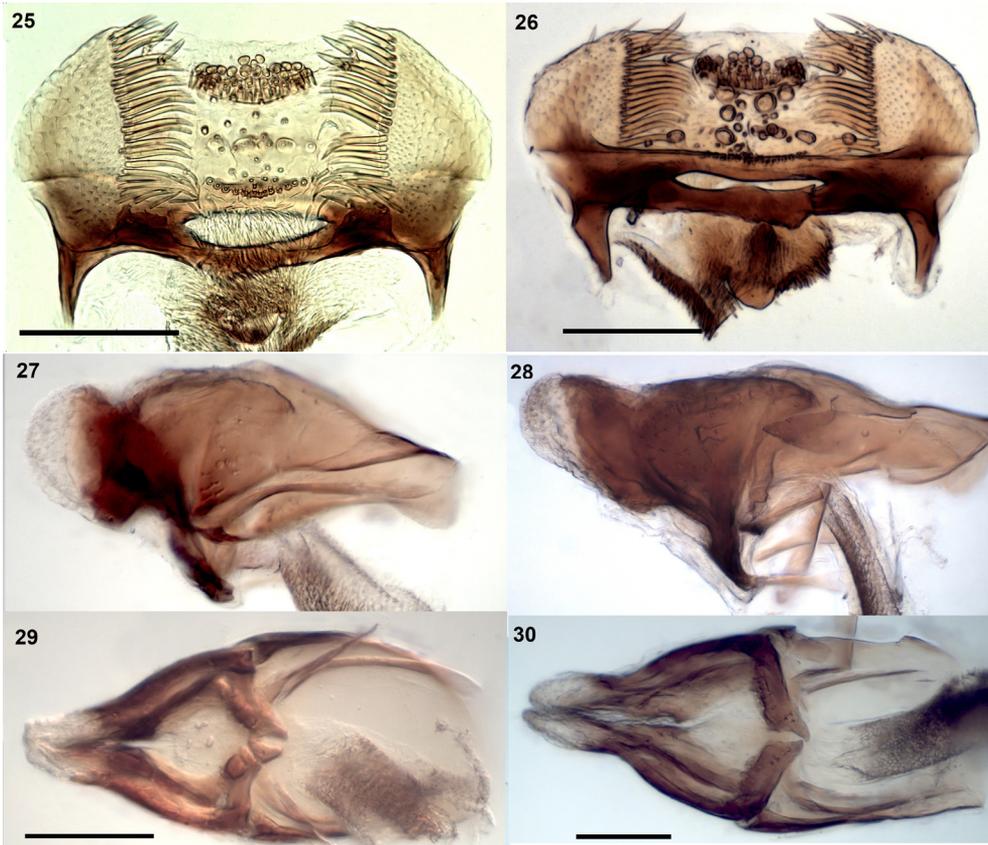
Name derivation. Toponymic (adjective based on the occurrence of the new species in northern Italy).

Additional material studied for comparison. For purposes of the present work, we particularly studied specimens of the species *Psammодиус asper*, which came from Austria, Belgium, Czech Republic, Germany, Hungary, France, Italy, the Netherlands, Slovakia, Sweden, Switzerland and Ukraine. See also Figs. 5-7, 9, 11, 13, 15, 17, 21-22, 26, 28, 30.

DISCUSSION

The new species described here is most similar to *P. asper*, which can be reliably supported by consideration of characters as shown in the key to species by Pittino (2007) in the most recent comprehensive work dealing with *Psammодиус*. That key to western Palaearctic species includes total of 13 species, from among them five similar species having bare (non-ciliate) genae. A detailed analysis of appropriate characters resulted in the fact that the species keys out to point 11 - *P. asper*.

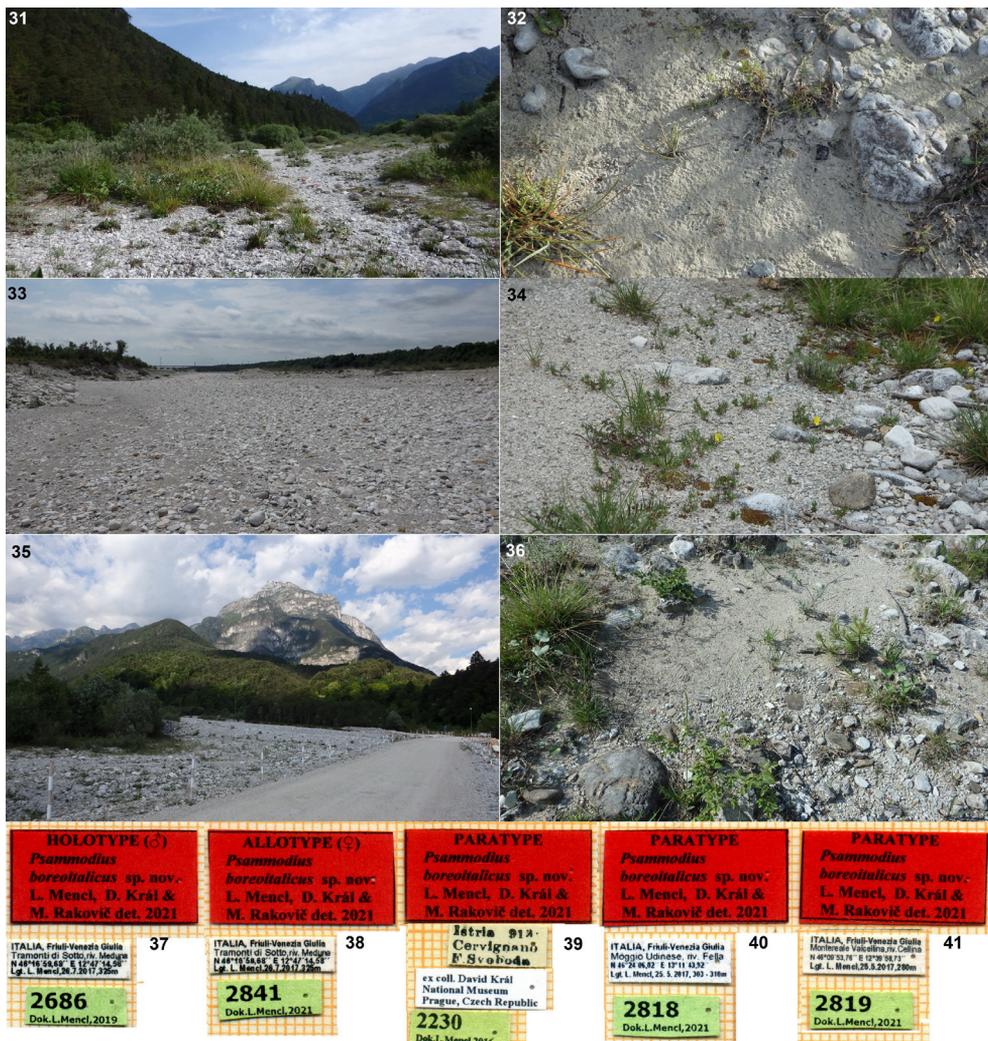
Due to all the data mentioned above, our efforts were namely focused on the following issues: the variability of the new species and the differential diagnosis in term of a comparison



Figs. 25-30. Epipharynx and aedeagus of two *Psammodius* species: 25- *P. boreoitalicus* sp. nov., allotype, epipharynx; 26- *P. asper* (see Methods), epipharynx; 27- *P. boreoitalicus* sp. nov., holotype, aedeagus, lateral view; 28- *P. asper* (see Methods), aedeagus, lateral view; 29- *P. boreoitalicus* sp. nov., holotype, aedeagus, ventral view; 30- *P. asper* (see Methods), aedeagus, ventral view. Scale lines: 0.1 mm. Photographs by L. Mencl.

with the most similar species. The photographs presented here were also selected to this end. The novelty of the species described there is obviously demonstrated by Table 1 summarizing the differences in characters of external parts, aedeagus and epipharynx.

As to our currently existing knowledge, *Psammodius boreoitalicus* sp. nov. occurs in areas of unregulated, repeatedly flooded rivers of north-eastern Italy (the Southern Limestone Alps). In the summer period, the rivers are frequently completely dry. It is found in alluvial sand-gravel at the bottom of dry pools sparsely covered with a vegetation, most typically up to a level of 1 m above the water surface, only rarely in moist sand at roots of grass tufts. Material collected by L. M. was found together (in the same grass tufts and the same dry puddles, but only at the location Tramonti di Soto) with low numbers of *Rhyssalus limbolarius* Petrovitz, 1963 (about 30 specimens) and very rarely with *Psammodius asper* (7 specimens) and *Diastictus vulneratus* (Sturm, 1805) (1 specimen).



Figs. 31-41. Photos of type localities and etiquettes pinned under type specimens: 31- Tramonti di Soto, riv. Meduna, overall photo; 32- Tramonti di Soto, riv. Meduna, detailed photo; 33- Montereale Valcellina, riv. Cellina, overall photo; 34- Montereale Valcellina, riv. Cellina, detailed photo; 35- Moggio Udinese, riv. Fella, overall photo; 36- Moggio Udinese, riv. Fella, overall photo; 37-41- Etiquettes pinned under holotype, allotype and paratypes, respectively. Note: white label in Fig. 31 includes word Istria [sic!]. All figures are out of scale. Photographs by L. Mencl.

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