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Satrapister nitens Bickhardt, 1912: redescription and tentative phylogenetic placement of a mysterious taxon (Coleoptera, Histeridae, Saprininae)

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Abstract

The monotypic genus *Satrapister* Bickhardt, 1912 is redescribed and figured. Its tentative position in the recently performed phylogeny of the subfamily, inferred from a new analysis based on the available morphological characters is discussed. Lectotype of *Satrapister nitens* Bickhardt, 1912 is designated.

Key Words

Coleoptera
Histeridae
Saprininae
Satrapister
phylogeny

Introduction

Satrapister nitens Bickhardt, 1912 was described more than a hundred years ago by Bickhardt, one of the leading experts of the histerid taxonomy from the first half of the 20th century, as the type species of the monotypic genus *Satrapister* Bickhardt, 1912. The species was described based on two specimens collected by A. Reclaire in Göttingen (Germany) in guano, originating from Peru and became a mystery practically since its description, both for its uncertain origin, biology and morphology. Its taxonomic placement was only briefly discussed by Bickhardt (1912), he compared the newly described taxon *Satrapister* with the genera *Haeterius* Dejean, 1833 (which belongs to a different subfamily Haeteriinae Marseul, 1857) and *Saprinus* Erichson, 1834, based on their respective external morphologies. In the original description, Bickhardt (1912) did not place *Satrapister* into subfamily; but later, in his catalogue of the family Histeridae (1916: 82), he placed it correctly into the subfamily Saprininae as the first genus of the subfamily. Mazur in his catalogues (1984, 1997, 2011) placed *Satrapister* between the genera *Myrmeosaprinus* Mazur, 1975 and *Euspilotus* Lewis, 1907 (Mazur 1984: 64); *Saprinus* and *Euspilotus* (1997: 232); and finally, between *Microsaprinus* Kryzhanovskij, 1976 and *Euspilotus* (2011: 189). *Satrapister*, together with *Auchmosaprinus* Wenzel, 1962 and *Paramyrmetes* Bruch, 1929 was one of the three Saprininae higher taxa that were not included in the phylogenetic treatment of the subfamily (Lackner 2014d) because of its unavailability. Recently I have had the opportunity to inspect *Auchmosaprinus* and *Satrapister*, so *Paramyrmetes* remains the last Saprininae genus or subgenus unknown to me. In this paper the taxon is redescribed based on the type material as well as three newly discovered specimens from Peru, and complement the redescription with habitus images

and drawings of the sensory organ of the antennal club and male genitalia. This work presents another contribution to my on-going revisionary work on the genera of the subfamily Saprininae (Lackner 2009a-c, 2010, 2011a,b; Lackner 2012; Lackner 2013a,b,c; Lackner and Gomy 2013; Lackner 2014a,b,c,d; Lackner 2015; Lackner and Tishechkin 2014; Tishechkin and Lackner 2012).

Material and methods

The lectotype specimen was soaked in water overnight, removed from its original mounting card, cleared from dust and remaining glue with 70% ethanol and mounted on a triangular point for observation. Other specimens were observed under binocular microscope. Colour images were made by F. Slamka (Bratislava, Slovakia). Measurements were made by ocular micrometer. Body part terminology follows that of Ôhara (1994) and Lackner (2010) and the following acronyms of museum collections are used throughout the text: MUSM – Universidad Mayor de San Marcos, Lima, Perú (Olga Bracamonte Guevara); NCB – National Centre for Biodiversity Naturalis, Leiden, the Netherlands (Hans Huijbregts); SENASA – Servicio Nacional de Sanidad Agraria, Lima, Perú (Nuñez Sacarias De Dioses Elizabeth Yolanda); ZMHUB – Museum für Naturkunde, Berlin, Germany (Bernd Jaeger). Separate lines of the same label are demarcated by a slash (/). Abbreviations of morphological measurements follow Ôhara (1994) and are used throughout the text as follows:

APW	width between anterior angles of pronotum
EL	length of elytron along elytral suture
EW	maximum width between outer margins of elytra
PEL	length between anterior angles of pronotum and apices of elytra
PPW	width between posterior angles of pronotum.

Analytical methods. Cladistic analyses were based on the external structures and male genitalia. In total, 95 morphological characters (see Lackner 2014d for details) of adults were scored (multistate coding) and analyzed. Adult morphological characters were treated as non-additive; inapplicable characters were assigned a gap value ('–') and treated as equivalent to missing data ('?'). The total number of ingroup taxa was 73 (taxa used in Lackner 2014d + *S. nitens*); cladograms were rooted with exemplars of Dendrophilinae Reitter, 1909 (genus *Dendrophilus* Leach, 1817), Bacaniini Kryzhanovskij in Kryzhanovskij and Reichardt 1976 (genus *Bacanius* LeConte, 1853), Abraeinae MacLeay, 1819 (genus *Chaetabraeus* Portevin, 1929), and Anapleini Olexa, 1982 (genus *Anapleus* Horn, 1873). The taxa selected as outgroup representatives were selected based on the existing phylogenies of the Histeridae by Ślipiński and Mazur (1999) and Caterino and Vogler (2002), which suggest that representatives of Dendrophilinae and Abraeinae are amongst the best contenders for the Saprininae sister groups. The most parsimonious trees (MPTs) were searched using PAUP 4.0B10 (Swofford 2001) with 1000 random addition replicates of tree bisection-reconnection branch swapping. All characters were unordered and equally weighted. Bootstrap (BS) values (Felsenstein 1985; Sanderson 1995) were calculated by resampling with 1000 replications using simple searches while holding one tree at each step and swapping on the best tree. Additional branch support was examined using decay indices (DIs; Bremer 1994), calculated by the program TreeRot (Sorenson 1999). Character states were optimized using MacClade 4.08 (Maddison and Maddison 2005); only the unambiguous optimizations are shown on the tree (Fig. 14A). The cladogram was graphically depicted using the FIGTREE program (Rambaut 2007) and subsequently redrawn using Adobe Illustrator CS5.

Results

Satrapister Bickhardt, 1912

Satrapister Bickhardt, 1912: 231. Type species *Satrapister nitens* Bickhardt, 1912: 232, by monotypy. *Satrapister*: Bickhardt (1926): 81, 82, table 4, fig. 27; Mazur (1984): 64; Mazur (1997): 232; Mazur (2011): 189.

Diagnosis. Very small elongate-oval non-metallic Saprininae beetle with sparsely punctate dorsum and reduced dorsal elytral striae. Venter of body with sparse microscopic setae; carinal prosternal striae very reduced or obsolete; lateral prosternal striae divergent anteriorly; prosternal foveae absent; apex of prosternal process with sulcus. Meso- and metaventrite almost impunctate; lateral disc of metaventrite + metepisternum punctuate and setose. Mandibles of unequal length, left mandible slightly longer than right. Eyes completely flattened, reduced, invisible from above. Sensory structures of antenna in form of a single stipe-shaped vesicle situated under round sensory area on internal distal part of the antennal club complemented by another round sensory area. Protibiae with 9-11 low teeth topped by rather long, curved thin amber denticles.

Differential diagnosis. As I am not familiar with most of the South American taxa of the species-rich genus *Euspilotus*, I hesitate to provide a clear-cut differential diagnosis of the genus *Satrapister*. It is, however, most readily distinguishable from the majority of the South American species of the subfamily that I am familiar with by its elongate-oval body form, reduced and flattened eyes and almost complete lack of elytral striation.

Biology. Unknown, the type specimens were found in guano originated from Peru; reduced eyes can indeed indicate its inquilinous habits. The other three specimens do not carry any biological data on their labels.

Distribution. Bickhardt (1912: 232) following the description of *S. nitens* in Latin gave 'South America ?' as

its terra typica, but explained further in the text in German that the two specimens he examined were found in Göttingen by Dr. A. Reclaire in 'Peru-Guano', and that was why he opted for South America as the continent of origin. The type locality 'South America ?' was repeated by Mazur (1984, 1997, 2011), followed by 'Peru ?'. The three non-type specimens collected in the years before and after WWII originate from two tiny islands off the Peruvian coast: Isla Don Martín and Isla de Pescadores [=Isla Grande]. Both these islands serve as important refugia and nesting grounds for numerous species of seabirds and are known to contain large amounts of guano (Cushman 2014).

Remarks. Bickhardt (1912) described the type species of this genus based on two specimens: one of them was to be kept in his private collection (now ZMHUB) and the second one was to be kept at the private collection of Dr. H.J. Veth (later acquired by NCB), who had sent him the two type exemplars found in guano allegedly originating from Peru in Göttingen, Germany by Dr. A. Reclaire (see also above). During my visit of ZMHUB, I found one of the two specimens of *S. nitens* (a female) that had been designated a lectotype by G. Arriagada (Santiago de Chile, Chile); however, this designation has apparently never been published. Recently, I discovered the second specimen, kept in the collection of NCB; this was most likely Veth's specimen. The specimen in ZMHUB is almost completely fallen apart and its body parts are glued on two separate mounting cards. The other specimen, housed in NCB was also observed to be badly damaged and very fragile. Judging from the state of the type specimens, I infer that they arrived to Europe from their alleged homeland (South America, Peru) already dead.

Satrapister nitens Bickhardt, 1912

Figs 1–13

Satrapister nitens Bickhardt, 1912: 232
Mazur (1984): 64; Mazur (1997): 232; Mazur (2011): 189.

Type material examined. Lectotype (designated here), ♂, glued on its side on a triangular mounting point, except for pretarsus all other tarsi missing, both antennae, left mandible missing, both hind legs missing, propygidium and pygidium dismembered, separated from the rest of the abdominal segments and glued to the mounting card separately from the specimen, right elytron wholly longitudinally cracked, with dismembered male genitalia glued also to the same mounting card as the specimen, with following labels: "in Peru guano" (written); followed by: "Type" (brick-red label, written); followed by: "Satrapister / nitens / n.gen. n. sp. / Bickh" (dark green, barely legible written label); followed by: "Coll. Veth" (printed); followed by: "Type" (red label, printed); followed by: "LECTOTYPE / Satrapister nitens / Bickhardt, 1912 / des. T. Lackner 2015" (red label, written) (NCB).

Figure 1. *Satrapister nitens* Bickhardt, 1912 SYNTYPE, dorsal view.

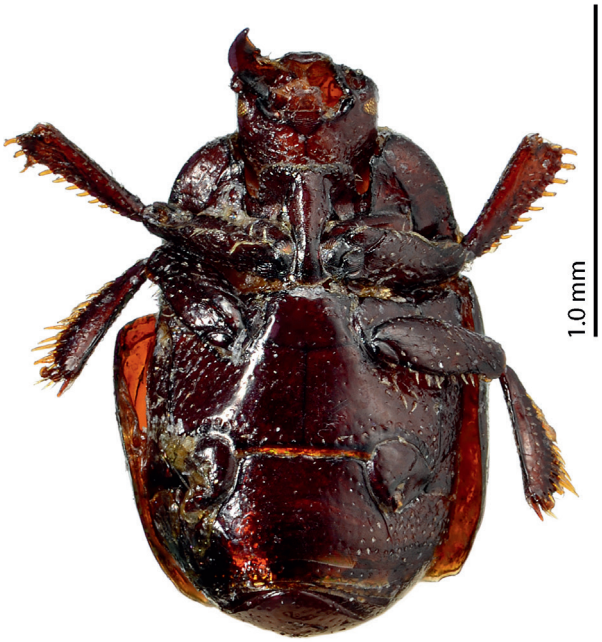

Figure 2. *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, prosternum, mesoventrite + metaventrite.

Syntype, ♀, designated as lectotype by G. Arriagada in 1990, but apparently never published, body and head glued on a triangular point, with five legs, both mandibles, two antennal scapes and one antennal club dismembered and glued in Canada balsam on a separate mounting

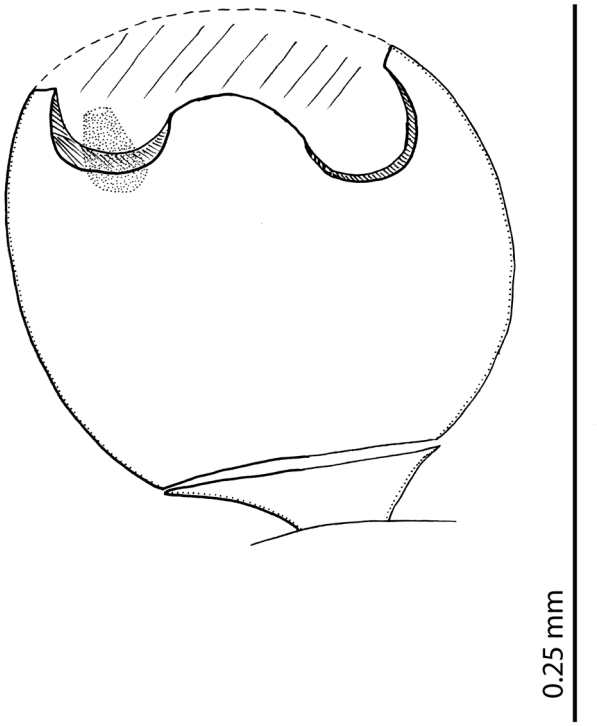

Figure 3. *Satrapister nitens* Bickhardt, 1912 SYNTYPE, sensory structures of the antenna.

card, with pygidium and dismembered female genitalia glued in Canada balsam on another mounting card under the former one, followed by: "in Peru guano" (written); followed by: "Type" (brick-red card, written); followed by: "Satrapister / nitens Bickh. / n.gen., n. sp." (written); followed by: "Satrapister / Bickh." (written); followed by: "nitens / Bickh." (written); followed by: "Zool. Mus. / Berlin" (printed); followed by: "Satrapister ♀ / nitens Bickh. / Lectotype / G. ARRIAGADA DET 1990" (black/red framed written-printed label) (ZMHUB). **Note.** This species was described based on two specimens. Bickhardt (1912) apparently did not check the sex of specimens. Although Arriagada examined the specimen from ZMHUB and furnished it with a lectotype label, his designation has never been published. Since the specimen housed in ZMNHUB is a badly damaged female and the second specimen in NCB is a male that is in somewhat better condition I designate the male from NCB as the lectotype here. The second specimen, housed in ZMHUB therefore bears the status of a syntype.

Additional material examined. PERU: 2 ♂♂, Isla Don Martín, 15.ii.1955, Coll. M. Peña (MUSM). 1 ♀, Isla de Pescadores [=Isla Grande], 5.viii.1934, collector illegible (SENASA).

Description. Body (Figs 1–2) PEL: 1.50–1.70 mm; APW: 0.625–0.65 mm; PPW: 1.00–1.125 mm; EW: 1.25 mm; EL: 1.00 mm; colour (including body appendages) light brown to castaneous, antennal club amber-coloured. Clypeus flat, with scattered punctuation; labrum with wide median depression, with two long labral setae arising from each labral pit; mandibles rather slender, left mandible slightly longer than right, both mandibles pointed apically, sub-apical tooth on left mandible situated approximately in mandibular mid-length, obtuse; vague vestiges of frontal stria present anterad eyes, frontal + supraorbital striae otherwise absent; frontal disc flat, with scattered punctuation, punctures separated by several times their diameter, on posterior margin with distinct fovea medially; occipital stria fine, complete. Antennal scape slightly thickened, antennal club round, sensory structures of antennal club (Fig. 3) in form of one stipe-shaped vesicle situated under round sensory area on internal distal side of the antennal club dorsally, bridge-like connected with another sensory area. Antennomeres 1-8 with distinct setae. Eyes small (reduced?), flattened, invisible from above; surface above eyes on frontal lateral margins with distinct regular microscopic setae.

Pronotal hypomeron punctate, with distinct regular microscopic setae, lateral pronotal margins (Fig. 1) on basal two-thirds almost sub-parallel, on apical third narrowing, anterior pronotal angles obtuse. Pronotal disc laterally with sparse, rather deep elongate punctures separated by their own to several times their diameter; medially disc with scattered microscopic punctuation. Marginal pronotal stria thin, but carinate and complete; pronotal base with a vague row of tiny punctures. Scutellum small, triangular.

Elytral epipleuron with several irregular wrinkles and few punctures, otherwise smooth; marginal epipleural stria fine, complete, marginal elytral stria carinate and complete; apical elytral stria obliterated on half its length. Oblique humeral stria deeply impressed on basal elytral fourth; in one specimen a median fragment of inner subhumeral stria as well as a basal fragments of elytral striae 1-2 present; in rest of specimens all other elytral striae, except for short basal fragment of fourth dorsal elytral stria that is basally connected to almost complete sutural elytral stria completely lacking. Elytral disc with scattered punctures separated by several times their diameter.

Propygidium and pygidium with punctuation similar to the elytra, but punctures deeper and denser, separated approximately twice their diameter.

Prosternal process (Fig. 2) on apical margin with distinct, rather long amber setae; marginal prosternal stria present as a median fragment; carinal prosternal striae very weak, usually present only between procoxae, next evanescent (in two specimens intermittent to almost complete); lateral prosternal striae widely divergent anteriorly and ending in apical sulcus; prosternal foveae absent; prosternal keel even, rounded, impunctate, alutaceous.

Mesoventrite (Fig. 2) sub-trapezoid, convex, sparsely punctuate, marginal mesoventral stria thin, weak; meso-metaventral sutural stria absent; metaventrite almost smooth, only with several scattered punctures becoming denser along metaventral base; lateral metaventral stria straight, thin, vaguely impressed, shortened; lateral disc of metaventrite with dense deep, almost confluent punctures fringed with long amber setae; metepisternum with similar punctuation.

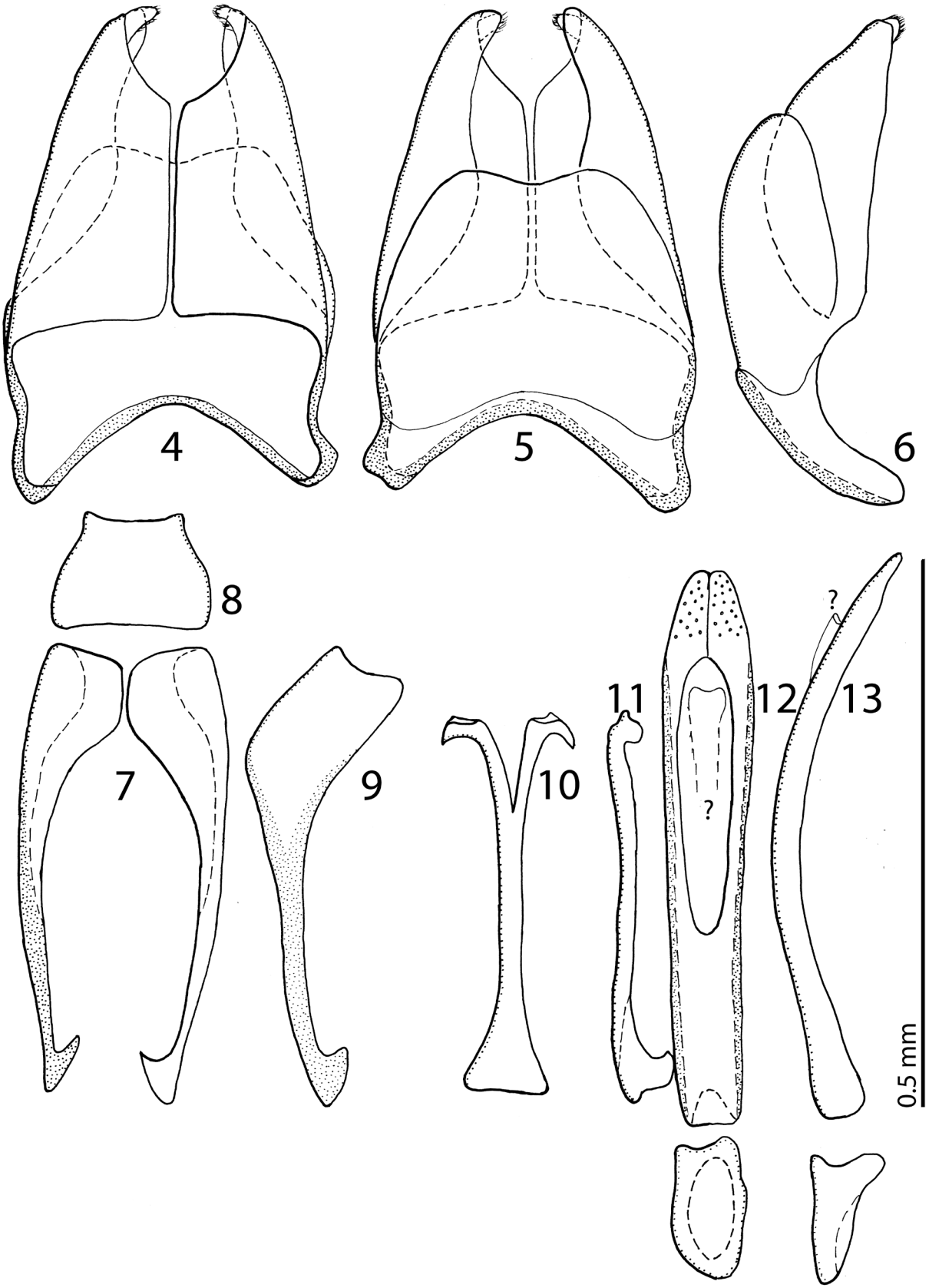

Figure 4–13. 4 *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, eighth sternite and tergite, ventral view **5** ditto, dorsal view **6** ditto, lateral view **7** *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, ninth tergite, dorsal view **8** *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, tenth tergite, dorsal view **9** *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, ninth tergite, lateral view **10** *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, spiculum gastrale, ventral view **11** ditto, lateral view **12** *Satrapister nitens* Bickhardt, 1912 LECTOTYPE, aedeagus, dorsal view **13** ditto, lateral view

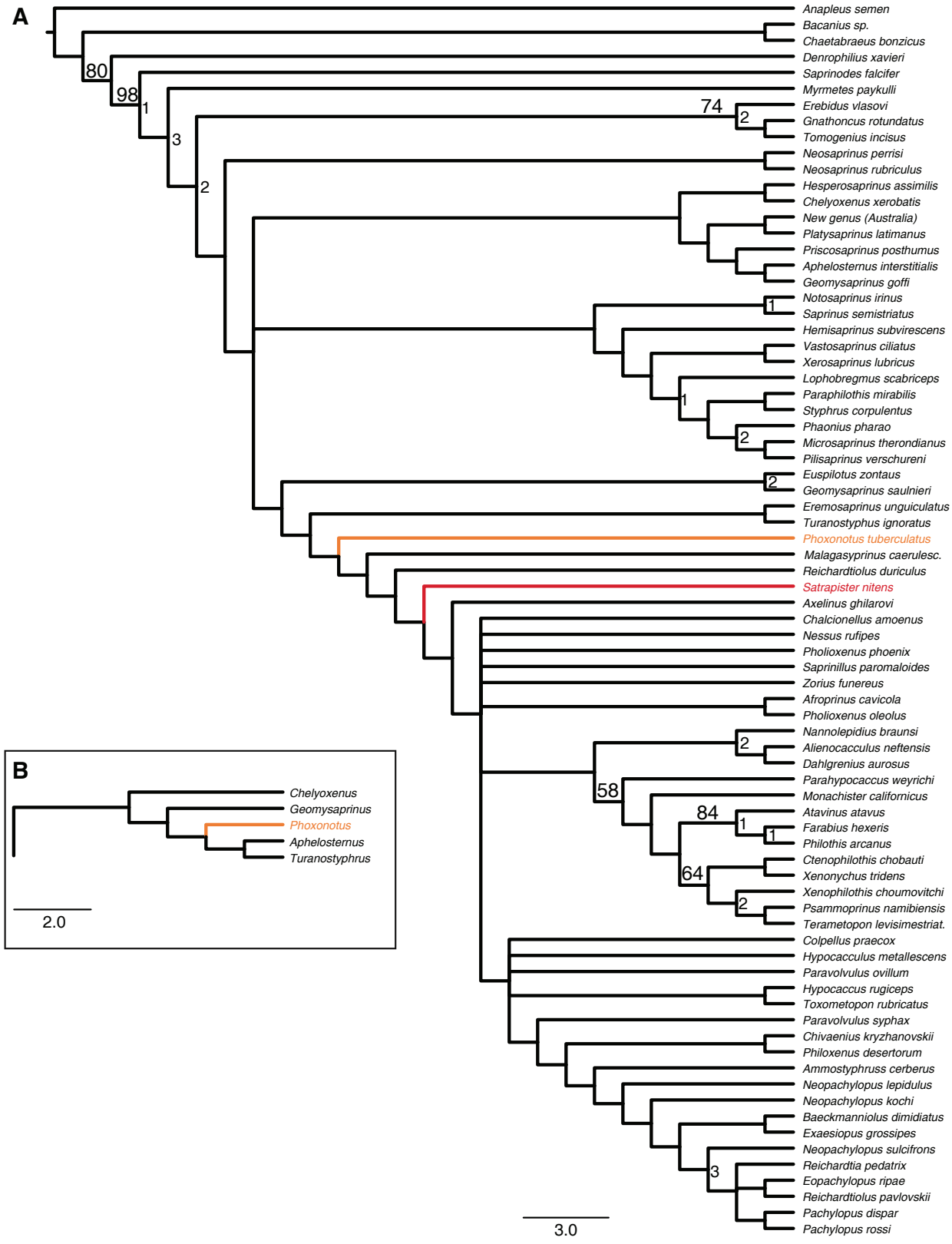

Figure 14. A The strict consensus of 1026 equally parsimonious trees; TL = 701, CI: 0.29, RI: 0.57, of the newly-performed analysis showing the position of *Satrapister* Bickhardt, 1912 and *Phoxonotus* Marseul, 1862, respectively. Double-digit numbers above branches show the percentage of bootstrap support (bootstrap values below 50% are not shown); single-digit numbers at nodes show Bremer indices for the nodes **B** Section of the cladogram of Lackner (2014d) showing the position of *Phoxonotus* Marseul, 1862.

First visible abdominal ventrite vaguely striate laterally, disc almost glabrous, only with scattered microscopic punctuation.

Legs: protibia slightly dilated, with 9–11 low teeth topped by rather long thin curved denticles diminishing in size in proximal direction, protarsal groove shallow, protibial spur short and stout, growing out from apical protibial margin, further characters of protibia not examined. Mesotibia on outer margin with a row of low teeth topped by long, slender amber-coloured denticles, setae of outer row dense and rather long; setae of median row finer and shorter; on anterior face of mesotibia another row of shorter dense amber denticles present, mesotibial spur stout and well-developed; metatibia slightly longer than mesotibia, denticles on outer metatibial margin more closely-set; metatarsal claws short, bent, about half-length of terminal metatarsal segment; other characters of legs not examined.

Male genitalia: eighth sternite (Figs 4–5) longitudinally divided medially, apically with tiny velum topped by several microscopic setae; eighth tergite inwardly arcuate apically; eighth sternite and tergite fused laterally (Fig. 6). Ninth tergite (Figs 7, 9) longitudinally separated medially; tenth tergite (Fig. 8) apically with lateral processes; spiculum gastrale (Fig. 10) apically separated into two arms; base distinctly triangular. Aedeagus (Fig. 12) with rather short phallobase, ratio phallobase: tegmen approximately 1:5; tegmen sub-parallel, faintly dilating apically; apex with pores and pseudo-pores; parameres fused apically and on their basal 2/5; aedeagus laterally curved ventrad (Fig. 13).

Cladistic analysis. Results of the tree reconstruction analyses are shown in Figure 14A. Heuristic search resulted in 1026 equally parsimonious trees of tree length (TL) = 582, CI = 0.33, RI = 0.66. The strict consensus of the equally parsimonious trees had the following characteristics: TL = 701, CI = 0.29, RI = 0.57. The strict consensus tree is mostly resolved, but bootstrapping resulted in low support values for most of the recovered branches.

Discussion

The genus *Satrapister* was, due to its unavailability not included in my phylogeny of the subfamily, which was based on the morphological characters of the adults alone (Lackner 2014d). Using the analytical methods of my previous work (Lackner 2014d; see also above) I coded the characters of *Satrapister* as well as male genitalia of another South American genus *Phoxonotus* Marseul, 1862 that were not available previously and performed the heuristic search. The analysis yielded a tree topology, which is in deeper branches largely congruent with my previous results, with the exception of the newly included *Satrapister*, naturally (Fig. 14A). The South American attaphilous genus *Phoxonotus* was recovered in my previous analysis (Lackner 2014d; see Fig. 14B of the present paper) as a member of a small monophyletic clade of mostly inquilinous, North American genera (with the exception of the Middle-Asian genus *Turanostyphrus* Tishechkin, 2005 whose type species is known only from a single specimen and whose mouthparts dissections were not possible to study and whose spiculum gastrale was not available for character coding). With the forthcoming revision of the genus *Phoxonotus* (Lackner, *in press*) I have had the possibility to examine numerous specimens of its type species, *P. tuberculatus* Marseul, 1862 and coded the male genitalia into the original matrix. Although the position of *P. tuberculatus* on the recent tree (Fig. 14A) is somewhat different from that of Lackner (2014d), it is newly recovered, together with Peruvian *Satrapister nitens*, Malagasy *Malagasyprinus caeruleatus* (Lewis, 1905) (unknown biology) as well as two Middle-Asian psammophilous taxa *Axelinus ghilarovi* Kryzhanovskij in Kryzhanovskij & Reichardt, 1976 and *Reichardtiolus duriculus* (Reitter, 1904) in a grade basal to a large clade of mainly psammophilous taxa with largely unresolved inter-relationships. The support for the clade including *P. tuberculatus* of Lackner (2014d) is low and based only on several homoplastic characters. Although this has been attributed to the lack of a male genitalic characters of *Phoxonotus* previously and the missing characters of the rare Middle-Asian *Turanostyphrus ignoratus* (Lackner 2014d: 548) the situation is no different even after inclusion of the male genitalia characters of *Phoxonotus*, and the support for the branches is low and based on mostly homoplastic characters again.

The position of the species *Satrapister nitens* on the cladogram, in the same grade as *P. tuberculatus* must, due to the low support of the most branches, be regarded as preliminary and tentative. Its morphological characters are a mix of plesiomorphic (e.g. absent supra-orbital striae) and apomorphic ones (e.g. the presence of only a single, stipe-shaped vesicle or the 8th sternite and tergite of male genitalia fused laterally).

Based on the reduced eyes as well as its presence in guano there is room for speculation that *S. nitens* is indeed an inquilinous species. The incomplete biological data and lack of larval and/or molecular characters of this species considerably blur the picture of its exact allegiance with the rest of the subfamily.

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