ACTA ENTOMOLOGICA
MUSEI NATIONALIS PRAGAE
ISSN 1804-6487 (online) – 0374-1036 (print)

2018
58(2): 407-418
doi: 10.2478/aemnp-2018-0032
www.aemnp.eu

RESEARCH PAPER

# *Synapsis puluongensis* sp. nov. and redescription of *S. horaki* (Coleoptera: Scarabaeidae), with a key to Vietnamese species

Van Bac BUI[1,2] & Michael BONKOWSKI[1]

[1] Institute of Zoology, Terrestrial Ecology, University of Cologne, Zülpicher Strasse 47b, D-50674 Cologne, Germany; e-mail: m.bonkowski@uni-koeln.de
[2] Department of Plant Protection, Faculty of Forest Resources and Environmental Management, Vietnam National University of Forestry, Xuan Mai, Chuong My, Hanoi, Vietnam; e-mails: buibac80@gmail.com, vbui3@smail.uni-koeln.de

Accepted:
17th July 2018

Published online:
25th September 2018

**Abstract.** A new species of coprophagous scarabaeid, *Synapsis puluongensis* sp. nov., is described based on six specimens collected in Pu Luong Nature Reserve in central Vietnam. The new species can be clearly distinguished from the remaining species of *Synapsis* Bates, 1868 by the following characters: hypomeral cavities present but not covered by red macrosetae; mesepisternal cavities absent; elytral striae extremely strong, bearing close and strong punctures; metafemora with dense and strong punctures in ventral view. Redescription of *S. horaki* Zídek & Pokorný, 2010 based on new material is also presented. Key to species of the genus *Synapsis* from Vietnam is provided.

**Key words.** Coleoptera, Scarabaeidae, *Synapsis*, dung beetles, new species, taxonomy, identification key, Vietnam, Oriental Region

**Zoobank:** http://zoobank.org/urn:lsid:zoobank.org:pub:8187447B-B951-4D73-973B-0AB6BB038A81


## Introduction

*Synapsis* Bates, 1868 is an Asian genus of Coprinae dung beetles, i.e. true dung beetles of the tunneler group, which burrow vertical tunnels near or below the dung pat and use it for dung removal (Hanski & Cambefort 1991). Currently, the genus comprises 23 valid species and is divided into five groups: the *Synapsis ovalis* group (*S. boonlongi* Hanboonsong & Masumoto, 1999, *S. gilleti* Arrow, 1931, *S. ovalis* Boucomont, 1920 and *S. strnadi* Král, 2002), the *S. birmanica* group (*S. birmanica* Gillet, 1907, *S. dickinsoni* Hanboonsong & Masumoto, 1999, *S. horaki* Zídek & Pokorný, 2010, *S. masumotoi* Ochi, 1992, *S. naxiorum* Král & Rejsek, 2000, *S. ochii* Masumoto, 1995, *S. punctata* Ochi, Kon & Kawahara, 2008, *S. roslihashimi* Ochi, Kon & Kawahara, 2008 and *S. yama* Gillet, 1911), the *S. ritsemae* group (*S. cambeforti* Krikken, 1987, *S. ritsemae* Lansberge, 1874 and *S. thoas* Sharp, 1875), the *S. brahmina* group (*S. brahmina* (Hope, 1831), *S. davidis* Fairmaire, 1878, *S. satoi* Ochi & Kon, 2007 and *S. tridens* Sharp, 1881), and the *S. tmolus* group (*S. kiuchii* Hanboonsong & Masumoto, 1999, *S. simplex* Sharp, 1875 and *S. tmolus* (Fischer von Waldheim, 1821)) (Balthasar 1963, Krikken 1987, Hanboonsong & Masumoto 1999, Král 2002, Ochi et al. 2008, Zídek & Pokorný 2010, Bezděk & Hájek 2012). In Vietnam, six species of the genus have been recorded so far: *S. ovalis* from Binh Phuoc and Song Be provinces, *S. strnadi* from Vinh Phuc and Lao Cai provinces, *S. yama* from Tuyen Quang and Thanh Hoa provinces, *S. horaki* from Vinh Phuc Province, *S. tridens* from Lao Cai and Nghe An provinces, and *S. simplex* from Dien Bien and Nghe An provinces (Balthasar 1963, Kabakov & Napolov 1999, Král & Rejsek 2000, Král 2002, Zídek & Pokorný 2010).

Our recent field surveys on dung beetle communities inhabiting forest and meadow fragments in limestone areas in northern and central Vietnam led to the discovery of a new, unnamed *Synapsis* population in the Pu Luong Nature Reserve (NR), which clearly differs from the known species of the genus in morphology. We describe this *Synapsis* population as a new species. We also provide a redescrip-

tion of the poorly known species *S. horaki* and a detailed key to the species of the genus *Synapsis* in Vietnam.

## Materials and methods

**Study area and sampling protocol.** The field research was conducted in limestone karst ecosystems in the Pia Oac Nature Reserve (Cao Bang Province, northern Vietnam) and the Pu Luong Nature Reserve (Thanh Hoa Province, central Vietnam) from March to May over a two year period (2015–2016). We used 90 baited pitfall traps in total to collect dung beetles. The traps were placed in habitats with increasing land use intensity, comprising primary forests, secondary forests and meadows at an elevational range of 800–1250 m in both reserves. Each trap consisted of a 5-liter plastic bucket buried to its rim in the soil, filled with 2 liters of 70% ethanol, and baited with 300 grams of a fresh pig and buffalo dung (50 : 50 ratio) mixture. Beetles that fell in traps were removed after 72 hours of trap exposure and preserved in 70% ethanol until examination in the lab (Bui et al. 2018).

**Comparative material** of following species was studied in the NMPC: *Synapsis birmanica, S. brahmina, S. davidis, S. naxiorum, S. ovalis, S. ritsemae, S. simplex, S. strnadi, S. tridens, S. yama,* and *S. tmolus.*

**Male genital morphology.** The aedeagus was extracted through the abdominal apex using forceps and needles, and was then cleaned and softened in 5% KOH at 65ºC for one hour. Also the internal sac of the aedeagus was drawn out and heated again for 30 minutes for clearing. The aedeagus and its internal sac were placed in glycerin and photographed with a digital microscope (Keyence VHX-500F) (Bui et al. 2018).

**Morphometrics.** Measurements were taken with a digital caliper and from photographs taken with a digital microscope (Keyence VHX-500F). The following morphometric traits were measured:

| | |
|---|---|
| BoL | body length from anterior margin of clypeus to posterior margin of elytra |
| BoW | maximum body width |
| HeadL | head length from anteriormost point of clypeus to posterior margin of head |
| HeadW | maximum head width |
| PronL | maximum pronotum length |
| PronW | maximum pronotum width |
| ElyL | elytra length from apex to base |
| MWoI123 | maximum width of first three intervals (interstriae) from elytral suture |
| DP10,15 | distance from puncture 10 (from base of elytra) to puncture 15 on first elytral stria |
| HoL | horn length from base to tip |
| PyL | maximum pygidium length |
| PyW | maximum pygidium width |
| ProTiL | protibia length |
| ProTiW | maximum protibia width |
| ProTiSL | protibial spur length |
| MesoTiL | mesotibia length |
| MesoTiW | maximum mesotibia width |
| 1st MesoTiSL | 1st mesotibial spur length (shortest spur) |
| 2nd MesoTiSL | 2nd mesotibial spur length (longest spur) |
| MetaTiL | metatibia length from proximal constriction to apex |
| MetaTiW | maximum metatibia width |
| MetaTiSL | metatibial spur length |
| MetaTaL | metatarsus length |
| MetaTa1L | metatarsomere 1 length |
| MetaTa1W | metatarsomere 1 width |
| MetaTa5W | metatarsomere 5 width |
| BoWeight | body weight after drying at 60ºC for 48 hours |
| DDC | distance between apices of clypeal denticles (teeth) |
| HyC | hypomeral cavity; |
| MeC | mesepisternal cavity |
| Gen | genae |
| MesoF | mesofemur at ventral side |
| MetaF | metafemur at ventral side |
| MetaTibrush | metatibial brush |

**Material examined.** The type specimens are deposited in the following institution (curators in parenthesis):

| | |
|---|---|
| NMPC | National Museum Prague, Czech Republic (Jiří Hájek); |
| PLNR | Pu Luong Nature Reserve, Thanh Hoa Province, Vietnam (NguyễnBáTâm); |
| VNUF | Vietnam National University of Forestry, Vietnam (Bùi Văn Bắc). |

## Systematics

### *Synapsis puluongensis* sp. nov.

(Figs 1A–F, 2A,C,E)

**Type locality.** Vietnam, Thanh Hoa Province, Puluong Nature Reserve, 20º28′54″N 105º14′31″E, 950 m a.s.l.

**Type material**. Holotype: ♂ 'VIETNAM | THANH HOA Prov. | Pu Luong Nat. Reserve, near Ban Ba vill. | 20º28'54''N 105º14'31''E, 950 m | primary forest | 10.–25.iv.2016 | Van Bac Bui leg.' (VNUF). Paratypes (five specimens): ♂, 'VIETNAM | THANH HOA Prov. | Pu Luong Nat. Reserve, near Ban Ba vill. | 20º28'55''N 105º14'29''E, 958 m | primary forest | 10.–25.iv. 2016 | Van Bac Bui leg.' (VNUF); ♀, 'VIETNNAM | THANH HOA Prov. | Pu Luong Nat. Reserve, near Ban Ba vill. | 20º28'54''N 105º14'29''E, 954 m | primary forest | 10.–25.iv.2016 | Van Bien Nguyen leg.' (VNUF); 3♀♀, 'VIETNAM | THANH HOA Prov. | Pu Luong Nat. Reserve, near Ban Ba vill. | 20º28'56''N 105º14'28''E, 956 m | primary forest | 10.–25.iv.2016 | Van Bac Bui leg.' (2 PLNR, 1 NMPC).

**Diagnosis.** Body length 17.2–18.5 mm, body width 10.4–11.5 mm; hypomeral cavities not covered by macrosetae; mesepisternal cavities absent; genae unexpanded; frons unarmed; anterolateral angles of pronotum not protruding; elytral striae strongly punctate; elytral intervals impunctate, convex and glossy, interval 2 near base not swollen; ventral sides of metafemora densely punctate.

**Description of holotype (male).** Body length 18.38 mm, body width 11.32 mm. Whole surface black, very shiny and glabrous. Margins of legs and pronotum with reddish-brown macrosetae.

***Head*** broad (HeadL 3.67 mm, HeadW 7.44 mm), extremely rugose anteriorly; posterior part sparsely punctate; fine punctures surrounding eyes. Anterior margin of clypeus bidentate, V-shaped, flexed upwards, with few reddish setae. Distance between apices of clypeal denticles (DDC) 1.43 mm. Genae rectangular, quite distinctly separated from clypeus and frons by well-defined suture with sculptural punctures. Genae closely and evenly punctate, with scanty reddish macrosetae. Frons glabrous and very unevenly punctate. Area surrounding eyes bearing more closely spaced and coarser punctures than base. Frons unarmed, only slightly swollen. Antennae composed of 9 antennomeres. Antennomere I 1.34 mm in length, longer than antennomeres II–IV combined (1.25 mm in length). Antennomeres I and II darker, bearing more yellow macrosetae than remaining antennomeres.

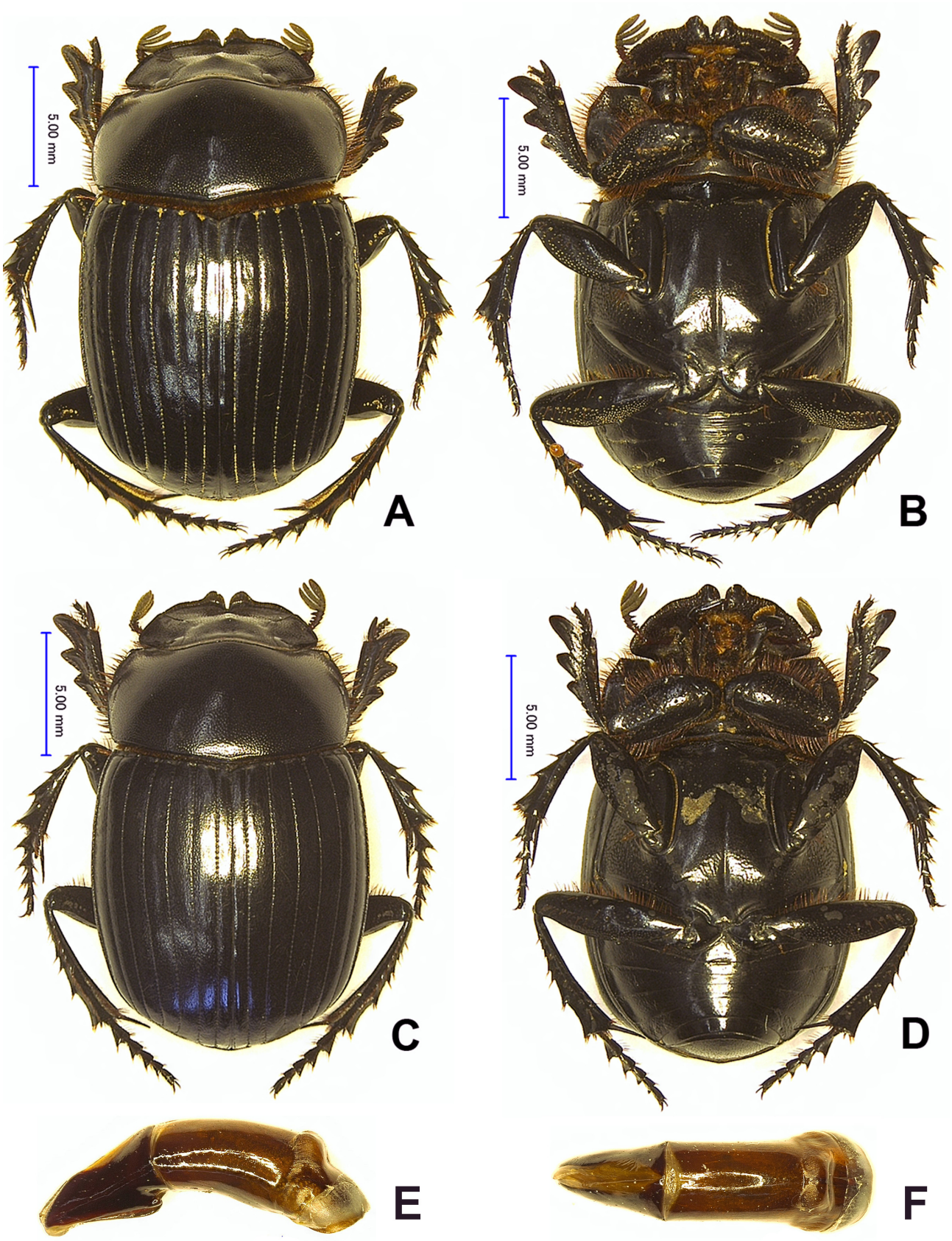


Fig. 1. *Synapsis puluongensis* sp. nov. A–B – male, holotype. C–D – female, paratype. E – aedeagus, lateral view. F – aedeagus, dorsal view.

***Prothorax.*** Pronotum transverse (PronL 4.9 mm, PronW 10.08 mm), widest at anterior quarter, with two distinct lateral carinae at each side. Area between carinae black, matte, glabrous and not punctate. Outer margin of outer carina with dense reddish-brown macrosetae. Anterolateral angles short and not protruding. Punctures not evenly distributed, denser at sides. Only small area at anterior edge of pronotal collar microrugose. Hypomeral cavities present but shallow, sparsely punctate and not covered with macrosetae. Meso-metaventrum quite smooth, with a few scattered fine punctures at its anterior end, bearing posterior median groove and deep excavation near metacoxae.

***Pterothorax.*** Elytra (ElyL 11.4 mm, MWoI123: 2.51 mm) convex, very shiny, deeply striate; elytral striae strongly, densely punctate (DP10, 15: 1.03 mm); intervals smooth and impunctate. Interval 2 near base not swollen.

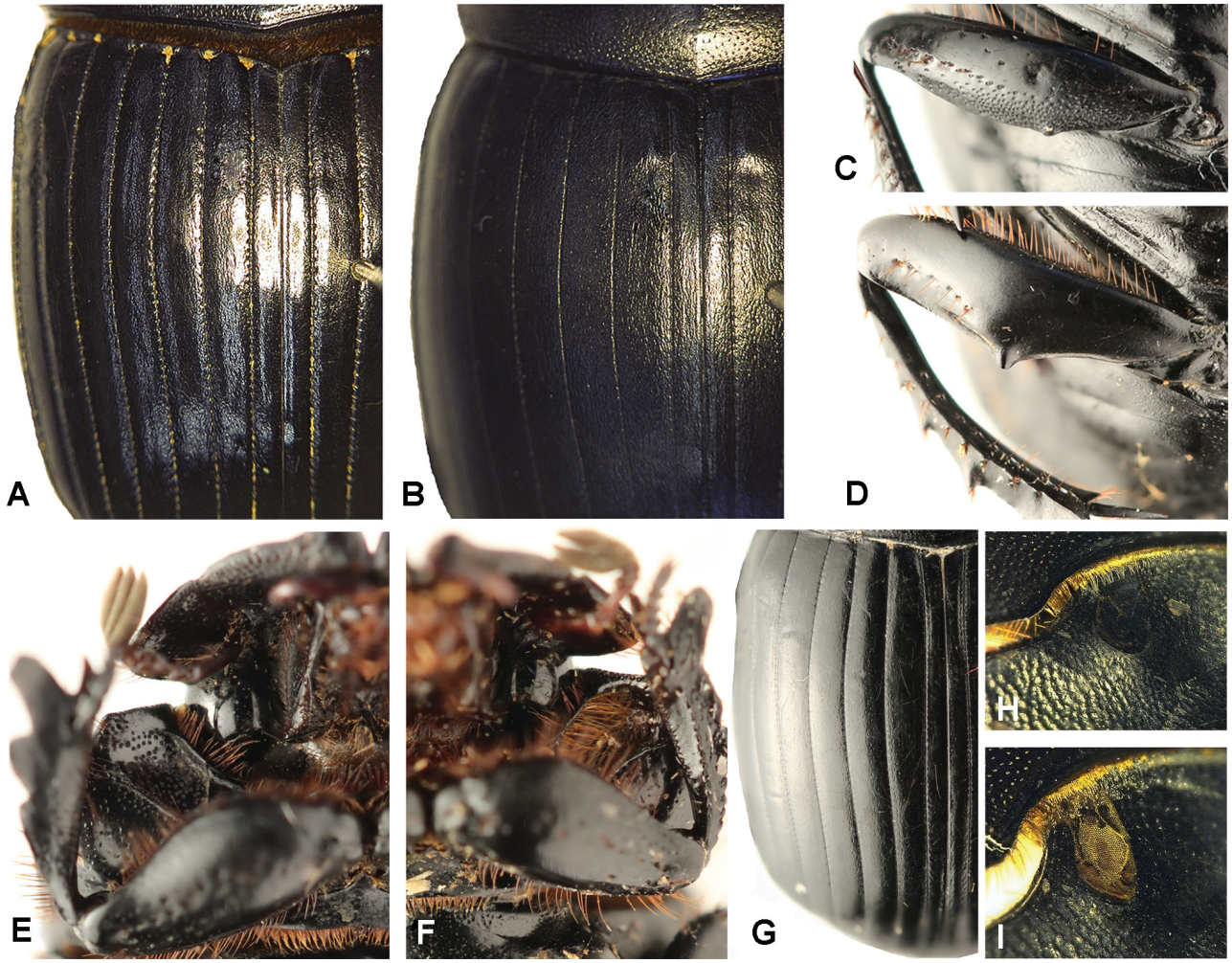


Fig. 2. Morphological details of *Synapsis* species. A–B – elytral surface: A – *S. puluongensis* sp. nov. with elytral striae strongly and densely punctate and interval 2 not swollen; B – *S. horaki* Zídek & Pokorný, 2010, with elytral striae impunctate and interval 2 swollen. C–D – metafemora: C – *S. puluongensis* sp. nov.; D – *S. yama* Gillet, 1911. E–F – setation of hypomeral cavities: E – *S. puluongensis* sp. nov.; F – *S. birmanica* Gillet, 1907. G – elytron of *S. naxiorum* Král & Rejsek, 2000 with weakly and sparsely punctate elytral striae and intervals weakly punctate. H–I – eye coloration in specimens of *S. horaki* Zídek & Pokorný, 2010: H – female; I – male.

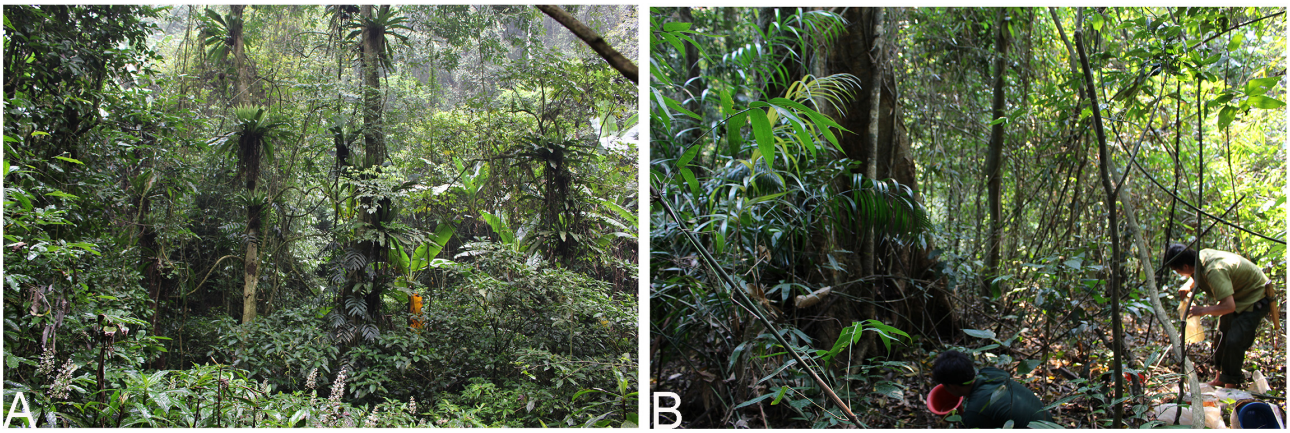


Fig. 3. Habitat of *Synapsis puluongensis* sp. nov. in Pu Luong Nature Reserve.

Mesepimeron and metepisternum flat, granulose and without macrosetae.

***Legs.*** Protibia (ProTiL 3.30 mm, ProTiW 2.35 mm, ProTiSL 1.21 mm) tridentate, terminal tooth as long as protibial spur and nearly as long as protibial tarsus. Mesotibia (MesoTiL 3.34 mm, MesoTiW 1.33 mm, 1stMesoTiSL 2.09 mm, 2ndMesoTiSL 0.9 mm) and metatibia (MetaTiL 4.95 mm, MetaTiW 1.27 mm, MetaTiSL 1.55 mm) with red scanty macrosetae and slender spurs. Metatarsomeres nearly similar in size (MetaTaL 3.72 mm, MetaTa1L 1.08 mm, MetaTa1W 0.68 mm, MetaTa5W 0.32 mm).

***Abdomen and pygidium.*** Abdominal ventrites opaque, sparsely punctate, and narrower at midline. Pygidium (PyL 2.46 mm, PyW 4.5 mm) feebly convex, densely and transversely punctate and scabrous.

***Aedeagus*** (Figs 1E, F). Phallobase length 3.57 mm in lateral view, with strong swelling in middle of basal suture. Parameres length 2.19 mm (in lateral view), triangle-shaped. Phallobase and parameres forming angle > 130º.

***Sexual dimorphism.*** Females differ from males in their weaker elytral striae, and meso- and metatrochanters with sparser reddish-brown macrosetae (absent in some specimens). Sexes also differ in the shape and strength of the metafemoral tooth, which is stronger in males. Compound eyes black in females but reddish brown in males.

**Morphometrics.** See Table 1.

**Differential diagnosis.** *Synapsis puluongensis* sp. nov. belongs to the *S. birmanica* group, as indicated by a combination of the following characters: hypomeral cavities present, genae unexpanded, frons unarmed, mesepisternal cavities absent, and upper longitudinal carina of male metatibia without brush of rusty setae. Species of the *S. birmanica* group may be clearly distinguished from those of *S. ovalis*, *S. brahmina* and *S. tmolus* groups by the presence of hypomeral cavities. The *S. ritsemae* group has expanded genae, in which it differs from the species of the *S. birmanica* group whose genae are unexpanded.

*Synapsis puluongensis* sp. nov. can be distinguished from other known species of the group by the following characters: in *S. puluongensis* the elytral interval 2 is not swollen near the base (swollen in *S. yama* from northern and central Vietnam and Laos, *S. horaki* from northern Vietnam, *S. dickinsoni* from northern Thailand: Phukieo, *S. ochii* from northern Thailand: Chiang Mai and in *S.*

Table 1. Morphometrics and morphology of *Synapsis puluongensis* sp. nov. and *S. horaki* Zídek & Pokorný, 2010 (in mm, except body weight in g)

| | ***Synapsis puluongensis* sp. nov.** | | | ***Synapsis horaki*** | |
|---|---|---|---|---|---|
| Character | Holotype | Male (n = 2) | Female (n = 4) | Male (n = 3) | Female (n = 1) |
| BoL | 18.38 | 18.2 | 17.84 ± 0.59 | 18.72 ± 1.08 | 18.49 |
| BoW | 11.32 | 11.19 | 10.97 ± 0.53 | 11.73 ± 0.71 | 11.79 |
| HeadL | 3.67 | 3.82 | 3.77 ± 0.19 | 4.84 ± 0.46 | 5.21 |
| HeadW | 7.44 | 7.43 | 7.17 ± 0.34 | 8.02 ± 0.41 | 8.17 |
| PronL | 4.9 | 4.9 | 4.90 ± 0.26 | 4.93 ± 0.09 | 4.96 |
| PronW | 10.08 | 9.89 | 9.57 ± 0.56 | 9.97 ± 0.54 | 9.98 |
| ElyL | 11.4 | 11.24 | 10.97 ± 0.8 | 11.29 ± 0.74 | 11.61 |
| MWoI123 | 2.51 | 2.51 | 2.48 ± 0.07 | 2.84 ± 0.2 | 2.86 |
| DP10,15 | 1.03 | 1.04 | 0.98 ± 0.05 | unclear | unclear |
| HoL | unarmed | unarmed | unarmed | unarmed | unarmed |
| PyL | 2.46 | 2.44 | 2.36 ± 0.13 | 2.33 ± 0.12 | 2.24 |
| PyW | 4.5 | 4.42 | 4.28 ± 0.33 | 4.59 ± 0.41 | 4.66 |
| ProTiL | 3.3 | 3.28 | 3.20 ± 0.12 | 3.41 ± 0.24 | 3.25 |
| ProTiW | 2.35 | 2.35 | 2.28 ± 0.10 | 2.62 ± 0.23 | 2.68 |
| ProTiSL | 1.21 | 1.22 | 1.23 ± 0.18 | 1.5 ± 0.09 | 1.48 |
| MesoTiL | 3.34 | 3.45 | 3.54 ± 0.26 | 3.75 ± 0.21 | 3.72 |
| MesoTiW | 1.33 | 1.32 | 1.28 ± 0.16 | 1.42 ± 0.1 | 1.49 |
| 1st MesoTiSL | 2.09 | 2.02 | 1.88 ± 0.24 | 2.26 ± 0.2 | 2.36 |
| 2nd MesoTiSL | 0.9 | 0.94 | 0.95 ± 0.14 | 1.17 ± 0.09 | 1.18 |
| MetaTiL | 4.95 | 4.91 | 4.77 ± 0.21 | 4.89 ± 0.18 | 4.69 |
| MetaTiW | 1.27 | 1.25 | 1.22 ± 0.13 | 1.41 ± 0.07 | 1.39 |
| MetaTiSL | 1.55 | 1.5 | 1.49 ± 0.18 | 1.65 ± 0.06 | 1.71 |
| MetaTaL | 3.72 | 3.71 | 3.68 ± 0.25 | 3.92 ± 0.11 | 4.08 |
| MetaTa1L | 1.08 | 1.1 | 1.12 ± 0.07 | 1.24 ± 0.08 | 1.24 |
| MetaTa1W | 0.68 | 0.68 | 0.67 ± 0.08 | 0.77 ± 0.07 | 0.74 |
| MetaTa5W | 0.32 | 0.32 | 0.35 ± 0.03 | 0.39 ± 0.02 | 0.38 |
| BoWeight | 0.67432 | 0.67 | 0.63 ± 0.04 | 0.86 ± 0.03 | 0.89676 |
| DDC | 1.43 | 1.41 | 1.39 ± 0.11 | 1.45 ± 0.09 | 1.58 |
| HyC | present | present | present | present | present |
| MeC | absent | absent | absent | absent | absent |
| Gen | unexpanded | unexpanded | unexpanded | unexpanded | unexpanded |
| MesoF | densely punctured | densely punctured | densely punctured | densely punctured | densely punctured |
| MetaF | densely punctured | densely punctured | densely punctured | densely punctured | densely punctured |
| MetaTibrush | absent | absent | absent | absent | absent |

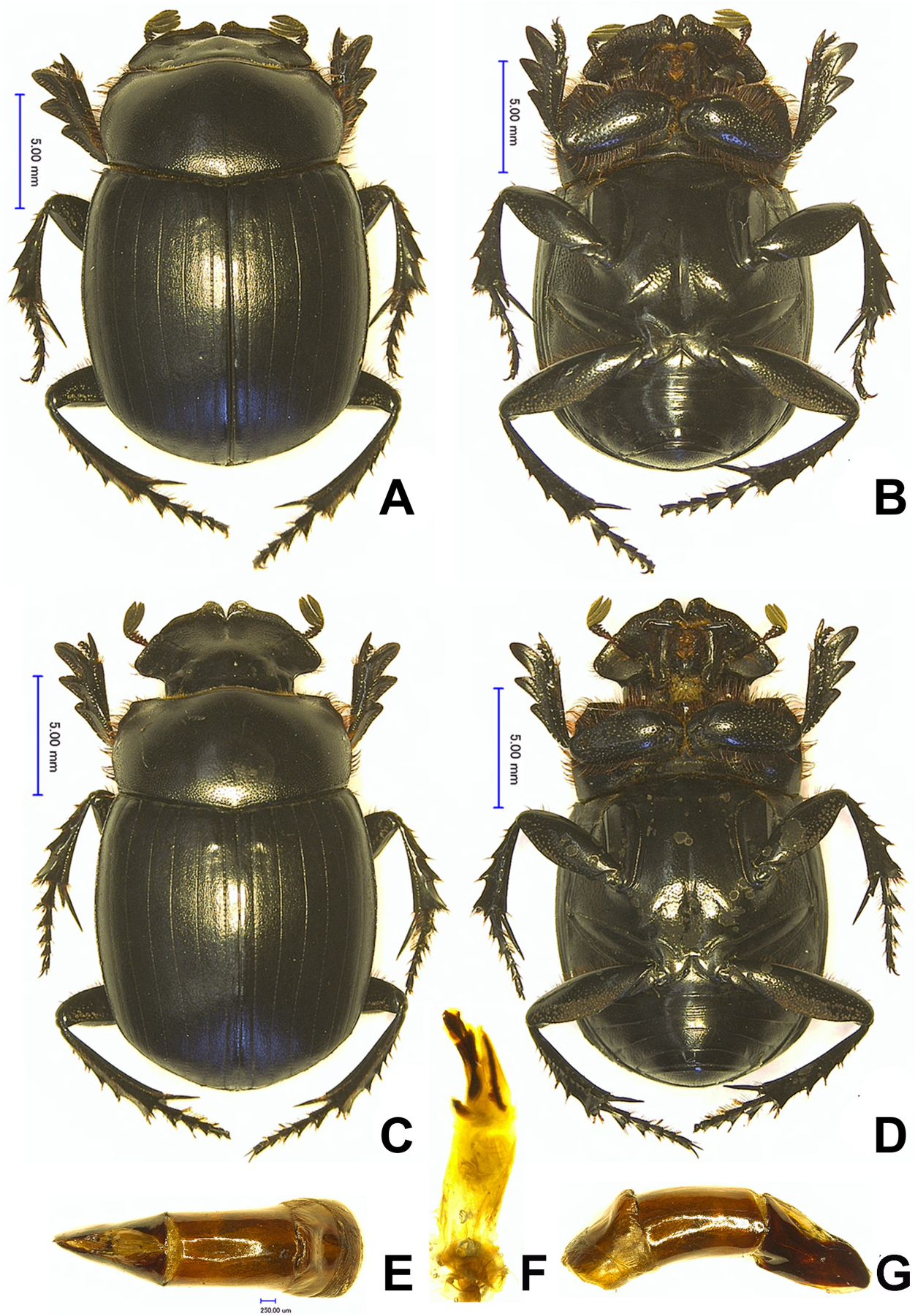


Fig. 4. *Synapsis horaki* Zídek & Pokorný, 2010: A – dorsal habitus, male. B – ventral habitus, male. C – dorsal habitus, female. D – ventral habitus, female. E – aedeagus, dorsal view. F – internal sac of aedeagus. G – aedeagus, lateral view.

*masumotoi* from Taiwan). Characters on the metafemora and elytral striae clearly differentiate *S. puluongensis* sp. nov. from the other species of the *S. birmanica* group recorded in Vietnam: both *S. puluongensis* sp. nov. and *S. horaki* have densely punctured metafemora on the ventral side, while *S. yama* has no punctures on the metafemur. In addition, *S. puluongensis* sp. nov. has coarse and closely spaced punctures on the elytral striae, which are absent or extremely weak in *S. horaki* (Figs 2A–D).

*Synapsis puluongensis* sp. nov. has hypomeral cavities without macrosetae, which distinguishes it from *S. birmanica* (hypomeral cavities are covered by a brush of rusty macrosetae). The new species has deep striae, whereas in *S. birmanica* the striae are feeble (Figs 2E–F).

*Synapsis puluongensis* sp. nov. is morphologically similar to *S. naxiorum* in its black and shiny dorsal side. However, the new species can be distinguished from *S. naxiorum* in having more punctures on the ventral side of the metafemora; elytral striae more densely punctate, intervals not punctate, and hypomeral cavities devoid of rusty setae (Figs 2A,G).

The entire surface of *S. puluongensis* sp. nov. is black and shiny, in contrast to the opaque surface of *S. punctata* from Myanmar and *S. roslihashimi* from Malaysia. In addition, *S. puluongensis* sp. nov. has convex intervals, whereas *S. roslihashimi* and *S. punctata* have flat or only weakly convex intervals. In *S. punctata* and *S. roslihashimi* all margins of intervals are punctate, whereas they are impunctate in the new species. The new species can also be distinguished from *S. punctata* and *S. roslihashimi* by the absence of hypomeral rusty macrosetae.

**Etymology.** The specific epithet *puluongensis* refers to the name of the type locality, Nature Reserve Puluong, Thanh Hoa Province, central Vietnam; adjective.

**Biology.** The new species was collected in primary forests on limestone bedrock. The primary forests are characterized by a complex structure with various storeys, comprising an upper storey with emergent trees more than 35 m tall, belonging to Dipterocarpaceae and Combretaceae, a dominant lower storey (various tree species from 15 to 30 m tall), and a brush layer on the forest floor containing various herbs (Urticaceae, Araceae, Begoniaceae), lianas and parasitic plants (Connaraceae, Fabaceae, Orchidaceae, Loranthaceae).

### *Synapsis horaki* Zídek & Pokorný, 2010

(Figs 2B,H,I, 4A–G)

*Synapsis horaki* Zídek & Pokorný, 2010: 18, figs 12–15 (original description).

**Type locality.** Vietnam, Vinh Phuc Province, Tam Dao, 900 m a.s.l.

**Type material examined.** Holotype: ♂, '6–10.v.1990 | Tam Dao | Vinh Phu Distr. | Vietnam | 900 m | Jan Horák leg.' (NMPC).

**Additional material examined. VIETNAM: Cao Bang Province:** Pia Oac Nature Reserve, primary forest, baited pitfall trap, 5.–20.v.2016, 22°34′3.6″N, 105°53′3.3″E, 1223 m, 1 ♂, 22°34′1.4″N, 105°53′3.3″E, 1220 m, 1 ♂, 22°34′3.1″N, 105°53′4.7″E, 1220 m, 1 ♂, 22°34′3.1″N 105°53′4.4″E, 1213 m, 1 ♀, Bùi Văn Bắc leg. (all in VNUF).

**Diagnosis.** Hypomeral cavities present; surface sparsely punctate, and not covered by macrosetae. Mesepisternal surface flat and rugose. Genae unexpanded. Frons unarmed. Pronotal anterolateral angles not protruding. Elytral striae weak and indistinctly punctate; elytral interval 2 swollen near base. Ventral surface of femora densely punctate.

**Description.** Body length 17.5–20.1 mm, body width 10.8–12.6 mm. Colour: Dorsal surface black and glabrous. Ventral surface black on head and shiny black on thorax, abdomen and femora. Reddish brown macrosetae upon legs and pronotal margins. Mouthparts, maxillary palpi and tarsi reddish brown. Antennae brown; antennomeres IV–VI darker than other antennomeres.

***Head*** nearly semicircular, 4.4–5.3 mm long, and 7.5–8.5 mm wide. Clypeal surface extremely rugose; apex strongly and deeply emarginated, V-shaped; distance between apices of clypeal denticles (DDC) 1.4–1.6 mm; anterior margin flexed upwards with few reddish setae. Genae rectangular, quite distinctly separated from clypeus and frons by well-defined suture; surface strongly rugose and weakly punctate; margins of anterolateral angles with dense reddish macrosetae. Frons unarmed, only slightly swollen; surface weakly rugose and punctate. Antennae with 9 antennomeres; length of antennomere I approx. 1.4 mm, equal in length to antennomeres II–VI combined; antennal club approx. 1.4 mm.

***Prothorax.*** Pronotum transverse, 4.8–5.1 mm long, and 9.3–10.6 mm wide, widest at anterior quarter; pronotal disc almost indistinctly punctate, except for small weakly punctured areas near base and sides (at 30× magnification); anterolateral angles sharp and not protruding. Two lateral carinae on each side of pronotum clearly distinct; margin of outer carina with dense reddish brown macrosetae; area between carinae smooth. Hypomeral cavities present; surface of cavities weakly and sparsely punctate, and without macrosetae. Meso-metaventrum plate almost smooth, with posterior median weak groove, and with distinct excavation near metacoxae; surface of sides and anterior part sparsely and weakly punctate.

***Pterothorax.*** Elytra 10.4–12.1 mm long, 10.8–12.6 mm wide, with weak and indistinctly punctured striae. Elytral intervals convex, smooth and impunctate (at 30× magnification); interval 2 swollen near base. Mesepimeron and metepisternum flat, granulose and without macrosetae.

***Legs.*** Ventral surface of profemora strongly, coarsely and quite equally punctate; macrosetae upon profemoral margin reddish brown and long, denser in anterior margin. Protibia (ProTiL 3.2–3.6 mm, ProTiW 2.3–2.9 mm) with three broad and flat lateral teeth; protibial spurs (ProTiSL 1.4–1.6 mm) sharp, strongly curved outwards near apex, and equal in length to protibial tarsus. Ventral surface of mesofemora strongly and unequally punctate; punctures becoming denser on third posteior part. Mesotibia (MesoTiL 3.5–4 mm, MesoTiW 1.3–1.5 mm) with two sharp spurs (1$^{st}$MesoTiSL 2.0–2.4 mm, 2$^{nd}$MesoTiSL 1.1–1.3 mm). Ventral surface of metafemora strongly and unequally punctate; punctures denser on posterior half of metafemora. Metatibia (MetaTiL 4.7–5.1 mm, MetaTiW 1.3–1.5 mm) elongate and slightly curved. Metatarsus length 3.9–4.1 mm, with 5 metatarsomeres nearly similar in size.

Table 2 (on this and the opposite page). Morphological comparsions between the new species and its congeners compiled after Gillet (1911), Arrow (1931), Balthasar (1963), Masumoto (1973, 1996), Hanboonsong & Masumoto (1999), Král & Rejsek (2000), Král (2002), Ochi & Kon (2007), Ochi et al. (2008), Zídek & Pokorný (2010).

| Character | *S. puluongensis* sp. nov. | *S. yama* | *S. horaki* | *S. dickinsoni* | *S. ochii* | *S. naxiorum* |
|---|---|---|---|---|---|---|
| Color (dorsal view) | black, shiny | black, opaque | black, moderately glossy | black | black | black, shiny |
| BoL | 17.2–18.5 | 27.0–29.0 | 17.5–24.0 | 26.0–28.5 | 26.0 | 18.0–29.0 |
| BoW | 10.7–11.5 | ?? | 10.8–13.1 | ?? | ?? | ?? |
| Frons | unarmed | unarmed | unarmed | unarmed | unarmed | unarmed |
| Gen | unexpanded | unexpanded | unexpanded | unexpanded | unexpanded | unexpanded |
| HyC | present | present | present | present | present | present |
| Rusty setae covering HyC | absent | present (long and dense) | absent | present (long and dense) | present (long and dense) | present (long) |
| MeC | absent | absent | absent | absent | absent | absent |
| Elytral striae | deep | feeble | feeble | deep | feeble | deep |
| Punctures on elytral striae | strong and dense | impunctate | weak | weak | strong and dense | sparse |
| Interstriae shape | convex | flat | flat | weakly convex | flat | convex |
| Punctures on interstriae | absent | absent | absent | absent | absent | present |
| Second interstria near base | not swollen | swollen | swollen | swollen | swollen | not swollen |
| MetaF | densely punctate | impunctate | densely punctate | sparsely punctate | sparsely punctate | sparsely punctate |
| MetaTibrush (male) | absent | absent | absent | absent | absent | absent |
| Distribution | Central Vietnam: Thanh Hoa Province | N+C Vietnam (Tuyen Quang, Thanh Hoa), Laos | N. Vietnam: Vinh Phuc Prov., Cao Bang Prov. | Northern Thailand (Phukieo) | Northern Thailand (Chiang Mai) | China (Yunnan) |

| Character | *S. punctata* | *S. roslihashimi* | *S. birmanica* | *S. masumotoi* | *S. cambeforti* |
|---|---|---|---|---|---|
| Color (dorsal view) | opaque | black, opaque | black, opaque | black, opaque | black, Shiny |
| BoL | 21.1 | 21.8–26.0 | 21.0-26.0 | 27.0–30.0 | 22.0–28.0 |
| BoW | 12.0 | 11.7–13.8 | 14.5 | ?? | max. 14.6 |
| Frons | unarmed | unarmed | unarmed | unarmed | armed (minute horn) |
| Gen | unexpanded | unexpanded | unexpanded | unexpanded | expanded |
| HyC | present | present | present | present | present |
| Rusty setae covering HyC | short and sparse | long and dense | long and dense | absent | ?? |
| MeC | absent | absent | absent | absent | absent |
| Elytral striae | ?? | deep | feeble | feeble | deep |
| Punctures on elytral striae | strong and dense | strong and dense | strong and dense | invisible | strong and dense |
| Interstriae shape | weakly convex | flat | flat | flat | flat |
| Punctures on interstriae | distinctly notched margin of interstriae | distinctly notched margin of interstriae | slightly notched margin of interstriae | absent | fine, sparse and scattered |
| Second interstria near base | not swollen | not swollen | not swollen | swollen | not swollen |
| MetaF | densely punctate | densely punctate | densely punctate | sparsely punctate | densely punctate |
| MetaTibrush (male) | absent | absent | absent | absent | absent |
| Distribution | Myanmar | Malaysia | China (Yunnan), Malaysia, Myanmar, Thailand | Taiwan | Brunei (Kalimantan) |

***Abdomen and pygidium*.** Abdominal ventrites opaque, indistinctly punctate, and narrower at midline. Pygidium 2.2–2.5 mm long, 4.0–4.8 mm wide; surface slightly convex, scabrous, and with mixture of punctures and rugosities.

***Aedeagus*.** Phallobase length 3.4–3.6 mm (in lateral view); basal suture with strong swelling at middle. Parameres length 2.0–2.2 mm (in lateral view). Phallobase and parameres forming angle > 130°.

***Sexual dimorphism*.** Based on an examination of the four specimens (3 males and 1 female), we did not find significant differences in morphological characters between both sexes, except for the colour of compound eyes, being black in the female but yellow in males (Figs 2H, I). This finding is consistent with the observed sexes of *S. puluongensis* sp. nov., raising the possibility of using this character to distinguish both sexes of these two species.

**Biology.** All four specimens were collected in the Pia Oac Nature Reserve. The habitat is primary forests at an elevation of 1220 m a.s.l. characterized by a forest canopy cover ranging from 76 to 95%. The percentage of exposed soil was 0–5%, with 6–25% herbaceous plant layer and leaf lit-

Table 2 (continued from previous page).

| Character | *S. ritsemae* | *S. thoas* = *S. sumatrensis* | *S. ovalis* | *S. strnadi* | *S. gilleti* |
|---|---|---|---|---|---|
| Color (dorsal view) | black | black | black, opaque | black | black, opaque |
| BoL | 25.0 | 24.0 | 23.0–26.0 | 22.0–29.0 | 24.0 |
| BoW | ?? | ?? | ?? | ?? | 14.0 |
| Frons | armed (minute horn) | armed (minute horn) | unarmed | unarmed | unarmed |
| Gen | expanded | strongly expanded | unexpanded | unexpanded | unexpanded |
| HyC | present | present | absent | absent | absent |
| Rusty setae covering HyC | ?? | present (long and dense) | absent | absent | ?? |
| MeC | absent | absent | present | present | present |
| Elytral striae | deep | deep | feeble | feeble | deep |
| Punctures on elytral striae | vague | distinct | irregular | irregular | distinct |
| Interstriae shape | flat | weakly convex | flat | flat | flat |
| Punctures on interstriae | fine, sparse and scattered | sparse | absent | absent | absent |
| Second interstria near base | not swollen | not swollen | not swollen | not swollen | not swollen |
| MetaF | ?? | weakly punctate | sparsely punctate | densely punctate | impunctate |
| MetaTibrush (male) | absent | absent | absent | absent | absent |
| Distribution | Borneo, Java, Sumatra (Indonesia) | Java, Sumatra (Indonesia) | Laos, Thailand, Vietnam | North Vietnam (Vinh Phuc, Lao Cai) | Bangladesh, India, Bhutan, Nepal |

| Character | *S. boonlongi* | *S. tridens* = *S. yunnana* | *S. davidis* | *S. brahmina* = *S. batesi* | *S. satoi* |
|---|---|---|---|---|---|
| Color (dorsal view) | black, not shiny | black, opaque | black, opaque | black, not shiny | black, opaque |
| BoL | 26.0–27.0 | 28.0–34.0 | 28.0–33.0 | 28.0–30.0 | 29.5 |
| BoW | ?? | 17.0–21.0 | ?? | 17.0–18.0 | 16.3 |
| Frons | unarmed | armed | armed | armed | armed |
| Gen | unexpanded | expanded | expanded | expanded | expanded |
| HyC | absent | absent | absent | absent | absent |
| Rusty setae covering HyC | ?? | absent | absent | absent | ?? |
| MeC | present | absent | absent | absent | absent |
| Elytral striae | deep | shallow | shallow | deep | deep |
| Punctures on elytral striae | weak, notching interstriae | weak | weak | weak | weak, indistinct |
| Interstriae shape | flat | flat | flat | slightly convex | slightly convex |
| Punctures on interstriae | present (very small) | absent | absent | absent | absent |
| Second interstria near base | ?? | not swollen | not swollen | not swollen | ?? |
| MetaF (ventral side) | ?? | impunctate | impunctate | impunctate | ?? |
| MetaTibrush (male) | absent | present | present | present | present |
| Distribution | Thailand | China, India, Laos, Myanmar, Thailand, northern Vietnam | China, Taiwan | Bhutan, Northeast India, Nepal, Pakistan | Laos-Myanmar border |

| Character | *S. simplex* | *S. tmolus* | *S. kiuchii* |
|---|---|---|---|
| Color (dorsal view) | black | black | black, shining |
| BoL | 24.0–26.0 | 36.0–52.0 | 23.0–25.0 |
| BoW | ?? | ?? | ?? |
| Frons | armed | armed | armed |
| Gen | unexpanded | unexpanded | unexpanded |
| HyC | absent | absent | absent |
| Rusty setae covering HyC | absent | absent | ?? |
| MeC | absent | absent | absent |
| Elytral striae | deep | deep | deep |
| Punctures on elytral striae | invisible | strong and close | invisible |
| Interstriae shape | weakly convex | weakly convex | weakly convex |
| Punctures on interstriae | absent | absent | absent |
| Second interstria near base | not swollen | not swollen | not swollen |
| MetaF (ventral side) | impunctate | impunctate | ?? |
| MetaTibrush (male) | present | present | present |
| Distribution | China (Yunnan), Laos, Myanmar, Thailand, Vietnam | Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, China | Thailand |

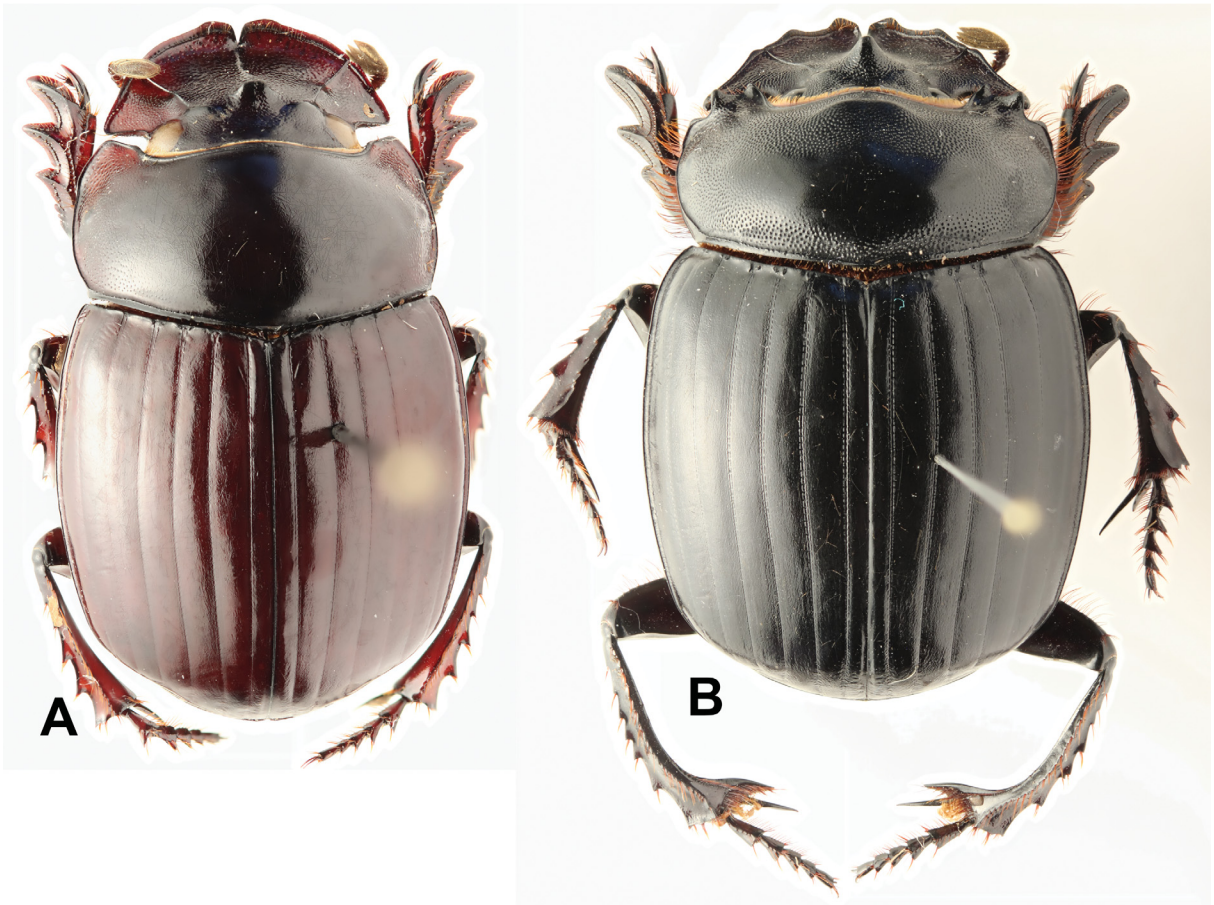


Fig 5. Dorsal habitus. A – *Synapsis simplex* Sharp, 1875. B – *S. tridens* Sharp, 1881

ter cover of 96–100%. The forests has a complex structure with various storeys. Dominant trees range from 20 to 30 m tall and belong mainly to two dominant families: Fagaceae (*Castanopsis* spp., *Lithocarpus* spp., *Castanea* spp.) and Lauraceae (*Litsea* spp., *Cinnamomum* spp., *Machilus* spp.), the herbaceous and parasitic plants comprised Poaceae, Asteraceae, Orchidaceae and Loranthaceae.

**Remarks.** So far, *Synapsis horaki* was known only from the holotype specimen collected in the Tam Dao National Park, Vinh Phuc Province, northern Vietnam. The herein presented specimens constitute a new record for the Cao Bang Province and the first known female. Morphometric measurements are summarized in the Table 1.

### *Synapsis tridens* Sharp, 1881

*Synapsis tridens* Sharp, 1881: xcii (original description).

**Type locality.** India, Assam.

**Material examined. VIETNAM: Cao Bang Province:** Pia Oac Nature Reserve, primary forest, baited pitfall trap, 30.iv–15.v.2016, 22°34′3.1″N 105°53′3.6″E, 1227 m, 1 ♂, 22°33′59.7″N 105°52′48.5″E, 1165 m, 1 ♀, 22°34′3.1″N, 105°53′4.7″E, 1220 m, 1 ♂, 22°34′3.1″N 105°53′4.4″E, 1213 m, 1 ♀, Van Bac Bui leg. (all in VNFU). **Thanh Hoa Province:** Pu Luong Nature Reserve, primary forest, baited pitfall trap, 5.–25.iv.2016, 20°28′55.1″N 105°14′29.3″E, 958 m, 1 ♂, 20°28′54.7″N 105°14′30.9″E, 950 m, 1 ♂ 1 ♀, Bùi Văn Bắc leg. (VNUF).

**Distribution.** SW China, NE India, Laos, Myanmar, Thailand and N Vietnam (Zídek & Pokorný 2010).

**Remarks.** The aforementioned specimens represent additional records from Vietnam.

## Discussion

Tropical forests on limestone bedrock in northern and central Vietnam are characterized by shallow soils. Perhaps these soil characteristics are not suitable for large *Synapsis* species which are known to tunnel deep nests for the storage of dung for feeding and breeding (Hanski & Cambefort 1991). *Synapsis puluongensis* sp. nov. and *S. horaki* were found exclusively in primary forests, and thus may be considered as indicator species for undisturbed forests. Specimens of the genus *Synapsis* were generally rare, comprising 10.45% of all coprine specimens found in primary forests.

The discovery of *S. puluongensis* sp. nov. increases the number of known species of *Synapsis* to 24, of which seven are now recorded from Vietnam. The Vietnamese species may be identified using the following key.

## Key to species of *Synapsis* recorded from Vietnam

The key is based on the specimens examined by us in NMPC and VNUF as well as on literature data (Arrow 1931, Balthasar 1963, Král & Rejsek 2000, Král 2002, Hanboonsong & Masumoto 1999, Ochi & Kon 2007, Ochi et al. 2008, Zídek & Pokorný 2010).

1(6) Hypomeral cavities present (Figs 2E–F).

2(3) Elytral interval 2 near base not swollen (Fig. 2A). ..... ***S. puluongensis* sp. nov.**

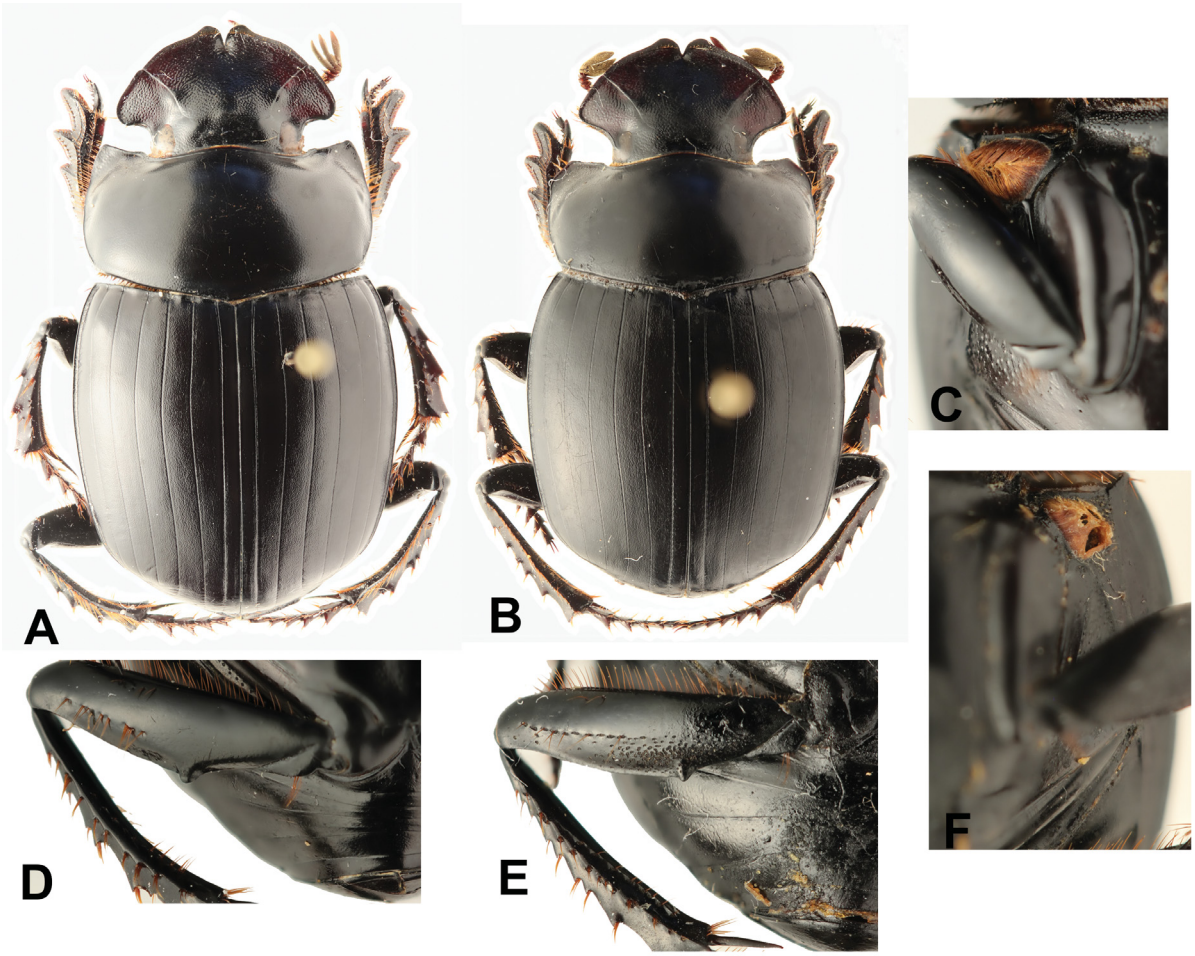


Fig. 6. Dorsal habitus, ventral surface of femora and mesepisternal cavities. A, C, D – *Synapsis ovalis* Boucomont, 1920; B, E, F – *S. strnadi* Král, 2002.

3(2) Elytral interval 2 near base swollen (Fig. 2B).

4(5) Metafemora in ventral view densely punctate, body length 17.5–24.0 mm. ..... ***S. horaki*** Zídek & Pokorný, 2010

5(4) Metafemora in ventral view not punctate, body length 27.0–29.0 mm (Fig. 2D). ..... ***S. yama*** Gillet, 1911

6(7) Hypomeral cavities absent.

7(10) Frons with minor horn or medial tubercle; mesepisternal cavities absent.

8(9) Genae not expanded, anterolateral angle of pronotum not dentate (Fig. 5A). ..... ***S. simplex*** Sharp, 1875

9(8) Genae expanded; anterolateral angle of pronotum tridentate (Fig. 5B). ..... ***S. tridens*** Sharp, 1881

10(11) Frons without minor horn or only with medial tubercle; mesepisternal cavities present and covered with red setae (Figs 6A–C, F).

11(12) Anterolateral angles of pronotum nearly rectangular (90°). Lateral angles of genae obtuse, rounded. Metafemora in ventral view sparsely punctate (Figs 6A, D). ..... ***S. ovalis*** Boucomont, 1920

12(11) Anterolateral angles of pronotum about 135°. Lateral angles of genae rather sharp, metafemora in ventral view densely punctate (Figs 6B, E). ..... ***S. strnadi*** Král, 2002

## Acknowledgements

We are grateful to David Král (Department of Zoology, Charles University, Czech Republic), Jiří Hájek and Martin Fikáček (National Museum Prague, Czech Republic) for their suggestions, support and revision of the manuscript. This research received support from the SYNTHESYS Project http://www.synthesys.info/ which is financed by European Community Research Infrastructure Action under the FP7 Integrating Activities Programme. Ministry of Education and Training of Vietnam (MOET, Project 911), and Idea Wild, 420 Riddle Drive, Fort Collins, CO 80521, USA funded Van Bac Bui for field surveys in Vietnam.

## References

ARROW G. J. 1931: *The fauna of British India, including Ceylon and Burma. Coleoptera Lamellicornia. Part III (Coprinae)*. Taylor and Francis, London, 428 pp.

BALTHASAR V. 1963: *Monographie der Scarabaeidae und Aphodiidae der palaearktischen und orientalischen Region. Coleoptera: Lamellicornia. Band 1. Allgemeiner Teil, Systematischer Teil: 1. Scarabaeinae, 2. Coprinae (Pinotini, Coprini)*. Verlag der Tschechoslowakischen Akademie der Wissenschaften, Prag, 391 pp.

BEZDĚK A. & HÁJEK J. 2012: Catalogue of type specimens of beetles (Coleoptera) deposited in the National Museum, Prague, Czech Republic (Scarabaeidae: Scarabaeinae: Coprini, Eurysternini, Gymnopleurini and Oniticellini). *Acta Entomologica Musei Nationalis Pragae* **52**: 297–334.

BUI V. B., DUMACK K. & BONKOWSKI M. 2018: Two new species and one new record for the genus Copris (Coleoptera: Scarabaeidae: Scarabaeinae) from Vietnam with a key to Vietnamese species. *European Journal of Entomology* **115**: 167–191. doi: 10.14411/eje.2018.016.

GILLET J. J. E. 1911: Coprides nouveaux de la région orientale et remarques synonymiques. *Annales de la Société Entomologique de Belgique* **55**: 313–314.

HANSKI I. & CAMBEFORT Y. 1991: *Dung beetle ecology*. Princeton University Press, Princeton, 481 pp.

HANBOONSONG Y. & MASUMOTO K. 1999: Dung beetles of Thailand, Part 1. Genus Synapsis. *Elytra* **27**: 453–462.

KABAKOV O. N. & NAPOLOV A. 1999: Fauna and ecology of Lamellicornia of subfamily Scarabaeinae of Vietnam and some parts of adjacent countries: South China, Laos, and Thailand. *Latvijas Entomologs* **37**: 58–96.

KRÁL D. 2002: Distribution and taxonomy of some Synapsis species, with description of S. strnadi sp. n. from Vietnam (Coleoptera: Scarabaeidae). *Acta Societatis Zoologicae Bohemicae* **66**: 279–289.

KRÁL D. & REJSEK J. 2000: Synapsis naxiorum sp. n. from Yunnan (Coleoptera: Scarabaeidae). *Acta Societatis Zoologicae Bohemicae* **64**: 267–270.

KRIKKEN J. 1987: A new species of the dung beetle genus Synapsis Bates from Borneo, with notes on its relatives (Coleoptera: Scarabaeidae). *Zoologische Mededelingen* (Leiden) **61**: 319–325.

MASUMOTO K. 1973: Observation of the nidification of Synapsis davidi Fairmaire. *Entomological Review of Japan* **25**: 60–63.

MASUMOTO K. 1996: Coprophagid-beetles from Northwest Thailand (X) (Coleoptera, Scarabaeidae). *Entomological Review of Japan* **50**: 87–94.

OCHI T. & KON M. 2007: A new species of the genus Synapsis (Coleoptera, Scarabaeidae) from Laos. *Elytra* **35**: 91–95.

OCHI T., KON M. & KAWAHARA M. 2008: Notes on the coprophagous scarabaeid beetles (Coleoptera: Scarabaeidae) from Southeast Asia (XIX). Three new taxa of Synapsis from Southeast Asia. *Entomological Review of Japan* **63**: 191–199.

SHARP D. 1881: Note sur l'Ateuchus tmolus Fisch. Avec description d'une espèce nouvelle du genre Synapsis. *Annales de la Société Entomologique de Belgique* **25**: xci–xcii.

ZÍDEK J. & POKORNÝ S. 2010: Review of Synapsis Bates (Scarabaeidae: Scarabaeinae: Coprini), with description of a new species. *Insecta Mundi* **142**: 1–21.