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A THESIS
FOR THE DEGREE OF MASTER OF SCIENCE

**Systematic Study of Subfamily Nitidulinae and
Prometopinae (Coleoptera: Cucujoidea:
Nitidulidae) in Korea and Phylogeny of Nitidulidae**

**한국산 밀빠진벌레아과, 큰턱밀빠진벌레아과의
분류학적 연구 및 밀빠진벌레과의 계통학적 분석**

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August, 2018

Abstract

Systematic Study of Subfamily Nitidulinae and Prometopinae (Coleoptera: Cucujoidea: Nitidulidae) in Korea and Phylogeny of Nitidulidae

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This thesis consists of two main themes: i) taxonomic review of the Korean Nitidulinae and Prometopinae; ii) molecular phylogeny of Nitidulidae.

In the first chapter, the subfamily Nitidulinae was reviewed as 38 species of 19 genera from Korea, including two new species, *Cyllodes* sp. nov., *Pallodes* sp. nov. and 9 unrecorded species, *Nitidula rufipes* (Linnaeus), *Soronia lewisi* Reitter, *Ipidia sibirica* (Reitter) *Stelidota multiguttata* Reitter, *Atarphia fasciculata* Reitter, *Hebasculinus japonus* (Reitter) *Xenostrogylus variegatus* (Fairmaire), *Neopallodes vicinus* Grouvelle and *Pocadites rufobasalis* Reitter. Subfamily Prometopinae Böving and Craighead, 1931 is recorded from Korea for the first time with 2 species from different genera, *Prometopia unidentata* Hisamatsu, *Parametopia x-rubrum* Reitter. Descriptions for all species, illustrations of habitus and genitalia, key to

tribes, genera and species from Korea are provided.

In the second part, phylogenetic study of family Nitidulidae is conducted based on the molecular data. Family Nitidulidae is the second largest family in Cucujoidea which includes ten subfamilies. Because of their morphological and biological diversity, the phylogenetic relationship within Nitidulidae is one of the most debated topics among Cucujoidea phylogeny and yet, is still open to many questions. To recover the internal relationship of Nitidulidae, we performed ML and BI analyses that targeted on five gene regions (COI, 28s, CAD, H3, Wingless) for 77 taxa. Our research also included the 7 outgroups and 67 ingroups which contain the nine out of ten currently recognized subfamilies of Nitidulidae. The results of our phylogenetic analysis suggest the three following conclusions i) Subfamilial status of Prometopinae is reconfirmed; ii) Epuraeinae is paraphyletic with inclusion of Calonecrinae; iii) Nitidulinae is paraphyletic with inclusion of Meligethinae and Cillaeinae. In addition, the generic relationships within Nitidulidae and the evolutionary history of their feeding behaviors are also briefly discussed.

Keyword : Nitidulidae, Nitidulinae, Prometopinae, taxonomy, molecular phylogeny

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PART I. Systematic Study of Subfamily Nitidulinae and Prometopinae (Coleoptera: Cucujoidea: Nitidulidae) in Korea

Abstract

The subfamily Nitidulinae was reviewed as 38 species of 19 genera from Korea, including two new species, *Cyllodes* sp. nov., *Pallodes* sp. nov. and 9 unrecorded species, *Nitidula rufipes* (Linnaeus), *Soronia lewisi* Reitter, *Ipidia sibirica* (Reitter) *Stelidota multiguttata* Reitter, *Atarphia fasciculata* Reitter, *Hebasculinus japonus* (Reitter) *Xenostromylus variegatus* (Fairmaire), *Neopallodes vicinus* Grouvelle and *Pocadites rufobasalis* Reitter.

Subfamily Prometopinae Böving and Craighead, 1931 is recorded from Korea for the first time with 2 species from different genera, *Prometopia unidentata* Hisamatsu, *Parametopia x-rubrum* Reitter.

Descriptions for all species, illustrations of habitus and genitalia, key to tribes, genera and species from Korea are provided.

Keywords: Nitidulidae, Nitidulinae, Prometopinae, Taxonomy, New records, Korea.

1. Introduction

1.1. General introduction of the Family Nitidulidae

The family Nitidulidae (Coleoptera: Cucujoidea) is the second largest family in Cucujoidea, comprising approximately 342 genera and nearly 4000 recorded species (Jeli'nek, et al., 2010; Cline et al., 2014) within ten recognized subfamilies (Calonecrinae, Cryptarchinae, Prometopinae, Amphicrossinae, Carpophilinae, Epuraeinae, Maynipeplinae, Meligethinae, Cillaeinae and Nitidulinae) (Kirejtshuk, 2008; Cline et al., 2014). Because of their morphological and biological diversity, the phylogenetic relationship within Nitidulidae is one of the most debated topics among Cucujoidea phylogeny. The family is currently placed in arguably monophyletic series nitidulid series or the Cucujoidea, along with Kateretidae and Smicripidae.

Characterization of the family is challenging due to extreme variation in body forms. For example, until recently, several other families such as Kateretidae and Cybocephalidae have been included in the Nitidulidae based on the following shared morphological characteristics, 1) antennae 11 segmented with the apical 3 forming a club (except Calonecrinae, some Cillaeinae (*Macrostola*), Maynipeplinae (antennae with 10 antennomeres with apical 1-2 forming a club); 2) abdominal ventrite 1 not much longer than 2; 3) anal lobe of hindwing present; 4) maxilla with lacinia only; 5) anal lobe of hindwing present. However, Nitidulidae can be distinguished from Smicripidae and Kateretidae, by the following characters, 1) procoxae strongly transverse; 2) prothoracic trochantin always exposed; 3) procoxal

cavities not always open externally.

Because of their variety of body forms and ambiguous mix of characters, Nitidulidae remains one of the most taxonomically confusing groups in Cucujoidea. Historically, the subfamilial status of Nitidulidae has been studied by only a few researchers. Earlier morphological phylogenetic analyses of subfamily relationships offered by Kirejtshuk (1982, 1986, 1995), were based only on several morphological characteristics and with his intuition for a few taxa, but not all subfamilies were studied (Fig 6). According to Kirejtshuk (1982, 1986) Calonecrinae is the most ancestral subfamily among the nitidulid subfamilies. Kirejtshuk (1995) suggested two groups: Carpophilinae- and Nitidulinae-lineages each characterized by genitalic characters, and Calonecrinae was included in the Carpophilinae-lineage along with Epuraeinae, Capophilinae and Amphicrossinae. Kirejtshuk proposed that Epuraeinae was the most basal subfamily in the carpophilinae-lineage, and Carpophilinae, Amphicrossinae and Calonecrinae were represented as a polytomy. Although Kirejtshuk (2008) proposed that the family Nitidulidae is classified into two groups (Carpophilinae-lineage: (Amphicrossinae, Epuraeinae and Carpophilinae), Nitidulinae-lineage: (Cryptarchinae, Nitidulinae, Cillaeinae, Meligethinae and Cybocephalinae)) and an ambiguous group (Calonecrinae and Maynipeplinae), rigorous morphological analyses for Nitidulidae are still inconclusive. Also, the phylogenetic position of Calonecrinae and its proposed position as an ancestral subfamily are still unknown.

Recently, the research performed by Cline et al. (2014) is the only molecular phylogenetic data available for the status of Nitidulid subfamilies, along with a

limited suited of morphological characters. In their study, the subfamily Prometopinae was resurrected by molecular phylogenetic evidence and some morphological evidence based on larval characteristics. Cline et al. (2014) also formalized Cybocephalidae as a distinct family based on morphological evidence of the adults and immature forms and molecular data. In addition, according to studies done by Cline et al. (2014) and Bocak et al. (2014), the Cybocephalidae is more closely related to Spindidae than to Nitidulidae, based on both molecular and morphological data.

However, Kirejtshuk and Mantič (2015) proposed a counterargument for the resurrection of the subfamily Prometopinae, and suggested that characters used by Cline et al., (2014) were inconclusive to define the subfamily. Furthermore, the objection pointed out that the size of dataset provided by Cline et al. (2014) is insufficient to support their conclusions. Kirejtshuk and Mantič (2015) also indicated that Cline et al., (2014) did not consider synapomorphy of the family Cybocephalidae and Nitidulidae and several branches of trees provided by Cline et al., (2014) are not characterized by high node values. Despite these objections, Cline et al. (2014) has been generally cited by many successive papers (Baviera and Audisio, 2014; Dasgupta et al., 2015; Lawrence, 2016; Navarrete-Heredia et al., 2016; Alekseev, 2017; Lee et al., 2018) as the most rigorous phylogenetic treatment of the family to date.

Members of Nitidulidae has exhibit one of the most diverse feeding habits repertoires among beetle families, presumably due to their occurrence. As different Nitidulid species occur in various many different habitats worldwide, their feeding

habits are highly varied in the group. Because of their various ingestion characters, some of a few Nitidulid species are classified as serious agricultural pests (e.g., *Stelidota geminatae*, *Aethina tumida*, *Glischrochilus quadrisignatus*, *Carpophilus* sp., *Lobiopa* sp.). With the exception of *Aethina tumida*, most pest species are secondary pests, attracted by the products of fermentation, followed by damage to sugar rich fruit and grain crops.

Nitidulid mycophagy has been studied by many authors. Many species of Nitidulinae feed on mushrooms (e.g., Agaricales=*Apsectochilus* Reitter, *Carinocyllodes* Leschen, *Cyclocaccus* Sharp, *Cyllodes* Sharp, *Eusphaerius* Sharp, *Hebascus* Erichson, *Neopallodes* Reitter, *Niliodes* Murray, *Oxycnemus* Erichson, *Pallodes* Sharp, *Somatoxus* Sharp, *Teichostethus* Sharp, *Triacanus* Erichson and others; Aphyllophorales=*Lobiopa* Erichson, *Platychora* Erichson, *Parametopia* Reitter, *Atarphia* Reitter, *Pocadites* Reitter, *Hebasculinus* Kirejtshuk, and others). Some species are specialists of particular fungi (e.g., Phallaceae= *Psilopyga* LeConte; Gasteromycetes=*Pocadius* Reitter, *Physoronia* Reitter; Hymenogastrales= *Thalycra* Erichson). And some nitidulid species feed on microscopic fungi that occur on subcortical habitats or decaying organic matter or on plant tissues.

As the common name “Sap beetle” suggests, some species feed on tree sap (e.g., Cryptarchinae, Calonecrinae, Cillaeinae, Nitidulinae, Amphicrossinae, Carpophilinae, Epuraeinae). Ingestion of tree sap is associated with general mycophagous feeding habits since ingesting tree sap involves ingestion of yeasts and other fermenting fungi.

Necrophagy are well known from *Nitidula*-Complex and a few other subfamily

members (e.g., *Glischrochilus*, *Epuraea*, *Carpophilus*). Both *Nitidula* and *Omosita* species feed on dead organisms, and due to forensic and ecological importance, their feeding habits are well known. Saprophagy has been verified in members of most subfamilies (e.g., *Glischrochilus*, *Epuraea*, *Carpophilus*, *Cillaeinae*, *Nitidulinae*).

Anthophagy and phytophagy are prevalent in many nitidulids (Crowson 1981). Some species associated with plant parts actually feed on smuts, rusts, yeasts and other surface fungi (LaChance et al., 2001), but many feed directly on plant tissue and fruits. Feeding on vegetative and plant structures, especially on pollen or flowers, is well known in most species of *Meligethinae*, *Epuraeinae*, *Cillaeinae*, and some *Nitidulinae* (e.g., *Cychramus*, *Aethina*, *Camptodes*, *Xenostrogylus*, *Anister*, *Mystropini* and others). Frugivory is most commonly associated with *Carpophilinae* species but also occurs in other taxa such as *Epuraea*, *Colopterus*, *Brachypeplus*, *Haptoncus* and *Lobiopa*. *Carpophilus* species are known from a variety of hosts and species exhibit a wide known host range including citrus, pineapple, stone fruit, figs, strawberries, corn, almond, cherries, grapes, quince, plum, peaches, apples, and more (Jeli'nek, et al., 2010).

Inquilinism is associated with the most specialized ecological habitus found in *Nitidulidae*. Some species in *Nitidulinae* are parasitic in nests of social insects (e.g., *Amphotis*, *Aethina tumida*). *Amphotis* species trespass in various ant nests and their adult species solicit food from ants by antennation. *Aethina tumida* (Common name: Small Hive Beetle, SHB) is an obligate associate of social bees (e.g., *Apis*, *Bombus*). SHB larvae make a tunnel in the nest, and their excrement causes

discoloration and fermentation of the honey. They are serious pest to European honeybee colonies throughout the world. SHB was originally distributed in sub-Saharan region but has rapidly spreaded into many parts of the world since the mid-1990s: USA in 1996, Australia in 2002, Canada in 2002, Jamaica in 2005, Portugal in 2005, Mexico in 2007, Philippines and Italy in 2014, Korea in 2016 (Palmeri et al., 2015; Giangaspero and Turno, 2015; Lee et al, 2017).

Predation is known in only a few species. Cychramptodes species are predator of the wattle tick scale (Homoptera: Coccidae). This species does not directly obtain nutrients from social Hymenoptera (ants), but are intimate associated with them. *Amphicrossus japonicus* hunts preimaginal mosquitoes from submerged bamboo stumps (Kovac et al. 2007).

1.2. Historical review

1.2.1. Taxonomy of the Subfamily Nitidulinae

The subfamily Nitidulinae Latreille, 1802 is a largest group of sap beetle with more than 1,000 species in 974 genera in the world (Jelínek et al., 2010) and seven tribes (Nitidulini Erichson, 1843; Cychramini Lacordaire, 1854; Mystropini Murray, 1864; Cyllodini Everts, 1898; Cychramptodini Kirejtshuk et Lawrence, 1992; Lawrencerosini Kirejtshuk, 1990; Amborotubini Leschen and Carlton, 2004) are recognized (Kirejtshuk, 2008). Characterization of the subfamily is difficult and until recently, Nitidulinae included many misplaced species of other subfamilies (e.g., Prometopinae). Based on the molecular phylogenetic study presented by Cline et al. (2014), the Nitidulinae is paraphyletic with inclusion of Meligethinae and

Cillaeinae. Cline et al. (2014) noted that Cillaeinae need to be either subsumed as a tribe of Nitidulinae, or Nitidulinae will need to be divided into several subfamilies. But they did not propose any classificatory emendations for Meligethinae, due to insufficient data. Therefore, still more research is needed to resolve taxonomic relationships of constituents of the subfamily.

1.2.2. Taxonomy of the Subfamily Prometopinae

The subfamily Prometopinae Böving and Craighead, 1931 (Coleoptera: Cucujoidea: Nitidulidae) is a small group of sap beetles with 12 species in 4 genera in the Palaearctic region (Jelínek and Audisio, 2007; Cline et al., 2014). Prometopinae has a complicated taxonomic history. The type species *Prometopia sexmaculata* (Say, 1825) was originally described as a member of Nitidulinae (Erichson, 1843). Prometopinae was elevated to subfamily based solely on larval characters (Böving and Craighead 1931), but the subfamily status had been largely ignored (Parsons, 1943; Audisio, 1993; Jelínek and Audisio, 2007; Kirejtshuk, 2005; Kirejtshuk, 2008). Recently, Prometopinae was resurrected by molecular phylogenetic evidence as well as some morphological evidence (Cline et al., 2014). The prometopine clade was removed from the Nitidulinae, Amphicrossinae, Carpophilinae, and Epuraeinae clades with high support values. They also provided six combinations of morphological characteristics that differentiate the subfamily Prometopinae from other subfamilies. However, an immediate argument against this resurrection was presented by Kirejtshuk and Mantič (2015), who stated that none of the characters used by Cline et al. (2014) can be used to define the subfamily Prometopinae since

they overlap with other taxa. It was also pointed that the size of data used in Cline et al. (2014) is insufficient to support the resurrection. Prometopinae has been accepted as a subfamily in some successive studies (Dasgupta et al., 2015; Lawrence, 2016), while Powell (2015) treated *Prometopia sexmaculata* (Say, 1825) as a member of the Nitidulinae. Since then, then results (e.g., elevation of Cybocephalidae Jacquelin du Val 1858, resurrection of Prometopinae) of Cline et al. (2014) have been generally accepted by many successive papers (Hisamatsu, 2013; Baviera and Audisio, 2014; Dasgupta et al., 2015; Lawrence, 2016; Navarrete-Heredia et al., 2016; Alekseev, 2017; Lee et al., 2018) and are accepted here, including subfamily status for Prometopinae.

1.2.3. History of Korean Nitidulinae (Table 1)

27 species of Nitidulinae have been record in Korea before this study.

In 1985, Kurosawa et al. firstly reported 4 species, *Ipidia variolosa* Reitter, *Aethina inconspicua* Nakane, *Aethina suturalis* Reitter, *Pallodes umbratilis* Reitter. After that, Kirejtshuk (1992) reported 8 species, *Soronia grisea* (Linnaeus), *Phenolia picta* (MacLeay), *Aethina flavicollis* Reitter, *Pocadius nobilis* Reitter, *Cychramus luteus* (Fabricius), *Cychramus variegatus* (Herbst), *Cyllodes dubius* (Reitter), *Omosita japonica* Reitter. In 1992, Chûjô and C.E. Lee reported 6 species from Is. Jeju, *Ussuriphia hilleri* (Reitter), *Pocadites dilatimanus* (Reitter), *Cyllodes ater* (Herbst), *Cyllodes literatus* (Reitter), *Coxollodes cyrtusoides* (Reitter), *Neopallodes omogonis* Hisamatsu. After that, Chûjô and C.E. Lee (1994) reported 3 species from mainland of Korea, *Phenolia borealis* (Hisamatsu), *Atarphia quadripunctata* Reitter,

Physoronia japonica (Reitter). In addition, Shin et al. (1994) reported 3 species, *Omosita colon* (Linnaeus), *Cyllodes bifascies* Walker, *Soronia fracta* Reitter. Recently, Lee et al. reported 3 species from 2015 to 2017, *Omosita discoidea* (Fabricius), *Aethina aeneipennis* (Reitter), *Aethina tumida* Murray. This is the first report of the small hive beetle in the Far Eastern Asia, which is a serious beekeeping pest all over the world (Lee et al., 2017).

Table 1. History of records of Korean Nitidulinae

No.	Author	Year	Scientific name	Korean common name
1	Kurosawa et al.	1985	<i>Ipidia variolosa</i> Reitter, 1879	큰검정밀빠진벌레
2			<i>Aethina inconspicua</i> Nakane, 1963	꼬마납작밀빠진벌레
3			<i>Aethina suturalis</i> Reitter, 1884	갈색납작밀빠진벌레
4			<i>Pallodes umbratilis</i> Reitter, 1873	버섯밀빠진벌레
5			<i>Soronia grisea</i> (Linnaeus, 1758)	회색납작밀빠진벌레
6			<i>Phenolia picta</i> (MacLeay, 1825)	갈색무늬납작밀빠진벌레
7			<i>Aethina flavicollis</i> Reitter, 1884	검정꼬마납작밀빠진벌레
8	Kirejtshuk A.G.	1992	<i>Pocadius nobilis</i> Reitter, 1873	황갈색무늬납작밀빠진벌레
9			<i>Cychramus luteus</i> (Fabricius, 1787)	큰가슴납작밀빠진벌레
10			<i>Cychramus variegatus</i> (Herbst, 1792)	낙점박이납작밀빠진벌레
11			<i>Cyllodes dubius</i> (Reitter, 1877)	큰감장알납작밀빠진벌레
12			<i>Omosita japonica</i> Reitter, 1874	구름무늬납작밀빠진벌레
13			<i>Ussuriphia hilleri</i> (Reitter, 1877)	알락납작밀빠진벌레
14			<i>Pocadites dilatimanus</i> (Reitter, 1877)	네점잔털밀빠진벌레
15	Chûjô & C.E. Lee.	1992	<i>Cyllodes ater</i> (Herbst, 1792)	감장알납작밀빠진벌레
16			<i>Cyllodes literatus</i> (Reitter, 1878)	무늬알납작밀빠진벌레
17			<i>Coxollobes cyrtusoides</i> (Reitter, 1884)	꼬마버섯밀빠진벌레
18	Chûjô & C.E. Lee.	1994	<i>Neopallodes omogonis</i> Hisamatsu, 1953	무늬버섯밀빠진벌레
19			<i>Phenolia borealis</i> (Hisamatsu, 1968)	무늬납작밀빠진벌레
20			<i>Atarphia quadripunctata</i> Reitter, 1884	낙점긴다리밀빠진벌레
21			<i>Physoronia japonica</i> (Reitter, 1873)	단색납작밀빠진벌레
22			<i>Omosita colon</i> (Linnaeus, 1758)	점박이납작밀빠진벌레
23	Shin et al.	1994	<i>Cyllodes bifascies</i> Walker, 1859	붉은점알납작밀빠진벌레
24	Lee et al.	2015	<i>Soronia fracta</i> Reitter, 1884	큰납작밀빠진벌레
25			<i>Omosita discoidea</i> (Fabricius, 1775)	노랑납작밀빠진벌레
26			<i>Aethina aeneipennis</i> (Reitter, 1873)	국명미정
27	Lee et al.	2017	<i>Aethina tumida</i> Murray, 1867	벌집꼬마밀빠진벌레

2. Materials and methods

2.1. Material examined

Collection of sap beetles

Materials for this study were mostly collected from 2014 to 2018. The samples were mainly collected by flight intercept traps (FIT, window traps), pitfall traps (Pig carcass bait) installed in the mixed forest. Light traps and visual collecting were also used for collection and observation of habits.

Most specimens examined in this study are deposited in the College of Agriculture and Life Sciences, Seoul National University (CALS, SNU). Some specimens were borrowed from the National Academy of Agricultural Science (NAAS, Wanju, Korea), Korea National Arboretum (KNA, Pocheon, Korea), and National Institute of Biological Resources (NIBR, Incheon, Korea).

Specimen preparation

Most of the specimens were preserved in dry for identifications. The remainder were preserved in 99% ethyl alcohol. Sap beetles too small to be pinned were glued to cards. To examine the male and female genitalia, the specimens were relaxed in distilled water for two hours. The genitalia were separated from the last abdominal segment using a hooked pin or forceps without removing the abdomen. Separated genitalia were cleared by heating in 5ml tubes of 10% potassium-hydroxide (KOH) 1~2 hrs at 50–60°C, depending on the sample condition. After examination,

genitalia were stored in polyethylene genitalia vials with glycerin.

Examinations

Photographs of dorsal and ventral habitus were captured using a Canon digital camera (80d, MP-E 65mm f/2.8 1–5x Macro lens mounted). Several layers of photographs were combined in Zerene Stacker 1.04 software (Zerene Systems 2014; <http://www.zerenesystems.com/cms/stacker>). Calibration of images and plates was completed using software (Photoshop CC 2014, Adobe system, USA). Photographs of genitalia were prepared using a Microscope (DM 4000B, Leica Microsystem, Wetzlar, Germany) with a USB digital camera (Infinity3, Lumenera Corporation, Ottawa, Ontario) was used. Measurements were made using Active Measure software (ver. 3.0.3, Mitani Co. ltd, Japan).

2.2. Terminology

Terminology for adult characters of Nitidulidae follows Cline (2005) (Figs. 1-4).

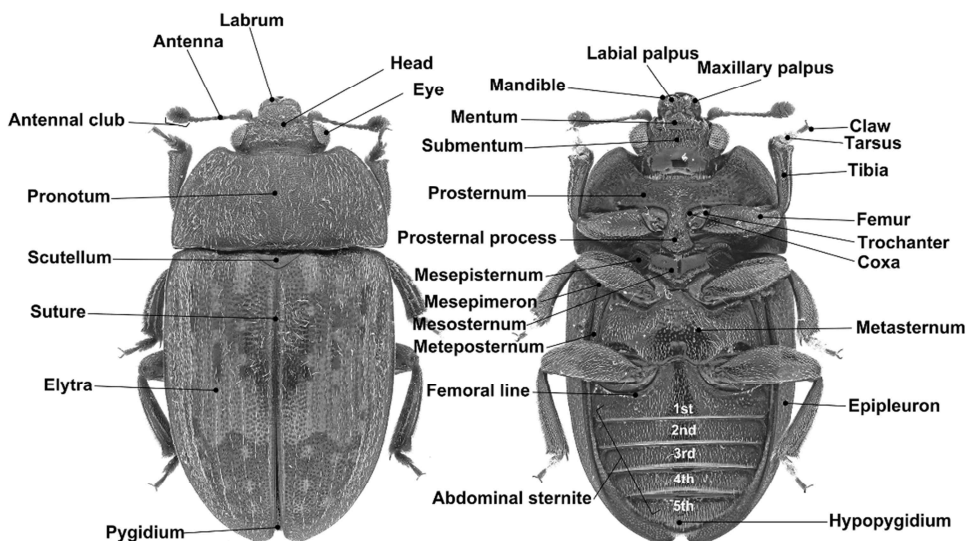


Fig. 1. The dorsal and ventral habitus of *Phenolia picta* (MacLeay). A, dorsal; B, ventral.

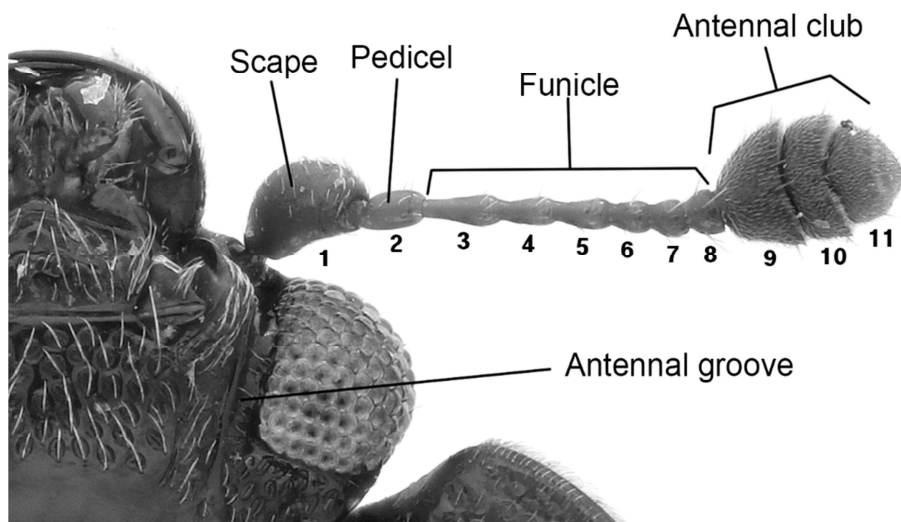


Fig. 2. Ventral habitus of antenna. (*Phenolia picta* (MacLeay))

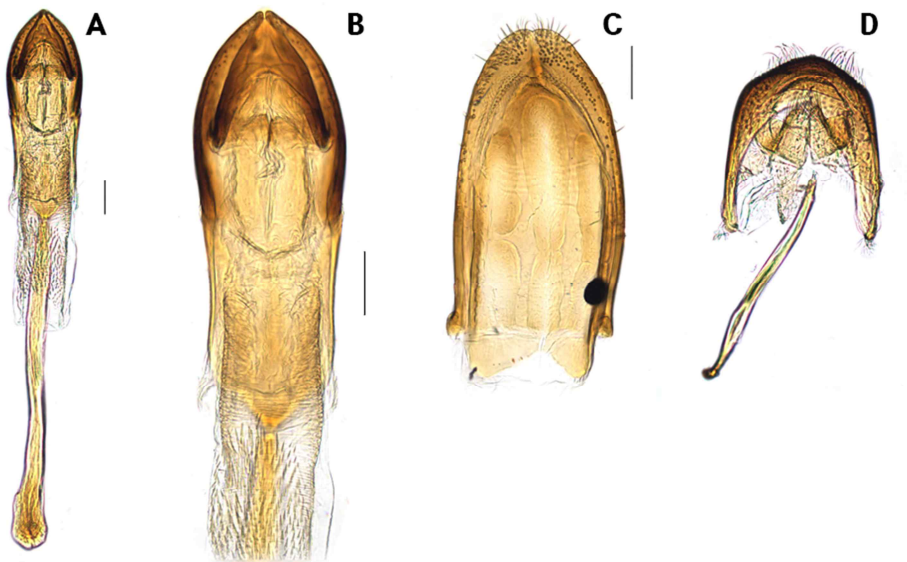


Fig. 3. Male genitalia A, B: median lobe; C: tegmen; D: male anal sclerite; (scale bar 0.1mm)

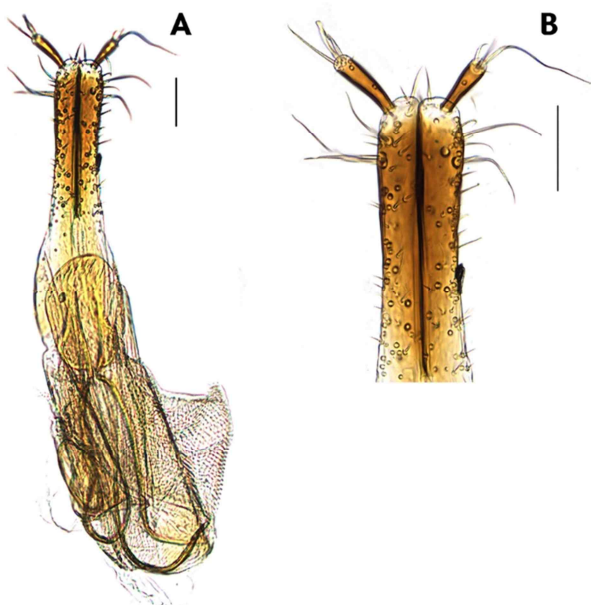


Fig. 4. Female ovipositor (A: Female ovipositor B: Apex of ovipositor (scale bar 0.1mm)

2.3. Abbreviations of localities in the Korean Peninsula

The province abbreviations are as follows: **SE**, Seoul-si; **IC**, Incheon-si; **GG**, Gyeonggi-do; **GW**, Gangwon-do; **CB**, Chungcheongbuk-do; **CN**, Chungcheongnam-do; **JB**, Jeollabuk-do; **JN**, Jeollanam-do; **GB**, Gyeongsangbuk-do; **GN**, Gyeongsangnam-do; **JJ**, Jeju-do (Is.).

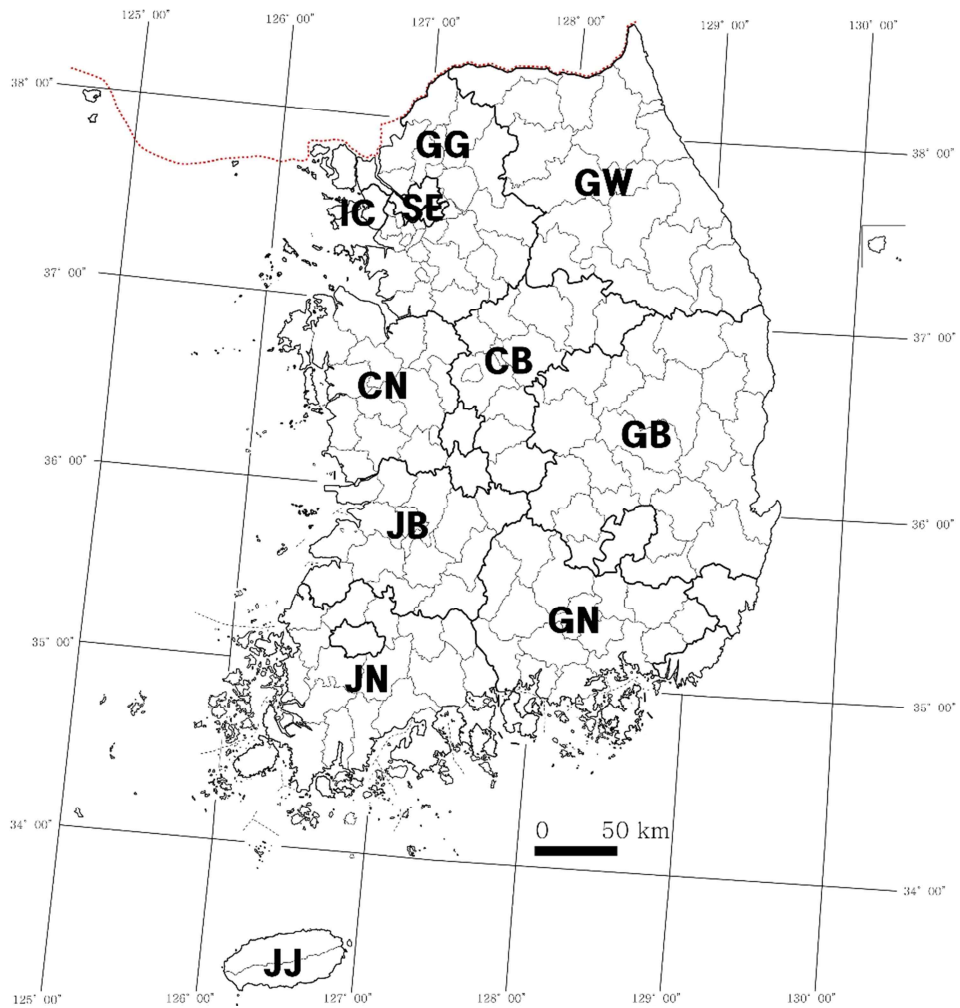


Fig. 5. A map for abbreviations of localities in the Korean peninsula.

3. Results

SYSTEMATIC ACCOUNTS

Class Insecta

Order Coleoptera

Suborder Polyphaga

Infraorder Cucujiformia

Superfamily Cucujoidea

Family Nitidulidae Latreille, 1802

Diagnosis

Family Nitidulidae is allied to Smicripidae or Kateretidae in several characters, 1) antennae 11 segmented with a last 3-segmented club (except Calonecrinae, some Cillaeinae (Macrostola), Meynipeplinae: 10 segmented with a last 1-2-segmented club); 2) abdominal ventrite 1 not much longer than 2; 3) anal lobe of hindwing present; 4) maxilla with lacinia only; 5) anal lobe of hindwing present. However, adult members Nitidulidae are distinguished from Smicripidae and Kateretidae by the following characters: 1) procoxae strongly transverse; 2) prothoracic trochantin always exposed; 3) procoxal cavities not always open externally.

Subfamily Nitidulinae Latreille, 1802 밀빠진벌레아과

Key to the tribes of Korean Nitidulinae

1. Pronotum not margined at base; head almost horizontal **Nitidulini**
 - Pronotum margined at base, covering base of elytra; head more or less deflexed .. 2
2. Dorsal surface of body pubescent **Cychramini**
 - Dorsal surface of body not pubescent..... **Cyllodini**

Tribe Nitidulini Erichson, 1843

Key to the Genera of Korean Nitidulini

1. Tarsomeres 1-3 not dilated..... 2
 - Tarsomeres 1-3 strongly dilated 6
2. Antennomere 8 flattened, disc-like 3
 - Antennomere 8 not flattened 4
3. Bicolored; protibia not curved medially **Pocadius**
 - Unicolored; protibia outer margin slightly, medially arcuate..... **Physoronia**
4. Antennal scape forming an asymmetrical ellipse; pronotum impunctate 5
 - Antennal scape asymmetrically triangular; pronotum punctate **Soronia**
5. Body setae dimorphic; hind tibia not elongated, similar in length to hind tarsi **Ussuriphia**
 - Body setae monomorphic; hind tibia elongated, almost two times longer than hind tarsi..... **Atarphia**

6. Pygidium with 8-10 punctures along anterior margin.....	<i>Aethina</i>
- Pygidium without punctures along anterior margin	7
7. Elytra with punctate-striate	8
- Elytra without striate	9
8. Bicolored; antennomere 3 longer than antennal pedicel	<i>Stelidota</i>
- Unicolored, almost black; antennomere 3 and antennal pedicel subequal	<i>Ipidia</i>
9. Antennomere 8 not flattened.....	10
- Antennomere 8 flattened, disc-like.....	12
10. Large, >5.5mm in length; tibia bicolored; sap feeding	<i>Phenolia</i>
- Smaller, <5.0mm in length; tibia unicolored; saprophagous	11
11. Elytral sutural stria distinct; pronotum with punctate impressions	<i>Omosita</i>
- Elytral sutural stria almost absent; pronotum impunctate	<i>Nitidula</i>
12. Bicolored; ovipositor apex simple, with stylus.....	<i>Pocadites</i>
- Unicolored; ovipositor with pointed apex, without stylus.....	<i>Hebasculinus</i>

Genus *Nitidula* Fabricius, 1775: 77 참밀빠진벌레속 (신칭)

Type species *Silpha bipustulata* Linnaeus, 1761

Theridiosmum Gistel, 1856: 361 Type species *Silpha bipustulata* Linnaeus, 1761

***Nitidula rufipes* (Linnaeus, 1767) 참밀빠진벌레 (신칭)**

Silpha rufipes Linnaeus, 1767: 573

Nitidula bicolor Dalla Torre, 1879: 87

Nitidula castanea C. Sahlberg, 1820: 74

Dermesles fulvipes Geoffroy, 1785: 22

Nitidula marginata Dalla Torre, 1879: 87

Nitidula obscura Fabricius, 1777: 215

Nitidula ossium Kirby, 1837: 106

Redescription

Length 3.4 - 3.5mm, Width 1.7mm. **Body** Weakly convex and oblong; mostly blackish brown; lateral margin of pronotum, legs, antennomeres 1-8 more brightly colored; covered with yellowish pubescence; pronotum and elytral margins fimbriate; ventral surface relatively brightly colored. **Head** prognathous, horizontal, transverse, wider than long (W:L = 2.6:1 / including eyes); with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, convergent; labrum short, medial anterior marginal incision almost absent. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish brown pubescence; antennal scape forming an

asymmetrical ellipse, 2 times longer than pedicel; antennal club compact, ovate, moderately flattened, almost symmetrical, 1/3 of total length and 1.3 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long (W:L = 1.7:1); anterior margin weakly concave; posterior margin almost rectilinear; lateral margins arciform, more brightly colored; circular or irregularly, densely punctate. **Scutellum** broadly rounded almost hemispherical, densely punctate. **Elytra** unicolored, subrectangular, somewhat rounded; densely punctate; sutural stria almost absent; elytra covering entire abdomen except apex of pygidium; lateral margins flatly arcuate, weakly explanate; epipleura narrow. **Prosternum** transverse; proepisternum more brightly colored; pubescence relatively less dense than other ventral surfaces; prosternal process laterally dilated at apex, apical margin moderately rounded. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; pubescence relatively longer and more dense than on prosternum; metasternal line incomplete. **Abdomen** relatively brightly colored, densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** rather stout and simple, covered with yellowish pubescence; more brightly colored than body; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia outer margin slightly, medially arcuate, protibial apical region slightly expanded, lateral margin smooth, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen thumb-shaped, rounded apically, longer than wide (W:L = 1.0:1.2 / without ring), short setae visible around apex. Penis trunk subrectangular, rounded apically;

shallowly incised at middle of apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

GW: 2exx, Hangye-ri, Buk-myeon, Inje-gun, 30 VI. 2017, Minhyeuk Lee (NIBR);
1ex, Wontong-ri, Buk-myeon, Inje-gun, 14 IV. 2018, Minhyeuk Lee (SNU).

SE: 2exx, Sillim-dong, Gwanak-gu, 03.V. 2018, Minhyeuk Lee (SNU).

Distribution

Korea, Europe, Russia, West Siberia, Japan, Mongolia, Kazakhstan, Nepal, Turkmenistan, Uzbekistan, Nearctic region

Remark

Most specimens were found on the dried carrion of *Sus scrofa* (Linnaeus, 1758) and some individuals were collected from food waste.

Genus *Omosita* Erichson, 1843: 298 송장밑빠진벌레속 (신칭)

Type species *Silpha depressa* Linnaeus, 1758

Saproboa Ganglbauer, 1899: 489 Type species *Silpha colon* Linnaeus, 1758

Scatocharis Gistel, 1856: 362 Type species *Silpha depressa* Linnaeus, 1758

Key to the species of Korean *Omosita*

1. Antennal club oblong, 1.5 times longer than wide *Omosita colon*
- Antennal club circular, almost same length and width 2

2. Elytra with yellowish pattern from middle to posterior margin; metasternal line strongly distinct..... *Omosita japonica*
- Elytra with bright yellowish pattern from scutellum to anterior 2/3; metasternal line slightly distinct *Omosita discoidea*

***Omosita colon* (Linnaeus, 1758) 점박이송장밀빠진벌레 (개칭)**

Silpha colon Linnaeus, 1758: 362

Nitidula bipartita Trost, 1801: 18

Nitidula haemorrhoidalis Fabricius, 1777: 216

Omosita viana Gistel, 1857: 587

Redescription

Length 2.0 - 3.9 mm, Width 1.0 - 2.1 mm. **Body** Weakly convex and oblong; mostly dark brown; lateral margin of pronotum, legs, antennomeres 1-8, apical margin of elytra more brightly colored; covered with whitish or yellowish pubescence; pronotum margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long (W:L = 2:1 / including eyes); with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum short, medial anterior marginal incision almost absent. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish brown pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; antennal club compact, ovate, moderately flattened, almost symmetrical, 1/4 of total

length and 1.3 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long ($W:L = 1.87:1$); with punctate impressions; anterior margin weakly undulate; posterior margin almost rectilinear; lateral margins arciform, more brightly colored; irregularly, densely punctate. **Scutellum** broadly rounded almost hemispherical, sparsely punctate. **Elytra** bicolored; subrectangular, somewhat rounded; densely punctate; with many pale spots, posterior spots largest and various pattern; sutural stria distinct, relatively brightly colored; elytra covering entire abdomen except apex of pygidium; lateral margins flatly arcuate, narrowly explanate; epipleura narrow. **Prosternum** transverse; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces; prosternal process laterally dilated at apex, apical margin moderately rounded. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** rather stout and simple, covered with yellowish pubescence; more brightly colored than body; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia outer margin slightly medially arcuate, protibial apical region slightly expanded, lateral margin weakly crenulate, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen thumb-shaped, rounded apically, slightly longer than wide ($W:L = 1.0:1.2$ / without ring), short setae visible around apex. Penis trunk subrectangular-shaped, with lateral apical angles slightly projecting; rounded apically; shallowly incised at middle of apex. **Female ovipositor** moderately long

and slightly sclerotized; with distinct apical styli.

Specimens examined

GB: 1ex, Cheongsong-gun, 27.iv.1994. (?).

GG: 2exx, Seodun-dong, Suwon-si, 27.iv.1983, Y.I.Lee; 1ex, Seodun-dong, Suwon-si, 10.vi.1983, S.B.Ahn; 1♂, Suwon-si, 2.iv.1985, K.J.Hong; 1ex, Seodun-dong, Suwon-si, 14.iv.1986, J.H.Yoo; 3exx, Seodun-dong, Suwon-si, 8.vii.1986, W.H.Paik; 1ex, Seodun-dong, Suwon-si, 20.iii.1989, S.B.Ahn; 1ex, Seodun-dong, Suwon-si, 29.iii.1989, K.J.Hong; 1ex, Goyang-si 16.vi.1989, S.H.Lee; 1♂, Suwon-si, 1.vi.1990, K.U.Chun; 1ex, Seodun-dong, Suwon-si, 26~30.vi.1993, R.G.O; 1ex, Seodun-dong, Suwon-si, 30.vii.1997; 1ex, Seodun-dong, Suwon-si, 14.vi.1999, J.Y. Choi; 1ex, Seodun-dong, Suwon-si, 12.iv.2000, M.O.Yeom.

GN: 1♀, Mt. jiri, 23.vi.1993, S.W.Park; 1♀, Mt. Geumoh, Geumnam-myeon, Hadong-gun, 16.ix.1994, J.G.Jung.

GW: 2exx, Wondongjae-ro, Yeongwol-gun, 3.x.2014, Seunghyun Lee; 1ex, Samcheok-si 26~30.vi.1993, R.G.O.; 1ex, Hongcheon-gun, 13.v.1996, J.Y.Choi; 1ex, Hongcheon-gun, 12.v.2006, J.Y.Choi.

IC: 1♂, Ongjin-gun, Deokjuk-myeon, Gureop-ri, 25.iv.2014, S.I.Park.

JB: 1ex, Mt. Nejang, Jeungeup-si, 6.xi.1999, S.I.Kim; 1ex, Jeonju-si, 20.x.2007, J.Y.Choi.

JN: 1ex, Gwangyang-si, Ongnyong-myeon, Chusan-ri, 23.iv.1991, D.J.K.

SW: 1♂, Seoul-si, 24.ix.1985, C.M.Kim.

Distribution

Korea, Europe, Siberia, Russia, Japan, China / Nearctic, Australia

Remarks

Most specimens were found on the dried carrion of *Sus scrofa* (Linnaeus, 1758) and one specimen was collected on the dried carrion of *Neophocaena phocaenoides* (G. Cuvier, 1829) on the seashore with *O. japonica*. Some individuals were collected from food waste or decaying fruits and vegetables together with *O. discoidea*.

Omosita japonica Reitter, 1874 구름무늬송장밀빠진벌레 (개칭)

Omosita japonica Reitter, 1874: 510

Redescription

Length 2.9 - 4.2 mm, Width 1.3 - 2.2 mm. **Body** Weakly convex and oblong; mostly reddish brown; lateral margin of pronotum, legs, antennomeres 1-8, apical margin of elytra more brightly colored; covered with whitish or yellowish pubescence; pronotum margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long (W:L = 1.5:1 / including eyes); with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum short, medial anterior marginal incision almost absent. **Antennae** 11 segments, apical 3 segments highly clavated and covered with yellowish brown pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; antennal club compact, almost circular, moderately flattened, almost symmetrical, 1/4 of total length, almost same length and width. **Pronotum** weakly convex, quadrate, wider than long (W:L = 1.7:1); with punctate impressions;

anterior margin broadly concave; posterior margin almost rectilinear; lateral margins arciform, more brightly colored; irregularly, densely punctate. **Scutellum** broadly rounded almost hemispherical, sparsely punctate. **Elytra** bicolored; subrectangular, somewhat rounded; densely punctate; with many pale spots, posterior spots largest and various pattern; sutural stria distinct, relatively brightly colored; elytra covering entire abdomen except apex of pygidium; lateral margins flatly arcuate, narrowly explanate; epipleura wider than mesotarsus. **Prosternum** transverse; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces; prosternal process laterally dilated at apex, apical margin rectilinear. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-3 subequal in length; sternites 4 narrowed. **Legs** rather stout and simple, covered with yellowish pubescence; more brightly colored than body; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia outer margin slightly medially arcuate, protibial apical region slightly expanded, lateral margin weakly crenulate, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen thumb-shaped, rounded apically, slightly longer than wide ($W:L = 1.0:1.14$ / without ring), short setae visible around apex. Penis trunk subrectangular with lateral apical angles slightly projecting; rounded apically; shallowly incised at middle of apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

CB: 3exx, Mt.Worak, Hansu-myeon, Jecheon-si, 24.v.1985, W.H.Paik.

CN: 1ex, Gongju-si, 19.vii.1992; 1ex, Gongju-si, 6~10.vii.1992, R.G.O.; 1ex, Nonsan-si, 11~15.viii.1993, R.G.O.; 1ex, Nonsan-si, 26~31.viii.1993, R.G.O.

GB: 1ex, Dodong-ri, Ulleung-eup, Ulleung-gun, 10.viii.2006, G.S.Lee.

GG: 2exx, Seodun-dong, Suwon-si, 9.viii.1982, C.H.Ryu; 1ex, Seodun-dong, Suwon-si, 10.vi.1983, O.J.IM; 1ex, Seodun-dong, Suwon-si, 20.vii.1983, W.H Paik; 1ex, Seodun-dong, Suwon-si, 29.viii.1984, W.H Paik; 1ex, Seodun-dong, Suwon-si, 31.x.1984, W.H Paik; 1♂, Suwon-si, 2.iv.1985, K.J.Hong; 2exx, Seodun-dong, Suwon-si, 14.vii.1990, S.D.Lee; 1ex, Seodun-dong, Suwon-si, 13.vi.1993; 2exx, Seodun-dong, Suwon-si, 13.vii.1993; 1ex, Seodun-dong, Suwon-si, 20.vii.1994; 1ex, Seodun-dong, Suwon-si, 20.vii.1994, J.Y.Choi; 2exx, Seodun-dong, Suwon-si, 30.vii.1994, J.Y.Choi; 1ex, Seodun-dong, Suwon-si, 25.vi.1995; 1ex, Pocheon-si, 18.ix.1996; 2exx, Seodun-dong, Suwon-si, 16.vii.1996, S.K.Lee; 1ex, Seodun-dong, Suwon-si, 14.viii.1996; 1ex, Seodun-dong, Suwon-si, 8.ix.1997; 2exx, Seodun-dong, Suwon-si, 30.vii.1997; 1ex, Seodun-dong, Suwon-si, 11.ix.1998; 3exx, Seodun-dong, Suwon-si, 11.ix.1998; 1ex, Seodun-dong, Suwon-si, 12.ix.1998; 5exx, Seodun-dong, Suwon-si, 5~6.ix.1998; 2exx, Taehwa, Sanglim-ri, Deokcheon-myeon, Gwangju-si, 5.viii.1998, J.B.Jeon; 1ex, Seodun-dong, Suwon-si, 8.viii.1998; 1ex, Seodun-dong, Suwon-si, 21.viii.1998; 1ex, Seokcheon-ri, Baegam-myeon, Yongin-si, 1.vii.2000, G.M.Kwon, M.H.Lee; 1♀, Mt.Taehwa, Sanglim-ri, Deokcheon-myeon, Gwangju-si, 16.vi.2013.

IC: 1♂, Ongjin-gun, Deokjuk-myeon, Gureop-ri, 25.iv.2014, S.I.Park.

JJ: 1ex, Seogwipo-si, 10.iii.1986, G.S.Lee.

SC: 1ex, Seoul, 15.vii.1993, R.G.O.

Distribution Korea, Russia, Sakhalin, Kuriles, Japan, China

Remarks

Some specimens were found on the dried carrion of *Sus scrofa* (Linnaeus, 1758) and one specimen was collected on the dried carrion of *Neophocaena phocaenoides* (G. Cuvier, 1829) on the seashore with *O. japonica*.

***Omosita discoidea* (Fabricius, 1775) 노랑송장밀빠진벌레 (개칭)**

Nitidula discoidea Fabricius, 1775: 78

Nitidula cincta Heer, 1841: 396

Omosita inversa LeConte, 1857: 36

Redescription

Length 2.0 – 3.8 mm, Width 1.1 – 1.9 mm. **Body** Weakly convex and oblong; mostly reddish brown; lateral margin of pronotum, central part of elytra more brightly colored; covered with whitish or dark pubescence; pronotum margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long ($W:L = 2.3:1$ / including eyes); with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum short, medial anterior marginal incision almost absent. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish brown pubescence; antennal scape forming an

asymmetrical ellipse, 2 times longer than pedicel; antennal club compact, almost circular, moderately flattened, almost symmetrical, 1/4 of total length, almost same length and width. **Pronotum** weakly convex, quadrate, wider than long (W:L = 2:1); with punctate impressions; anterior margin undulate; posterior margin almost rectilinear; lateral margins arciform, yellowish brown colored; irregularly, densely punctate. **Scutellum** broadly rounded, almost hemispherical, sparsely punctate. **Elytra** bicolored; subrectangular, somewhat rounded; densely punctate; with many pale spots; largest pattern from scutellum to anterior 2/3; sutural stria distinct; elytra covering entire abdomen except apex of pygidium; lateral margins flatly arcuate, narrowly explanate; epipleura wider than mesotarsus. **Prosternum** transverse; proepisternum yellowish brown colored, pubescence almost absent; prosternal process laterally dilated at apex, apical margin weakly acuminate. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** rather stout and simple, covered with yellowish pubescence; more brightly colored than body; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia outer margin slightly medially arcuate, protibial apical region slightly expanded, lateral margin weakly crenulate, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen thumb-shaped, rounded apically, slightly longer than wide (W:L = 1.0:1.2 / without ring), short setae visible around apex. Penis trunk subrectangular with lateral apical angles slightly projecting; rounded apically;

shallowly incised at middle of apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

GB: 53ex, Ulleung-gun, 6.vi.1985, W.H.Paik.

GG: 1ex, Anyang, 22.v.1990, E.T.Kim; 1ex, Seodun-dong, Suwon-si, 20.iii.1993, S.B.Ahn.

GW: 2♂, 1♀, 7exx, Wondongjae-ro, Yeongwol-gun, 3.x.2014, Seunghyun Lee; 5exx, Hangye-ri, Buk-myeon, Inje-gun, 30 VI. 2017, Minhyeuk Lee.

JJ: 2exx, Seogwipo-si, 2.i.1986, G.S.Lee; 1ex, Aewol-eup, Jeju-si 4.vi.1998, J.Y.Choi.

Distribution Korea, Europe, Siberia, Middle East, Turkey, Iran, Russia, Japan, China, India, South Africa, Nearctic and Neotropical.

Remarks

Some specimens were found on the dried carrion of *Sus scrofa* (Linnaeus, 1758) with *N.rufipes*. Also some individuals were collected from food waste or decaying fruits and vegetables with *O. colon*.

Genus *Soronia* Erichson, 1843: 298 얼룩밀빠진벌레속 (신칭)

Type species *Silpha grisea* Linnaeus, 1758

Norosia Portevin, 1931: 149 Type species *Nitidula punctatissima* Illiger, 1794

Key to Korean *Soronia* species

1. Body size more than 6.6mm; sexually dimorphic in shape of protibia, male
protibial apical 1/2 inner margin expanded.....*Soronia fracta*
- Body size less than 6.6mm; no distinction of male and female protibia **2**
2. Body more chunky; dark colored.....*Soronia lewisi*
- Body more slender; bright yellowish colored..... *Soronia grisea*

Soronia fracta Reitter, 1884 큰얼룩밀빠진벌레 (개칭)

Soronia fracta Reitter, 1884: 263

Soronia maxima Heller, 1923: 67

Redescription

Length 6.6 - 9.5 mm. **Body** weakly convex and oblong; mostly dark brown; lateral margin of pronotum, legs, apical and lateral margin of elytra more brightly colored; covered with dark or yellowish pubescence, some pubescence relatively thick and translucent; ventral surface reddish brown. **Head** prognathous, horizontal, transverse, wider than long (W:L = 2:1 / including eyes); with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct and strongly impressed, almost convergent; labrum normal length, medial anterior margin strongly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape asymmetrical rounded, triangular; antennal club compact, ovate, moderately flattened, almost symmetrical, 1/3.6 of total length and 2 times longer than wide.

Pronotum weakly convex, quadrate, wider than long ($W:L = 1.8:1$); with punctate impressions; anterior margin broadly concave; posterior margin almost rectilinear; lateral margins arciform, narrowed to anterior, more brightly colored; irregularly, densely punctate. **Scutellum** broadly rounded triangular, apical margin moderately rounded, densely punctate. **Elytra** bicolored; subrectangular, narrowed to posterior, somewhat rounded; densely punctate; with many pale spots; sutural stria almost absent; elytra covering entire abdomen include pygidium; lateral margins flat, arcuate, moderately explanate; epipleura wider than mesotarsus. **Prosternum** transverse; sparsely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces; prosternal process laterally dilated at apex, apical margin moderately rounded. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; more brightly colored than body; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibiae lateral margin weakly crenulate, protibiae sexually dimorphic; apical 1/2 of male protibia inner margin expanded, lateral margin arcuate; female protibial apical inner not expanded, lateral margin rectilinear; mesotibia and metatibia almost rectilinear. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; rounded apically; shallowly incised in the middle of apex; longer than wide ($W:L = 1:1.7$ / without ring); short setae visible around apex. Penis trunk thumb-shaped; rounded apically; shallowly

incised at middle of apex. **Female ovipositor** long and slightly sclerotized; with distinct apical styli.

Specimens examined

IC: 5exx, Namchon-dong, Namdong-gu, 12.vii.2014, Seunghyun Lee (SNU).

GG: 5exx, Bogwangsa(temple), Yeongjiang-ri, Gwangtan-myeon, Paju-si, 30.viii.2014, Seunghyun Lee (SNU); 3exx, Bogwangsa(temple), Yeongjiang-ri, Gwangtan-myeon, Paju-si, 30.ix.2017, Min Hyeuk Lee (SNU); 10exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 12.vii.2018, Min Hyeuk Lee (SNU); 3exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 20.vii.2018, Min Hyeuk Lee (SNU).

GW: 2exx, Osaek-ri, Seo-myeon, Yangyang-gun, 14.ix.2014, Woong Choi.

Distribution Korea, Russia, Japan, China

Remarks

Most specimens were found on tree sap of *Quercus* sp., and some individuals were collected using pineapple bait traps.

***Soronia grisea* (Linnaeus, 1758) 회색얼룩밀빠진벌레 (개칭)**

Silpha grisea Linnaeus, 1758: 362

Nitidula colon A.G. Olivier, 1811: 210

Soronia conicicollis Roubal, 1923: 181

Soronia japonica Reitter, 1873: 47

Silpha maculata DeGeer, 1774: 184

Nitidula varia Fabricius, 1781: 92

Dermestes variegata Geoffroy, 1785: 20

Redescription

Length 3.0 - 6.2 mm. **Body** Weakly convex and oblong; mostly yellowish brown; covered with dark or yellowish pubescence, some pubescence relatively thick and translucent; ventral surface reddish brown, sparsely punctate. **Head** prognathous, horizontal, transverse, wider than long; with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct and strongly impressed, weakly convergent; labrum normal length, medial anterior margin strongly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape asymmetrical rounded, triangular; antennal club reddish brown, compact, ovate, moderately flattened, almost symmetrical, 1/4 of total length and 1.5 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long ($W:L = 2:1$); with punctate impressions; anterior margin broadly concave; posterior margin almost rectilinear; lateral margins arciform, narrowed anteriorly, more brightly colored; irregularly, densely punctate. **Scutellum** broadly subtriangular, apical margin moderately rounded, densely punctate. **Elytra** bicolored; subrectangular, narrower posteriorly, somewhat rounded; densely punctate; with many dark spots; sutural stria weakly developed; elytra covering entire abdomen include pygidium; lateral margins flatly arcuate, moderately explanate; epipleura wider than mesotarsus. **Prosternum** transverse; sparsely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces; prosternal process strongly dilated at apex, apical margin moderately rounded. **Mesosternum** sparsely punctate;

posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia outer margin almost rectilinear, protibial apical region not expanded, lateral margin weakly crenulate, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; rounded apically; shallowly incised in the middle of apex; longer than wide ($W:L = 1:1.8$ / without ring); short setae visible around apex. Penis trunk thumb-shaped; pointed apically; shallowly incised at middle of apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

JJ: 1♀, Gwaneumsa, Ara-dong, Jeju-si, 12.vi.1998, Light trap, J.Y.Choi (NIAS).

GW: 1♂, Mt. Hambaeksan, Taebaek-si, 14.viii.1999, T.H.Kang (SNU); 1ex, Gwangwon-ri, Nae-myeon, Hongcheon-gun, 19.vi.2018, Light trap, Min Hyeuk Lee (SNU).

Distribution

Korea, East Siberia, Russia, Japan, Mongolia, Europe, Nearctic Region

Remarks

Only few individuals were found in this study. This species is generally known to be found in tree sap.

***Soronia lewisi* Reitter, 1884 꼬마얼룩밀빠진벌레 (신칭)**

Soronia lewisi Reitter, 1884: 263

Redescription

Length 3.6 - 6.6 mm. **Body** Weakly convex and oblong; mostly dark brown; lateral margin of pronotum, legs, Antennomeres 1-8, apical and lateral margin of elytra more brightly colored; covered with dark or yellowish pubescence, some pubescence relatively thick and translucent; ventral surface reddish brown. **Head** prognathous, horizontal, transverse, wider than long ($W:L = 2:1$ / including eyes); with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct and strongly impressed, almost convergent; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape asymmetrical rounded, triangular; antennal club darkish brown, compact, ovate, moderately flattened, almost symmetrical, $1/3$ of total length and 1.6 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long ($W:L = 1.8:1$); with punctate impressions; anterior margin broadly concave; posterior margin almost rectilinear; lateral margins arciform, narrowed to anterior, more brightly colored; irregularly, densely punctate. **Scutellum** broadly subtriangular, apical margin moderately rounded, densely punctate. **Elytra** bicolored; subrectangular, narrowed to posterior, somewhat rounded; densely punctate; with many pale spots; sutural stria almost absent; elytra covering entire abdomen include pygidium; lateral margins flat, arcuate, moderately explanat;

epipleura wider than mesotarsus. **Prosternum** transverse; sparsely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces; prosternal process strongly dilated at apex, apical margin rectilinear forms. **Mesosternum** sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; more brightly colored than body; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia outer margin almost rectilinear, protibial apical region not expanded, lateral margin weakly crenulate, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; rounded apically; shallowly incised in the middle of apex; longer than wide ($W:L = 1:2.6$ / without ring); short setae visible around apex. Penis trunk sharply narrow toward end with acute apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

CB: 1ex, Seokhyeon-ri, Baekgok-myeon, Jincheon-gun, 17.ix.2009, Jong Un Sung.

GG: 3exx, Bogwangsa(temple), Yeonggang-ri, Gwangtan-myeon, Paju-si, 30.viii.2014, Seunghyun Lee (SNU); 1ex, Bogwangsa(temple), Yeonggang-ri, Gwangtan-myeon, Paju-si, 30.ix.2017, Min Hyeuk Lee (SNU); 20exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 12.vii.2018, Min Hyeuk Lee (SNU).

GW: 2exx, Osaek-ri, Seo-myeon, Yangyang-gun, 05.vi.2018, Min Hyeuk Lee

(SNU).

Distribution

Korea, Russia, Japan

Remarks

Most specimens were found on tree sap of *Quercus* sp., and some individuals were collected using pineapple bait traps.

Genus *Stelidota* Erichson, 1843: 300 애밀빠진벌레속 (신칭)

Type species *Nitidula geminata* Say, 1825

***Stelidota multiguttata* Reitter, 1877 애밀빠진벌레 (신칭)**

Stelidota multiguttata Reitter, 1877: 110

Redescription

Length 2.4 – 2.9 mm. **Body** Weakly convex and oval; mostly reddish brown; lateral margin of pronotum more brightly colored; covered with yellowish pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with large, dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, parallel sided; labrum normal length, medial anterior margin moderately incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse;

antennal club reddish brown, compact, ovate, moderately flattened, almost symmetrical, 1/3.6 of total length and 1.5 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long (W:L = 1.86:1); anterior margin weakly concave; posterior margin almost rectilinear; lateral margins arciform, narrowed anteriorly, more brightly colored; with large, circular, irregularly dense punctures. **Scutellum** transverse, subtriangular, apical margin moderately rounded, rarely punctate. **Elytra** bicolored; subrectangular; strongly narrower posteriorly, somewhat rounded; with many pale spots; distinctly punctate-striate, with alternating circular and tiny irregular punctures, each bearing a single seta; sutural stria almost absent; elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, moderately explanate; epipleura wider than mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces, rarely punctate; prosternal process dilated at apex, apical margin moderately acuminate. **Mesosternum** sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 3-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin weakly crenulate, without sexual dimorphism. **Male genitalia** well-sclerotized. Tegmen pointed square-shaped; narrowed apically; longer than wide (W:L = 1:1.6 / without ring); long setae visible around apex and

lateral side. Penis trunk thumb-shaped; rounded apically. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

GG: 20exx, Nam-dong, Cheoin-gu, Yongin-si, 09.viii.2017, Min Hyeuk Lee (SNU); 1ex, Yongam-ri, Byeollae-myeon, Namyangju-si, 08.ix.2017, Min Hyeuk Lee (SNU).

GW: 1ex, Mt. Seorak, Osaek-ri, Seo-myeon, Yangyang-gun, 4.v.2015, Seunghyun Lee (SNU).

JN: 2exx, Haedong-ri, Yaksan-myeon, Wando-gun, 23.viii.2017, Pitfall trap, Min Hyeuk Lee (SNU).

JJ: 6exx, Gyorae-ri, Jocheon-eup, Jeju-si, 05.vii.2017 – 28.viii.2017 Pitfall trap, Min Hyeuk Lee (SNU).

Distribution

Korea, China, Japan, Taiwan, Pakistan, Nepal, India

Remarks

Most specimens were found under dead tree bark, and in mushrooms and tree sap.

Genus *Ipidia* Erichson, 1843: 289 검정밀빠진벌레속 (신칭)

Type species *Ips quadrinotata* Fabricius, 1798

Key to the Subgenus of Korean *Ipidia*

1. Elytral lateral margin arciform, less 1.5 times longer than width..... *Hemipidia*
- Elytral lateral margin paralleled, more 2 times longer than width..... *Ipidia*

Subgenus *Hemipidia* Kirejtshuk, 1992: 188

Type species *Nitidula sexguttata* R.F.Sahlberg, 1834

Ipidia (Hemipidia) sibirica (Reitter, 1879) 검정밑빠진벌레 (신칭)

Stelidota sibirica Reitter, 1879: 216

Redescription

Length 3.0 – 3.8 mm. **Body** Weakly convex and oval; mostly black; covered with yellowish pubescence; lateral margin of pronotum, legs, antennomeres 1-8, apical and lateral margin of elytra more brightly colored; ventral surface similar in color, sparsely pubescence. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, parallel sided; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; antennal club reddish brown, compact, ovate, moderately flattened, almost symmetrical, 1/3.4 of total length and 1.4 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long (W:L = 1.8:1); anterior margin moderately concave; posterior margin weakly

undulate; lateral margins arciform, narrowed anteriorly, more brightly colored; large, dense, circular punctures. **Scutellum** broadly subtriangular, apical margin moderately rounded, rarely punctate. **Elytra** unicolored; subrectangular, narrower posteriorly, somewhat rounded; distinctly punctate-striate, circular and tiny-irregular punctation alternately; sutural stria almost absent; elytra covering entire abdomen include pygidium; lateral margins flatly arcuate, moderately explanate; epipleura wider than mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less than other ventral sides; prosternal process weakly dilated at apex, apical margin moderately rounded. **Mesosternum** sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin weakly crenulate, without sexual dimorphism; metatibia outer margin almost rectilinear form. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; narrowed apically; longer than wide ($W:L = 1:4.6$ / without ring); no setae visible. Penis trunk sharply narrow toward end with acute apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

SE: 4exx, SNU engineering building, Daehak-dong, Gwanak-gu, 21.iv.2015, Jinbae Seung (SNU).

GG: 1ex, Gapyeong Lumbermill, Sansaek-ri, Gapyeong-eup, Gapyeong-gun, 24.iv.2016, Seunghyun Lee (SNU).

GW: 1ex, Yongdae-ri, Buk-myeon, Injae-gun, 16.v.2015, Seunghyun Lee (SNU);
2exx, Wontong-ri, Buk-myeon, Inje-gun, 14 IV. 2018, Minhyeuk Lee (SNU).

Distribution

Korea, China, Russia, Japan

Remarks

Most specimens were found on dead tree trunks or under bark.

Subgenus *Ipidia* Erichson, 1843: 289

Type species *Ips quadrinotata* Fabricius, 1798

***Ipidia (Ipidia) variolosa variolosa* Reitter, 1879 큰검정밀빠진벌레 (개칭)**

Ipidia variolosa variolosa Reitter, 1879: 215

Stelidota hattorii Kôno, 1940: 57

Redescription

Length 3.3 – 5.4 mm. **Body** Weakly flattened and oblong; mostly black; covered with sparse, short yellowish pubescence; lateral margin of pronotum, antennomeres 1-8, apical margin of elytra more brightly colored; ventral surface similar in color, sparsely pubescence. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, parallel sided; labrum short,

medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; antennal club dark brown, compact, ovate, moderately flattened, almost symmetrical, $1/3.4$ of total length and 1.7 times longer than wide. **Pronotum** weakly flattened, quadrate, wider than long ($W:L = 1.7:1$); anterior margin weakly concave; posterior margin weakly undulate; lateral margins arciform, narrowed anteriorly, more brightly colored; large, dense, circular punctures. **Scutellum** broadly subtriangular, apical margin moderately rounded, rarely punctate. **Elytra** unicolored; subrectangular, narrower posteriorly, somewhat rounded; distinctly punctate-striate; sutural stria almost absent; elytra covering entire abdomen include pygidium; lateral margins moderately explanate, anterior $1/2$ almost parallel sided; epipleura wider than mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence almost absent; prosternal process dilated at apex, apical margin moderately rounded. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin weakly crenulate, without sexual dimorphism; metatibia outer margin almost rectilinear. **Male genitalia** well-sclerotized. Tegmen thumb-shaped; rounded apically; longer than wide ($W:L = 1:2$ / without ring); with long

setae from the apex to middle. Penis trunk thumb-shaped; slightly protruding apex.

Female ovipositor moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

SE: 2exx, SNU engineering building, Daehak-dong, Gwanak-gu, 21.iv.2015, Jinbae Seung (SNU).

GG: 9exx, Gapyeong Lumbermill, Sansaek-ri, Gapyeong-eup, Gapyeong-gun, 24.iv.2016, Seunghyun Lee (SNU); 1ex, Bogwang-ro, Gwangtan-myeon, Paju-si, 30.v.2015, Seunghyun Lee (SNU).

GW: 1ex, Yongdae-ri, Buk-myeon, Injae-gun, 16.v.2015, Seunghyun Lee (SNU); 2exx, Hoenggye-ri, Daegwallyeong-myeon, Pyeongchang-gun, 29.vi.2017, Flight Intercept Trap, Min Hyeuk Lee (SNU); 2exx, Wontong-ri, Buk-myeon, Inje-gun, 14 IV. 2018, Minhyeuk Lee (SNU); 2ex, Gwidun-ri, Inje-eup, Inje-gun, 09.v.2018 – 23.v.2018, Flight Intercept Trap, Min Hyeuk Lee (SNU);.

JJ: 4exx, Gyorae-ri, Jocheon-eup, Jeju-si, 20.v.2017 – 05.vii.2017, Flight Intercept Trap, Min Hyeuk Lee (SNU); 9exx, Gyorae-ri, Jocheon-eup, Jeju-si, 05.vii.2017 – 28.viii.2017, Flight Intercept Trap, Min Hyeuk Lee (SNU); 10exx, Gyorae-ri, Jocheon-eup, Jeju-si, 17.v.2018 – 30.vi.2018, Flight Intercept Trap, Jinbae Seung (SNU).

Distribution

Korea, East Siberia, Russia, Japan, Nepal

Remarks

Most specimens were found on dead tree trunks or under bark.

Genus *Phenolia* Erichson, 1843: 299 왕밀빠진벌레속 (신칭)

Type species *Nitidula grossa* Fabricius, 1801

Key to Korean *Phenolia* species

- Body smaller, stocky; sexual dimorphism in shape of protibia, apical 1/2 of inner margin of male protibia expanded *Phenolia borealis*
- Body larger, slender; no differences between male and female protibia
..... *Phenolia picta*

Subgenus *Lasiodites* Jelínek, 1999: 276

Type species *Nitidula picta* MacLeay, 1825

***Phenolia (Lasiodites) borealis* (Hisamatsu, 1968) 왕밀빠진벌레 (개칭)**

Lasiodactylus borealis Hisamatsu, 1968: 11

Redescription

Length 6.0 – 7.6 mm. **Body** weakly convex and oval; mostly reddish brown; lateral margin of pronotum, apical and lateral margin of elytra more brightly colored; covered with yellowish pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum normal length, medial anterior margin moderately incised. **Antennae** 11 segments,

apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; antennal club reddish brown, compact, ovate, moderately flattened, almost symmetrical, 1/3.5 of total length and 1.5 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long (W:L = 2.2:1); anterior and posterior margin weakly undulate; lateral margins arciform, narrowed anteriorly, more brightly colored; with circular, irregularly dense punctures. **Scutellum** transverse; subtriangular, apical margin moderately rounded, rarely punctate. **Elytra** bicolored; subrectangular; strongly narrower posteriorly, somewhat rounded; with many pale spots; with circular, irregularly dense punctures; sutural stria almost absent; elytra covering entire abdomen, include pygidium; lateral margins arcuate, moderately explanate; epipleura wider than mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces, densely punctate; prosternal process dilated at apex, apical margin moderately acuminate. **Mesosternum** rarely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. Abdomen densely punctate; first abdominal sternite 2-times longer than second **abdominal** sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin weakly crenulate, protibiae sexually dimorphic; apical 1/2 of male protibia inner margin expanded; female protibia apical margin not expanded; mesotibia strongly curved; metatibia almost rectilinear; femur bicolored, apical 1/2 reddish

orange. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; rounded apically; longer than wide (W:L = 1:2.7 / without ring); with short setae from the apex to middle. Penis trunk sharply narrowed to acute apex. **Female ovipositor** moderately long and slightly sclerotized; with distinct apical styli.

Specimens examined

GB: 1ex, Deukmyeong-ri, Dongmyeong-myeon, Chilgok-gun, 1.vii.2014, Seunghyun Lee (SNU).

GG: 9exx, SNU Experiment forest, Mt. Taehwa, Sanglim-ri, Docheok-myeon, Gwangju-si, 18.vi.2014, Seunghyun Lee (SNU); 1ex, Mt. Suri, Sanbon-dong, Gunpo-si, 28.vi.2014, Seunghyun Lee (SNU); 1ex, Mt. Bara, Hagui-dong, Uiwang-si, 1.vi.2015, Jinbae Seung (SNU).

Distribution

Korea, Japan

Remarks

Most specimens were found on tree sap of *Quercus* sp., and some individuals were attracted to pineapple bait trap.

***Phenolia (Lasiodites) picta* (MacLeay, 1825) 갈색왕밀빠진벌레 (개칭)**

Nitidula picta MacLeay 1825: 40

Lordites costulata Fairmaire, 1869: 775

Lordites glabricola Candèze, 1861: 340

Lasiodactylus testudinaria Reitter, 1873: 87

Redescription

Length 5.5 – 8.5 mm. **Body** convex and oblong; mostly blackish brown; lateral margin of pronotum, and apical and lateral margins of elytra more brightly colored; covered with yellowish pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum normal length, medial anterior margin moderately incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; antennal club reddish brown, compact, ovate, moderately flattened, almost symmetrical, 1/4 of total length and 1.5 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long (W:L = 2.2:1); anterior margin broadly concave; posterior margin weakly undulate; lateral margins arciform, narrowed anteriorly, more brightly colored; with circular, irregularly dense punctures. **Scutellum** transverse; subtriangular, apical margin moderately rounded, rarely punctate. **Elytra** bicolored; subrectangular; narrower posteriorly, somewhat rounded; with many yellowish orange spots; with circular, irregularly dense punctures; sutural stria almost absent; elytra covering entire abdomen include pygidium; lateral margins arcuate, moderately explanate; epipleura wider than mesotarsus. **Prosternum** transverse; densely punctate; proepisternum margin more brightly colored, pubescence relatively less dense than on other ventral surfaces, densely punctate; prosternal process dilated at apex, apical margin moderately rounded. **Mesosternum** rarely punctate; posterior margin extending midway

between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin weakly crenulate, without sexual dimorphism; mesotibia moderately curved; metatibia almost rectilinear; femur bicolored, apical 1/2 reddish orange. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; rounded apically; longer than wide ($W:L = 1:3$ / without ring); with short setae around apex. Penis trunk sharply narrow toward end with acute apex. **Female ovipositor** long and slightly sclerotized; with distinct apical styli.

Specimens examined

GW: 1ex, Samok-ri, Yeongwol-eup, Yeongwol-gun, 3.x.2014, Seunghyun Lee (SNU).

IC: 2exx, Namchon-dong, Namdong-gu, 12.vii.2014, Seunghyun Lee (SNU).

JJ: 10exx, Dosun-dong, Seogwipo-si, 05.vii.2017, Min Hyeuk Lee (SNU); 4exx, Dosun-dong, Seogwipo-si, 16.vii.2017, Min Hyeuk Lee (SNU).

Distribution

Korea, Russia, China, Japan, Taiwan, Pakistan / Afrotropical Region, Oriental Region, Australian Region

Remarks

Most specimens were found on tree sap of *Quercus* sp., and some individuals were attracted to pineapple bait trap.

Genus *Ussuriphia* Kirejtshuk, 1992: 185 알락밀빠진벌레속 (신칭)

Type species *Soronia hilleri* Reitter, 1877

***Ussuriphia hilleri* (Reitter, 1877) 알락밀빠진벌레 (개칭)**

Soronia hilleri Reitter, 1877: 109

Omosita excellentis Kirejtshuk, 1984: 178

Redescription

Length 3.1 – 4.5 mm. **Body** weakly convex and oval; mostly blackish brown; lateral margin of pronotum, legs, antennomeres 1-8, lateral margin of elytra more brightly colored; covered with yellowish pubescence, some pubescence strongly thick and translucent; pronotum and elytral margins fimbriate; ventral surface reddish brown, without pubescence dimorphism. **Head** prognathous, horizontal, transverse, wider than long; with circular or irregular, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct and strongly impressed, almost parallel sided; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; antennal club dark brown, compact, ovate, moderately flattened, almost symmetrical, 1/3 of total length and 1.3 times longer than wide. **Pronotum** weakly convex, quadrate, wider than long ($W:L = 2.1:1$); anterior and posterior margin weakly undulate; lateral margins arciform, narrowed anteriorly, more brightly colored; circular or irregularly, densely punctate. **Scutellum** broadly subtriangular,

apical margin moderately rounded, densely punctate. **Elytra** bicolored; subrectangular, narrower posteriorly, somewhat rounded; densely punctate; with many pale spots; sutural stria distinct; elytra covering entire abdomen except apex of pygidium; lateral margins flatly arcuate, moderately explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum similar in color, pubescence relatively less dense than on other ventral surfaces; prosternal process moderately dilated at apex, apical margin rounded forms. **Mesosternum** sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line absent. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** simple, covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not strongly dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; tibia lateral margin crenulate; without sexual dimorphism.; mesotibia and metatibia simple rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen bell-shaped; narrowed apically; longer than wide ($W:L = 1:2$ / without ring); short setae visible around apex and lateral side. Penis trunk sharply narrow toward acute apex. **Female ovipositor** not available for study.

Specimens examined

GN: 1ex, Donghang-ri, Yokji-myeon, Tongyeong-si, 25.viii.2014, Woong Choi.

GW: 1ex, Haesanryeong, Dongchon-ri, Hwacheon-eup, Hwacheon-gun, 14.vi.2014, Seunghyun Lee (SNU); 2ex, Mt. Neunggyeongbong, Hoenggye-ri, Daegwallyeong-myeon, Pyeongchang-gun, 06.vi.2018, Min Hyeuk Lee (SNU); 1ex, Gwidun-ri,

Inje-eup, Inje-gun, 09.v.2018 – 23.v.2018, Flight Intercept Trap, Min Hyeuk Lee (SNU); 4exx, Gwidun-ri, Inje-eup, Inje-gun, 23.v.2018 – 05.vi.2018, Flight Intercept Trap, Min Hyeuk Lee (SNU).

JJ: 2exx, Gyorae-ri, Jocheon-eup, Jeju-si, 17.v.2018, Jinbae Seung (SNU).

Distribution

Korea, Russia, China, Japan / Oriental region

Remarks

Most specimens were found on dead tree trunks, under bark and various flowers.

Genus *Aethina* Erichson, 1843: 306 꼬마밀빠진벌레속 (신칭)

Type species *Aethina pubescens* Erichson, 1843

Key to the Subgenera of Korean *Aethina*

1. Elytra pubescence uniform; without rows of hairs and differences in lengths
..... *Aethina*
- Elytra with longitudinal rows of longer hairs between 1-3 rows of shorter hairs
..... *Circopes*

Subgenus *Aethina* Erichson, 1843: 306

Type species *Aethina pubescens* Erichson, 1843

Aethinopa Reitter, 1875: 109 Type species *Aethinopa fulvovestita* Reitter, 1875

Meligethopsis Rebmann, 1944: 25 Type species *Meligethopsis singularis* Rebmann, 1944

Pseudomystrops Grouvelle, 1913: 389 Type species *Idaethina humeralis*

Grouvelle, 1890

Key to Korean *Aethina* species

1. Antennal club widely explanate, almost as long as wide..... 2
- Antennal club longer than wide..... 3
2. Elytra more elongate, longer than wide; prosternal process relatively wide; pygidium with 8 punctures along anterior margin..... *Aethina aeneipennis*
- Elytra less elongate, almost as long as wide; prosternal process relatively narrow; pygidium with 10 punctures along anterior margin..... *Aethina tumida*
3. Dorsal integument bicolored..... *Aethina flavicollis*
- Dorsal integument unicolored..... *Aethina inconspicua*

Aethina (Aethina) aeneipennis Reitter, 1873 남방꼬마밀빠진벌레 (신칭)

Aethina aeneipennis Reitter, 1873: 85

Meligethopsis singularis Rebmann, 1944: 26

Redescription

Length 2.8 – 4.5 mm. **Body** convex and oval; unicolored, mostly yellowish brown; lateral margin of pronotum, legs, antennomeres 1-6 more brightly colored; covered with long yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider

than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments strongly clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally; antennal club reddish brown, compact, oval, moderately flattened, mostly asymmetrical, 1/3 of total length and almost equal in length and width. **Pronotum** moderately convex, hemispherical, wider than long (W:L = 1.9:1); anterior margin moderately concave; posterior margin weakly undulate, both edges somewhat projecting; lateral margins rounded, strongly narrowed anteriorly; with dense, circular punctures. **Scutellum** transverse; hemispheric, apical margin strongly rounded, densely punctate. **Elytra** unicolored; subrectangular; weakly narrower posteriorly; separately rounded at apices; with dense, circular punctures; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins weakly rounded, scarcely explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces, densely punctate; prosternal process moderately dilated at apex, apical margin rounded. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2 times longer than second abdominal sternite, femoral lines well-developed posteriorly; sternites 2-4 subequal in length; pygidium with 8 punctures along anterior margin. **Legs** covered with yellowish

pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae sparsely, tarsal claws simple; protibia flattened subtriangular, lateral margin crenulate; without sexual dimorphism; mesotibia and metatibia almost flattened rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen almost subparallel; rounded apically; longer than wide ($W:L = 1:2.6$ / without ring); gradually narrowed toward apex, comparatively long hairs densely distributed apically. Penis trunk almost rounded-rectangular, approximately 1.71 times longer than wide without including speculum, apical tip of tegmen almost flattened with slightly projected apical center. **Female ovipositor** short and slightly sclerotized; with distinct styli near apices.

Specimens examined

JJ: 1 male and 1 female, Wimi-ri, Namwon-eup, Seogwipo-si, Jeju-do, Korea, 17.v.2016, Lee, Nam and Seung (SNU); 4exx, Hwasun-ri, Andeok-myeon, Seogwipo-si, 06.vii.2017, Min Hyeuk Lee (SNU).

Distribution

Korea, Russia, China, Japan / Oriental region

Remarks

Most specimens were found on various flowers from Jeju Island.

***Aethina (Aethina) flavicollis* Reitter, 1884 무늬꼬마밀빠진벌레 (개칭)**

Aethina flavicollis Reitter, 1884: 266

Aethina maculicollis Reitter, 1884: 266

Redescription

Length 2.8 – 4.3 mm. **Body** convex and oval; bicolored, reddish brown to black; lateral margin of pronotum, legs, antennae more bright color; covered with long yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments strongly clavated and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally; antennal club yellowish brown, compact, ovoid, moderately flattened, mostly asymmetrical, 1/3.2 of total length and 1.5 times longer than wide. **Pronotum** bicolored, large dark pattern in center; moderately convex, hemispherical, wider than long ($W:L = 2.4:1$); anterior and posterior margin moderately concave; both edges of posterior margin somewhat projecting; lateral margins rounded, strongly narrowed anteriorly; with dense, circular punctures. **Scutellum** transverse; hemispheric, apical margin strongly rounded, densely punctate. **Elytra** unicolored; subrectangular; weakly narrower posteriorly; separately rounded at apices; with dense, circular punctures; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins weakly rounded, scarcely explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces, densely punctate; prosternal process moderately dilated at apex, apical margin

rounded. **Mesosternum** densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2 times longer than second abdominal sternite, femoral lines well-developed posteriorly; sternites 2-4 subequal in length; pygidium with 8 punctures along anterior margin. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae sparsely, tarsal claws simple; protibia flattened subtriangular, lateral margin crenulate; without sexual dimorphism; mesotibia and metatibia almost flattened rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide ($W:L = 1:2$ / without ring); gradually narrowed toward apex, comparatively long hairs densely distributed apically. Penis trunk almost rounded-rectangular, approximately 2.11 times longer than wide not including spiculum, apical tip of tegmen almost flattened with slightly projected apical center. **Female ovipositor** short and slightly sclerotized; with distinct styli near apices.

Specimens examined

GW: 1ex. (SNU), Mt. Gyebang, Nodong ri, Yongpyeong myeon, Pyeongchang gun, 23.iv.2014, Seunghyun Lee; 4exx. (SNU), Naedeok ri, Sangdong eup, Yeongwol gun, 13.vi.2014, Seunghyun Lee; 1ex. (SNU), Yongdae-ri, Buk-myeon, Injae-gun, 16.v.2015, Seunghyun Lee; 2exx. (SNU), Jeombongsan-ro, Girin-myeon, Inje-gun, Gangwon-do, 21.v.2015, Jinbae Seung.

GG: 1ex. (SNU), Jugyeopsan-ro, Sohol-eup, Pocheon-si, 21.v.1995, P.S.W.; 1ex. (SNU), Yeongtong-gu, Suwon-si, 23.vi.1992, H. T. Lee.

GB: 2 exx. (NAAS), Nari-gil, Buk-myeon, Ulleung-gun, 9.viii.2006, Gwan Seok Lee.

Distribution

Korea, Russia, China, Japan, Taiwan / Oriental region

Remarks

Most specimens were found on various flowers.

***Aethina (Aethina) inconspicua* Nakane, 1967 꼬마밀빠진벌레 (개칭)**

Aethina inconspicua Nakane, 1967: 68

Redescription

Length 2.8 – 4.2 mm. **Body** convex and oval; unicolored, almost black; lateral margin of pronotum, legs, antennae and abdomen more bright color; covered with long yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct and strongly impressed, curved inward at apex; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally; antennal club yellowish brown, compact, oblong, moderately flattened, mostly symmetric, 1/3.5 of total length and 1.4 times longer than wide. **Pronotum** unicolored; most parts covered with long yellowish pubescence and some dark pubescence located in

middle area; moderately convex, hemispherical, wider than long ($W:L = 2.3:1$); anterior and posterior margin moderately concave; both edges of posterior margin somewhat projecting; lateral margins rounded, strongly narrowed anteriorly; with dense, circular punctures. **Scutellum** transverse; hemispheric, apical margin strongly rounded, densely punctate. **Elytra** unicolored; subrectangular; weakly narrower posteriorly; separately rounded at apices; with dense, circular punctures; sutural stria almost absent; elytra covering entire abdomen except apex of pygidium; lateral margins weakly rounded, scarcely explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces, densely punctate; prosternal process slightly dilated at apex, apical margin rounded. **Mesosternum** rarely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line absent. **Abdomen** densely punctate; first abdominal sternite 2 times longer than second abdominal sternite, femoral lines well-developed posteriorly; sternites 2-4 subequal in length; pygidium with 6 punctures along anterior margin. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae densely, tarsal claws simple; protibia flattened subtriangular, lateral margin crenulate; without sexual dimorphism; mesotibia and metatibia almost flattened rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide ($W:L = 1:2$ / without ring); gradually narrowed toward apex, comparatively long hairs densely distributed apically. Penis trunk almost hexagonal with apex gradually protruding toward center,

approximately 2.11 times longer than wide not including spiculum, apical center slightly projected. **Female ovipositor** moderately long and slightly sclerotized; with distinct styli near apices.

Specimens examined

GW: 5exx. (SNU), Mt. Gyebang, Nodong ri, Yongpyeong myeon, Pyeongchang gun, 23.iv.2014, Seunghyun Lee; 1ex. (SNU), Mt. Taehwa, Samok ri, Yeongwol eup, Yeongwol gun, 24.iv.2014, Seunghyun Lee; 1ex. (SNU), Jangneung, Yeongheung ri, Yeongwol eup, Yeongwol gun, 24.iv.2014, Seunghyun Lee; Silrae pass, 10exx. (SNU), Damok ri, Sangseo myeon, Hwacheon gun, 26.iv.2014, Seunghyun Lee; 1ex. (SNU), Omi-ri, Bangsan-myeon, Yanggu-gun, 16.v.2015, Seunghyun Lee; 1ex. (SNU), Cheonmi-ri, Bangsan-myeon, Yanggu-gun, 16.v.2015, Seunghyun Lee; 3exx. (SNU), Yongdae-ri, Buk-myeon, Injae-gun, 16.v.2015, Seunghyun Lee; 1ex. (SNU), Beopheungsa Temple, Beopheung-ri, Suju-myeon, Yeongwol-gun, 20.v.2015, Seunghyun Lee; 3exx. (SNU), Jeombongsanro, Girin-myeon, Inje-gun, 21.v.2015, Jinbae Seung; 3exx. (SNU), Yongdae-ri, Buk-myeon, Injae-gun, 18.vi.2015, Seunghyun Lee; 2exx. (NAAS), Yongdae-ri, Buk-myeon, Injae-gun, 25.v.2002, Jindong Yeo; 1ex. (NAAS), Seokbyeong-san, San-gye-ri, Okgye-myeon, Gangneung-si, 21.v.2002, Jindong Yeo; 3exx. (NAAS), Deokduwon-gil, Seo-myeon, Chuncheon-si, 2001.iv.23, Taewoo Kim; 3exx. (NAAS), Seokbyeong-san, Imgye-ri, Imgye-myeon, Jeongseon-gun, 22.v.2002, Youngbo Lee.

GG: 1ex. (NAAS), Myeongji-san, Dodae-ri, Buk-myeon, Gapyeonggun, 26.iv.2001, Mihye Kim; 3exx. (NAAS), Yongcheon-ri, Okcheonmyeon, Yangpyeong-gun,

27.iv.2006, Haechul Park; 1ex. (NAAS), Myeongji-san, Baekdun-ri, Buk-myeon, Gapyeong-gun, 28.v.2001, Gyusook Lee; 1ex. (NAAS), Myeongji-san, Baekdun-ri, Buk-myeon, Gapyeong-gun, 28.v.2001, Heeah Lee; 1ex. (NAAS), Myeongji-san, Baekdun-ri, Buk-myeon, Gapyeong-gun, 28.v.2001, Taewoo Kim; 2ex. (NAAS), Myeongji-san, Baekdun-ri, Buk-myeon, Gapyeong-gun, 28.v.2001, Taewoo Kim; 2exx. (NAAS), Myeongji-san, Baekdun-ri, Buk-myeon, Gapyeong-gun, 28.v.2001, Haechul Park; 1ex. (KNAE), Jikdong-ri, Sohol-eup, Pocheon-si, 9.v.1998, Gab – jaeWon.

JN: 1 ex. (SNU), Mt. Manyeon, Hwasun-eup, Hwasun-gun, 11.iv.2015, Seunghyun Lee.

CN: 1ex. (SNU), Gyeryongsan-ro, Gyeryong-myeon, Gongju-si, 27.v.2015, Hwaseop Song.

JB: 1ex. (NAAS), Micheon-ri, Seolcheon-myeon, Muju-gun, 13.v.2005, Haechul Park.

Distribution

Korea, Russia, China, Japan, Nepal, Pakistan, Taiwan, India / Oriental region

Remarks

Most specimens were found on various flowers from early spring to late summer (Lee et al., 2017). This species is also known to be found under bark of fallen trees (Kirejtshuk, 1992).

***Aethina (Aethina) tumida* Murray, 1867 벌집꼬마밀빠진벌레**

Aethina tumida Murray, 1867: 177

Redescription

Length 5.0 – 7.0 mm. **Body** convex and oval; unicolored, almost black or dark brown; lateral margin of pronotum, legs, antennae more brightly colored; covered with long yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral surface reddish brown. **Head** prognathous, horizontal, transverse, wider than long; with tiny, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct and strongly impressed, curved inward at apex; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, covered with yellowish pubescence; antennal scape with long yellowish setae at anterior margin, broadly convex dorsally; antennal club dark brown, strongly compact, oval, moderately flattened, mostly symmetrical, 1/3 of total length and almost same length and width. **Pronotum** unicolored; most parts covered with long yellowish pubescence and some dark pubescence located medially; moderately convex, hemispherical, wider than long ($W:L = 2:1$); anterior and posterior margin moderately concave; both edges of posterior margin sharply projecting; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; hemispheric, apical margin strongly rounded, densely punctate. **Elytra** unicolored; subrectangular; weakly narrower posteriorly; separately rounded at apices; with tiny, dense punctures; sutural stria absent; elytra covering entire abdomen except pygidium; lateral margins weakly rounded,

scarcely explanate; epipleura narrower than mesotarsus. **Prosternum** transverse; densely punctate; proepisternum similar in color, pubescence relatively less dense than on other ventral surfaces, densely punctate; prosternal process not dilated at apex, apical margin rounded. **Mesosternum** rarely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line distinct. **Abdomen** densely punctate; first abdominal sternite 2 times longer than second abdominal sternite; sternites 2-4 not equal in length; pygidium with 10 punctures along anterior margin. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated, tarsal setae dense, tarsal claws simple; tibia flattened subrectangular form, lateral margin crenulate; without sexual dimorphism; femur well developed and unicolored. **Male genitalia** well-sclerotized. Tegmen almost bell-shaped; longer than wide ($W:L = 1:1.62$ / without ring); rounded in distal 1/2 with sparse setae. Penis trunk bullet-shaped, approximately 1.76 times longer than wide not including spiculum, apex roundly truncate and slightly incised. **Female ovipositor** moderately long and slightly sclerotized; with distinct styli near apices.

Specimens examined

GB: 144 ex, San 163, Maheul-ri, Muan-myeon, Miryang-si, 5.x.2016, Seunghyun Lee (SNU); 4exx, 823, Hwabong-ri, Muanmyeon, Miryang-si, 5.x.2016, Seunghyun Lee (SNU).

Distribution

Origin: Afrotropical Region

Introductions: Australian region, Nearctic region, Oriental region, Palearctic region

Remarks

Aethina tumida Murray (small hive beetle, SHB) originated in sub-Saharan Africa but has rapidly spread into many parts of the world since the mid 1990s. In Korea, this species was first recorded in Milyang during 2016 (Lee et al., 2017). After that, SHB was also found in Gyoungnam province and Gangwon province in 2017. Most specimens were found in European honeybee (*Apis mellifera*) hives.

Subgenus *Circopes* Reitter, 1873: 79

Type species *Pocadius subquodratu* Motschulsky, 1858

Aethina (Circopes) suturalis Reitter, 1884 갈색꼬마밀빠진벌레(개칭)

Aethina suturalis Reitter, 1884: 266

Specimens examined

Specimens of this species were not available for study.

Distribution

Korea, China, Russia, Japan

Remarks

This species has been commonly found on various flowers. Specimens were also attracted to benzyl acetate and methyl phenylacetate traps (S.-T. Hisamatsu 2014).

Genus *Atarphia* Reitter, 1884: 260 긴다리밀빠진벌레속 (신칭)

Type species *Atarphia fasciculata* Reitter, 1884

Key to Korean *Atarphia* species

- Body unicolored, almost black, with tubercles; Elytra pubescence, partially setae bundled.....*Atarphia fasciculata*
- Body bicolored, with pale spots on elytra, without tubercles; Elytral setae without bundled.....*Atarphia quadripunctata*

***Atarphia fasciculata* Reitter, 1884 공보긴다리밀빠진벌레 (신칭)**

Atarphia fasciculata Reitter, 1884: 263

Redescription

Length 3.2 – 5.5 mm. **Body** moderately convex and ovate; mostly black; covered with yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral side same colored. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, almost 2 times longer than pedicel; antennal club blackish brown, compact, ovate, moderately flattened, almost symmetrical, 1/3.5 of total length and 1.4 times longer than wide. **Pronotum** moderately convex, quadrate,

wider than long (W:L = 2.2:1); anterior margin moderately concave; posterior margin weakly undulate; lateral margins arciform, narrowed anteriorly; with circular, irregularly dense punctures. **Scutellum** transverse; subtriangular, apical margin moderately rounded, densely punctate. **Elytra** unicolored; subrectangular; strongly narrowed posteriorly, somewhat rounded; tubercles; with yellowish or dark pubescence, partially setae bundled; with circular, irregularly dense punctures; sutural stria absent; elytra covering entire abdomen include pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum same colored, pubescence relatively less dense than on other ventral surfaces, sparsely punctate; prosternal process weakly dilated at apex, apical margin moderately rounded. **Mesosternum** sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line almost complete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region weakly expanded, lateral margin weakly crenulate, w without sexual dimorphism; mesotibia weakly curved; metatibia almost rectilinear, 2-times longer than metatarsi; femur unicolored, posterior margin of mesofemur without prominent tooth. **Male genitalia** not available for study. **Female ovipositor** moderately long and slightly sclerotized; with distinct styli near apices.

Specimens examined

GG: 1ex, Jikdong 2-gil, Soheul-eup, Pocheon-si, 06.viii.2008, T.S. Kwon (KNA).

Distribution

Korea, China, Russia, Japan

Remarks

This species has been found on Aphyllophorales, shelf/bracket fungi (Jeli'nek, et al., 2010).

***Atarphia quadripunctata* Reitter, 1884** 낙점긴다리밀빠진벌레

Atarphia quadripunctata Reitter, 1884: 263

Redescription

Length 3.2 – 4.6 mm. **Body** moderately convex and ovate; mostly blackish brown; lateral margin of pronotum, legs, antennae, and lateral margin of elytra more brightly colored; covered with yellowish or dark pubescence; pronotum and elytral margins weakly fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, almost parallel sided; labrum normal length, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, almost 2 times longer than pedicel; antennal club yellowish brown, weakly compact, ovate, moderately flattened, almost symmetrical, 1/3.5 of total length and 1.4 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L = 1.9:1);

anterior margin moderately concave; posterior margin almost rectilinear; lateral margins arciform, narrowed anteriorly; with dense, circular punctures. **Scutellum** transverse; subtriangular, apical margin moderately rounded, densely punctate. **Elytra** bicolored; subrectangular; strongly narrowed posteriorly, somewhat rounded; with 4-6 pale spots; not tubercles; with yellowish or dark pubescence, without bundles of setae; with circular, irregularly dense punctures; sutural stria absent; elytra covering entire abdomen include pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence relatively less dense than on other ventral surfaces, sparsely punctate; prosternal process dilated at apex, apical margin broadly V-shaped. **Mesosternum** sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line almost complete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin not crenulate, without sexual dimorphism; mesotibia moderately curved; metatibia almost rectilinear, 2-times longer than metatarsi; femur unicolored, posterior margin of mesofemur with acute tooth on proximal half. **Male genitalia** not available for study. **Female ovipositor** moderate in length and slightly sclerotized; without distinct styli near apex.

Specimens examined

GW: 2exx, Daegwanryeong-myeon, Pyeongchang-gun, 5.vii.2015, Jinbae Seung (SNU); 1ex, Osaek-ri, Seo-myeon, Yangyang-gun, 08.v.2018 – 23.v.2018, Flight Intercept Trap, Min Hyeuk Lee (SNU).

US: 1ex, Mt. Gaji, Doukhyeon-ri, Sangbuk-myeon, Ulju-gun, 28.iv.2009 – 3.vi.2009, Malaise trap, KG Kim (NIBR); 1 ex, Mt. Sinbul, Icheon-ri, Sangbuk-myeon, Ulju-gun, 28.iv.2009 – 3.vi.2009, Malaise trap, KG Kim (NIBR).

Distribution

Korea, China, Russia, Japan

Remarks

This species has been found on Aphyllophorales, shelf/bracket fungi (Jeli'nek, et al., 2010).

Genus *Hebasculinus* Kirejtshuk, 1992: 195 먹둥글밀빠진벌레속 (신칭)

Type species *Hebascus hilleri* Reitter, 1877

***Hebasculinus japonus* (Reitter, 1877) 먹둥글밀빠진벌레 (신칭)**

Hebascus japonus Reitter, 1877: 372

Hebascus hilleri Reitter, 1877: 373

Redescription

Length 2.3 – 3.9 mm. **Body** strongly convex and oval; mostly glossy black; lateral margin of pronotum, legs, antennomeres 1-8 more brightly colored; covered with

long yellowish or dark setae; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, paralleled; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; antennomere 8 flattened; antennal club blackish brown, weakly compact, ovate, moderately flattened, almost symmetrical, 1/2.7 of total length and 1.6 times longer than wide. **Pronotum** strongly convex, quadrate, wider than long (W:L = 2.2:1); anterior and posterior margin rectilinear; middle area of posterior margin convexed as long as scutellum; lateral margins arciform, narrowed anteriorly; with circular, irregularly dense punctures. **Scutellum** transverse; subtriangular, apical margin rounded, densely punctate. **Elytra** unicolored; subrectangular; narrower posteriorly, somewhat rounded; with circular, irregularly dense punctures; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum similar in color, pubescence relatively less dense than on other ventral surfaces, sparsely punctate; prosternal process moderately dilated at apex, apical margin rounded rectilinear. **Mesosternum** depressed between apex of prosternal process and metasternum; without punctures; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer

than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical 2/3 region expanded, lateral margin crenulate, without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored. **Male genitalia** well-sclerotized. Tegmen thumb-like shaped; longer than wide ($W:L = 1:1.97$ / without ring); gradually narrowed toward apex, comparatively long hairs densely distributed middle area. Penis trunk rectangular, approximately 1.57 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GG: 10exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 12.vii.2018, Min Hyeuk Lee (SNU).

JJ: 3exx, Hwasun-ri, Andeok-myeon, Seogwipo-si, 07.ix.2015, Seunghyun Lee (SNU); 30exx, Gyora-ri, Jocheon-eup, Jeju-si, 04.vii.2017, Min Hyeuk Lee (SNU); 10exx, Hawon-dong, Seogwipo-si, 05.vii.2017, Jinbae Seung (SNU); 2exx, Gyora-ri, Jocheon-eup, Jeju-si, 17.v.2018, Jinbae Seung (SNU).

Distribution

Korea, Russia, Japan

Remarks

Most specimens were found on dead tree trunks on shelf fungi.

Genus *Physoronia* Reitter, 1884: 260

Type species *Physoronia explanata* Reitter, 1884

Subgenus *Pocadiodes* Ganglbauer, 1899: 543

Type species *Pocadius wajdelola* Wankowicz, 1869

***Physoronia (Pocadiodes) japonica* (Reitter, 1873) 단색밑빠진벌레 (개칭)**

Pocadius japonica Reitter, 1873: 94

Pocadius rufimargo Reitter, 1884: 267

Pocadius unicolor Reitter, 1884: 267

Redescription

Length 3.1 – 5.1 mm. **Body** moderately convex and oval; mostly blackish brown; lateral margin of pronotum, antennomeres 1-6 more brightly colored; covered with yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal grooves distinct, convergent; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; antennomere 8 flattened; antennal club blackish brown, weakly compact, ovate, moderately flattened, almost symmetrical, 1/3.2 of total length and 1.35 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L =

2.3:1); anterior margin weakly concave; posterior margin weakly undulate; lateral margins arciform, narrowed anteriorly; with circular, irregularly dense punctures. **Scutellum** transverse; subtriangular, apical margin rounded, densely punctate. **Elytra** unicolored; subrectangular; narrower posteriorly, somewhat rounded; with circular, irregularly dense punctures; with pale pubescence, rows of elytral setae present; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum more brightly colored, pubescence almost absent, sparsely punctate; prosternal process moderately dilated at apex, apical margin acuminate. **Mesosternum** weakly depressed between apex of prosternal process and metasternum; sparsely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial lateral margin arciform, crenulate; without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide (W:L = 1:2.5 / without ring); gradually narrowed toward apex, rounded apically; extremely short hairs densely distributed lateral sides. Penis trunk almost hexagonal with apex gradually protruding toward center, slightly projecting (Fig. 26, 27). **Female ovipositor** not available for study.

Specimens examined

CB: 1ex, Jeosuryeong, Daegang-myeon, Danyang-gun, ?.viii.2007, T.S.Kwon (KNA).

GW: 2exx, Dongsan-ri, Jinbu-myeon, Pyeongchang-gun, 31.vii.2012 – 30.viii.2012, Flight Intercept Trap, S.J. Park & I.J.Huh (NIBR); 1ex, MT. Odae, Dongsan-ri, Jinbu-myeon, Pyeongchang-gun, 30.viii.2012 – 25.ix.2012, Flight Intercept Trap, S.J. Park & I.J.Huh (NIBR).

Distribution

Korea, Russia, Japan

Remarks

This species is known from epigeous Gasteromycetes (Lycoperdaceae: *Lycoperdon*, *Calvatia*, *Bovista*), plate-like fungi, both woody and mycorrhizal (Kirejtshuk, 1992) and hypogean fungi (Kirejtshuk & Leschen, 1998; Cline, 2008; Jeli'nek, et al., 2010).

Genus *Pocadites* Reitter, 1884: 264 잔털밑빠진벌레속 (신칭)

Type species *Stelidota dilatimana* Reitter, 1877

Key to Korean *Pocadites* species

- Dorsal surface covered with whitish and dark setae.....*Pocadites dilatimanus*
- Dorsal surface covered with mostly dark setae*Pocadites rufobasalis*

***Pocadites dilatimanus* (Reitter, 1877) 네점잔털밀빠진벌레**

Stelidota dilatimanus Reitter, 1877: 110

Pocadites dorsiger Reitter, 1884: 267

Redescription

Length 2.9 – 4.4 mm. **Body** convex and oval; bicolor, reddish brown to almost black; lateral margin of pronotum, antennomeres 1-7, legs more brightly colored; covered with dark or whitish pubescence; pronotum and elytral margins fimbriate; ventral surface more brightly colored. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, paralleled; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally; antennomere 8 flattened into disclike structure; antennal club blackish brown, compact, oval, moderately flattened, almost symmetrical, 1/3 of total length and 1.5 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L = 2.3:1); anterior and posterior margin weakly undulate, middle area of posterior margin convexed wider than scutellum; lateral margins arciform, narrowed anteriorly; with dense, circular punctures. **Scutellum** transverse; subtriangular, apical margin strongly rounded, densely punctate. **Elytra** bicolored; subrectangular; narrower posteriorly, somewhat rounded; dense, circular punctures; 4 pale spots in anterior margin; with whitish setae in 3 parts (anterior, middle, 3/4 of posterior); sutural stria absent;

elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum similar in color, pubescence almost absent, densely punctate; prosternal process moderately dilated at apex, apical margin rounded rectilinear. **Mesosternum** weakly depressed between apex of prosternal process and metasternum; without punctures; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2 times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae sparsely, tarsal claws simple; protibia subtriangular, apical 2/3 region expanded, lateral margin crenulate; without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide ($W:L = 1:2$ / without ring); slightly narrowed toward apex, rounded apically; without setae. Penis trunk almost hexagonal with apex gradually protruding, slightly projecting medially at apex (Fig. 26, 27). **Female ovipositor** moderately long and slightly sclerotized; without distinct styli near apices.

Specimens examined

JJ: 5^{exx}, Hawon-dong, Seogwipo-si, 05.vii.2017, Jinbae Seung (SNU); 2^{exx}, Gyora-ri, Jocheon-eup, Jeju-si, 17.v.2018, Jinbae Seung (SNU).

GW: 1^{ex}, Gwidun-ri, Inje-eup, Inje-gun, 09.v.2018 – 23.v.2018, Flight Intercept Trap, Min Hyeuk Lee (SNU).

GG: 1ex, Jikdong-ri, Soheul-eup, Pocheon-si, 16.vi.2005, T.S. Kwon (KNA).

Distribution

Korea, Russia, Japan

Remarks

Most specimens were found on dead tree trunks or various mushrooms.

***Pocadites rufobasalis* Reitter, 1884 큰잔털밑빠진벌레**

Pocadites rufobasalis Reitter, 1884: 267

Redescription

Length 3.8 – 5.2 mm. **Body** convex and oval; bicolor, reddish brown to almost black; antennomeres 1-7, legs more brightly colored; covered with dark or yellowish pubescence; pronotum and elytral margins fimbriate; ventral surface same colored. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, paralleled; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally; antennomere 8 flattened into disclike structure; antennal club blackish brown, compact, oval, moderately flattened, almost symmetrical, 1/2.7 of total length and 1.6 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L = 2.2:1); anterior and posterior margin weakly undulate, middle area of posterior margin convexed wider than scutellum; lateral margins

arciform, narrowed anteriorly; with dense, circular punctures. **Scutellum** transverse; subtriangular, apical margin strongly rounded, densely punctate. **Elytra** bicolored; subrectangular; narrower posteriorly, somewhat rounded; dense, circular punctures; pale maculae in both side of anterior margin; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum similar in color, pubescence almost absent, densely punctate; prosternal process moderately dilated at apex, apical margin rounded rectilinear. **Mesosternum** weakly depressed between apex of prosternal process and metasternum; without punctures; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line complete. **Abdomen** densely punctate; first abdominal sternite 2 times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae sparsely, tarsal claws simple; protibia subtriangular, apical 3/4 region expanded, lateral margin crenulate; without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide ($W:L = 1:1.8$ / without ring); slightly narrowed toward apex, rounded apically; without setae. Penis trunk almost thumb-shaped with apex gradually protruding. **Female ovipositor** not available for study.

Specimens examined

JJ: 1ex, Hwasun-ri, Andeok-myeon, Seogwipo-si, 17.v.2018-30.vi.2018, Flight Intercept Trap, Jinbae Seung (SNU).

Distribution

Korea, Russia, Japan

Remarks

Only one specimen found on Flight Intercept Trap in Jeju Island.

Genus *Pocadius* Erichson, 1843: 3184

Type species *Nitidula ferruginea* Fabricius, 1775

Holopterus Gistel, 1856: 361 Type species *Nitidula ferruginea* Fabricius, 1775

Pocadius nobilis Reitter, 1873 황갈색밀빠진벌레 (개칭)

Pocadius nobilis Reitter, 1873: 95

Pocadius yunnanensis Grouvelle, 1910: 251

Redescription

Length 2.9 – 3.7 mm. **Body** convex and oval; bicolor, reddish brown to almost black; antennal club, temples of head, pronotal disc from apex to base, scutellum, lateral region of elytra more dark colored; covered with yellowish pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with dense, circular punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, deep and somewhat curved posteriomediaally; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate

and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally, 2 times longer than pedicel; antennomere 8 strongly flattened into disclike structure; antennal club blackish brown, compact, oval, moderately flattened, almost symmetrical, 1/2.5 of total length and 1.6 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L = 2.3:1); anterior margin broadly shallowly concave; posterior margin weakly undulate; lateral margins rounded, narrowed anteriorly; with circular, irregularly dense punctures. **Scutellum** large, transverse; subtriangular, apical margin rounded, sparsely punctate. **Elytra** bicolored; subrectangular; narrower posteriorly, somewhat rounded; distinctly punctate-striate, with alternating circular and tiny irregular punctures, each bearing a single seta; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum similar in color, pubescence relatively less dense than on other ventral surfaces, sparsely punctate; prosternal process moderately dilated at apex, apical margin rounded acuminate. **Mesosternum** weakly depressed between apex of prosternal process and metasternum; without punctures; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line incomplete. **Abdomen** densely punctate; first abdominal sternite 2.5 times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae sparsely, tarsal claws simple; protibia not expanded, lateral margin crenulate, without sexual dimorphism; mesotibia and

metatibia almost rectilinear; femur unicolored. **Male genitalia** and **Female ovipositor** as figured.

Specimens examined

GB: 1ex, Imgok-ri, Hwanam-myeon, Sangju-si 27.vii.2001, MH Kim (NIBR).

DJ: 2exx, Gung-dong, Yuseong-gu, 15.vii.2003, JH Choi (NIBR).

GW: 1ex, MT. Odae, Dongsan-ri, Jinbu-myeon, Pyeongchang-gun, 04.vii.2013 – 31.vii.2013, Flight Intercept Trap, S.J. Park & S.B. Oh (NIBR).

Distribution

Korea, Japan, China / Oriental region

Tribe Cychramini Lacordaire, 1854

Key to the Genera of Korean Cychramini

- Dorsal surface covered with monochromatic hairs; Antennal club loosened
.....*Cychramus*
- Dorsal surface covered with various color hairs; Antennal club compact
.....*Xenostrogylus*

Genus *Cychramus* Kugelann, 1794: 543 큰가슴밀빠진벌레속 (신칭)

Type species *Strongylus quadripunctatus* Herbst, 1792

Campta Stephens, 1830:44 Type species *Sphaeridium luteum* Fabricius, 1787

Key to the species of Korean *Cychramus*

- Elytra unicolored *Cychramus luteus*
- Elytra bicolored *Cychramus variegatus*

Cychramus luteus (Fabricius, 1787) 큰가슴밀빠진벌레 (개칭)

Sphaeridium luteus Fabricius, 1787: 378

Cychramus alutaceus Reitter, 1875: 266

Cychramus dorsalis Reitter, 1884: 266

Cychramus floricola Reitter, 1884: 408

Cychramus fungicola Heer, 1841: 175

Nitidula latus Scriba, 1790: 1893

Cychramus mantandoni Pic, 1893: cclxxxviii

Cychramus pubescens Pic, 1894: 133

Cychramus subopacus Reitter, 1884: 266

Anthribus unicolor A. G. Olivier, 1790: 160

Nitidula verris P. Rossi, 1790: 60

Specimens examined

Russia: 2exx, Tver reg., Kimry distr., Schelkovo vill, 21.vi.2008, A.A. Azarov.

Korean fauna specimens not available for study.

Distribution

Korea, Russia, China, Japan, Mongolia, Turkey, Europe

Remarks

This species has been commonly found on various flowers (Jeli'nek, et al., 2010).

***Cychramus variegatus* (Herbst, 1792) 낙점큰가슴밀빠진벌레 (개칭)**

Strongylus variegatus Herbst, 1792: 184

Sphaeridium colon Fabricius, 1792: 78

Strongylus quadripunctatus Herbst, 1792: 185

Specimens examined

Russia: 2exx, Tver reg., Kimry distr., Schelkovo vill, 25-27.viii.2009, A.A. Azarov.

Korean fauna specimens not available for study.

Distribution

Korea, Russia, China, Japan, Europe

Remarks

This species has been found on various flowers (Kirejtshuk, 1992; Jeli'nek, et al., 2010).

Genus *Xenostromylus* Wollaston, 1854: 127

Type species *Xenostromylus histrio* Wollaston, 1854

Strongylodes Kirejtshuk, 1992: 196 Type species *Xenostromylus variegatus* Fairmaire, 1891

Strongylolasius Reitter, 1911: 26 Type species *Xenostromylus arcuatus* Liesenwetter, 1859

Xenostromylus variegatus Fairmaire, 1891 앞굴털밑빠진벌레 (신칭)

Xenostromylus variegatus Fairmaire, 1891: cxcii

Redescription

Length 2.2 – 2.8 mm. **Body** convex and oval; unicolor, mostly black color; antennae, legs more brightly colored; covered with dark, yellowish and whitish pubescence; pronotum and elytral margins fimbriate; ventral surface same colored. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, few subapical teeth present; antennal groove distinct, weakly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, yellowish brown, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming

an asymmetrical ellipse; pedicel small, shorter than antennomere 3; antennal club same colored, compact, oblong, moderately flattened, almost symmetrical, 1/3 of total length and 1.8 times longer than wide. **Pronotum** convex; somewhat transverse, hemispheric, wider than long ($W:L = 2:1$); anterior margin moderately concave; posterior margin almost rectilinear, not expanded in medial region; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; semicircular, apical margin strongly rounded, densely punctate; with whitish pubescence. **Elytra** unicolored; subrectangular; weakly narrowed posteriorly, somewhat rounded; smooth and glabrous, with dark, yellowish and whitish pubescence; with tiny, dense punctures, without punctate-striate; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, weakly explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; with dense, circular punctures; pale pubescence sparsely; proepisternum similar in color, pubescence absent, sparsely punctate; prosternal process dilated at apex, apical margin rectilinear. **Mesosternum** slightly concealed, depressed between apex of prosternal process and metasternum; without punctures; posterior margin extended between mesocoxae. **Metasternum** covered with long yellowish pubescence; protuberant; much wider than long; circular and with tiny, dense punctures; metasternal line absent. **Abdomen** densely punctate; covered with long yellowish pubescence; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws

simple; protibial apical region expanded, lateral margin crenulate, without sexual dimorphism; mesotibia subtriangular form; metatibia almost rectilinear; femur unicolored. **Genitalia** not available for study.

Specimens examined

GW: 1ex, 427 Jikjeon-ri, Sabuk-eup, Jeongseon-gun, 10.v.2018, Hodan Lee.

Distribution

Korea, China, Russia, Japan

Remarks

This species has been found on various flowers.

Tribe Cyllodini Everts, 1898

Key to the Genus of Korean Cyllodini

1. All tarsomeres 1-3 dilated *Cyllodes*
 - Hind tarsomeres 1-3 not dilated 2
2. Midtibia outer margin rectilinear *Neopallodes*
 - Midtibia outer margin arcuate form 3
3. Tip of female ovipositor pointed; Punctate-striate distinct *Pallodes*
 - Tip of female ovipositor blunts, almost rounded rectangular shape; punctate striate absent *Coxollodes*

Genus *Cyllodes* Erichson, 1843: 342 알버섯밑빠진벌레속 (신칭)

Type species *Strongylus ater* Herbst, 1792

Pseudocamptodes Grouvelle, 1896: 76 (Type species *Pseudoeamptodes africanus* Grouvelle, 1896)

Strongylus Herbst, 1792: 179 (Type species *Strongylus ater* Herbst, 1792)

Mecyllodes Sharp 1891: 357 (Type species: *Mecyllodes clavicornis* Sharp, 1891)

Key to the species of Korean *Cyllodes*

1. Elytra unicolored 2
 - Elytra bicolored 3
2. Body smaller, more chunky and oval *Cyllodes ater*

- Body larger, more slender..... *Cyllodes dubius*
- 3. Elytra with two reddish circular spots..... *Cyllodes bifascies*
- Elytra with 2-4 irregular maculae **4**
- 4. Body larger; pronotum with pale spots or pattern..... *Cyllodes literatus*
- Body smaller; pronotum unicolored *Cyllodes sp. nov.*

***Cyllodes ater* (Herbst, 1792) 검정알버섯밑빠진벌레 (개칭)**

Strongylus ater Herbst, 1792: 188

Strongylus aterrimus Reitter, 1879: 210

Sphaeridium glabratus Panzer, 1795: 26

Volvox morio Kugelann, 1794: 537

Cychramus tenebrio Gistel, 1857: 536

Pocadius tenebrio Gistel, 1857: 552

Agathidium wankowiczi Hochhut, 1872: 212

Redescription

Length 2.7 – 4.9 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly blackish color; tarsus and antennomeres 1-7 more brightly colored; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pale pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, few subapical teeth present; antennal groove distinct, convergent posteriorly; labrum short, medial anterior margin weakly incised.

Antennae 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; pedicel small, shorter than antennomere 3; antennal club blackish brown, loose, oblong, moderately flattened, almost symmetrical, 1/2.4 of total length and 1.9 times longer than wide.

Pronotum highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2.5:1); anterior margin moderately concave; posterior margin almost rectilinear, expanded in medial region wider than scutellum; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; semicircular, apical margin strongly rounded, densely punctate. **Elytra** unicolored; subrectangular; weakly narrowed posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, distinct punctate-striate; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura nearly as long as the width of mesotarsus.

Prosternum transverse; with dense, circular punctures; pale pubescence rarely; proepisternum similar in color, pubescence absent, sparsely punctate; prosternal process dilated at apex, apical margin rectilinear. **Mesosternum** concealed, strongly depressed between apex of prosternal process and metasternum; without punctures; posterior margin not extended between mesocoxae. **Metasternum** protuberant; much wider than long; circular and with tiny, dense punctures; metasternal line absent. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded,

lateral margin highly crenulate, without sexual dimorphism; mesotibia subtriangular form; metatibia almost rectilinear; femur unicolored. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide ($W:L = 1:2.24$ / without ring); narrowed toward apex, rounded apically; with long setae around apex to middle. Penis trunk oval, approximately 1.64 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GW: 6exx, Osaek-ri, Seo-myeon, Yangyang-gun, 19.vi.2018, Min Hyeuk Lee (SNU).

JJ: 10exx, Gyora-ri, Jocheon-eup, Jeju-si, 20.v.2017 – 05.vii.2017, Flight Intercept Trap, Min Hyeuk Lee (SNU).

Distribution

Korea, Russia, Japan, Turkey, Europe

Remarks

Most specimens were found on various mushrooms.

***Cyllodes bifascies* (Walker, 1859) 붉은점알버섯밑빠진벌레 (개칭)**

Tritoma bifascies Walker, 1859: 259

Strongylus binotatus Reitter, 1879: 217

Strongylus dorsalis Reitter, 1884: 268

Chilocorus opponens Walker, 1859: 219

Camptodes ornatus Motschulsky, 1863: 442

Strongylus notatus Reitter, 1873: 129

Redescription

Length 2.3 – 4.5 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly blackish with reddish pattern; legs and antennomeres 1-7 more brightly colored; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface reddish brown, pale pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; posterior half reddish-orange colored; with tiny, dense punctures; mandibles moderately developed with acute apices, few subapical teeth present; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; pedicel small, shorter than antennomere 3; antennal club blackish brown, apex of terminal segment yellow, loose, oblong, moderately flattened, mostly asymmetrical, 1/2.3 of total length and 2.3 times longer than wide. **Pronotum** bicolored, reddish-orange spots on lateral posterior region; highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2.6:1); anterior margin moderately concave; posterior margin almost rectilinear, expanded in medial region wider than scutellum; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; semicircular, apical margin rounded, densely punctate. **Elytra** subrectangular; bicolored, reddish circular pattern on medially; weakly narrowed posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures; sutural stria absent; elytra covering entire abdomen except apex of

pygidium; lateral margins rounded, not explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; with dense, circular punctures; proepisternum similar in color, pubescence absent, sparsely punctate; prosternal process weakly dilated at apex, apical margin moderately rounded. **Mesosternum** concealed, strongly depressed between apex of prosternal process and metasternum; without punctures; posterior margin not extended between mesocoxae. **Metasternum** protuberant; much wider than long; circular and with tiny, dense punctures; metasternal line absent. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae densely, tarsomeres 4 minute, tarsal claws simple; tibia wide and flat, lateral margin highly crenulate, without sexual dimorphism; femur unicolored; wide and flat, widest near middle. **Male genitalia** well-sclerotized. Tegmen almost bullet-shaped; longer than wide ($W:L = 1:2$ / without ring); narrowed toward apex, pointed apically; with long setae around apex. Penis trunk subrectangular-shaped, approximately 1.7 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GG: 3exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 12.vii.2018, Min Hyeuk Lee (SNU).

GW: 4exx, Osaek-ri, Seo-myeon, Yangyang-gun, 19.vi.2018, Min Hyeuk Lee (SNU).

JJ: 20exx, Hwasun-ri, Andeok-myeon, Seogwipo-si, 05.vii.2017, Min Hyeuk Lee

(SNU); 2exx, Gyorae-ri, Jocheon-eup, Jeju-si, 17.v.2018, Jinbae Seung (SNU).

Distribution

Korea, Japan, Russia, Taiwan

Remarks

Most specimens were found on various mushrooms.

***Cyllodes dubius* (Reitter, 1877) 큰검정알버섯밑빠진벌레 (개칭)**

Strongylus dubius Reitter, 1877: 374

Redescription

Length 3.9 - 6.2 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly dark color, with oily iridescence; tarsus and antennomeres 1-8 more brightly colored; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pale pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, few subapical teeth present; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; pedicel small, shorter than antennomere 3; antennal club blackish brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.5 of total length and 2.4 times longer than wide. **Pronotum** highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2.5:1); anterior

margin moderately concave; posterior margin almost rectilinear, expanded in medial region wider than scutellum; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** unicolored; subrectangular; weakly narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, distinctly punctate-striate; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; with dense, circular punctures; pale pubescence rarely; proepisternum similar in color, pubescence absent, sparsely punctate; prosternal process dilated at apex, apical margin rectilinear. **Mesosternum** concealed, strongly depressed between apex of prosternal process and metasternum; without punctures; posterior margin not extended between mesocoxae. **Metasternum** protuberant; much wider than long; circular and with tiny, dense punctures; metasternal line absent. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin highly crenulate, without sexual dimorphism; mesotibia subtriangular form; metatibia almost rectilinear; femur unicolored, wide and flat, widest near middle. **Male genitalia** well-sclerotized. Tegmen short bullet-shaped; slightly longer than wide ($W:L = 1:1.3$ / without ring); narrowed toward apex, rounded apically; with short setae around apex. Penis trunk oval, approximately 1.5 times

longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GW: 8exx, Osaek-ri, Seo-myeon, Yangyang-gun, 19.vi.2018, Min Hyeuk Lee (SNU).

JJ: 12exx, Gyorae-ri, Jocheon-eup, Jeju-si, 20.v.2017 – 05.vii.2017, Flight Intercept Trap, Min Hyeuk Lee (SNU); 20exx, Gyorae-ri, Jocheon-eup, Jeju-si, 17.v.2018, Jinbae Seung (SNU).

Distribution

Korea, Russia, Japan

Remarks

Most specimens were found on various mushrooms.

***Cyllodes literatus* (Reitter, 1878) 무늬알버섯밑빠진벌레 (개칭)**

Strongylus literatus Reitter, 1878: 89

Redescription

Length 3.2 – 4.5 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly dark color, with yellowish pattern; legs and antennomeres 1-8 yellowish colored; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface bright yellowish colored, pale pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised.

Antennae 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, 2 times longer than pedicel; pedicel small, shorter than antennomere 3; antennal club dark brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.6 of total length and 2 times longer than wide. **Pronotum** bicolored, mostly dark color, with two yellowish maculae medially; highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2.6:1); anterior margin moderately concave; posterior margin almost rectilinear, expanded in medial region wider than scutellum; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** bicolored, with 2-4 irregular yellowish patters; subrectangular; weakly narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, without punctate striae; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; with dense, circular punctures; pubescence absent; proepisternum similar in color, pubescence absent, sparsely punctate; prosternal process dilated at apex, apical margin somewhat rounded. **Mesosternum** concealed, strongly depressed between apex of prosternal process and metasternum; without punctures; posterior margin not extended between mesocoxae. **Metasternum** protuberant; much wider than long; circular and with tiny, dense punctures; metasternal line absent. **Abdomen** densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with

yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin highly crenulate, without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored, wide and flat, widest near middle.

Male genitalia well-sclerotized. Tegmen short subrectangular-shaped; slightly longer than wide ($W:L = 1:1.5$ / without ring); narrowed toward $2/3$ of apex; with long setae both side of apex to middle. Penis trunk hexagonal-shaped, approximately 1.9 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GW: 2exx, Hoenggye-ri, Daegwallyeong-myeon, Pyeongchang-gun, 29.vi.2017 – 19.vii.2017, Flight Intercept Trap, Min Hyeuk Lee (SNU); 8exx, Osaek-ri, Seomyeon, Yangyang-gun, 19.vi.2018, Min Hyeuk Lee (SNU).

Distribution

Korea, Japan, Russia, Taiwan

Remarks

Most specimens were found on various mushrooms.

***Cyllodes* sp. nov.** 붉은무늬알버섯밑빠진벌레 (신칭)

Redescription

Length 2.9 – 3.0 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly dark color, with reddish pattern; tarsi and antennomeres 1-8

more bright colored; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface dark colored, pale pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; pedicel not small, slightly shorter than antennomere 3; antennal club dark brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.5 of total length and 2 times longer than wide. **Pronotum** unicolored, mostly dark color; highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2.7:1); anterior margin moderately concave; posterior margin almost rectilinear, expanded in medial region wider than scutellum; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** bicolored, with 4 irregular reddish patterns; subrectangular; weakly narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, without punctate striae; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; with dense, circular punctures; pubescence absent; proepisternum similar in color, pubescence absent, sparsely punctate; prosternal process dilated at apex, apical margin somewhat rounded. **Mesosternum** concealed, strongly depressed between apex of prosternal process and metasternum; without punctures;

posterior margin not extended between mesocoxae. **Metasternum** protuberant; much wider than long; circular and with tiny, dense punctures; metasternal line absent. Abdomen densely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 strongly dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple; protibial apical region expanded, lateral margin highly crenulate, without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored, wide and flat, widest near middle. **Male genitalia** well-sclerotized. Tegmen short bullet-shaped; slightly longer than wide ($W:L = 1:1.5$ / without ring); narrowed toward apex, rounded apically; with short setae around apex. Penis trunk oval, approximately 1.4 times longer than wide not including spiculum. Female ovipositor as figured.

Specimens examined

GW: 1ex, Yeongheung-ri, Yeongwol-eup, Yeongwol-gun, 19.vi.2015 – 3.vii.2015, FLIGHT INTERCEPT TRAP, J.B. Seung & S.H. Lee (SNU); 1ex Yeongheung-ri, Yeongwol-eup, Yeongwol-gun, 4.vii.2015 – 17.vii.2015, FLIGHT INTERCEPT TRAP, J.B. Seung & S.H. Lee (SNU); 1ex, Beopheung-ro, Mureungdowon-myeon, Yeongwol-gun, 5.vi.2015 – 18.vi.2015, FLIGHT INTERCEPT TRAP, J.B. Seung & S.H. Lee (SNU).

Distribution

Korea

Remarks

Most specimens were mainly collected by flight intercept traps

Genus *Pallodes* Erichson, 1843: 348

Type species *Strongylus annulifer* Laporte, 1840

Key to the species of Korean *Pallodes*

- Metasternal transverse suture absent *Pallodes umbratilis*
- Metasternal transverse suture distinct..... *Pallodes* sp. nov.

Pallodes umbratilis Reitter, 1873 버섯밑빠진벌레

Pallodes umbratilis Reitter, 1873: 134

Redescription

Length 2.7 – 4.0 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly reddish-brown color; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pale pubescence rarely.

Head prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; pedicel moderate, longer than antennomere 3; antennal club yellowish brown, loosened, oblong, moderately flattened, almost symmetrical, 1/3 of total length and 2 times longer than wide. **Pronotum** highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2:1); anterior margin moderately

concave; posterior margin slightly rounded rectilinear, not expanded in medial region; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** large; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** unicolored; subrectangular; narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, distinctly punctate-striate; sutural stria distinct; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura shorter than width of mesotarsus. **Prosternum** transverse; without punctures; pubescence almost absent; proepisternum similar in color, pubescence absent, without punctures; prosternal process dilated to apex, apical margin rounded form. **Mesosternum** concealed, depressed between apex of prosternal process and metasternum; without punctures; posterior margin extended between mesocoxae. **Metasternum** much wider than long; rarely with tiny, circular punctures; metasternal transverse suture absent. **Abdomen** rarely punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence rarely; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple, metatarsus elongated almost same length of metatibia; protibial apical region not expanded, lateral margin highly crenulate, without sexual dimorphism; mesotibia outer margin arcuate form; metatibia almost rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; longer than wide ($W:L = 1:2.6$ / without ring); narrowed to apical $1/2$, rounded apically; with long setae around apex to middle. Penis trunk hexagonal-shaped, approximately 1.8

times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GG: 6exx, Mt. Yongam, Yongam-ri, Byeolnae-myeon, Namyangju-si, 24.viii.2014, Seunghyun Lee (SNU); 30exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 12.vii.2018, Min Hyeuk Lee (SNU).

Distribution

Korea, Japan, Russia

Remarks

Most specimens were found on various mushrooms.

***Pallodes* sp. nov. 닭은버섯밑빠진벌레 (신칭)**

Length 3.2 – 3.6 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly yellowish or reddish-brown color; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pale pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; pedicel moderate, longer than antennomere 3; antennal club yellowish brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.8 of total length and 2.2 times longer than wide. **Pronotum** highly convex;

somewhat transverse, hemispheric, wider than long ($W:L = 2:1$); anterior margin moderately concave; posterior margin slightly rounded rectilinear, not expanded in medial region; lateral margins rounded, strongly narrowed anteriorly; with tiny, dense punctures. **Scutellum** large; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** unicolored; subrectangular; narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, distinctly punctate-striate; sutural stria distinct; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura shorter than width of mesotarsus. **Prosternum** transverse; without punctures; pubescence almost absent; proepisternum similar in color, pubescence absent, without punctures; prosternal process dilated to apex, apical margin rounded form. **Mesosternum** concealed, depressed between apex of prosternal process and metasternum; without punctures; posterior margin extended between mesocoxae. **Metasternum** much wider than long; rarely with tiny, circular punctures; metasternal transverse suture distinct. **Abdomen** moderate punctate; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence rarely; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple, metatarsus elongated almost same length of metatibia; protibial apical region not expanded, lateral margin highly crenulate, without sexual dimorphism; mesotibia outer margin arcuate form; metatibia almost rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen bullet-shaped; longer than wide ($W:L = 1:2.6$ / without ring); rounded apically; with long setae around apex to

middle. Penis trunk bullet-shaped, approximately 2.1 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GW: 30exx, Yongdae-ri, Buk-myeon, Inje-gun, 04.vii.2018, Jinbae Seung (SNU).

JN: 8exx, Haedong-ri, Yaksan-myeon, Wando-gun, 23.viii.2017, Min Hyeuk Lee (SNU).

Distribution

Korea

Remarks

Most specimens were found on various mushrooms.

Genus *Coxollodes* Kirejtshuk, 1987: 168 꼬마버섯밑빠진벌레속 (신칭)

Type species *Pallodes cyrtusoides* Reitter, 1884

***Coxollodes cyrtusoides* (Reitter, 1884) 꼬마버섯밑빠진벌레**

Pallodes cyrtusoides Reitter, 1884: 269

Redescription

Length 1.9 – 2.5 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly yellowish brown color; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pubescence rarely.

Head prognathous, deflexed, transverse, wider than long; with tiny, dense punctures;

mandibles moderately developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; pedicel moderate, longer than antennomere 3; antennal club yellowish brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.5 of total length and 1.8 times longer than wide. **Pronotum** highly convex; somewhat transverse, hemispheric, wider than long ($W:L = 1.7:1$); anterior margin moderately concave; posterior margin broadly rounded, not expanded in medial region; lateral margins rounded, narrowed anteriorly; with tiny, dense punctures. **Scutellum** large; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** unicolored; subrectangular; narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, without punctures-striate; sutural stria distinct; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura shorter than width of mesotarsus. **Prosternum** short, transverse; without punctures; pubescence absent; proepisternum similar in color, pubescence absent, without punctation; prosternal process dilated to apex, apical margin rounded form. **Mesosternum** concealed, depressed between apex of prosternal process and metasternum; without punctures; posterior margin extended between mesocoxae. **Metasternum** much wider than long; circular and tiny punctate rarely; metasternal line incomplete. **Abdomen** rarely punctate; first abdominal sternite 3-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** rarely covered with yellowish

pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple, metatarsus elongate, almost same length of metatibia; protibial apical region not expanded, lateral margin highly crenulate, without sexual dimorphism; mesotibia outer margin arcuate; metatibia almost rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen longer than wide (W:L = 1:2.5 / without ring); narrowed toward apex, rounded apically; without setae. Penis trunk bullet-shaped, approximately 1.8 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GG: 20exx, Yongam-ri, Byeollae-myeon, Namyangju-si, 12.vii.2018, Min Hyeuk Lee (SNU).

GW: 1ex, Seorim valley, Seorim-ri, Seo-myeon, Yangyang-gun, 05.vii,2018, Jinbae Seung (SNU).

DJ: 5exx, Gung-dong, Yuseong-gu, 16.vi.2010 S.G.Lee (NIBR).

Distribution

Korea, Japan, Russia, Taiwan

Remarks

Most specimens were found on various mushrooms.

Genus *Neopallodes* Reitter, 1884: 264

Type species *Pallodes hilleri* Reitter, 1877

Key to the species of Korean *Neopallodes*

- Dorsal surface bicolored.....*Neopallodes omogonis*
- Dorsal surface unicolored.....*Neopallodes vicinus*

Neopallodes omogonis Hisamatsu, 1953 무늬버섯밑빠진벌레

Neopallodes omogonis Hisamatsu, 1953: 141

Redescription

Length 2.5 – 3.7 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly yellowish brown or dark color; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pubescence rarely.

Head prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, moderately convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse; pedicel moderate, longer than antennomere 3; antennal club dark brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.3 of total length and 1.8 times longer than wide. **Pronotum** bicolored mostly yellowish brown color, with two dark maculae or single large pattern in middle; highly convex; somewhat transverse, hemispheric, wider than long (W:L = 2:1); anterior margin concave, posterior margin moderately undulate; posterior margin expanded in medial region;

lateral margins rounded, narrowed anteriorly; with tiny, dense punctures. **Scutellum** large; subtriangular; apical margin rounded acuminate; densely punctate. **Elytra** bicolored mostly yellowish brown or dark color; subrectangular; narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, punctures-striate distinct; sutural stria present; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura shorter than width of mesotarsus. **Prosternum** short, transverse; with circular, dense punctures; pubescence absent; proepisternum similar in color, pubescence absent, with circular, rarely punctures; prosternal process dilated to apex, apical margin rounded form. **Mesosternum** slightly concealed, depressed between apex of prosternal process and metasternum; with circular, dense punctures; posterior margin extended between mesocoxae. **Metasternum** much wider than long; with circular or tiny, dense punctures; metasternal line absent. **Abdomen** with circular, dense punctures; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple, metatarsus elongate, almost same length of metatibia; protibial apical region not expanded, lateral margin highly crenulate, without sexual dimorphism; meso- and metatibia outer margin almost rectilinear; femur simple and unicolored. **Male genitalia** well-sclerotized. Tegmen longer than wide ($W:L = 1:2.3$ / without ring); narrowed toward apex, rounded apically; with short setae around the apex. Penis trunk bullet-shaped, approximately 1.8 times longer than wide not including spiculum. **Female ovipositor** as figured.

Specimens examined

GG: 2exx, Mt. Yongam, Yongam-ri, Byeolnae-myeon, Namyangju-si, 24.viii.2014, Seunghyun Lee (SNU).

GW: 3exx, Osaek-ri, Seo-myeon, Yangyang-gun, 19.vi.2018, Min Hyeuk Lee (SNU); 20exx, Yongdae-ri, Buk-myeon, Inje-gun, 04.vii.2018, Jinbae Seung (SNU).

JJ: 1ex, Aewol-eup, Jeju-si, 27.vii.1990, M.T.Chujo (NIBR).

Distribution

Korea, Japan

Remarks

Most specimens were found on various mushrooms.

***Neopallodes vicinus* Grouvelle, 1892 민무늬버섯밑빠진벌레 (신칭)**

Neopallodes vicinus Grouvelle, 1892:850

Redescription

Length 2.3 – 3.0 mm. **Body** highly convex dorsally and oval; dorsal surface smooth and glabrous; mostly reddish brown color; pubescence absent; pronotum and elytral margins not fimbriate; ventral surface similar in color, pubescence rarely. **Head** prognathous, deflexed, transverse, wider than long; with tiny, dense punctures; mandibles moderately developed with acute apices, 1-2 subapical teeth present; antennal groove distinct, slightly convergent posteriorly; labrum short, medial anterior margin weakly incised. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical

ellipse; pedicel moderate, longer than antennomere 3; antennal club dark brown, loosened, oblong, moderately flattened, almost symmetrical, 1/2.3 of total length and 2.2 times longer than wide. **Pronotum** unicolored; highly convex; somewhat transverse, hemispheric, wider than long ($W:L = 2.6:1$); anterior margin concave, posterior margin moderately undulate; posterior margin expanded in medial region; lateral margins rounded, narrowed anteriorly; with tiny, dense punctures. **Scutellum** large; corrugated trapezoid; apical margin broadly rounded; with tiny, dense punctures. **Elytra** unicolored; subrectangular; narrower posteriorly, somewhat rounded; smooth and glabrous, without pubescence; with tiny, dense punctures, punctures-striate distinct; sutural stria present; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, not explanate; epipleura shorter than width of mesotarsus. **Prosternum** short, transverse; with circular, dense punctures; pubescence absent; proepisternum similar in color, pubescence absent, with circular, rarely punctures; prosternal process dilated to apex, apical margin rounded form. **Mesosternum** slightly concealed, depressed between apex of prosternal process and metasternum; with circular, dense punctures; posterior margin extended between mesocoxae. **Metasternum** much wider than long; with circular or tiny, dense punctures; metasternal line absent. **Abdomen** with circular, dense punctures; first abdominal sternite 2-times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsomeres 4 minute, tarsal claws simple, metatarsus elongate, almost same length of metatibia; protibial apical region not expanded, lateral margin highly crenulate, without sexual

dimorphism; meso- and metatibia outer margin almost rectilinear; femur simple and unicolored. **Genitalia** not available for study.

Specimens examined

GW: 1ex, Mt. Odae, Tapdong-ri, Jinbu-myeon, Pyeongchang-gun, 28.vi.2012-31.vii.2012, Malaise Trap, S.J.Park & I.J.Huh (NIBR); 1ex, Osaek-ri, Seo-myeon, Yangyang-gun, 19.vi.2018, Min Hyeuk Lee (SNU).

Distribution

Korea, Japan, Taiwan, Russia

Remarks

Only few specimens were found on mushrooms.

Subfamily Prometopinae Böving and Craighead, 1931 큰턱밀빠진벌레아과 (신칭)

Diagnosis

Body oblong or almost circular, weakly convex dorsally. Head prognathous, horizontal, post-ocular lateral sulcus present. Mandibles well developed and additional tooth on inner margin. Mentum broad and covering base of maxillae. Antennae 11 segmented, last three segments enlarged. Antennomere 3 at least two times longer than pedicel. Elytra dark colored and frequently with light patterns. Distinctly diverging metacoxal lines on abdominal sternite I. Legs simple, mesocoxae and metacoxae widely separated, tarsomeres simple.

Key to the Genus of Korean Prometopinae

- Elytra bicolored, black and orange, with orange pattern; antennal club pectinate; body rounded, almost circular, pubescence almost absent *Parametopia*
- Elytra unicolored; antennal club clavate; body slightly convex, oval, pubescence present..... *Prometopia*

Remarks.

The subfamily Prometopinae Böving and Craighead, 1931 (Coleoptera: Cucujoidea: Nitidulidae) is a small group of sap beetles with 12 species in 4 genera in the Palearctic region (Jelínek and Audisio, 2007; Cline et al., 2014).

Prometopinae has a complicated taxonomic history. Recently, Prometopinae was

resurrected based on molecular phylogenetic evidence as well as some morphological evidence (Cline et al., 2014). Even though arguments were presented against this resurrection (Kirejtshuk and Mantič, 2015), Cline's study has been generally accepted in many successive papers (Hisamatsu, 2013; Baviera and Audisio, 2014; Dasgupta et al., 2015; Lawrence, 2016; Navarrete-Heredia et al., 2016; Alekseev, 2017; Lee et al., 2018). Therefore, in this study we treat Prometopinae as a subfamily, and Parametopia Erichson 1843 and Prometopia Reitter, 1884 as distinct genera.

Genus *Parametopia* Erichson, 1843

Type species *Parametopia x-rubrum* Reitter, 1884

***Parametopia x-rubrum* Reitter, 1884 무늬큰턱밀빠진벌레 (신칭)**

Parametopia x-rubrum Reitter, 1884: 262

Redescription

Length 3.22 – 3.88 mm (including mandible), Width 2.05 -2.60 mm. **Body** round, almost circular; bicolored, black and orange; antennae, legs, lateral margin of pronotum, apical and lateral margin of elytra orange-brown; pubescence indistinctly; pronotum and elytral margins not fimbriate; ventral surface less brightly colored. **Head** prognathous, horizontal, transverse, wider than long; with tiny, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present;

post-ocular lateral sulcus present; antennal groove distinct, deep and somewhat curved posteriomediaally; labrum short, medial anterior margin moderately incised; mentum broad and covering base of maxillae. **Antennae** 11 segments, apical 3 segments pectinated and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally, 2 times longer than pedicel; antennomere 3 two times longer than pedicel; antennal club reddish brown, not compact, moderately flattened, strongly asymmetrical, 1/2.7 of total length and 1.75 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L = 2.4:1); anterior margin broadly deeply concave; posterior margin weakly undulate; lateral margins rounded, narrowed anteriorly; with tiny, dense punctures. **Scutellum** transverse; subtriangular; apical margin acuminate; sparsely punctate. **Elytra** bicolored, black and orange; semicircular, almost as wide as long (W:L = 1.22:1); 'X' shaped orange-brown pattern in the center; with tiny, dense punctures; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins arcuate, strongly explanate, orange-brown; epipleura 2 times wider than width of mesotarsus. **Prosternum** transverse; densely punctate; propisternum orange-brown colored, pubescence almost absent, sparsely punctate; prosternal process strongly dilated at apex, apical margin rectilinear. **Mesosternum** not depressed; densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line absent. **Abdomen** densely punctate; distinctly diverging metacoxal lines on first abdominal sternite; first abdominal sternite 2 times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish

pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsal claws simple; protibia not expanded, lateral margin crenulate, without sexual dimorphism; mesotibia and metatibia almost rectilinear; femur unicolored. **Male genitalia** well sclerotized. Tegmen bell-shaped, almost parallel sided on side, smoothly and slightly incised in middle apex with subapical setose ridge and punctuation. Median lobe trilobed, bullet-shaped with acute of apex. **Female ovipositor** weakly sclerotized, gonocoxites elongated and moderately slender, gonostylus present.

Specimens examined

GG: 2exs. (SNU), Taehwa-san, Gwangju-si, 18.vi.2014, G.B. Choe, (Light trap); 1ex. (SNU), Mt. Bara, Hagui-dong, Uiwang-si, 1.vi.2015, J.B. Seung.

GW: 3exs. 2♂, 1♀ (SNU), Maebong-san, Inje-gun, 7.vi.2014, S.H. Lee; 1ex. (SNU), ditto, 16.v.2015, S.H. Lee; 3exs. (SNU), Beopheung-ri, Suju-myeon, Yeongwol-gun, 5-18.vi.2015, S.H. Lee, (flight intercept trap).

Distribution Korea, Taiwan, Japan

Remarks

Most individuals were found on a dead tree trunk of *Quercus* sp. at night.

Parametopia x-rubrum is placed within the subfamily Prometopinae based on the following combination of characters in Cline et al. (2014): post-ocular lateral sulcus present; distinctly diverging metacoxal lines on abdominal ventrite I; mesocoxae and metacoxae widely separated; tarsomeres simple; antennomere 3 at least two times longer than pedicel.

Genus *Prometopia* Erichson, 1843

Type species *Nitidula sexmaculata* Say, 1825

***Prometopia unidentata* Hisamatsu, 1959 큰턱밑빠진벌레 (신칭)**

Prometopia unidentata Hisamatsu, 1959: 21.

Redescription

Length 4.22 - 7.43 mm (including mandible), width 2.05 - 3.16 mm. **Body** weakly convex and oblong; unicolored, mostly reddish brown; antennae, legs, lateral margin of pronotum and elytra more brightly colored; covered with yellowish or dark pubescence; pronotum and elytral margins fimbriate; ventral surface similar in color. **Head** prognathous, horizontal, transverse, wider than long; with tiny, dense punctures; mandibles well developed with acute apices, 1-2 subapical teeth present; post-ocular lateral sulcus present; antennal groove distinct, deep and somewhat curved posteriomediaally; labrum moderated, medial anterior marginal incision; mentum broad and covering base of maxillae. **Antennae** 11 segments, apical 3 segments clavate and covered with yellowish pubescence; antennal scape forming an asymmetrical ellipse, broadly convex dorsally, 2 times longer than pedicel; antennomere 3 at least three times longer than pedicel; antennal club reddish brown, not compact, moderately flattened, almost symmetrically, 1/3.2 of total length and 2 times longer than wide. **Pronotum** moderately convex, quadrate, wider than long (W:L = 2.15:1); anterior margin broadly concave; posterior margin rectilinear; lateral margins rounded, narrowed anteriorly; with tiny, dense punctures. **Scutellum**

transverse; subtriangular; apical margin acuminate; sparsely punctate. **Elytra** unicolored, blackish brown; subrectangular, longer than wide; with tiny, dense punctures; sutural stria absent; elytra covering entire abdomen except apex of pygidium; lateral margins rounded, moderately explanate, orange-brown; epipleura nearly as long as the width of mesotarsus. **Prosternum** transverse; densely punctate; proepisternum orange-brown, pubescence relatively less dense than on other ventral surfaces, sparsely punctate; prosternal process strongly dilated at apex, apical margin rectilinear. **Mesosternum** not depressed; densely punctate; posterior margin extending midway between mesocoxae. **Metasternum** much wider than long; densely punctate; metasternal line absent. **Abdomen** densely punctate; distinctly diverging metacoxal lines on first abdominal sternite; first abdominal sternite 2 times longer than second abdominal sternite; sternites 2-4 subequal in length. **Legs** covered with yellowish pubescence; tarsi 5-5-5, tarsomeres 1-3 not dilated and tarsal setae present, tarsal claws simple; tibia rectilinear, without sexual dimorphism; femur unicolored. **Male genitalia** well sclerotized. Tegmen bullet-shaped, almost parallel sided, smoothly and slightly incised in middle of apex with ventroapical setae and punctuation. Median lobe trilobed, sharply narrower to acute apex. **Female ovipositor** moderately sclerotized, gonocoxites elongate and slender, gonostylus present.

Specimens examined

GG: 1ex. (SNU), Suri-san, Gunpo-si, 29.viii.2014, Seunghyun Lee.

GW: 2exs. 1♂, 1♀, (NAAS), Hambaksan-ro, Sangdong-eup, Yeongwol-gun, 14.viii.1999, T.H. Kang; 1ex. 1♂, (NAAS), Sumgol-ro 310 beon-gil, Wondang-ri,

Dong-myeon, Yanggu-gun, 22.viii.2009, H.C. Park; 1ex. (SNU), Namjeon-ri, Nam-myeon, Inje-gun, 16.viii.2017, M.H. Lee, (Light trap)

Distribution Korea, Russia, Japan

Remarks

Most individuals were found on a dead tree trunk of *Quercus* sp. at night.

Prometopia unidentata is placed within the subfamily Prometopinae based on the following combination of characters in Cline et al. (2014): distinctly diverging metacoxal lines on abdominal ventrite I; mesocoxae and metacoxae widely separated; tarsomeres simple; antennomere 3 at least two times longer than pedicel.

4. Discussion

In this study, Subfamily Nitidulinae was reviewed as 38 species of 19 genera from Korea, including two new species, *Cyllodes* sp. nov., *Pallodes* sp. nov. and 9 unrecorded species, *Nitidula rufipes* (Linnaeus), *Soronia lewisi* Reitter, *Ipidia sibirica* (Reitter) *Stelidota multiguttata* Reitter, *Atarphia fasciculata* Reitter, *Hebasculinus japonus* (Reitter) *Xenostrogylus variegatus* (Fairmaire), *Neopallodes vicinus* Grouvelle and *Pocadites rufobasalis* Reitter. Subfamily Prometopinae Böving and Craighead, 1931 is recorded from Korea for the first time with 2 species from different genera, *Prometopia unidentata* Hisamatsu, *Parametopia x-rubrum* Reitter. Unfortunately, among previously recorded species from Korea, we couldn't available 1 species, *Aethina suturalis* Reitter and only use Russian samples at 2 species, *Cychramus luteus* (Fabricius), *Cychramus variegatus* (Herbst).

Korean common name of Nitidulidae is complicated, because existing common name was following old taxonomic status rather than its external characteristic. Nitidulinae and Epurainae was same subfamily before 1986, so they have same based on common name. For example, tribe Cyllodini has strongly convexed body, however Korean common name was 'flat sap beetle'. Because all Nitidulinae species named 'flat sap beetle' by Shin et al. (1994). In this study we change some Korean common name follow newest generic classification and characteristic habitus. Most samples of in this study were collected during only few years, from 2014 to 2018. Although, we found several unrecorded specie in this study, it's only 55% of the species recorded in Japanese fauna. Therefore, Korean Nitidulinae species are still need more research.

Table 2. Checklist of the Subfamily Nitidulinae from Korea.

No.	Subfamily	Tribe	Genus	Scientific name	Korean name	Remarks
1	Nitidulinae	Nitidulini	<i>Nitidula</i>	<i>Nitidula rufipes</i> (Linnaeus, 1767)*	참밀빠진벌레	
2			<i>Omosita</i>	<i>Omosita colon</i> (Linnaeus, 1758)	점박이송장밀빠진벌레	
3				<i>Omosita japonica</i> Reitter, 1874	노랑송장밀빠진벌레	
4				<i>Omosita discoidea</i> (Fabricius, 1775)	구름무늬송장밀빠진벌레	
5			<i>Soronia</i>	<i>Soronia fracta</i> Reitter, 1884	큰얼룩밀빠진벌레	
6				<i>Soronia grisea</i> (Linnaeus, 1758)	회색얼룩밀빠진벌레	
7				<i>Soronia lewisi</i> Reitter, 1884*	꼬마얼룩밀빠진벌레	
8			<i>Ipidia</i>	<i>Ipidia sibirica</i> (Reitter, 1879)*	검정밀빠진벌레	
9				<i>Ipidia variolosa variolosa</i> Reitter, 1879	큰검정밀빠진벌레	
10			<i>Stelidota</i>	<i>Stelidota multiguttata</i> Reitter, 1877*	애밀빠진벌레	
11			<i>Phenolia</i>	<i>Phenolia borealis</i> (Hisamatsu, 1968)	왕밀빠진벌레	
12				<i>Phenolia picta</i> (MacLeay, 1825)	갈색왕밀빠진벌레	
13			<i>Ussuriphia</i>	<i>Ussuriphia hilleri</i> (Reitter, 1877)	알락밀빠진벌레	
14			<i>Aethina</i>	<i>Aethina aeneipennis</i> (Reitter, 1873)	남방꼬마밀빠진벌레	
15				<i>Aethina inconspicua</i> Nakane, 1963	꼬마밀빠진벌레	
16				<i>Aethina flavicollis</i> Reitter, 1884	무늬꼬마밀빠진벌레	
17				<i>Aethina tumida</i> Murray, 1867	벌집꼬마밀빠진벌레	
18				<i>Aethina suturalis</i> Reitter, 1884	갈색꼬마밀빠진벌레	
19			<i>Atarphia</i>	<i>Atarphia fasciculata</i> Reitter, 1884*	공보긴다리밀빠진벌레	

20			<i>Atarphia quadripunctata</i> Reitter, 1884	넥점긴다리밀빠진벌레
21		<i>Hebasculinus</i>	<i>Hebasculinus japonus</i> (Reitter, 1877)*	먹동글밀빠진벌레
22		<i>Physoronia</i>	<i>Physoronia japonica</i> (Reitter, 1873)	단색밀빠진벌레
23		<i>Pocadites</i>	<i>Pocadites dilatimanus</i> (Reitter, 1877)	네점잔털밀빠진벌레
24			<i>Pocadites rufobasalis</i> Reitter, 1884*	큰잔털밀빠진벌레
25		<i>Pocadius</i>	<i>Pocadius nobilis</i> Reitter, 1873	황갈색밀빠진벌레
26	Cychramini	<i>Cychramus</i>	<i>Cychramus luteus</i> (Fabricius, 1787)	큰가슴밀빠진벌레
27			<i>Cychramus variegatus</i> (Herbst, 1792)	넥점큰가슴밀빠진벌레
28		<i>Xenostrogylus</i>	<i>Xenostrogylus variegatus</i> (Fairmaire, 1891)*	앞굴털밀빠진벌레
29	Cyllodini	<i>Cyllodes</i>	<i>Cyllodes ater</i> (Herbst, 1792)	검정알버섯밀빠진벌레
30			<i>Cyllodes bifascies</i> Walker, 1859	붉은점알버섯밀빠진벌레
31			<i>Cyllodes dubius</i> (Reitter, 1877)	큰검정알버섯밀빠진벌레
32			<i>Cyllodes literatus</i> (Reitter, 1878)	무늬알버섯밀빠진벌레
33			<i>Cyllodes</i> sp. nov.*	붉은무늬알버섯밀빠진벌레
34		<i>Pallodes</i>	<i>Pallodes umbratilis</i> Reitter, 1873	버섯밀빠진벌레
35			<i>Pallodes</i> sp. nov.*	닭은버섯밀빠진벌레
36		<i>Coxollodes</i>	<i>Coxollodes cyrtusoides</i> (Reitter, 1884)	꼬마버섯밀빠진벌레
37		<i>Neopallodes</i>	<i>Neopallodes omogonis</i> Hisamatsu, 1953	무늬버섯밀빠진벌레
38			<i>Neopallodes vicinus</i> Grouvelle, 1892*	민무늬버섯밀빠진벌레
39	Prometopinae	<i>Parametopia</i>	<i>Parametopia x-rubrum</i> Reitter, 1884*	무늬큰턱밀빠진벌레
40		<i>Prometopia</i>	<i>Prometopia unidentata</i> Hisamatsu, 1959*	큰턱밀빠진벌레

Asterisk symbols (*) with species indicate new records to the fauna from this study.

PART II. Molecular phylogeny of family Nitidulidae (Coleoptera: Cucujoidea)

Abstract

Family Nitidulidae is the second largest family in Cucujoidea which includes ten subfamilies. Because of their morphological and biological diversity, the phylogenetic relationship within Nitidulidae is one of the most debated topics among Cucujoidea phylogeny and yet, is still open to many questions. To recover the internal relationship of Nitidulidae, we performed ML and BI analyses that targeted on five gene regions (COI, 28s, CAD, H3, Wingless) for 77 taxa. Our research also included the 7 outgroups and 67 ingroups which contain the nine out of ten currently recognized subfamilies of Nitidulidae. The results of our phylogenetic analysis suggest the three following conclusions i) Subfamilial status of Prometopinae is reconfirmed; ii) Epuraeinae is paraphyletic with inclusion of Calonecrinae; iii) Nitidulinae is paraphyletic with inclusion of Meligethinae and Cillaeinae. In addition, the generic relationships within Nitidulidae and the evolutionary history of their feeding behaviors are also briefly discussed.

Keywords: Nitidulidae, Molecular phylogeny, 28S, COI, H3, CAD, Wingless

1. Introduction

The family Nitidulidae (Coleoptera: Cucujoidea) is the second largest family in Cucujoidea, comprising approximately 342 genera and nearly 4000 recorded species (Jeli'nek, et al., 2010; Cline et al., 2014) within ten recognized subfamilies (Calonecrinae, Cryptarchinae, Prometopinae, Amphicrossinae, Carpophilinae, Epuraeinae, Maynipeplinae, Meligethinae, Cillaeinae and Nitidulinae) (Kirejtshuk, 2008; Cline et al., 2014).

Because of their morphological and biological diversity, the phylogenetic relationship within Nitidulidae is one of the most debated topics among Cucujoidea phylogeny. Characterization of the family is challenging due to extreme variation in body forms. For example, until recently, several other families such as Kateretidae and Cybocephalidae have been included in the Nitidulidae based on the following shared morphological characteristics, 1) antennae 11 segmented with the apical 3 forming a club (except Calonecrinae, some Cillaeinae (*Macrostola*), Maynipeplinae (antennae with 10 antennomeres with apical 1-2 forming a club); 2) abdominal ventrite 1 not much longer than 2; 3) anal lobe of hindwing present; 4) maxilla with lacinia only; 5) anal lobe of hindwing present. However, Nitidulidae can be distinguished from Smicripidae and Kateretidae, by the following characters, 1) procoxae strongly transverse; 2) prothoracic trochantin always exposed; 3) procoxal cavities not always open externally.

Because of their variety of body forms and ambiguous mix of characters, Nitidulidae remains one of the most taxonomically confusing groups in Cucujoidea. Historically, the subfamilial status of Nitidulidae has been studied by only a few

researchers. Earlier morphological phylogenetic analyses of subfamily relationships offered by Kirejtshuk (1982, 1986, 1995), were based only on several morphological characteristics and with his intuition for a few taxa, but not all subfamilies were studied (Fig 6). According to Kirejtshuk (1982, 1986) Calonecrinae is the most ancestral subfamily among the nitidulid subfamilies. Kirejtshuk (1995) suggested two groups: Carpophilinae- and Nitidulinae-lineages each characterized by genitalic characters, and Calonecrinae was included in the Carpophilinae-lineage along with Epuraeinae, Capophilinae and Amphicrossinae. Kirejtshuk proposed that Epuraeinae was the most basal subfamily in the carpophilinae-lineage, and Carpophilinae, Amphicrossinae and Calonecrinae were represented as a polytomy. Although Kirejtshuk (2008) proposed that the family Nitidulidae is classified into two groups (Carpophilinae-lineage: (Amphicrossinae, Epuraeinae and Carpophilinae), Nitidulinae-lineage: (Cryptarchinae, Nitidulinae, Cillaeinae, Meligethinae and Cybocephalinae)) and an ambiguous group (Calonecrinae and Maynipeplinae), rigorous morphological analyses for Nitidulidae are still inconclusive. Also, the phylogenetic position of Calonecrinae and its proposed position as an ancestral subfamily are still unknown.

Recently, the research performed by Cline et al. (2014) is the only molecular phylogenetic data available for the status of Nitidulid subfamilies, along with a limited suited of morphological characters. In their study, the subfamily Prometopinae was resurrected by molecular phylogenetic evidence and some morphological evidence based on larval characteristics. Cline et al. (2014) also formalized Cybocephalidae as a distinct family based on morphological evidence of

the adults and immature forms and molecular data. In addition, according to studies done by Cline et al. (2014) and Bocak et al. (2014), the Cybocephalidae is more closely related to Spindidae than to Nitidulidae, based on both molecular and morphological data.

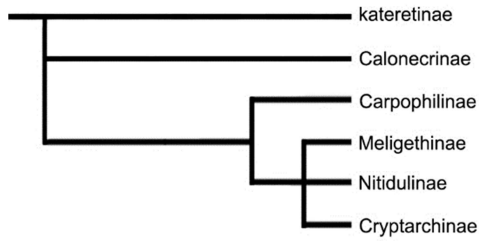
However, Kirejtshuk and Mantič (2015) proposed a counterargument for the resurrection of the subfamily Prometopinae, and suggested that characters used by Cline et al., (2014) were inconclusive to define the subfamily. Furthermore, the objection pointed out that the size of dataset provided by Cline et al. (2014) is insufficient to support their conclusions. Kirejtshuk and Mantič (2015) also indicated that Cline et al., (2014) did not consider synapomorphy of the family Cybocephalidae and Nitidulidae and several branches of trees provided by Cline et al., (2014) are not characterized by high node values. Despite these objections, Cline et al. (2014) has been generally cited by many successive papers (Baviera and Audisio, 2014; Dasgupta et al., 2015; Lawrence, 2016; Navarrete-Heredia et al., 2016; Alekseev, 2017; Lee et al., 2018) as the most rigorous phylogenetic treatment of the family to date.

Members of Nitidulidae exhibit one of the most diverse feeding repertoires among beetle families, presumably due to their occurrence in many different habitats worldwide. A few Nitidulid species are classified as serious agricultural pests (e.g., *Stelidota geminata*, *Aethina tumida*, *Glischrochilus quadrisignatus*, *Carpophilus* sp., *Lobiopa* sp.). With the exception of *Aethina tumida*, most pest species are secondary pests, attracted by the products of fermentation, followed by damage to sugar rich fruit and grain crops. However, the evolution of feeding habits in

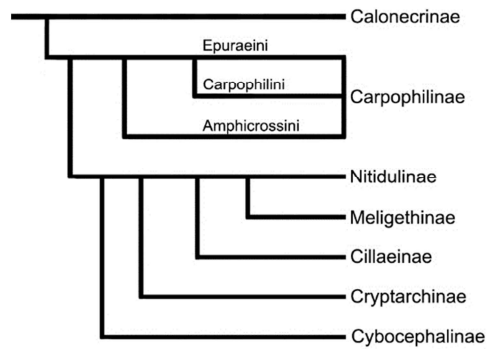
nitidulids based on molecular phylogenetic relationships has never been studied.

In this study, we reconfirm the tests of the monophyly of the subfamilies of Nitidulidae, especially the subfamilial status of Prometopinae and Calonecrinae and evaluate phylogenetic relationships at the inter- and intra-subfamily level. In addition, the evolutionary history of their feeding behaviors is also briefly discussed.

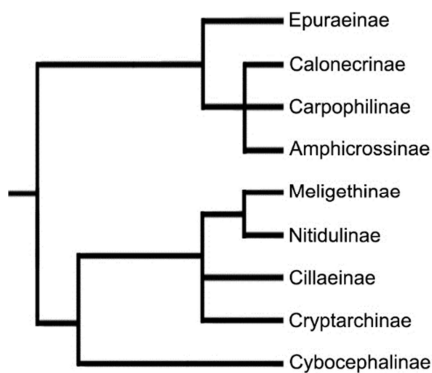
(a) Kirejtshuk, 1982



(b) Kirejtshuk, 1986



(c) Kirejtshuk, 1995



(d) Cline et al., 2014

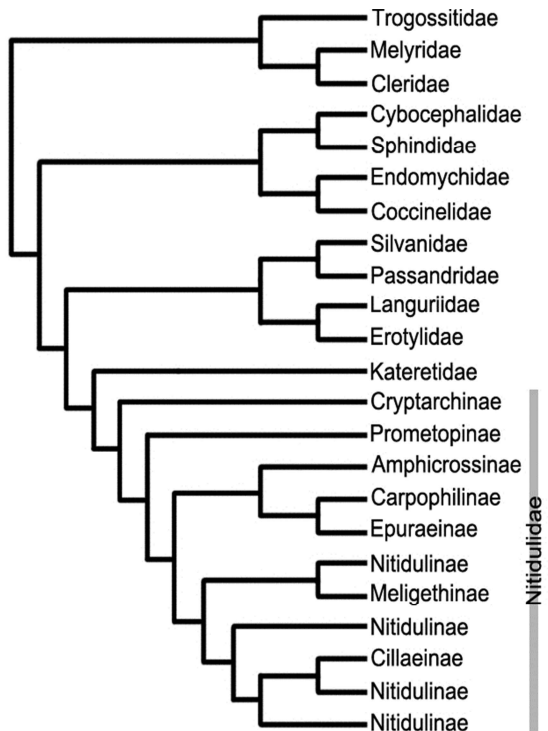


Fig. 6. Phylogenetic studies of the Family Nitidulidae.

2. Materials and Methods

2.1. Taxon sampling

A total of 40 species in 9 subfamilies of Nitidulidae: Calonecrinae, Cryptarchinae, Prometopinae, Amphicrossinae, Carpophilinae, Epuraeinae, Meligethinae, Cillaeinae and Nitidulinae (Kirejtshuk, 2008; Cline et al., 2014) were collected from Korea, Laos and USA. Only one subfamily (Maynipeplinae) was not used in this study due to unavailability. In addition, 34 species was downloaded from NCBI Genbank including 7 outgroup species (Kateretidae, Monotomidae and Erotylidae). As a result, the final dataset is consisted of 74 species (Table 4). Most collected samples were preserved in 99% ethyl alcohol (ETOH) at -20°C for the DNA extraction and some were in dried condition.

2.2. Laboratory work

2.2.1. DNA extractions

Total genomic DNA was extracted from whole body of vouchers, using non-destructive method for the morphological identification. DNA was extracted using the Qiagen DNeasy blood and tissue kit (Valencia, CA) according to the manufacturer's protocol and stored at -20°C until use. All voucher specimens are deposited in the insect collection of College for Agriculture and Life Science, Seoul National University (CALS, SNU).

2.2.2. PCR amplification and sequencing

Genes were chosen by utility in previous study of Nitidulidae or Cucujoidea phylogeny (Cline et al., 2014; Robertson et al., 2015; McKenna et al., 2015). One mitochondrial protein coding gene: cytochrome c oxidase subunit I gene (COI; Simon et al., 1994), one nuclear ribosomal RNA genes: 28S rRNA (28S; Kim et al., 2000) and three nuclear protein coding genes: carbomoylphosphate synthase (CPS) domain of CAD (CAD; Wild et al., 2008), wingless (Wg; Wild et al., 2008) and histon H3 (H3; Colgan et al., 1998) were selected. The primers for amplifying each gene are listed in Table 3. PCR amplifications were performed using AccuPower PCR Premix (Bioneer, Daejeon, Korea) in 20 µl-volumed mixtures. The PCR thermal cycling program was performed according to protocols as follow: 1) 28S markers: initial denaturation of 94°C/2min, followed by 45cycles of 95°C/1min, 50°C/1min and 72°C/2min, and with a final extension at 72°C/7min. 2) COI marker: initial denaturation of 94°C/5min, followed by 40cycles of 94°C/30s, 47°C/30s and 72°C/2min, and with a final extension at 72°C/10min. 3) H3 marker: initial denaturation of 94°C/2min, followed by 40cycles of 94°C/1min, 50°C/1min and 72°C/1min, and with a final extension at 72°C/7min. 4) CAD and Wg marker: initial denaturation of 94°C/5min, followed by 40cycles of 94°C/1min, 50°C/1min and 72°C/1min, and with a final extension at 72°C/5min. Successful amplification was confirmed by running electrophoresis PCR products in 1.0% agarose gels. After identification of single band, PCR products were purified and sequenced at Bionics (Seoul, Korea).

Table 3. Primers used in this study.

Gene	Direction	Primer	Sequences (5' – 3')	Target length	References
28s	F	28S-01	GACTACCCCCTGAATTTAAGCAT	810 bp	Kim et al. (2000)
	R	28SR-01	GACTCCTTGGTCCGIGTTTCAAG		Kim et al. (2000)
COI	F	C1-J-2183	CAACATTTATTTTGATTTTTTGG	826 bp	Simon et al. (1994)
	R	TL2-N-3014	GCACTAWTCTGCCATATTAGA		Simon et al. (1994)
H3	F	Haf	ATGGCTCGTACCAAGCAGACVGC	325 bp	Colgan et al. (1998)
	R	Har	ATATCCTTRGGCATRATRGIGAC		Colgan et al. (1998)
CAD	F	CD821F	AGCACGAAAATHGGNAGYTCNATGAARAG	728 bp	Wild et al. (2008)
	R	CD1098R2	GCTATGTTGTTNGGNAGYTGDCNCCCAT		Wild et al. (2008)
Wg	F	Wg550F	ATGCGTCAGGARTGYAARTGYCAYGGYATGTC	417 bp	Wild et al. (2008)
	R	WgAbRZ	CACTTNACYTCRCARCACCARTG		Wild et al. (2008)

2.2.3. Sequencing alignments

The dataset used for the analyses contained 810bp of 28s, 826bp of COI, 325bp of H3, 728bp of CAD, 417bp of Wingless, for a total of 3,106bp of sequence. Raw sequences were assembled and edited using Seqman pro ver. 7.1.0 (DNA star). The online version of MAFFT (Katoh et al., 2002, Katoh et al., 2017) version 7 (<https://mafft.cbrc.jp/alignment/server/>) was used to align each dataset of 5 genes. The software MEGA 7 (Kumar et al., 2016) was used to assess the sequence properties of the individual genes. Each sequence data was concatenated using Sequence Matrix windows version 1.8. Not all genes were obtained for all specimens (31.6% missing; Table 4).

2.3. Phylogenetic analyses

The combined data set was analyzed in two phylogenetic analyses, Bayesian Inference (BI) and Maximum Likelihood (ML).

The best substitution models for each dataset were determined by PartitionFinder2 on XSEDE version 2.1.1 (Lanfear et al., 2016) at CIPRES web portal, using the Akaike information criterion (AIC).

Bayesian Inference analysis (BI), was performed using MrBayes 3.2.6 (Ronquist et al., 2012). GTR+I+G model was selected for COI, 28s and CAD. SYM+I+G model selected for H3 and Wingless. The BI analyses ran for 10 million Markov chain Monte Carlo (MCMC) generations and trees sampled every 100 generations. The burninfrac was set at 0.3 (30%) of the sampled number of trees. Tracer ver. 1.4 (Rambaut and Drummond, 2007) was used to view the graphical representation of MCMC chain mixing to ensure that distribution had stabilized.

Maximum Likelihood analysis (ML), were performed using RAxML-HPC2 on XSEDE version 8.2.10 (Stamatakis, 2014) at CIPRES web portal (Miller et al., 2015). GTR+I+G model was selected for all cases. Supports for nodes were estimated with 1,000 bootstrap replications.

2.4. Evolution of food preferences

For the analysis of food preferences were performed using BayesTraits V3.0.1 with Reversible-jump MCMC methods. Total of 50 million iterations were run for each analysis; first 1 million burn-in, sampling every 1000th generation. Feeding habitus were coded as follows: Mycophagy, Saprophagy, Necrophagy, Anthophagy, Frugivory, Tree sap, Inquiline and Herbivore.

Table 4. Checklist of the Subfamily Nitidulinae from Korea.

Family	Subfamily	Scientific name	Localities	Food	GenBank accession number				
					28s	COI	H3	Wingless	CAD
Nitidulidae	Calonecrinae	<i>Calonecrus jendeki</i>	Laos	G ⁽¹⁾	-	-	-	-	-
	Cryptarchinae	<i>Glischrochilus parvipustulatus</i>	Korea	B ⁽⁸⁾ , C ⁽⁸⁾ , D ⁽⁸⁾ , G ⁽²⁷⁾ , J ⁽⁸⁾	-	x	-	-	-
		<i>Glischrochilus quadrisignatus</i>	-	G ^(2, 7)	KC966632	KC966665	KC966465	KP813432	KP812856
		<i>Eucalospaera</i> sp.	Laos	F ⁽⁰⁾	-	-	-	-	-
		<i>Cryptarcha strigata</i>	Korea	F ⁽⁷⁾ , G ⁽²⁾	x	-	-	-	-
	Prometopinae	<i>Megauchenia</i> sp. 1		A ⁽⁶⁾	KC966624	KC966658	x	x	x
		<i>Megauchenia</i> sp. 2		A ⁽⁶⁾	KP829351	x	KP829926	x	x
		<i>Prometopia unidentata</i>	Korea	A ⁽³⁾	-	-	-	-	-
		<i>Parametopia x-rubrum</i>	Korea	A ⁽³⁾	-	-	-	-	-
		<i>Parametopia</i> sp.	Laos	A ⁽⁰⁾	-	x	-	-	-
	Amphicrossinae	<i>Amphicrossus ciliatus</i>		B ⁽¹⁸⁾ , G ⁽¹⁸⁾	KC966629	KC966662	KC966471	x	x
		<i>Amphicrossus lewisi</i>	Korea	G ⁽⁰⁾	-	-	-	x	-
	Carpophilinae	<i>Carpophilus</i> sp. 1		UnKnown	KC966630	KC966663	KC966468	x	x
		<i>Carpophilus</i> sp. 2		UnKnown	KC966608	KC966682	KC966453	x	x
		<i>Carpophilus pallipennis</i>		F	KP419387	x	x	KP813365	KP812781
		<i>Carpophilus hemipterus</i>	Korea	C ⁽⁰⁾ , F ⁽¹⁸⁾	x	-	-	x	x
		<i>Urophorus</i> sp. 1	Korea	C ⁽⁰⁾ , F ⁽⁰⁾	-	-	-	x	x
		<i>Urophorus</i> sp. 2	Laos	F ⁽⁰⁾	-	-	-	x	-
	Epuracinae	<i>Trimenus parallelopipedus</i>		UnKnown	KC966628	x	KC966470	x	x

	<i>Trimenus</i> sp.		UnKnown	KC966635	KC966668	KC966463	x	x
	<i>Epuraea</i> sp.		UnKnown	KC966633	KC966666	KC966466	x	x
	<i>Epuraea melanocephala</i>		E ⁽¹⁶⁾	x	HQ165212	x	x	x
	<i>Epuraea ocularis</i>	Korea	F ⁽⁰⁾	-	-	-	-	-
	<i>Epuraea domina</i>	Korea	F ⁽¹⁵⁾	-	-	-	-	-
Meligethinae	<i>Fabogethes nigrescens</i>		E ⁽⁸⁾	KC966631	KC966664	KC966469	x	x
	<i>Brassicogethes aeneus</i>		E ⁽⁸⁾	x	AJ536171	x	x	x
	<i>Brassicogethes subaeneus</i>		E ⁽⁸⁾	x	AM491643	x	x	x
	<i>Brassicogethes matronalis</i>		E ⁽⁸⁾	x	AM491655	x	x	x
	<i>Meligethes flavicollis</i>	Korea	E ⁽⁸⁾	-	-	-	-	-
	<i>Meligethes</i> sp.	Korea	E ⁽⁸⁾	x	-	x	x	x
	Meligethinae sp.	Korea	E ⁽⁰⁾	-	-	x	x	x
Cillaeinae	<i>Macrostola straminea</i>		E ⁽²⁾	KC966606	KC966679	KC966452	x	x
	<i>Conotelus obscurus</i>		E ⁽¹⁰⁾	KC966641	x	x	x	x
	<i>Brachypeplus anceps</i>		A ⁽¹¹⁾	KP419377	x	x	x	x
	Cillaeinae sp. 1	Laos	F ⁽⁰⁾	-	-	-	x	-
	Cillaeinae sp. 2	Laos	F ⁽⁰⁾	-	-	x	x	-
Nitidulinae	<i>Thalycra</i> sp.		B ⁽²⁾	KC966620	KC966654	x	x	x
	<i>Nitidula flavomaculata</i>		D ⁽¹⁾	KC966603	KC966675	KC966456	x	x
	<i>Nitidula rufipes</i>	Korea	D ⁽¹⁾	-	-	-	-	-
	<i>Omosita japonica</i>	Korea	C ⁽⁴⁾ , D ^(1,4)	-	-	-	-	-
	<i>Omosita discoidea</i>	Korea	C ⁽⁴⁾ , D ^(1,4)	-	-	-	-	-

	<i>Soronia fracta</i>	Korea	G ⁽²⁾	-	-	-	-	-
	<i>Soronia lewisi</i>	Korea	G ⁽²⁾	-	-	-	-	x
	<i>Lobiopa</i> sp.	USA	G ⁽²⁾	-	-	-	-	x
	<i>Lobiopa falli</i>		G ⁽²⁾	KC966622	KC966656	KC966475	x	x
	<i>Cyllodes</i> sp.	Korea	B ⁽⁰⁾	-	-	-	x	-
	<i>Triacanus</i> sp.		B ⁽²⁾	KC966621	KC966655	KC966478	x	x
	<i>Neopallodes</i> sp.	Korea	B ⁽⁰⁾	-	-	-	-	-
	<i>Ipidia variolosa</i>	Korea	A ⁽⁷⁾	-	-	-	x	-
	<i>Ipidia sibirica</i>	Korea	A ⁽⁷⁾	-	-	x	-	x
	<i>Ussuriphia hilleri</i>	Korea	B ⁽⁰⁾	-	-	-	x	-
	<i>Atarphia quadripunctata</i>	Korea	A ⁽⁷⁾ , B ⁽⁷⁾	-	-	-	-	x
	<i>Stelidota geminata</i>	Korea	C ⁽¹⁸⁾ , B ⁽¹⁸⁾ , F ⁽¹⁷⁾				KP813591	KP813029
	<i>Stelidota multiguttata</i>	Korea	A ⁽⁰⁾ , B ⁽⁰⁾ , F ⁽⁰⁾	-	-	-	-	-
	<i>Pallodes umbratilis</i>	Korea	B ⁽²⁾	-	-	-	-	-
	<i>Pallodes pallidus</i>		B ⁽²⁾	KC966623	KC966657	KC966473	x	x
	<i>Coxollodes cyrtusoides</i>	Korea	B ⁽⁰⁾	-	-	-	-	-
	<i>Aethina tumida</i>		H, I ⁽²⁾	KC966618	KC966652	KC966476	x	x
	<i>Aethina aeneipennis</i>	Korea	E ⁽¹²⁾	-	-	-	-	x
	<i>Aethina</i> sp.	Laos	F ⁽⁰⁾	-	-	-	-	-
	<i>Cratonura rufithorax</i>		UnKnown	KC966627	KC966661	KC966472	x	x
	<i>Phenolia</i> sp.		G ⁽²⁾	KC966634	KC966667	KC966467	x	x
	<i>Phenolia borealis</i>	Korea	G ⁽²⁾	-	-	-	x	-

	<i>Hebascus</i> sp.		B ⁽²⁾	KC966643	KC966674	KC966458	x	x
	<i>Hebasculinus japonus</i>	Korea	B ⁽⁷⁾	-	-	-	-	-
	<i>Pocadites dilatimanus</i>	Korea	B ⁽⁷⁾	-	-	x	-	x
	Nitidulinae sp.	Laos	UnKnown	-	-	-	x	-
Kateretidae	<i>Anthonaeus agavensis</i>		E ⁽²⁾	KC966605	KC966678	KC966454	x	x
	<i>Kateretes rufilabris</i>		E ⁽²⁾	X	DQ221966	x	x	x
	<i>Amartus</i> sp.		E ⁽²⁾	KP419347	x	x	KP813327	KP812744
Monotomidae	<i>Lenax</i> sp.		UnKnown	KP829342	KP829637	KP829919	x	x
	<i>Rhizophagus remotus</i>		H ⁽¹⁴⁾	KP419619	x	x	KP813563	KP812998
	<i>Bactridium</i> sp.		B ⁽¹³⁾	KP134121	KP134188	KP134301	x	x
Erotylidae	<i>Iphichus</i> sp.		B ⁽⁵⁾	KC966611	KC966646	KC966483	x	x

* Indet, indeterminate; -, unpublished; x, unavailable.

A: Mycophagy (subcorticolous); B: Mycophagy (Mushroom); C: Saprophagy; D: Necrophagy; E: Anthophagy; F: Frugivory; G: Tree sap; H: Predation; I: Inquiline; J: Herbivore;

0: This study; 1: Jeli'nek, 2002; 2: Jeli'nek, et al., 2010; 3: Lee et al., 2018; 4: Lee et al., 2015; 5: Robertson et al., 2004; 6: Dasgupta et al., 2015; 7: Kirejtshuk, 1992; 8: Audisio et al., 2009; 9: Kovac et al., 2007; 10: Lachance et al., 2001; 11: Cline et al., 2013; 12: Lee et al., 2017; 13: Bousquet, 2010; 14: Hammond et al., 2004; 15: Hisamatsu, 2016; 16: Audisio et al., 2008; 17: Williams et al., 1996; 18: Price et al., 2006;

3. Results

3.1. Phylogenetic analyses (fig. 7, fig. 8)

The tree from ML and BI analysis showed no difference in the subfamilial status topology. Monophyly of the family Nitidulidae was strongly supported by both analysis (ML/BI: 88/100). Kateretidae appeared as a sister group of Nitidulidae. Of the 9 subfamilis used in the analysis, only 6 subfamilies (Cryptarchinae, Prometopinae, Amphicrossinae, Carpophilinae, Cillaeinae, Meligethinae) were recovered as monophyletic in this study. Monophyly of Calonecrinae was not confirmed in this analysis because only one sample was used.

Cryptarchinae was found to be the most ancestral subfamily within Nitidulidae and their monophyly was strongly supported (ML/BI: 100/100). Prometopinae was not allied with Nitidulinae and highly supported as a distinct subfamily within Nitidulidae (ML/BI: 100/100). Calonecronae was grouped with Carpophilinae-lineage (Carpophlilinae, Amphicrossinae, and Epuraeinae). Epuraeinae was paraphyletic with in respect to Calonecrinae. Although the grouping of these two subfamilies were well supported (ML/BI: 99/100), the node of Epuraa and Trimenus within Epuraeinae was weakly supported (ML/BI: 38/99). Nitidulinae was polyphyletic with in respect to Meligethinae and Cillaeinae. Within the subfamily Nitidulinae, two clades were confirmed with a strong support (ML/BI: 99/100). First clade consisting of the Nitidula-complex, Soronia-complex, Thalykra and Meligethinae and the second clade consisting of the remaining Nitidulinae and Cillaeinae. In first clade, Soronia-complex was confirmed as a sister to the Meligethinae (ML/BI: 94/100). Cillaeinae located between Nitidulinae-part. Some

members of the Cyllodini were separated to basal part of the second clade.

3.2. Evolution of food preference (fig. 9)

The food preference assumption does not appear as a clear pattern at the Nitidulidae tree. The analysis indicates that the ancestral state could be at least three other feeding habits including Mycophagy, Frugivory and Tree sap (56%, 20%, 18%, respectively). The ancestral state is ambiguous, but there are some indications about the evolution of feeding habitus in family Nitidulidae. Most groups are clearly classified by the food preference. Some subfamilies (e.g. Prometopinae, Meligethinae, Cillaeinae, Carpophilinae) were consistent with food preferences, but others (e.g. Nitidulinae, Cryptarchinae) preferred various foods. Mycophagy frequently appeared in all main clades. Sap feeding and saprophagy have evolved at least four times and frugivory appears to be evolved at least three times.

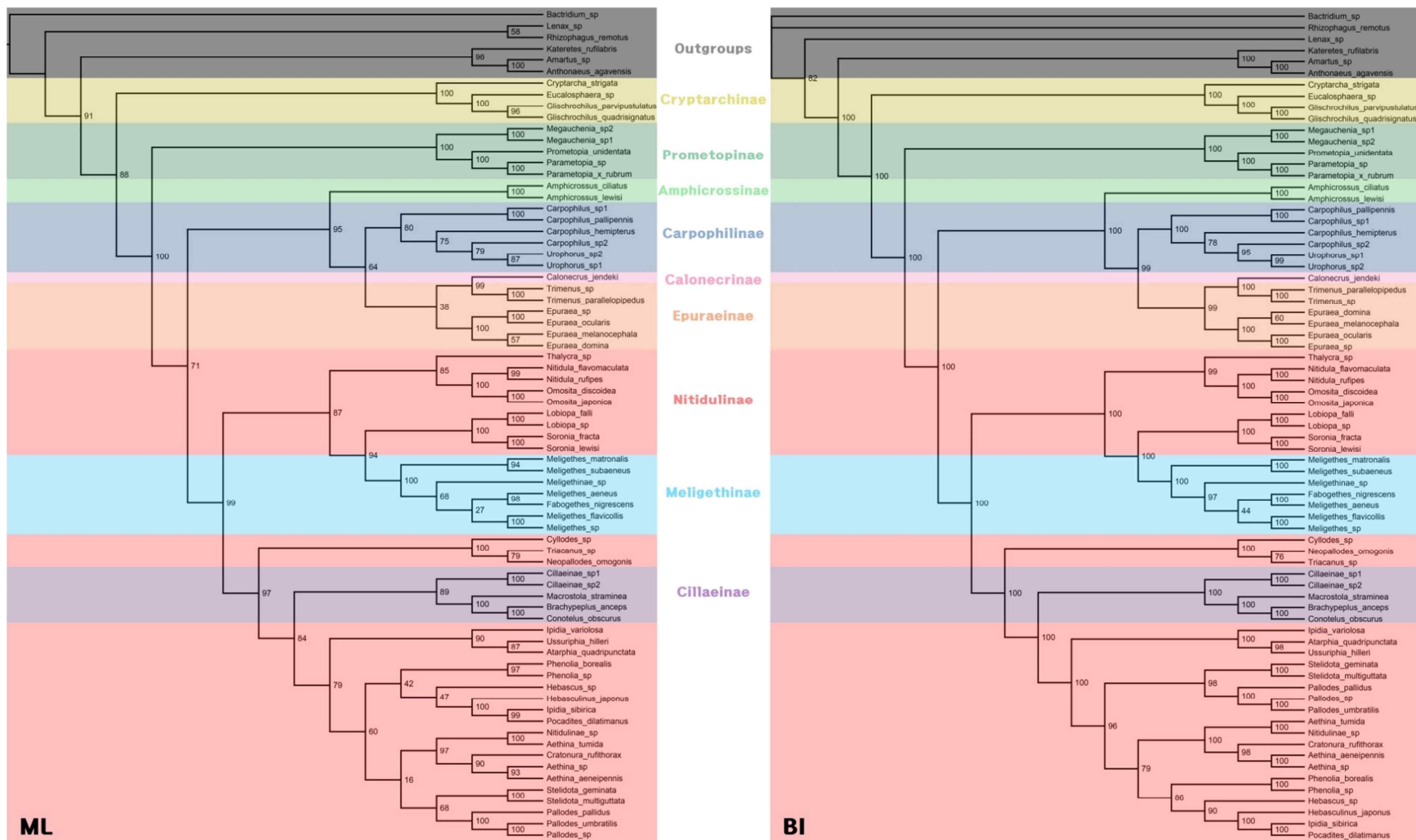


Fig. 7. Phylogenetic trees (ML, BI) indicating in subfamily level based on current classification

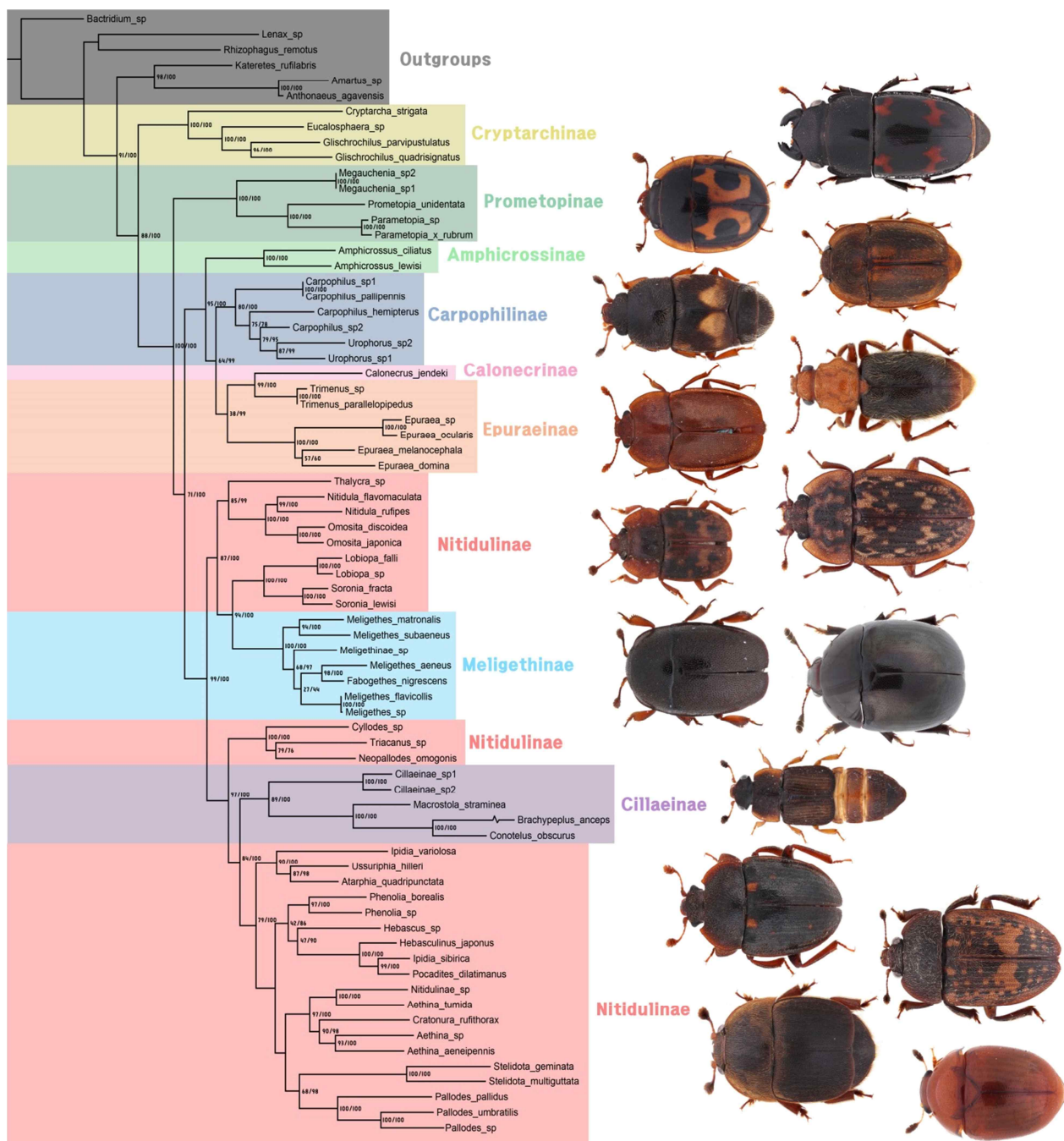


Fig. 8. Phylogenetic trees (ML/BI) of Nitidulidae

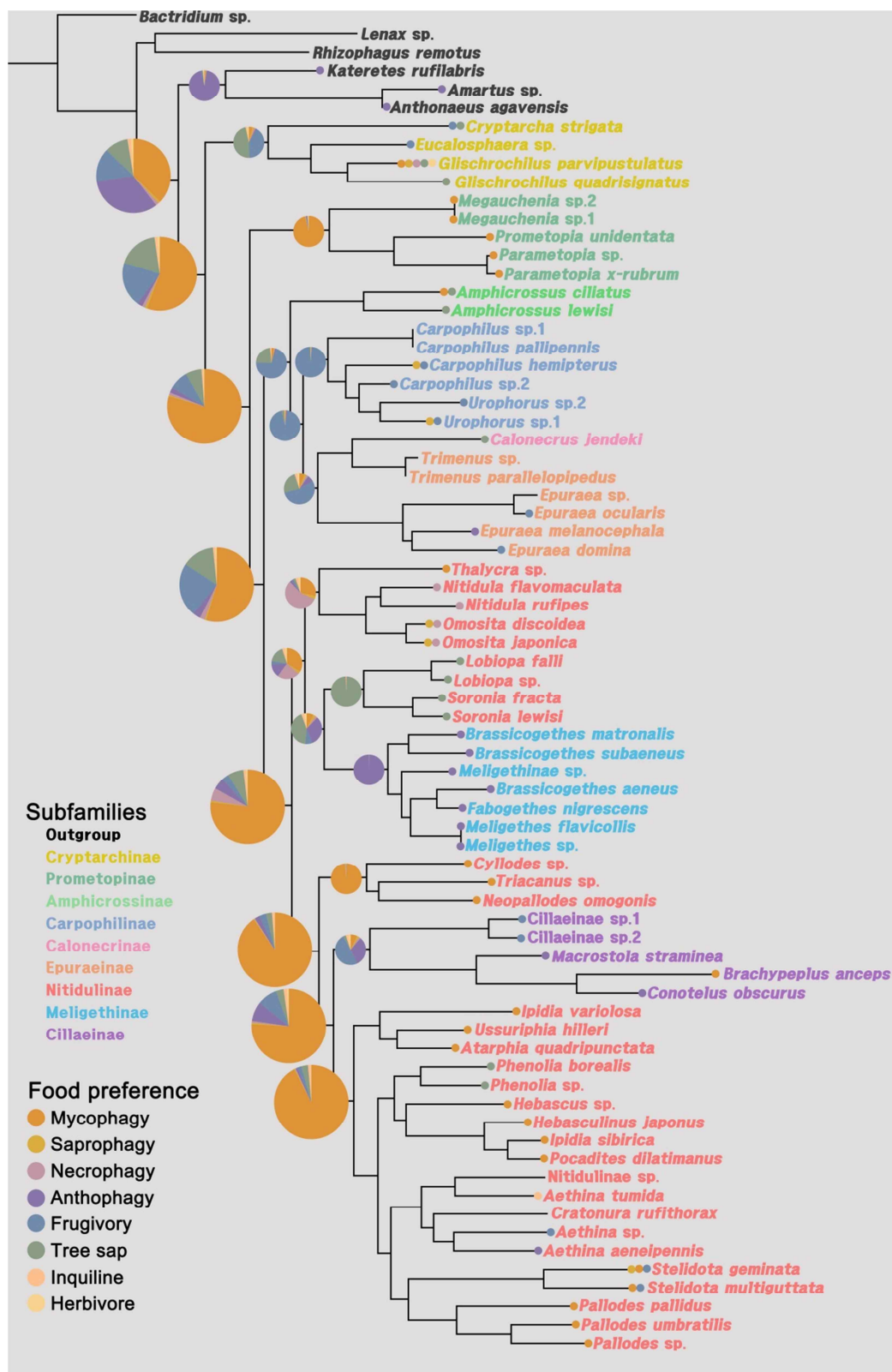


Fig. 9. Phylogenetic tree with ancestral character states of food preference

4. Discussion

The family Nitidulidae comprises approximately 342 genera and nearly 4000 species (Jeli'nek, et al., 2010; Cline et al., 2014). After Latreille (1802), several different subdivisions of the family have been proposed based on morphological characters as well as several phylogenetic hypotheses about the relationships between subfamilies. However, only a few phylogenetic analyses based on morphological characters by Kirejtshuk (1982, 1986 and 1995) and a molecular phylogeny proposed by Cline et al. (2014) have been performed. The family was generally accepted to be monophyletic on morphological grounds except for several taxa that are expected to belong to other families (e.g. Cybocephalidae) which are recently supported by the molecular phylogenetic study (Cline et al., 2014).

4.1. Cryptarchinae

Cryptarchinae was the best defined monophyletic group in Nitidulidae according to both morphologically and molecular data. In this study, Cryptarchinae appeared to be the most basal group of Nitidulidae. This is inconsistent with the assert proposed by Kirejtshuk's (2008) that Calonecrinae or Maynipepilinae would be the most ancestral. According to Cline et al (2014), the Calonecrinae and Maynipeplinae are probably closer to the Carpophilin lineage based on their morphological characteristics. Also In this study, Calonecrinae appeared very close to Epuraeinae. The diagnostic characters were as followed: 1) labrum fused with clypeus; 2) head with lateral margin of front more or less straight; 3) covering base of antenna in dorsal aspect 4) presence of an occipital stridulatory file. No

comprehensive analyses of immature stages to define the subfamily. However, most larvae of the subfamily appear to have branched urogomphi and pupae have elongate paired tubercles on the vertex of the head (Cline et al., 2014).

4.2. Prometopinae

The subfamily Prometopinae Böving and Craighead, 1931 was a small group of sap beetle. Prometopinae has a complicated history on its taxonomic status. The type species *Prometopia sexmaculata* (Say, 1825) was originally described as a member of Nitidulinae (Erichson, 1843). Prometopinae was elevated as a subfamily based solely on larval characters (Böving and Craighead 1931). Although Jelínek (1982) proposed the ‘Axyra-group’ of genera forming a monophyletic lineage, corresponding to Prometopinae, the subfamilial status has been largely ignored (Parsons, 1943; Audisio, 1993; Jelínek and Audisio, 2007; Kirejtshuk, 2005; Kirejtshuk, 2008). Recently, Prometopinae was resurrected by molecular phylogenetic evidences as well as some morphological evidences (Cline et al., 2014). The Prometopinae clade was apparently grouped out of the Nitidulinae, Amphicrossinae, Carpophilinae, Epuraeinae clade with high supporting values. Although, Kirejtshuk and Mantič, (2015) suggested that the characters proposed by Cline et al. (2014) were inconclusive for defining the subfamily Prometopinae and also pointed that the size of the data was insufficient to support the resurrection, Cline et al. (2014) has been generally accepted by many successive papers (Hisamatsu, 2013; Baviera and Audisio, 2014; Dasgupta et al., 2015; Lawrence,

2016; Navarrete-Heredia et al., 2016; Alekseev, 2017; Lee et al., 2018). Our study also supported the monophyly of Prometopinae, and they also appeared as a basal group among Nitidulidae following Cryptarchinae. The diagnostic characters were as followed: 1) paired postocular lateral sulci on head; 2) mentum broad and covering base of maxillae; 3) distinctly diverging femoral lines on abdominal ventrite I 4) meso- and metacoxae widely separated 5) tarsomeres simple, never bilobed or with densely setose 6) antennomere 3, more than 2 times longer than length of antennomere 2.

4.3. Carpophilinae+Amphicrossinae+Epuraeinae+Calonecrinae

Kirejtshuk (1995) suggested two groups: Carpophilinae- and Nitidulinae-lineages each characterized by genitalic characters. From his 1995 dendrogram, Calonecrinae was included in the Carpophilinae-lineage along with Epuraeinae, Capophilinae and Amphicrossinae. However, Kirejtshuk (2008) proposed that family Nitidulidae is classified into two groups (Carpophilinae-lineage, Nitidulinae-lineage and ambiguous group (Calonecrinae and Maynipeplinae)). Kirejtshuk (2008) also noted that although ambiguous group was a closely related with Nitidulidae, this group may be excluded from the Nitidulid family and changed into a separate family. However, our study does not support Kirejtshuk (2008)'s opinion for Calonecrinae. In our result, Epuraeinae is paraphyletic with inclusion of Calonecrinae. Due to insufficient amount of Calonecrinae used in our analysis, we did not include any taxonomical alternative at this study. Although the taxonomical state of Calonecrinae was ambiguous, some general conclusions about the

phylogenetic position can be made. Calonecrinae was highly intimate with Epuraeinae. However Calonecrinae can be classified with, the number of antennomeres (Calonecrinae: 10; Epuraeinae: 11), the characteristic shape of the pronotum, and the shape of the elytral margin. Also as suggested by Kirejtshuk in 1995, the genital characteristics appears to be conclusive to define the Carpophilinae-lineage. Our data suggests that this group needs additional testing and more samples numbers.

4.4. Nitidulinae+Meligethinae+Cillaeinae

In this study, Nitidulinae was paraphyletic with inclusion of Meligethinae and Cillaeinae. These results are very consistent with Cline's data. According to Cline et al. (2014), Cillaeinae and Meligethinae may need to be either subsumed as a tribe of Nitidulinae, or Nitidulinae should be divided into several subfamilies with Cillaeinae and Meligethinae maintaining subfamilial status. However, they do not make any classificatory changes with these taxa until more samples and data are included. Meligethinae is monophyletic group supported by both adult and larval synapomorphies (Audisio, 1993; Jelínek et al., 2010). The Cillaeinae was also well differentiated grouping of nitidulids. However, no hypotheses were suggested as to the phylogenetic position within Nitidulidae. According to our tree, Nitidulinae sensu lato (Nitidulinae, Meligethinae and Cillaeinae) was divided into 2 large groups, and Nitidulinae needs to be divided into at least 4 different subfamilies. Nitidula-complex and Thalycrea sp. were inclusion in the first node. The second node was containing Soronia-complex, which appear to be sister taxa of

Meligethinae. These three taxa were included in first large groups. The third node was containing several members of Cyllodini, and the next node was containing Cillaeinae species. The last node was containing every other nitidulinae members (e.g. Aethina, Pocadius, Phenolia, Ipdia), and these three taxa makes the second largest group. Each node was also clearly distinguished by their feeding habits. (Fig.9; Nitidulinae1: Necrophagy + Mycophagy (hypogean fungi); Nitidulinae2: Tree sap; Meligethinae: Anthophagy; Nitidulinae3: Mycophagy; Cillaeinae: Frugivory + Anthophagy; Nitidulinae4: Mycophagy + others). Although they were clearly grouped by feeding habits, additional studies based on morphological characters are necessary to define these taxons.

4.5. Evolution of food preference

The food preference assumption does not appear as a clear pattern at the Nitidulidae tree. However two of the three main feeding habits are highly relevant. Ingestion of sap almost always corresponds to the general mycophagous feeding strategy, which includes the consumption of yeast and other fermenting fungi. (Jelinek et al., 2010). If sap feeding is included in a wide range of mycophagy (74%), their ancestral feeding state can be mycophagy high probability. In addition, mycophagy appears at a high probability in all backbone nodes, indicating that their feeding behavior did not deviate significantly from mycophagy.

LITERATURES CITED

- ALEKSEEV, Vitalii I. (2017). Coleoptera from the middle-upper Eocene European ambers: generic composition, zoogeography and climatic implications. *Zootaxa*, 4290.3: 401-443.
- AUDISIO, Paolo, et al. (2008). Selected beetle families in natural forests and Norway spruce stands at Vincheto di Celarda Nature Reserve and the effects of conservation actions (Coleoptera). Research on the natural heritage of the Reserves Vincheto di Celarda and Val Tovanella (Belluno province, Italy). Conservation of two protected areas in the context of a LIFE project. *Quaderni Conservazione Habitat*, 5: 195-217.
- AUDISIO, Paolo, et al. (2009). Preliminary re-examination of genus-level taxonomy of the pollen beetle subfamily Meligethinae (Coleoptera: Nitidulidae). *Acta Entomologica Musei Nationalis Pragae*, 49.2: 341-504.
- AUDISIO, Paolo. (1993). Coleoptera Nitidulidae-Kateretidae. *Fauna d'Italia*, 32.
- AUDISIO, Paolo; SABATELLI, Simone; JELÌNEK, Josef. (2014). Revision of the pollen beetle genus *Meligethes* (Coleoptera: Nitidulidae). *Fragmenta entomologica*, 46.1-2: 19-112.
- BAVIERA, Cosimo; AUDISIO, Paolo. (2014). The Nitidulidae and Kateretidae (Coleoptera: Cucujoidea) of Sicily: recent records and updated checklist. *Atti della Accademia Peloritana dei Pericolanti-Classe di Scienze Fisiche, Matematiche e Naturali*, 92.2.
- BOCAK, Ladislav, et al. (2014). Building the Coleoptera tree-of-life for > 8000

- species: composition of public DNA data and fit with Linnaean classification. *Systematic Entomology*, 2014, 39.1: 97-110.
- BOUSQUET, Y., (2010). 10.8. Monotomidae Laporte, 1840. In *Handbook of Zoology. Coleoptera, Vol. II*. Leschen, R.A.B. & Beutel, R.G., eds, De Gruyter, Berlin, New York, 319–324.
- BÖVING, A. G.; CRAIGHEAD, F. S. (1930). An illustrated synopsis of the principal larval forms of the order.
- Böving, A.G. & Craighead, F.C. (1931) An illustrated synopsis of the principal larval forms of the order Coleoptera. *Entomologica Americana (New Series)*, 11, 1–351.
- CARLTON, Chris; LESCHEN, Richard AB. (2007). Descriptions of *Soronia* complex (Coleoptera: Nitidulidae: Nitidulinae) larvae of New Zealand with comments on life history and taxonomy. *New Zealand Entomologist*, 30.1: 41-51.
- CHUJO, Michitaka; LEE, Chang Eon. (1992). Nitidulidae from Chejudo Island. *Esakia: occasional papers of the Hikosan Biological Laboratory in Entomology*, 32: 19-24.
- CHUJO, Michitaka; LEE, Chang Eon. (1994). Nitidulidae from Korea (Coleoptera, Insecta). *Esakia*, 34: 195-202.
- CLINE, Andrew R. (2005). Revision of *Pocadius* Erichson (Coleoptera: Nitidulidae).
- CLINE, Andrew R., et al. (2014). Molecular phylogeny of Nitidulidae: assessment

of subfamilial and tribal classification and formalization of the family Cybocephalidae (Coleoptera: Cucujoidea). *Systematic Entomology*, 39.4: 758-772.

CLINE, Andrew R.; POWELL, Gareth S.; AUDISIO, Paolo R. (2015). Beetles (Coleoptera) of Peru: A Survey of the Families. Nitidulidae. *Journal of the Kansas Entomological Society*, 88.2: 217-220.

CLINE, Andrew R.; SKELLEY, Paul E.; AUDISIO, Paolo. (2013). Morphology and life history of *Brachypeplus glaber* LeConte (Coleoptera: Nitidulidae), with a discussion of multiple life stage data for phylogenetic analyses. *Zootaxa*, 3734.2: 259-272.

COLGAN, D. J., et al. (1998). Histone H3 and U2 snRNA DNA sequences and arthropod molecular evolution. *Australian Journal of Zoology*, 46.5: 419-437.

DASGUPTA, J.; PAL, T. K.; HEGDE, V. D. (2015). Review of the *Megauchenia* Macleay of India (Coleoptera: Nitidulidae: Prometopinae). *Zootaxa*, 4058.4: 551-560.

Erichson W. F. (1843). Versuch einer systematischen Eintheilung der Nitidularien. *Zeitschrift für die Entomologie*, 4:225-361

ERICHSON, W. F. (1843). Versuch einer systematischen Einteilung der Nitidularien. *German Zeitschrift für die Entomologie*, 4: 225-361.

Everts E. J. G. (1898). *Coleoptera Neerlandica. De Schildvleugeligen insecten van Nederland en het aangrenzende gebied. Erste deel.* 'S Gravenhage: Martinus Nijhoff, [8] + 676 + [1] pp.

- Fabricius J. C. (1787). *Mantissa insectorum sistens eorum species nuper detectas adjectis characteribus genericis, differentiis specificis, emendationibus, observationibus*. Tom II. Haffniae: Christ. Gottl. Proft, 382 pp.
- Fabricius, J. C. (1775). *Systema entomologiae, sistens insectorum classes, ordines, genera, species, adjectis synonymis, locis, descriptionibus, observationibus*. Kort.
- Fairmaire L. (1891). Coléoptères de l'interieur de la Chine (Suite: 7e partie). *Bulletin ou Compte Rendus des Seances de la Société Entomologique de Belgique* 35: clxxxvii-ccxxiii.
- Ganglbauer L. (1899). *Die Kafer von Mitteleuropa. Die Kafer der österreichisch-ungarischen Monarchie, Deutschlands, der Schweiz, sowie des französ'schen und italienischen Alpengebietes. Familienreihe Clavicornia. Sphaeritidae, Ostomidae, Byturidae, Nitidulidae, Cucujidae, Erotylidae, Phalacridae, Thorictidae, Lathridiidae, Mycetophagidae, Colydiidae, Endomychidae, Coccinellidae*. Volume III. Wien: C. Gerald's Sohn, iii + 1046 pp.
- HABECK, D. H. (2002). 77. Nitidulidae Latreille 1802. *American beetles*, 2, 311-315.
- HAMMOND, HE James; LANGOR, David W.; SPENCE, John R. (2004). Saproxylic beetles (Coleoptera) using *Populus* in boreal aspen stands of western Canada: spatiotemporal variation and conservation of assemblages. *Canadian Journal of Forest Research*, 34.1: 1-19.
- Herbst J. F. W. (1792). *Natursystem aller bekannten in- und ausländischen insecten*,

als eine Fortsetzung der von Büffonschen Naturgeschichte. Der Käfer vierter Theil. Berlin: J. Pauli, viii + 197 pp., 12 pis.

HISAMATSU, S. (1953). The insect fauna of Mt. Ishizuchi and Omogo valley, Iyo, Japan. The Nitidulidae. Transactions of the Shikoku Entomological Society 3: 139-143.

HISAMATSU, S. (1959). The genus *Prometopia* in Japan (Coleoptera: Nitidulidae). Memoirs of Ehime University Matsuyama, 6, pp. 115-117

HISAMATSU, S. (1959). The genus *Prometopia* in Japan (Coleoptera: Nitidulidae). Memoirs of the Ehime University, Section VI. {Agriculture} 4: 21-23.

HISAMATSU, S. (1968). The genus *Lasiodactylus* Perty in Japan (Coleoptera: Nitidulidae). Transactions of the Shikoku Entomological Society 18: 11-14.

HISAMATSU, Sadatomo. (2013). A review of the Japanese Cybocephalidae (Coleoptera: Cucujoidea). Zootaxa, 3616.3: 253-267.

HISAMATSU, Sadatomo. (2016). A revision of Japanese Epuraeinae (Coleoptera, Nitidulidae). Part I. Epuraea subgenera: *Dadopora* Thomson, *Epuraea* Erichson, and *Epuraeanella* Crotch. Zootaxa, 4080.1: 1-100.

JELÍNEK, J. (1974). Generic reclassification of oriental Cryptarchinae (Coleoptera, Nitidulidae). Acta Entomologica Bohemoslovaca.

JELÍNEK, J. (1982). New and little known taxa of Nitidulidae (Coleoptera). Sborník-Narodní museum, Oddíl přírodovědy. Rada B. Přírodní vědy.

JELÍNEK, J. (1999). Contribution to taxonomy of the beetle subfamily Nitidulinae

- (Coleoptera. Nitidulidae). *Folia Heyrovskyana* 7: 251-281.
- JELÍNEK, J. (2007). Family Nitidulidae. *Catalogue of Palaearctic Coleoptera*, 459-491.
- JELÍNEK, J., Carlton, C.E., Cline, A.R. & Leschen, R.A.B. (2010). Nitidulidae Latreille, 1802. In: *Handbook of Zoology. Vol. IV. Arthropoda: Insecta, Part 38. Coleoptera, Beetles* (ed. by R.A.B. Leschen, R.G. Beutel and J.F. Lawrence), pp. 390–407. Walter deGruyter GmbH & Co., Berlin.
- JELÍNEK, J., et al. (2002). *Calonecrus jendeki* sp. n. (Coleoptera: Nitidulidae: Calonecrinae) from Laos. *Folia Heyrovskyana*, 10.4: 155-160.
- JELINEK, Josef; JIA, Fenglong; HÁJEK, Jiří. (2012). A new species of the genus *Atarphia* (Coleoptera: Nitidulidae) from China. *ACTA ENTOMOLOGICA MUSEI NATIONALIS PRAGAE*, 52.2: 467-474.
- KATOH, Kazutaka, et al. (2002). MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. *Nucleic acids research*, 30.14: 3059-3066.
- KATOH, Kazutaka; ROZEWICKI, John; YAMADA, Kazunori D. (2017). MAFFT online service: multiple sequence alignment, interactive sequence choice and visualization. *Briefings in bioinformatics*.
- KIM, Choong-Gon, et al. (2000). Pattern of morphological diversification in the *Leptocarabus* ground beetles (Coleoptera: Carabidae) as deduced from mitochondrial ND5 gene and nuclear 28S rDNA sequences. *Molecular Biology and Evolution*, 17.1: 137-145.

- KIREJTSHUK, A. G. (1982). Systematic position of the genus *Calonecrus* J. Thomas and notes on the phylogeny of the family Nitidulidae (Coleoptera). Entomologicheskoye Obozreniye 61: 117-129. Russian, English translation in Entomological Review, 61: 109-122.
- KIREJTSHUK, A. G. (1986a). Analysis of structure of genitalia for reconstruction of phylogeny and substantiation of system of the family of sap beetles (Nitidulidae, Coleoptera). Proc. All-Union Ent. Soc, 68: 22-28.
- KIREJTSHUK, A. G. (1986b). On polyphyly of the Carpophilinae with description of a new subfamily, Cillaeinae (Coleoptera: Nitidulidae). The Coleopterists' Bulletin, 217-221.
- KIREJTSHUK, A. G. (1987). New species of the *Cyllodes* complex of genera (Coleoptera, Nitidulidae) from Indochina and adjacent territories. Entomofauna Vietnam, 137-170.
- KIREJTSHUK, A. G. (1987). Novye vidy kompleksa rodov, blizkikh k *Cyllodes* Erichson (Coleoptera, Nitidulidae) iz Indokitaya i sopredel'nykh stran [New species of the complex of genera related to *Cyllodes* Erichson (Coleoptera, Nitidulidae) from Indochina and adjacent countries]. Pp. 137-170.
- KIREJTSHUK, A. G. (1992). 59., 61. Sem. Nitidulidae - Blestyanki. Pp. 114-209; 60. Sem. Kateretidae - Kateretidy. Pp. 210-216.
- KIREJTSHUK, A. G. (1992). The insects of the USSR Far East. III Coleoptera, 2. Nitidulidae, Kateretidae. Russian Acad. of Sci., St. Petersburg, «Nauka, 114-216.
- KIREJTSHUK, A. G. (1995). System, Evolution of the Way of Life, and Phylogeny

- of the Order Coleoptera. I. Entomological Review, 74.3: 12-31.
- KIREJTSHUK, A. G. (1998). Position of the subfamily Maynipeplinae subfamily n. from equatorial Africa in the classification of sap-beetles (Coleoptera, Nitidulidae) with notes on the evolution and structural modifications. Entomologicheskoe Obozrenie, 77: 540-554.
- KIREJTSHUK, A. G. (2005). On the fauna of Nitidulidae (Insecta, Coleoptera) from Taiwan with some taxonomical notes. In Annales Historico-Naturales Musei Nationalis Hungarici (Vol. 97, pp. 51-113).
- KIREJTSHUK, A. G. (2008). A current generic classification of sap beetles (Coleoptera, Nitidulidae). Zoosystematica Rossica, 17.1: 107-122.
- KIREJTSHUK, A. G.; MANTIČ, M. (2015). On systematics of the subfamily Cybocephalinae (Coleoptera: Nitidulidae) with description of new species and generic taxa. Труды Зоологического института РАН, 319.2: 196-214.
- KIREJTSHUK, Alexander Georgievich; LAWRENCE, John Francis. (1999). Notes on the Aetina complex (Coleoptera: Nitidulidae: Nitidulinae), with a review of Aetina (Cleidorura) subgen. nov. and Aetina (Idaethina) Gemminger et Harold. In: Annales Zoologici. Muzeum i Instytut Zoologii PAN, p. 233-254.
- KIREJTSHUK, Alexander Georgievich; LESCHEN, Richard AB. (1998). Review of the Thalycrea complex (Coleoptera: Nitidulinae) with three new genera and notes on mycophagy. In: Annales zoologici. Muzeum i Instytut Zoologii Polskiej Akademii Nauk, p. 253-273.
- KOVAC, Damir, et al. (2007). Transition from bamboo sap to water: Aquatic habits in the sap beetle *Amphicrosus japonicus* (Coleoptera: Cucujoidea:

- Nitidulidae). *European Journal of Entomology*, 104.3: 635.
- Kugelann J. G. (1794). Verzeichniss der in einigen Gegenden Preussens bis jetzt entdeckten Käferarten, nebst kurzen Nachrichten von denselben. *Neuestes Magazin für die Liebhaber der Entomologie* 1 (5): 513-582.
- KUMAR, Sudhir; STECHER, Glen; TAMURA, Koichiro. (2017). MEGA7: molecular evolutionary genetics analysis version 7.0 for bigger datasets. *Molecular biology and evolution*, 33.7: 1870-1874.
- KUROSAWA, Y.; HISAMATSU, S.; SASAJI, H. (1985). *Colored Illustrations of the Coleoptera of Japan*, Vol. 3. Hoikusha, Osaka.
- LACHANCE, Marc-André, et al. (2001). Biogeography of the yeasts of ephemeral flowers and their insects. *FEMS yeast research*, 1.1: 1-8.
- LANFEAR, Robert, et al. (2016). PartitionFinder 2: new methods for selecting partitioned models of evolution for molecular and morphological phylogenetic analyses. *Molecular Biology and Evolution*, 34.3: 772-773.
- LATREILLE, P. A. (1802). *Histoire naturelle, générale et particulière des crustacés et des insectes: ouvrage faisant suite aux oeuvres de Leclerc de Buffon, et partie du cours complet d'histoire naturelle rédigé par C. S. Sonnini. F. Dufart*, Paris, France.
- LAWRENCE, J. F. (2016). 2 Classification (families & subfamilies). *Coleoptera, Beetles. Morphology and Systematics*, 1854.
- LEE, Min Hyeuk, et al. (2018). New record of subfamily Prometopinae (Coleoptera: Cucujoidea: Nitidulidae) in Korea. *Journal of Asia-Pacific Entomology*, 21.1:

239-243.

LEE, Seunghyun, et al. (2015). Review of the genus *Omosita* Erichson (Coleoptera: Nitidulidae: Nitidulinae) in Korean fauna, with key to the Palaearctic species. *Journal of Asia-Pacific Entomology*, 18.4: 837-843.

LEE, Seunghyun, et al. (2017). Review of the subgenus *Aethina* Erichson s. str.(Coleoptera: Nitidulidae: Nitidulinae) in Korea, reporting recent invasion of small hive beetle, *Aethina tumida*. *Journal of Asia-Pacific Entomology*, 20.2: 553-558.

LINNAEUS, C. (1767). *Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis.* Typis Ioannis Thomae.

LINNAEUS, C. (1758). *Systema Naturae*, edition X, vol. 1 (*Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio decima, reformata*). Holmiae Salvii, 824.

MacLeay W. S. (1825). *Annulosa Javanica, or an attempt to illustrate the natural affinities and analogies of the insects collected in Java by Thomas Horsfield, M. D. F. L & G. S. and deposited by him in the Museum of the Honourable East-India Company. Number 1.* London: Kingsbury, Parbury, and Allen, xii + 50 pp., 1 pi.

MCKENNA, Duane D., et al. (2015). Phylogeny and evolution of Staphyliniformia and Scarabaeiformia: forest litter as a stepping stone for diversification of nonphytophagous beetles. *Systematic Entomology*, 40.1: 35-60.

- MILLER, Mark A., et al. (2015). A RESTful API for access to phylogenetic tools via the CIPRES science gateway. *Evolutionary Bioinformatics*, 11: EBO. S21501.
- Murray A. (1867). List of Coleoptera received from Old Calabar, on the West Coast of Africa. *The Annals and Magazine of Natural History* (3) 19: 167-180.
- Nakane T. (1967). New and little known Coleoptera from Japan and its adjacent regions, XXIV. *Fragmenta Coleopterologica* 17: 67-69.
- NAVARRETE-HEREDIA, J. L., & Cline, A. R. (2016). First Record of *Pocadius niger* Parsons, 1936 (Coleoptera: Nitidulidae) in Mexico. *The Coleopterists Bulletin*, 70(2), 382-383.
- ÖZDEMİR, Senem; SERT, Osman. (2008). Systematic studies on male genitalia of Coleoptera species found on decomposing pig (*Sus scrofa* L.) carcasses at Ankara Province. *Hacettepe Journal of Biology and Chemistry*, 36(2), 137-161.
- PAGEL, M.; MEADE, (2007). A. BayesTraits. Computer program and documentation available at <http://www.evolution.rdg.ac.uk/BayesTraits.Html>.
- PARSONS, Carl T. (1943). A revision of nearctic Nitidulidae (Coleoptera) with thirteen plates. The Museum.
- POWELL, G. S. (2015). A checklist of the sap beetle (Coleoptera: Nitidulidae) fauna of Indiana, with notes on effective trapping methods.
- PRICE, Michele B.; YOUNG, Daniel K. (2006). An annotated checklist of Wisconsin sap and short-winged flower beetles (Coleoptera: Nitidulidae,

Kateretidae).

RAMBAUT, A.; DRUMMOND, A. J. (2007). Tracer v1. 4: MCMC trace analyses tool. See <http://tree.bio.ed.ac.uk/software/tracer>.

Reitter E. (1873). Systematische Eintheilung der Nitidularien. Verhandlungen des Naturforschenden Vereins in Brünn 12 (1): 3-194.

Reitter E. (1877a). [new taxa]. In: Putzeys J. A. A. H., Weise J., Kraatz G., Reitter E. & Eichhoff W.: Beiträge zur Käferfauna von Japan, meist auf R. Hiller's Sammlungen basirt (Erstes Stück). Deutsche Entomologische Zeitschrift 21: 81-128.

Reitter E. (1877b). Beiträge zur Käferfauna von Japan. (Drittes Stück.). Deutsche Entomologische Zeitschrift 21: 369-384.

Reitter E. (1878). *Strongylus literatus* n. sp. Deutsche Entomologische Zeitschrift 22: 89.

Reitter E. (1879). Verzeichniss der von H. Christoph in Ost-Sibirien gesammelten Clavicomier etc. Deutsche Entomologische Zeitschrift 23: 209-226.

Reitter E. (1884). Die Nitiduliden Japans. Wiener Entomologische Zeitung 3: 257-272, 299-302.

Reitter, E. (1874). Beschreibungen neuer Käfer-Arten nebst synonymischen Notizen. Alfred Hölder.

Reitter, E. (1884). Die Nitiduliden Japans. Wiener Entomologische Zeitung, 3, 257-272.

- ROBERTSON, James A., et al. (2015). Phylogeny and classification of Cucujoidea and the recognition of a new superfamily Coccinelloidea (Coleoptera: Cucujiformia). *Systematic Entomology*, 40.4: 745-778.
- ROBERTSON, James A.; MCHUGH, Joseph V.; WHITING, Michael F. (2004). A molecular phylogenetic analysis of the pleasing fungus beetles (Coleoptera: Erotylidae): evolution of colour patterns, gregariousness and mycophagy. *Systematic Entomology*, 29.2: 173-187.
- RONQUIST, Fredrik, et al. (2012). MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. *Systematic biology*, 61.3: 539-542.
- SAY, Thomas. (1825). *Descriptions of New Hemipterous Insects, Collected in the Expedition to the Rocky Mountains, Performed by Order of Mr. Calhoun, Secretary of War, Under Command of Major Long: Read 1824.*
- SHIN, Y. H.; YOON, I. B. (1994). *Check list of insects from Korea.* Kon-Kuk University Press, Seoul, 362-363.
- SIMON, Chris, et al. (1994). Evolution, weighting, and phylogenetic utility of mitochondrial gene sequences and a compilation of conserved polymerase chain reaction primers. *Annals of the entomological Society of America*, 87.6: 651-701.
- STAMATAKIS, Alexandros. (2014). RAXML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. *Bioinformatics*, 30.9: 1312-1313.
- Walker F. (1859). *Characters of some apparently undescribed Ceylon Isects.* The

Annals and Magazine of Natural History (3) 3: 50-56, 258-265.

WILD, Alexander L.; MADDISON, David R. (2008). Evaluating nuclear protein-coding genes for phylogenetic utility in beetles. *Molecular phylogenetics and evolution*, 48.3: 877-891.

WILLIAMS, Roger N., et al. (1996) A migration study of *Stelidota geminata* (Coleoptera: Nitidulidae). *Great Lakes Entomologist*, 29.1: 31.

Wollaston T. V. (1854). *Insecta Maderensia; being an account of the insects of the Islands of the Madeiran Group*. London: J. van Voorst, xlv + 634 pp., 13 pis.

PLATES

Plate 1 (Fig. 10: Nitidulini 1)

Nitidula rufipes (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Omosita colon (e: male dorsal; f: male ventral; g: female dorsal; h: female ventral)

Plate 2 (Fig. 11: Nitidulini 2)

Omosita japonica (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Omosita discoidea (e: male dorsal; f: male ventral; g: female dorsal; h: female ventral)

Plate 3 (Fig. 13: Nitidulini 3)

Soronia fracta (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Soronia grisea (e: male dorsal; f: male ventral; g: female dorsal; h: female ventral)

Plate 4 (Fig. 14: Nitidulini 4)

Soronia lewisi (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Stelidota multiguttata (e: male dorsal; f: male ventral; g: female dorsal; h: female ventral)

Plate 5 (Fig. 15: Nitidulini 5)

Ipidia sibirica (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Ipidia variolosa (e: male dorsal; f: male ventral; g: female dorsal; h: female ventral)

Plate 6 (Fig. 16: Nitidulini 6)

Phenolia borealis (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Phenolia picta (e: male dorsal; f: male ventral; g: female dorsal; h: female ventral)

Plate 7 (Fig. 17: Nitidulini 7)

Ussuriphia hilleri (a: male dorsal; b: male ventral)

Aethina aeneipennis (c: female dorsal; d: female ventral)

Aethina inconspicua (e: female dorsal; f: female ventral)

Aethina flavicollis (g: male dorsal; h: male ventral)

Plate 8 (Fig. 18: Nitidulini 8)

Aethina tumida (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Atarphia fasciculata (e: female dorsal; f: female ventral)

Atarphia quadripunctata (g: female dorsal; h: female ventral)

Plate 9 (Fig. 19: Nitidulini 9)

Hebasculinus japonus (a: male dorsal; b: male ventral; c: female dorsal; d: female ventral)

Pocadites dilatimanus (e: female dorsal; f: female ventral; g: variant form dorsal; h: variant form ventral)

Plate 10 (Fig. 20: Nitidulini 10)

Pocadites rufobasalis (a: dorsal; b: ventral)

Physoronia japonica (c: dorsal; d: ventral)

Pocadius nobilis (e: dorsal; f: ventral)

Plate 11 (Fig. 21: Cychramini)

Cychramus luteus (a: dorsal; b: ventral)

Cychramus variegatus (c: dorsal; d: ventral)

Xenostrogylus variegatus (e: dorsal; f: ventral)

Plate 12 (Fig. 22: Cyllodini 1)

Cyllodes ater (a: dorsal; b: ventral)

Cyllodes bifascies (c: dorsal; d: ventral)

Cyllodes dubius (e: dorsal; f: ventral)

Cyllodes literatus (g: dorsal; h: ventral)

Plate 13 (Fig. 23: Cyllodini 2)

Cyllodes sp. nov. (a: dorsal; b: ventral)

Pallodes umbratilis (c: dorsal; d: ventral)

Pallodes sp. nov. (e: dorsal; f: ventral)

Coxollobes cyrtusoides (g: dorsal; h: ventral)

Plate 14 (Fig. 24: Cyllodini 3)

Neopallodes omogonis (a: dorsal; b: ventral; c: variant form 1 dorsal; d: variant form 1 ventral; e: variant form 2 dorsal; f: variant form 2 ventral)

Neopallodes vicinus (e: dorsal; f: ventral)

Plate 15 (Fig. 25: Prometopinae)

Parametopia x-rubrum (a: dorsal; b: ventral)

Prometopia unidentata (c: male dorsal; d: male ventral; e: female dorsal; f: female ventral)

Plate 16 (Fig. 26: Prosternal process 1)

A: *Nitidula rufipes*; B: *Omosita colon*; C: *Omosita japonica*; D: *Omosita discoidea*; E: *Soronia fracta*; F: *Soronia grisea*; G: *Soronia lewisi*; H: *Ipidia sibirica*; I: *Ipidia variolosa*; J: *Stelidota multiguttata*; K: *Phenolia borealis*; L: *Phenolia picta*; M: *Ussuriphia hilleri*; N: *Aethina aeneipennis*; O: *Aethina inconspicua*; P: *Aethina flavicollis*; Q: *Aethina tumida*; R: *Atarphia fasciculata*; S: *Atarphia quadripunctata*; T: *Hebasculinus japonus*.

Plate 17 (Fig. 27: Prosternal process 2)

A: *Physoronia japonica*; B: *Pocadites dilatimanus*; C: *Pocadites rufobasalis*; D: *Pocadius nobilis*; E: *Cychramus luteus*; F: *Cychramus variegatus*; G: *Xenostromylus variegatus*; H: *Cyllodes ater*; I: *Cyllodes bifascies*; J: *Cyllodes*

dubius; K: *Cyllodes literatus*; L: *Cyllodes* sp. nov.; M: *Pallodes umbratilis*; N: *Pallodes* sp. nov.; O: *Coxollodes cyrtusoides*; P: *Neopallodes omogonis*; Q: *Neopallodes vicinus*; R: *Parametopia x-rubrum*; S: *Prometopia unidentata*.

Plate 18 (Fig. 28: Male Genitalia: median lobe)

1: *Nitidula rufipes*; 2: *Omosita colon*; 3: *Omosita japonica*; 4: *Omosita discoidea*; 5: *Soronia fracta*; 6: *Soronia grisea*; 7: *Soronia lewisi*; 8: *Ipidia sibirica*; 9: *Ipidia variolosa*; 10: *Stelidota multiguttata*; 11: *Phenolia borealis*; 12: *Phenolia picta*; 13: *Ussuriphia hilleri*; 14: *Aethina aeneipennis*; 15: *Aethina inconspicua*; 16: *Aethina flavicollis*; 17: *Aethina tumida*; 18: *Hebasculinus japonus*; 19: *Physoronia japonica*; 20: *Pocadites dilatimanus*; 21: *Pocadius nobilis*; 22: *Cyllodes ater*; 23: *Cyllodes bifascies*; 24: *Cyllodes dubius*; 25: *Cyllodes literatus*; 26: *Cyllodes* sp. nov.; 27: *Coxollodes cyrtusoides*; 28: *Pallodes umbratilis*; 29: *pallodes* sp. nov.; 30: *Neopallodes omogonis*; 31: *Parametopia x-rubrum*; 32: *Prometopia unidentata*.

Plate 19 (Fig. 29: Male Genitalia: tegman)

1: *Nitidula rufipes*; 2: *Omosita colon*; 3: *Omosita japonica*; 4: *Omosita discoidea*; 5: *Soronia fracta*; 6: *Soronia grisea*; 7: *Soronia lewisi*; 8: *Ipidia sibirica*; 9: *Ipidia variolosa*; 10: *Stelidota multiguttata*; 11: *Phenolia borealis*; 12: *Phenolia picta*; 13: *Ussuriphia hilleri*; 14: *Aethina aeneipennis*; 15: *Aethina inconspicua*; 16: *Aethina flavicollis*; 17: *Aethina tumida*; 18: *Hebasculinus japonus*; 19: *Physoronia japonica*; 20: *Pocadites dilatimanus*; 21: *Pocadius nobilis*; 22: *Cyllodes ater*; 23: *Cyllodes bifascies*; 24: *Cyllodes dubius*; 25: *Cyllodes literatus*; 26: *Cyllodes* sp. nov.; 27: *Coxollodes cyrtusoides*; 28: *Pallodes umbratilis*; 29: *pallodes* sp. nov.; 30: *Neopallodes omogonis*; 31: *Parametopia x-rubrum*; 32: *Prometopia unidentata*.

Plate 20 (Fig. 30: Female ovipositor)

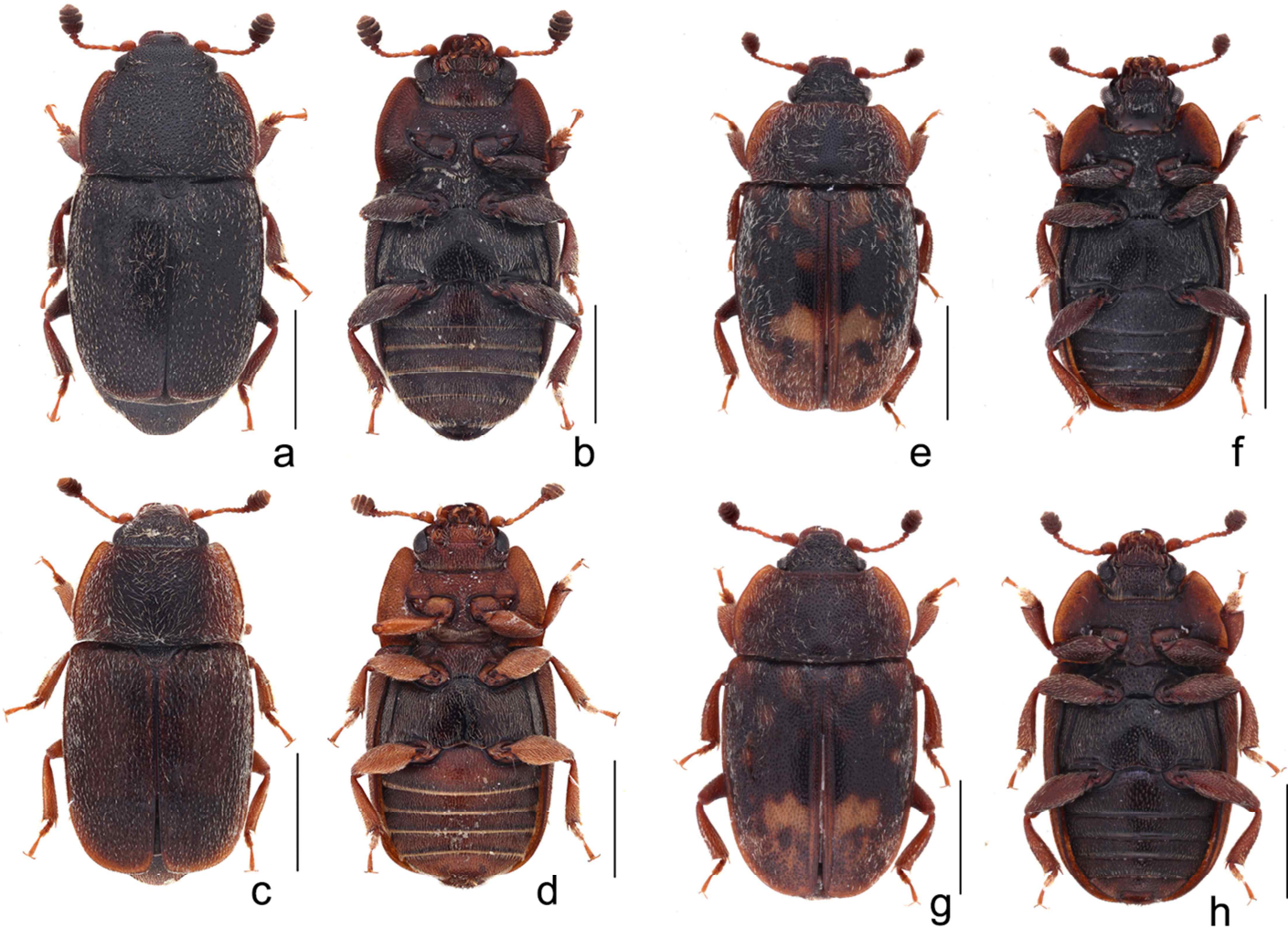
1: *Nitidula rufipes*; 2: *Omosita colon*; 3: *Omosita japonica*; 4: *Omosita discoidea*; 5: *Soronia fracta*; 6: *Soronia grisea*; 7: *Soronia lewisi*; 8: *Ipidia sibirica*; 9: *Ipidia variolosa*; 10: *Stelidota multiguttata*; 11: *Phenolia borealis*; 12: *Phenolia picta*; 13: *Aethina aeneipennis*; 14: *Aethina inconspicua*; 15: *Aethina flavicollis*; 16: *Aethina tumida*; 17: *Atarphia fasciculata*; 18: *Atarphia quadripunctata*; 19: *Hebasculinus japonus*; 20: *Pocadites dilatimanus*; 21: *Pocadius nobilis*; 22: *Cyllodes ater*; 23: *Cyllodes bifascies*; 24: *Cyllodes dubius*; 25: *Cyllodes literatus*; 26: *Cyllodes* sp. nov.; 27: *Coxollodes cyrtusoides*; 28: *Pallodes umbratilis*; 29: *pallodes* sp. nov.; 30: *Neopallodes omogonis*; 31: *Parametopia x-rubrum*; 32: *Prometopia unidentata*.

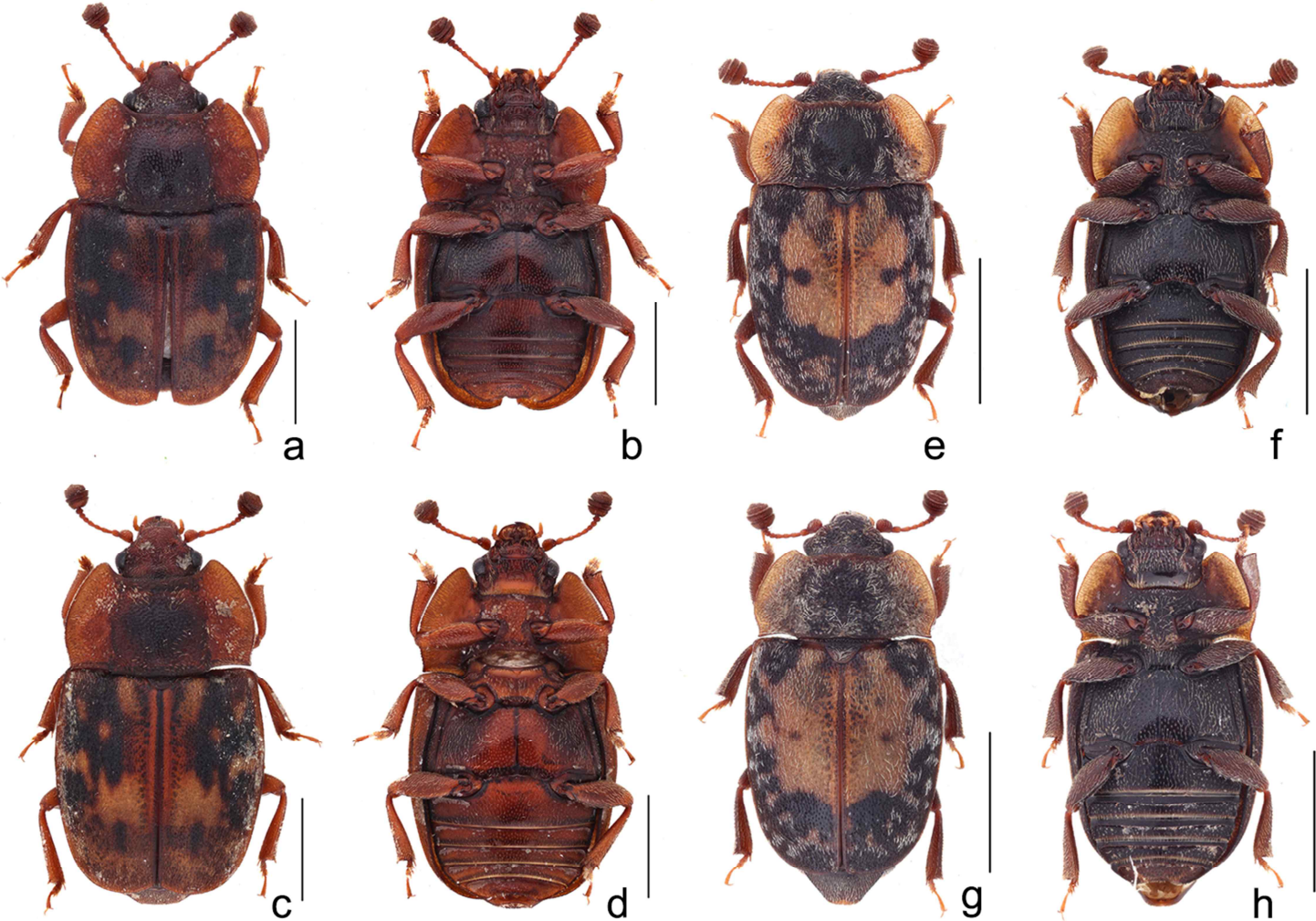
Plate 21 (Fig. 31: Habitats of new record species)

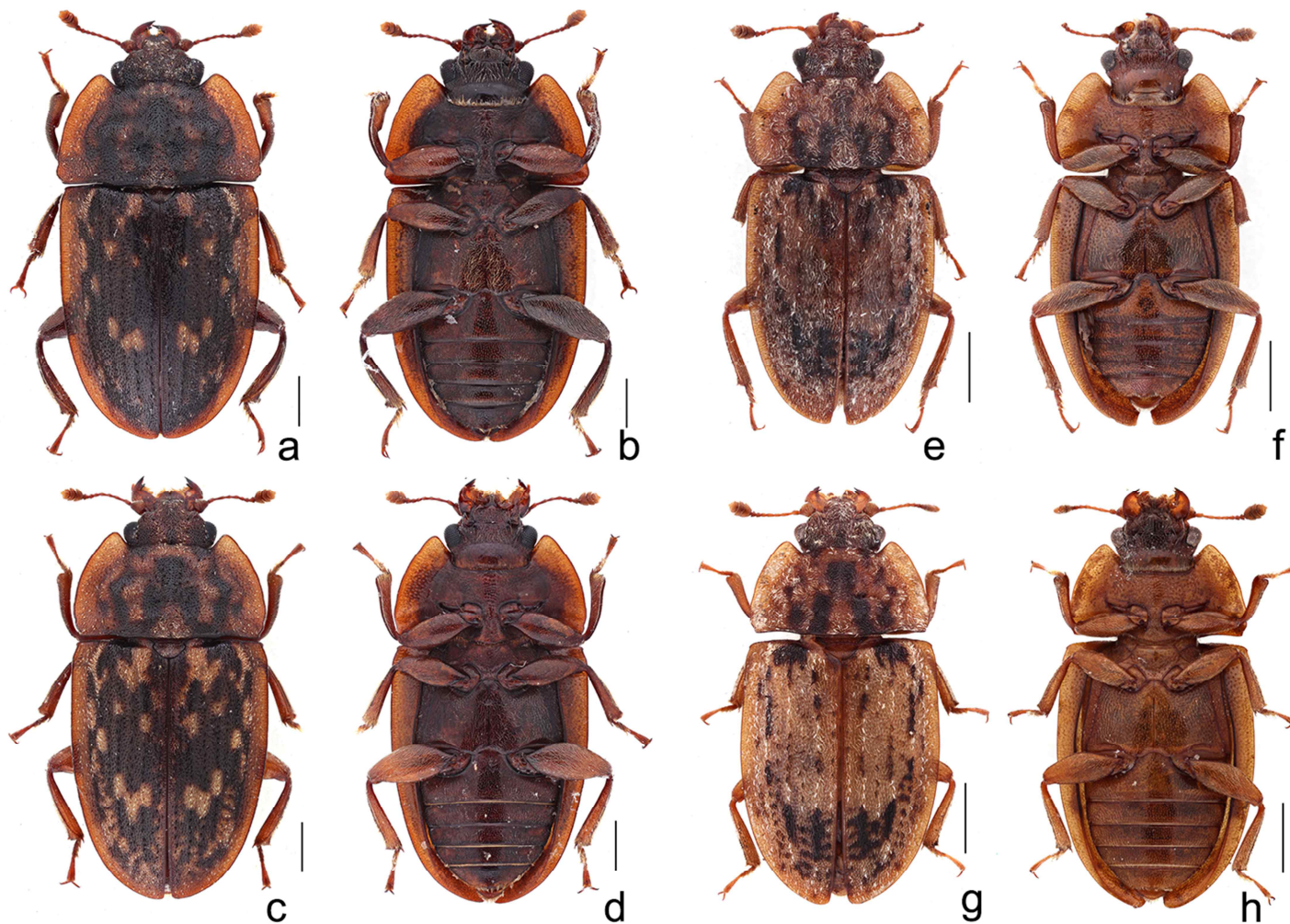
A: *Stelidota multiguttata*; B: *Ipidia sibirica*; C: *Hebasculinus japonus*; D: *Soronia lewisi*; E: *Nitidula rufipes*; F: *Neopallodes vicinus*; G: *Prometopia unidentata* H: *Parametopia x-rubrum*.

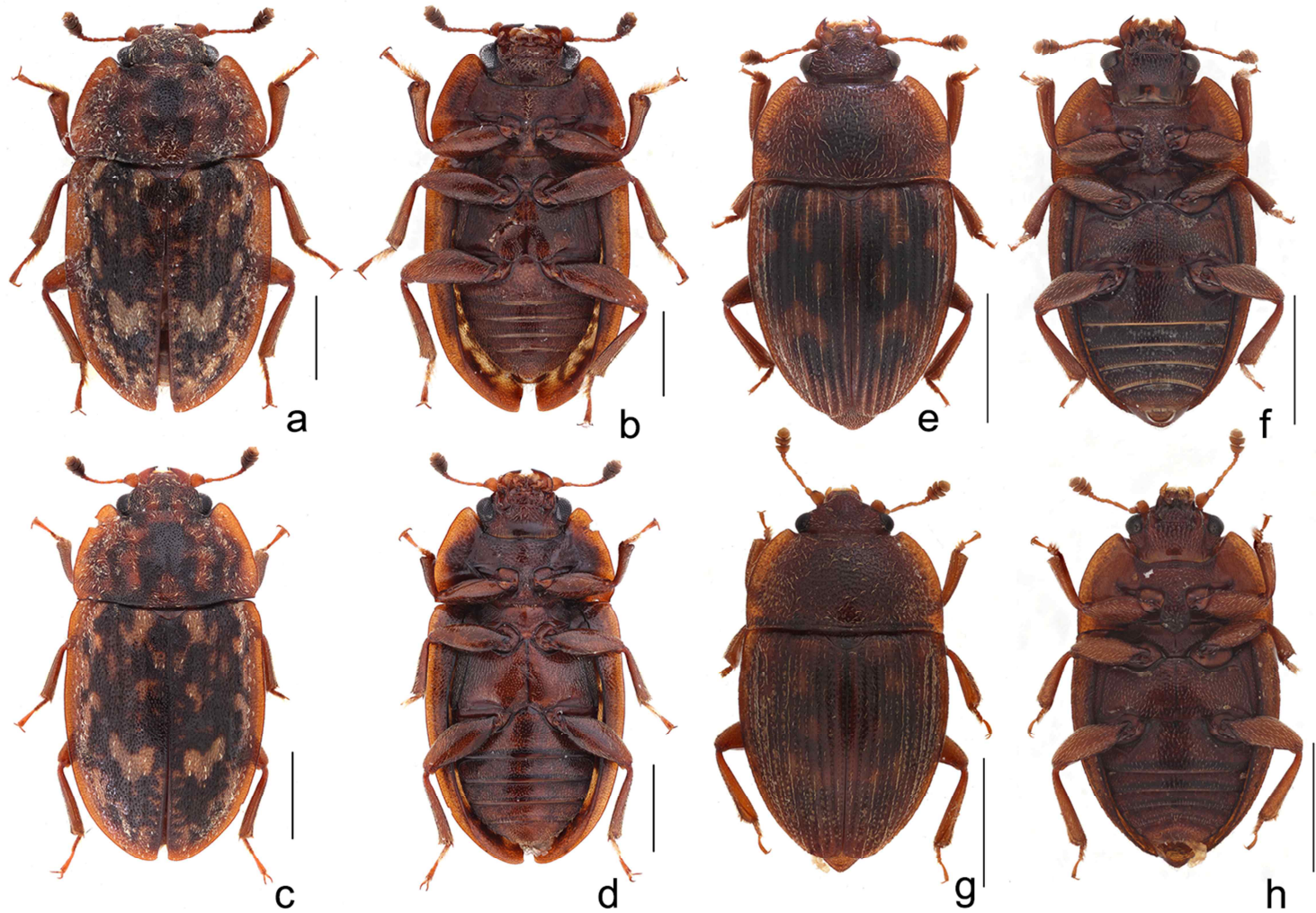
Plate 22 (Fig. 32: Phylogenetic tree from the Bayesian Inference)

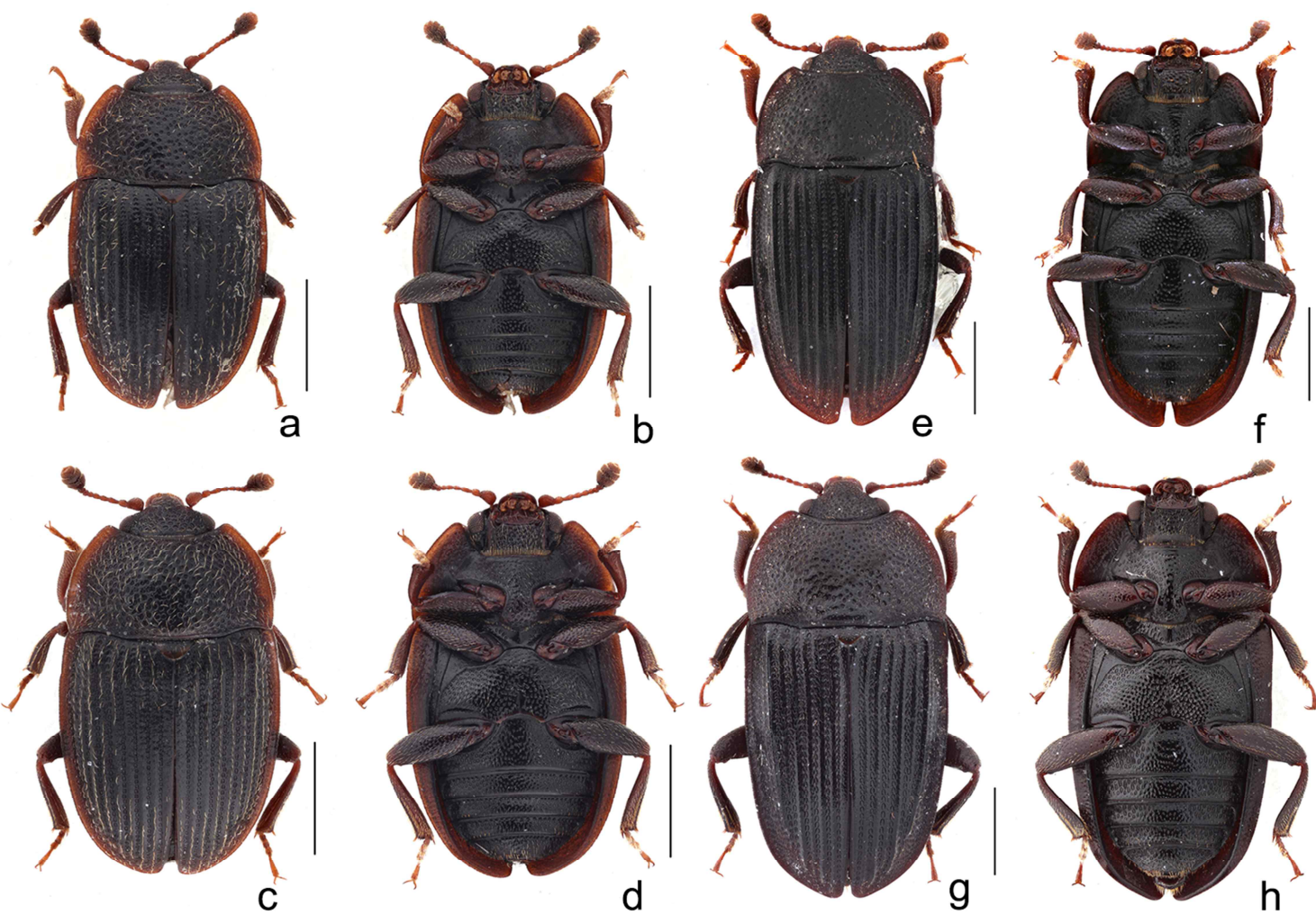
Plate 23 (Fig. 33: Phylogenetic tree from the Maximum Likelihood)

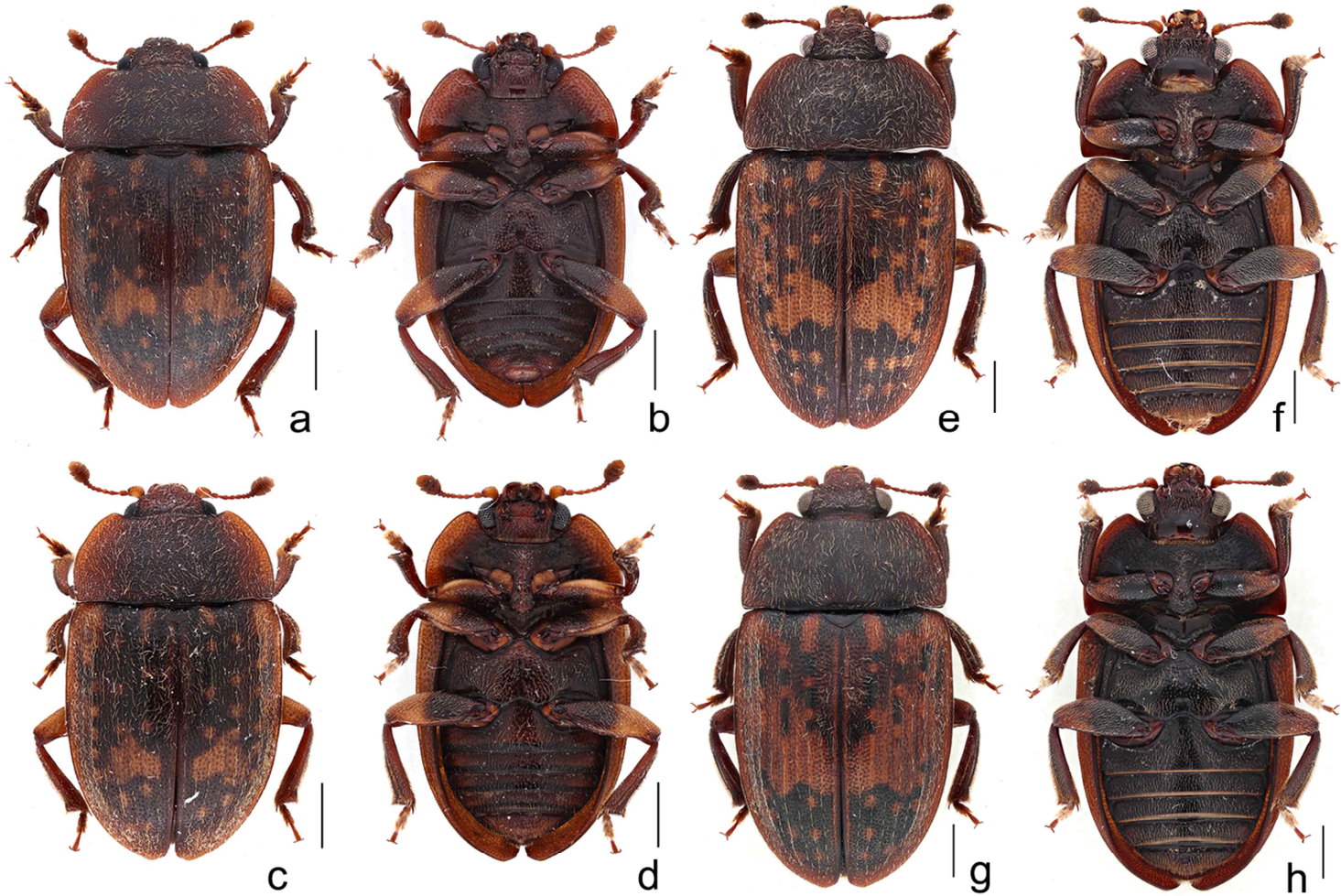


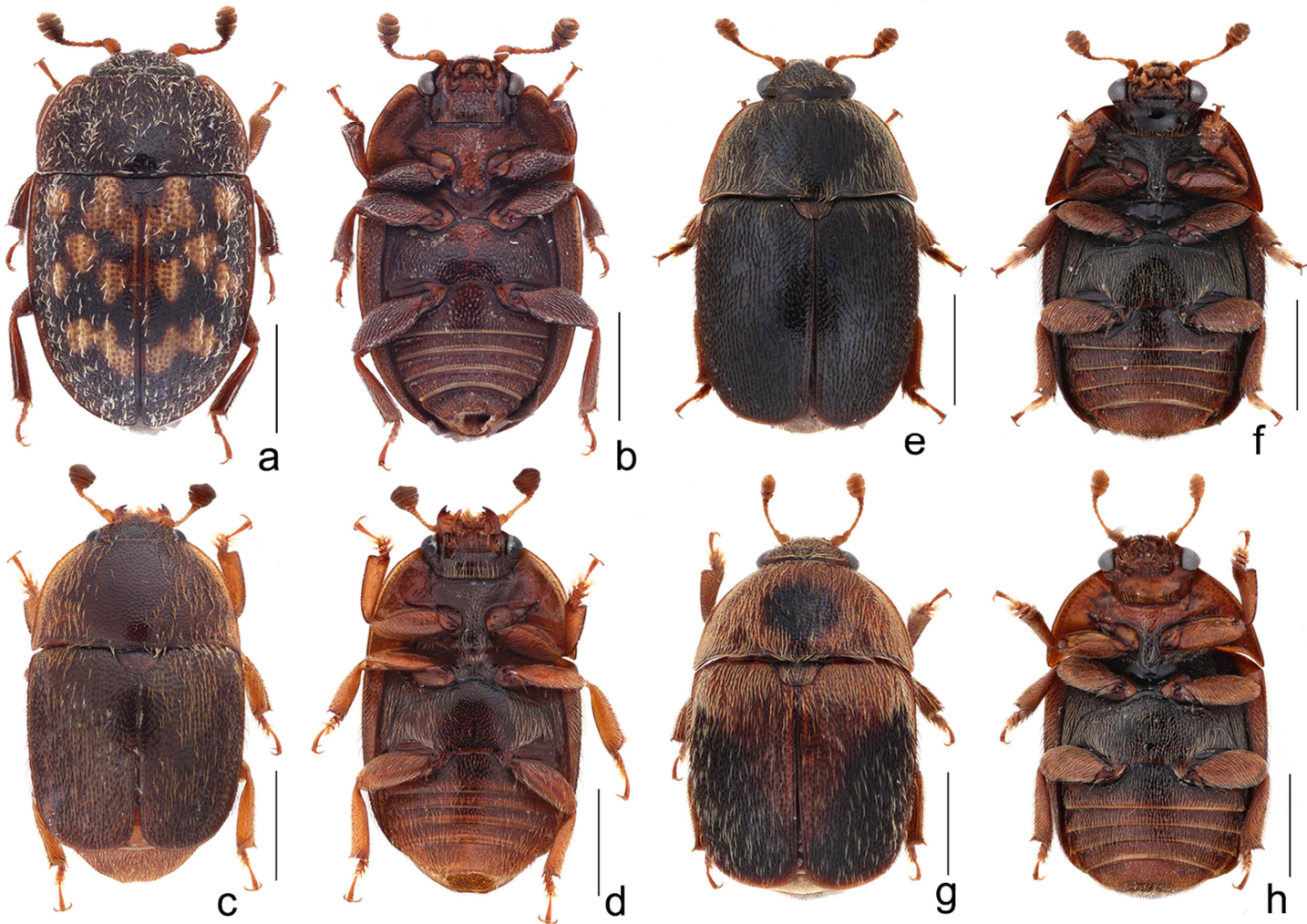


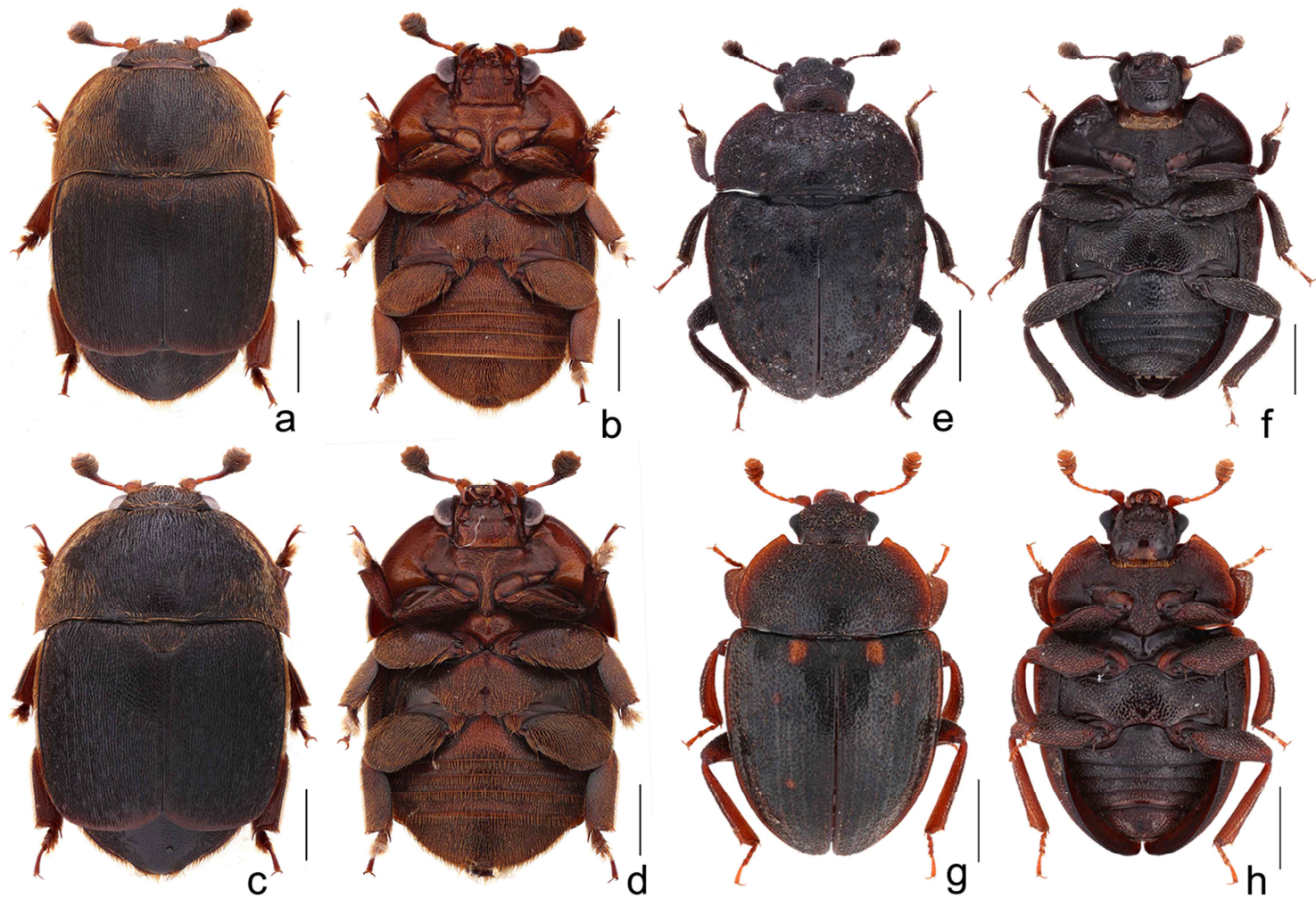


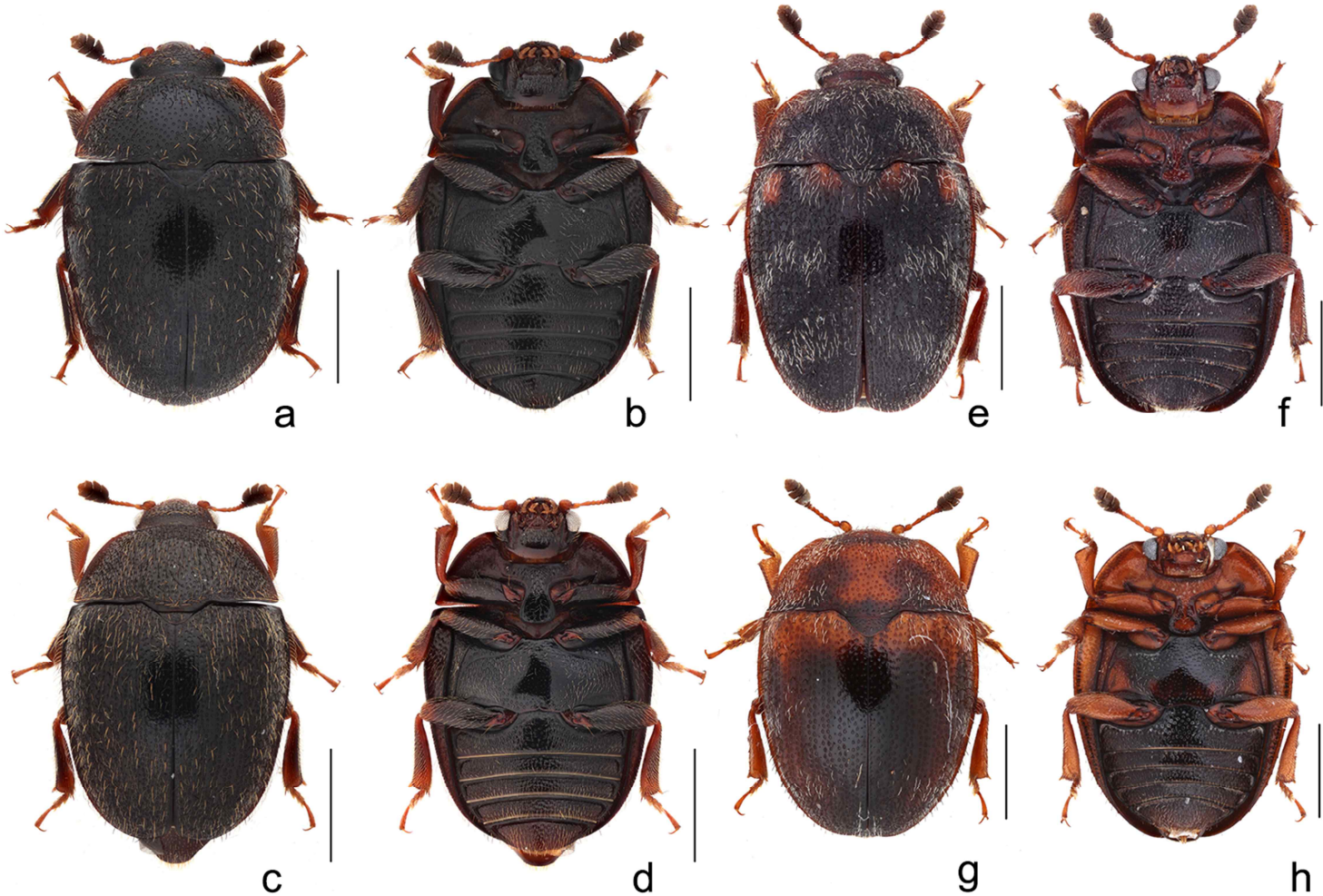


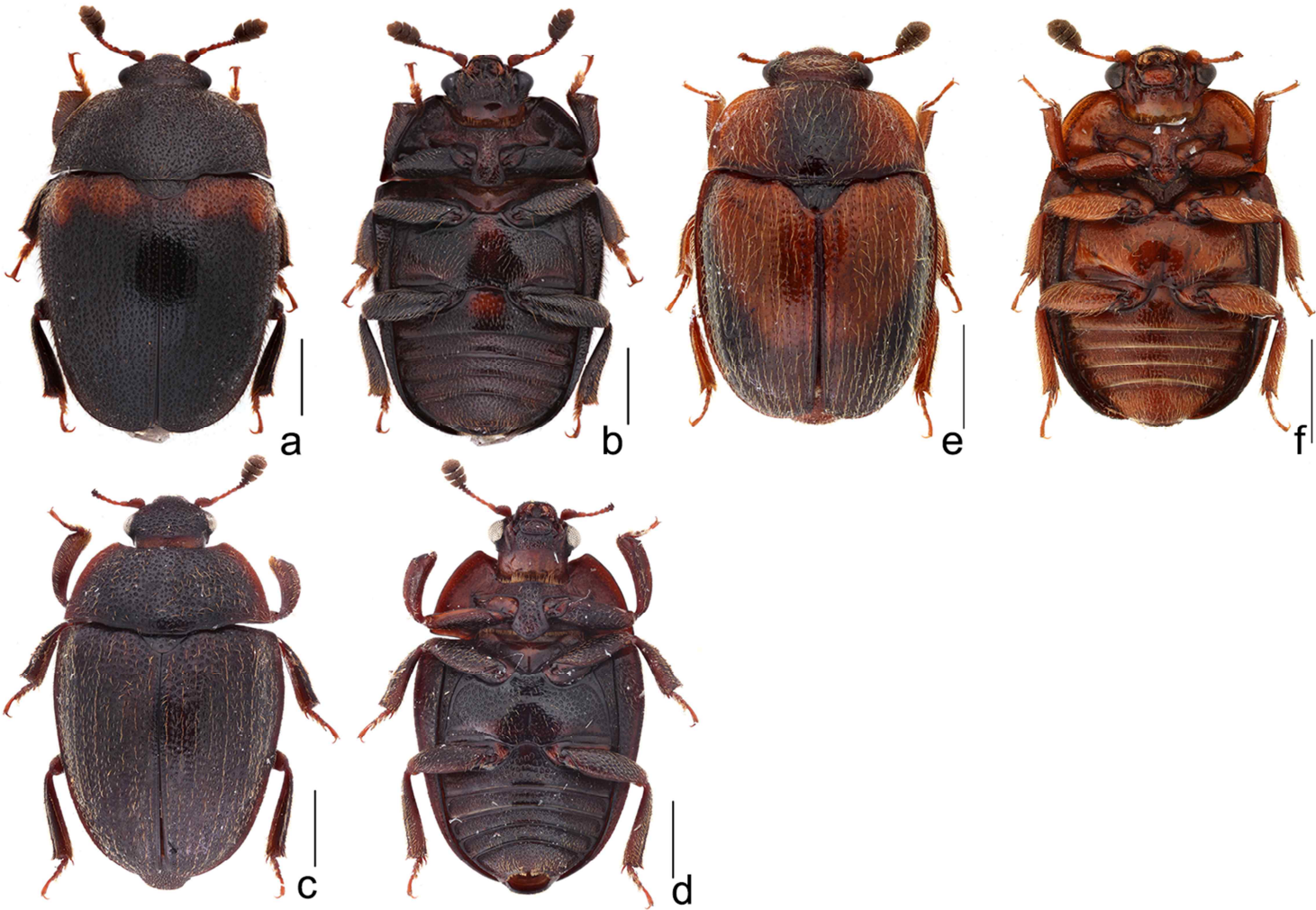


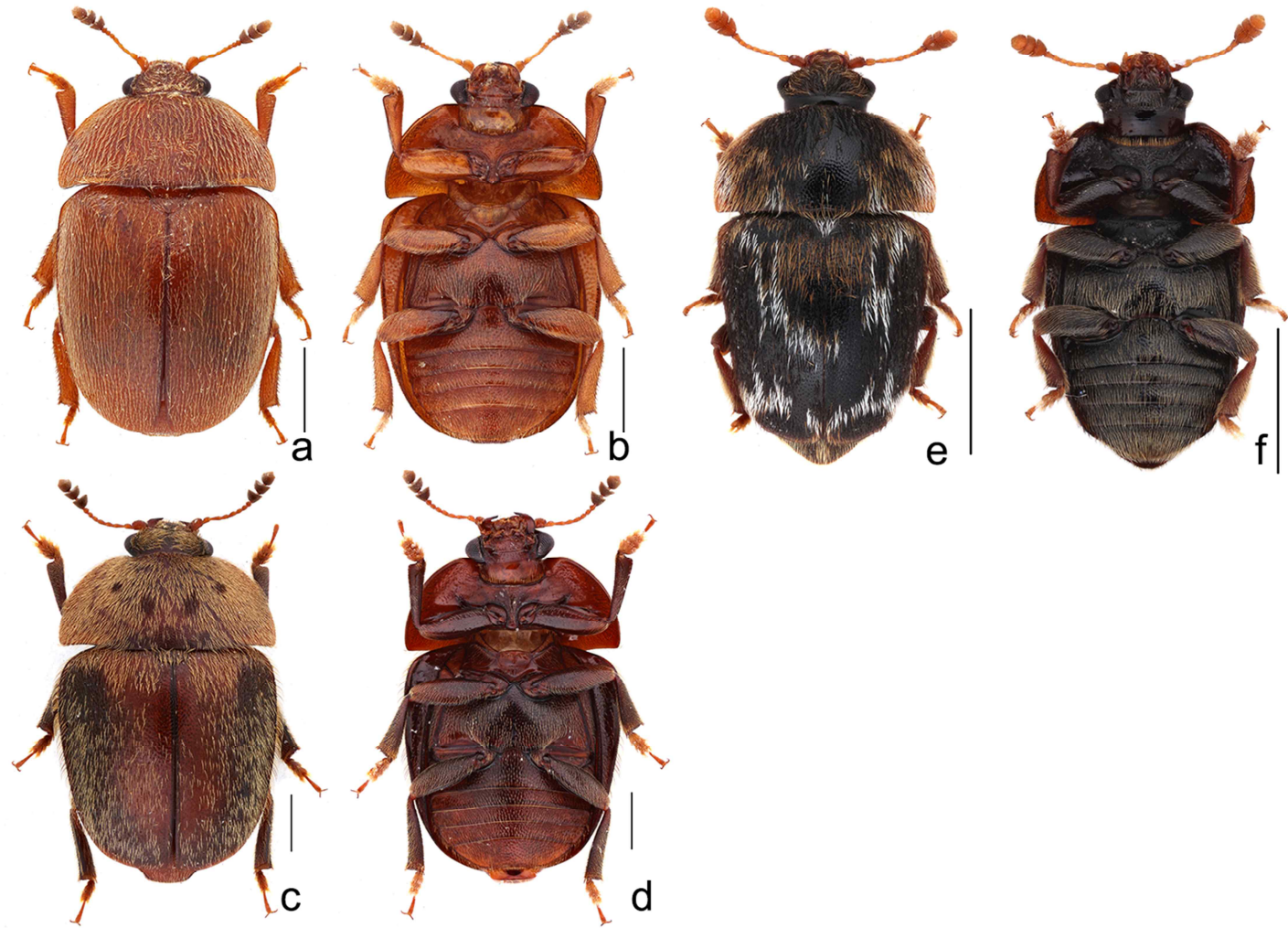


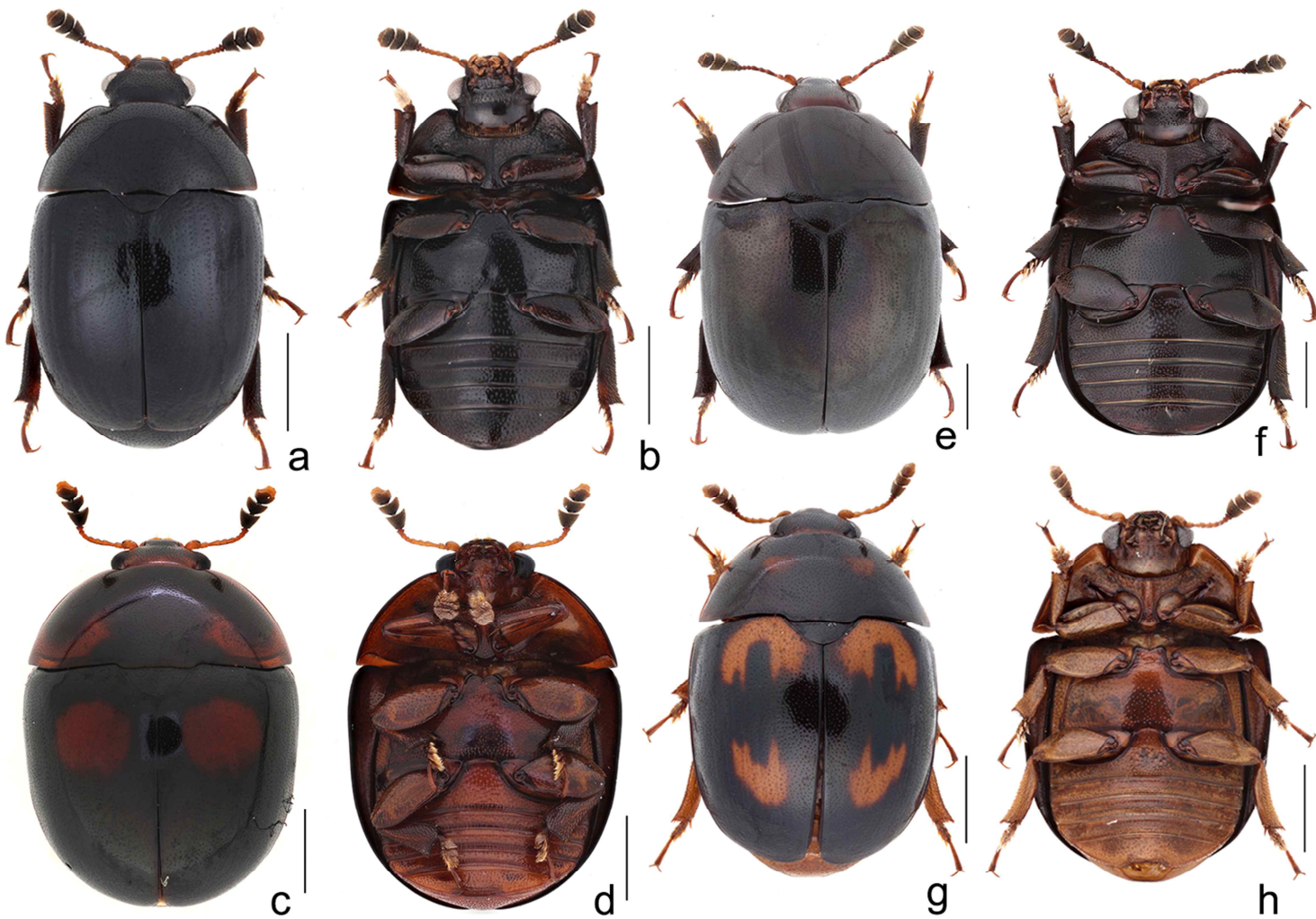


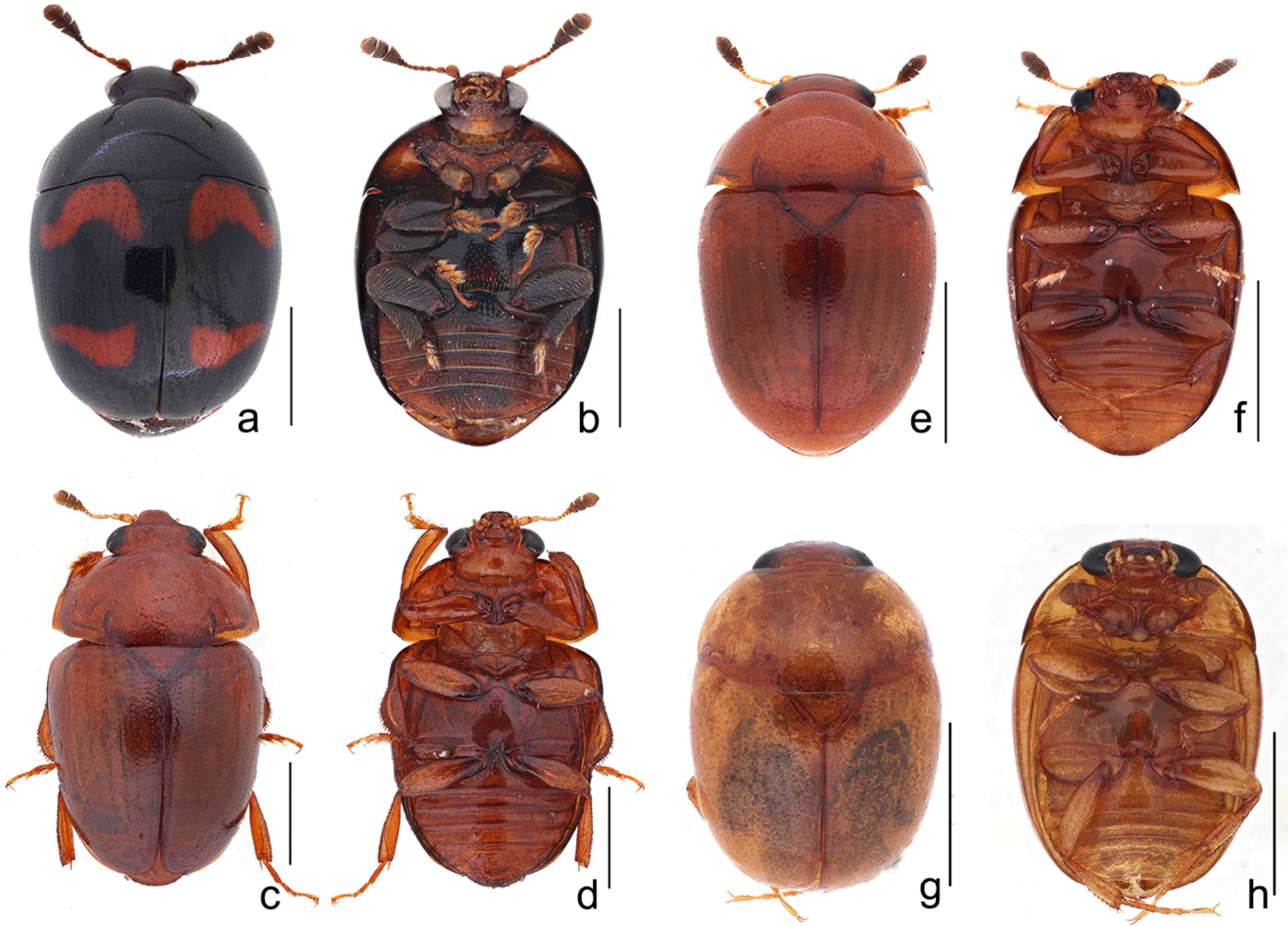


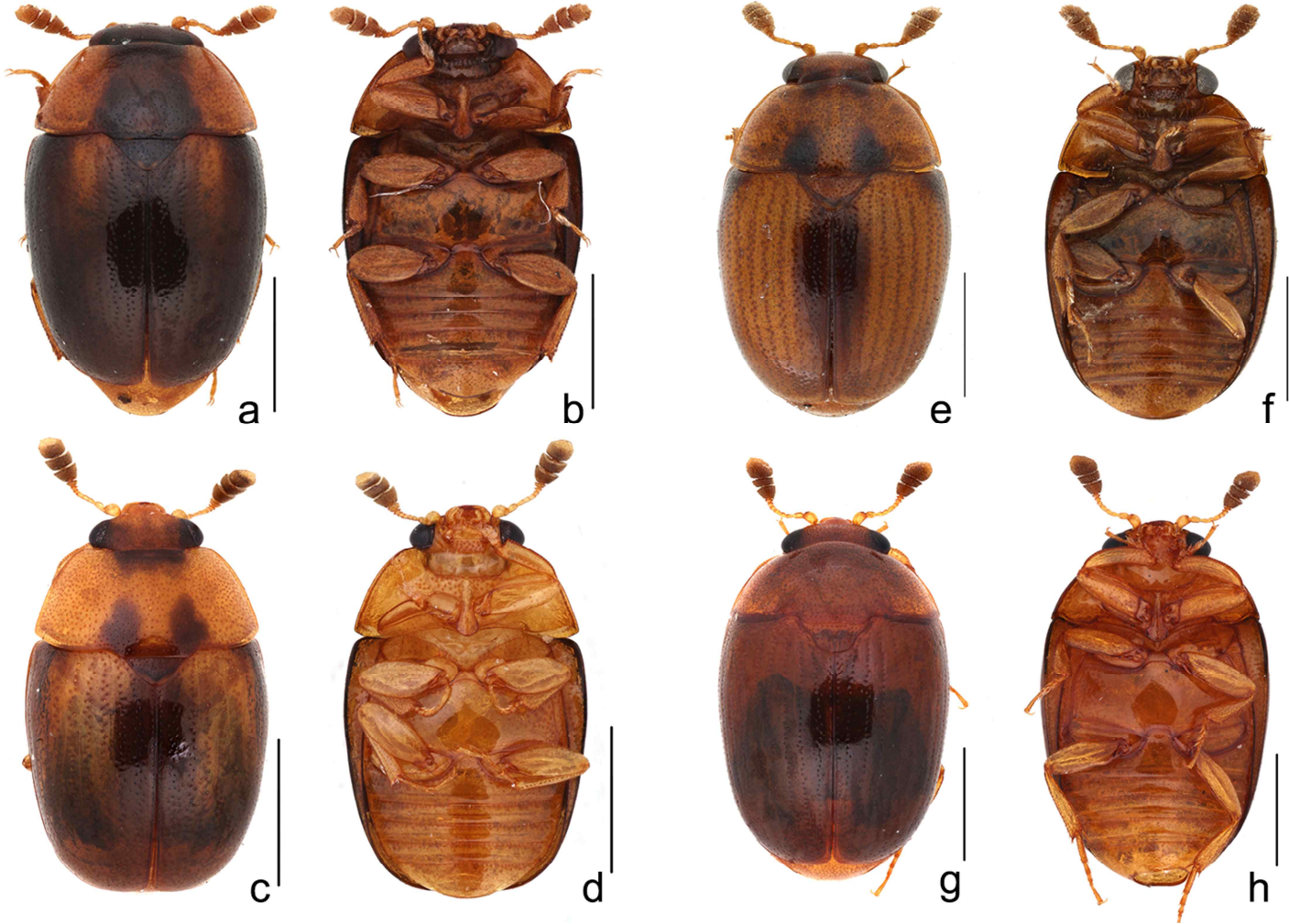


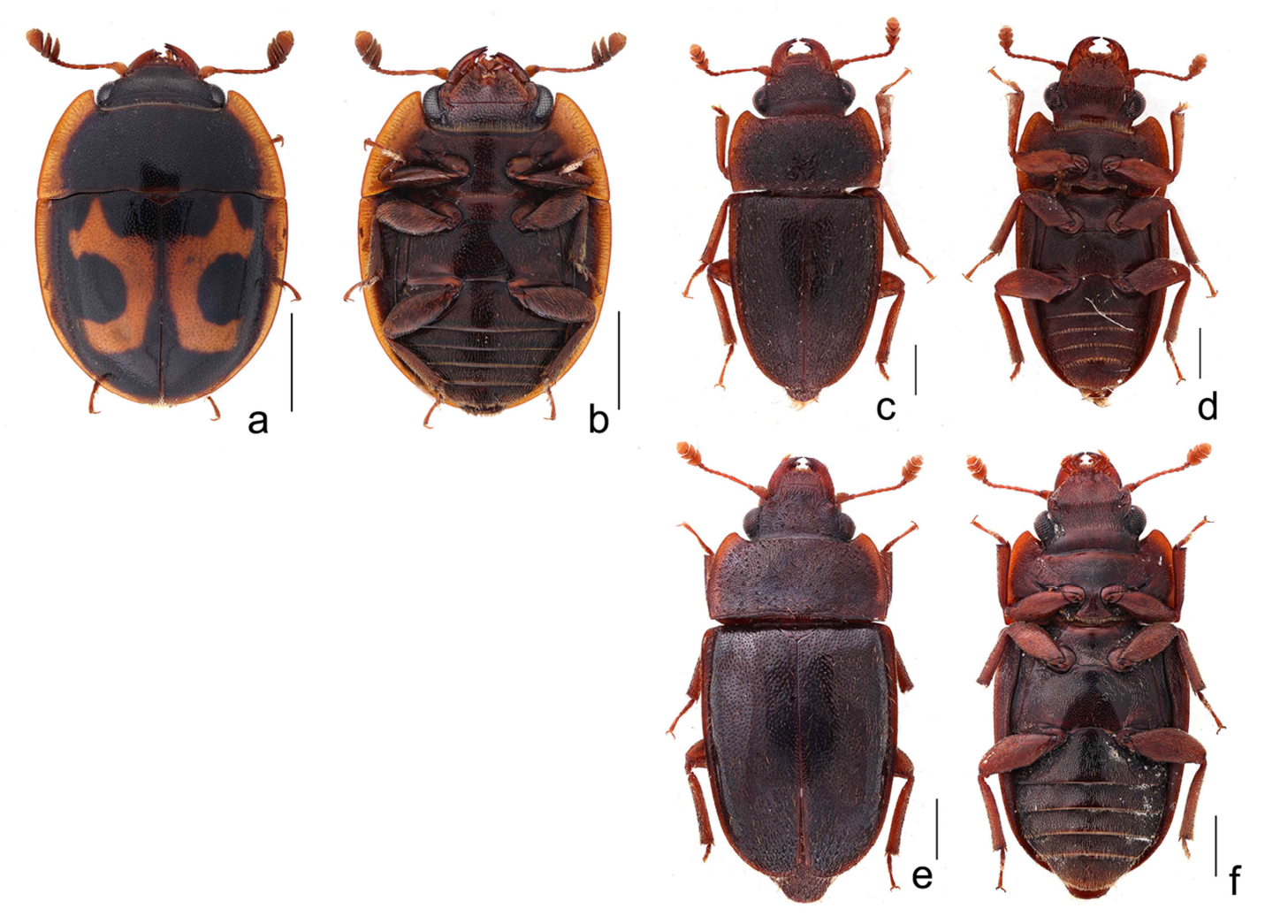


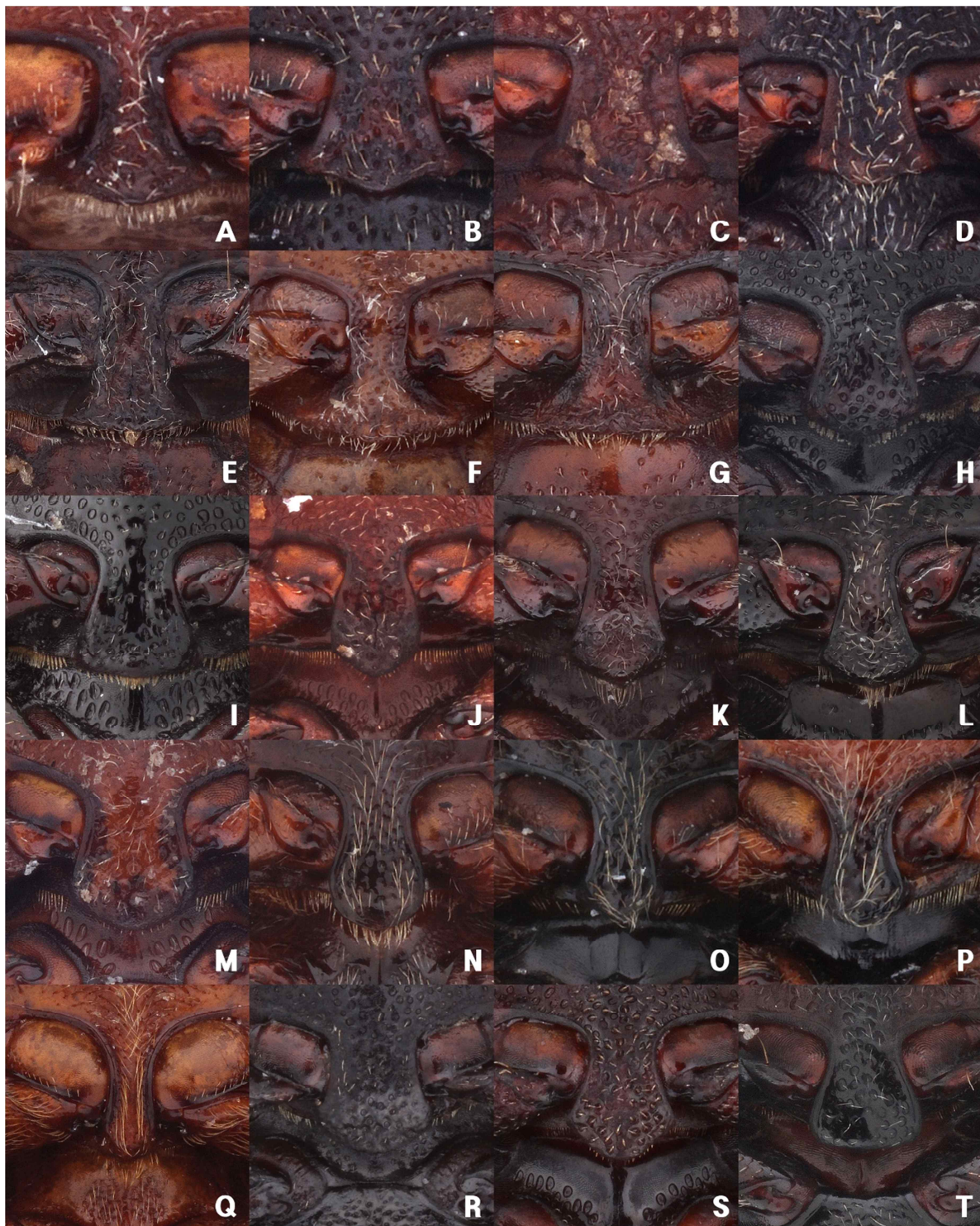












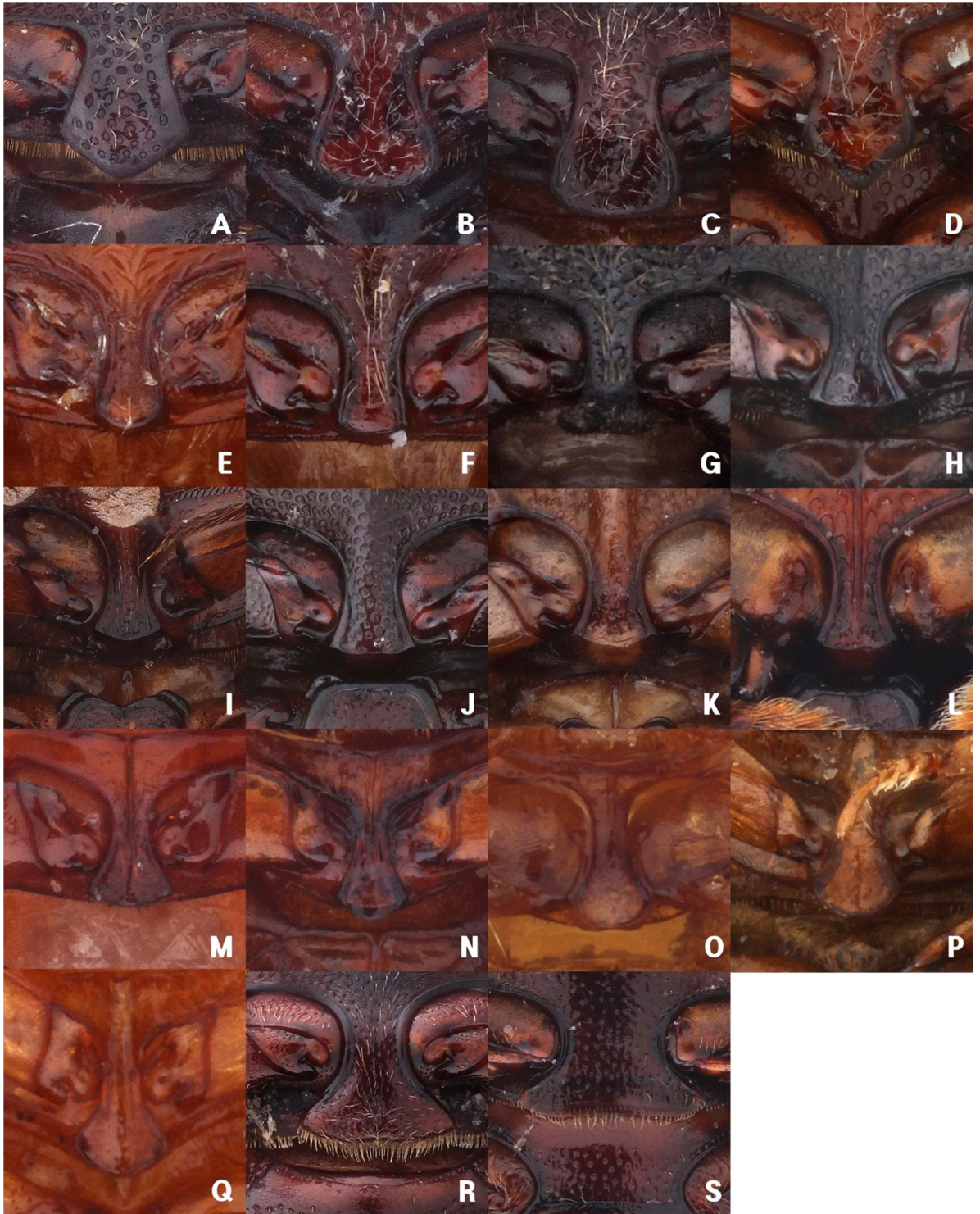


Plate 18 (Male Genitalia: median lobe)

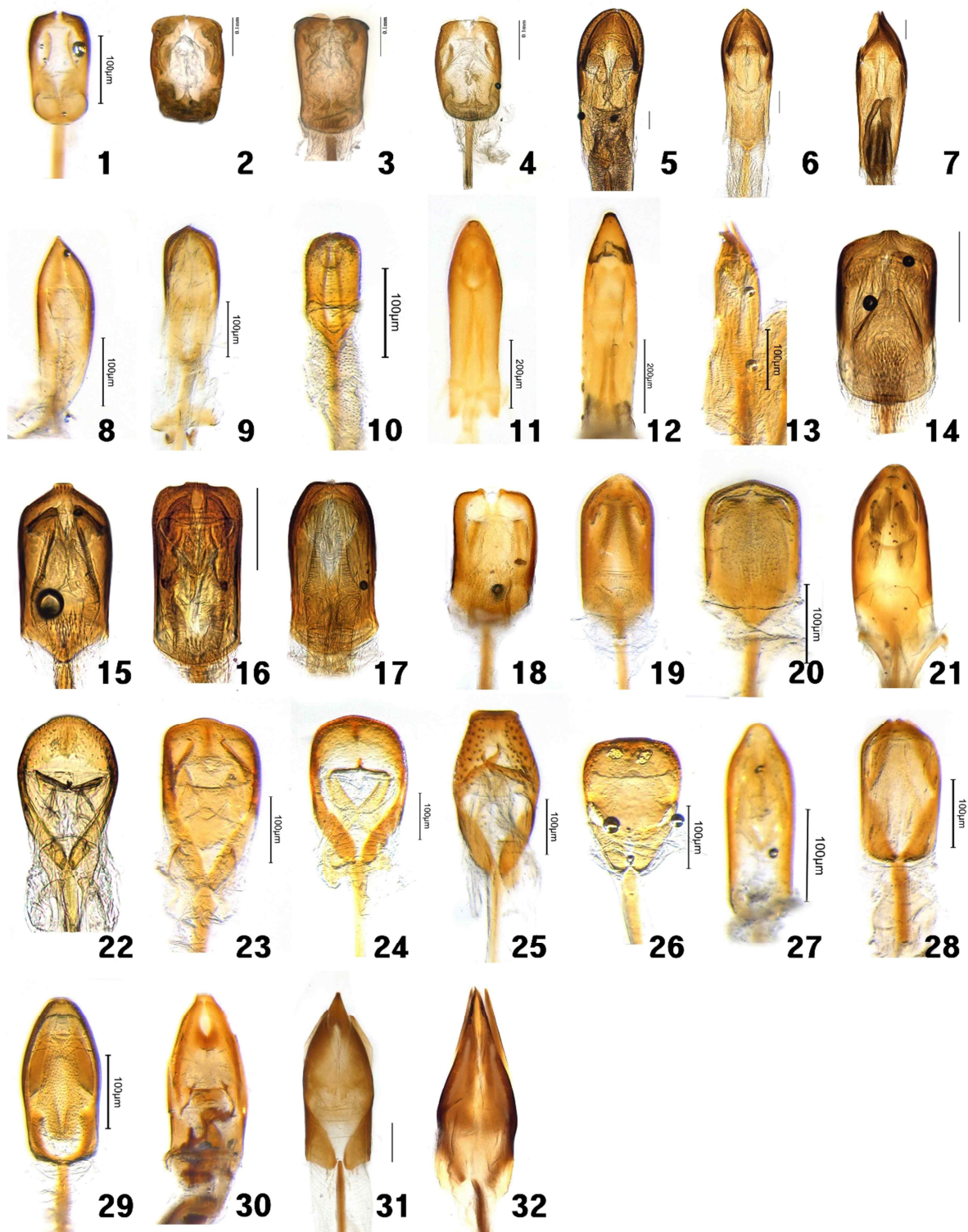


Plate 19 (Male Genitalia: tegman)

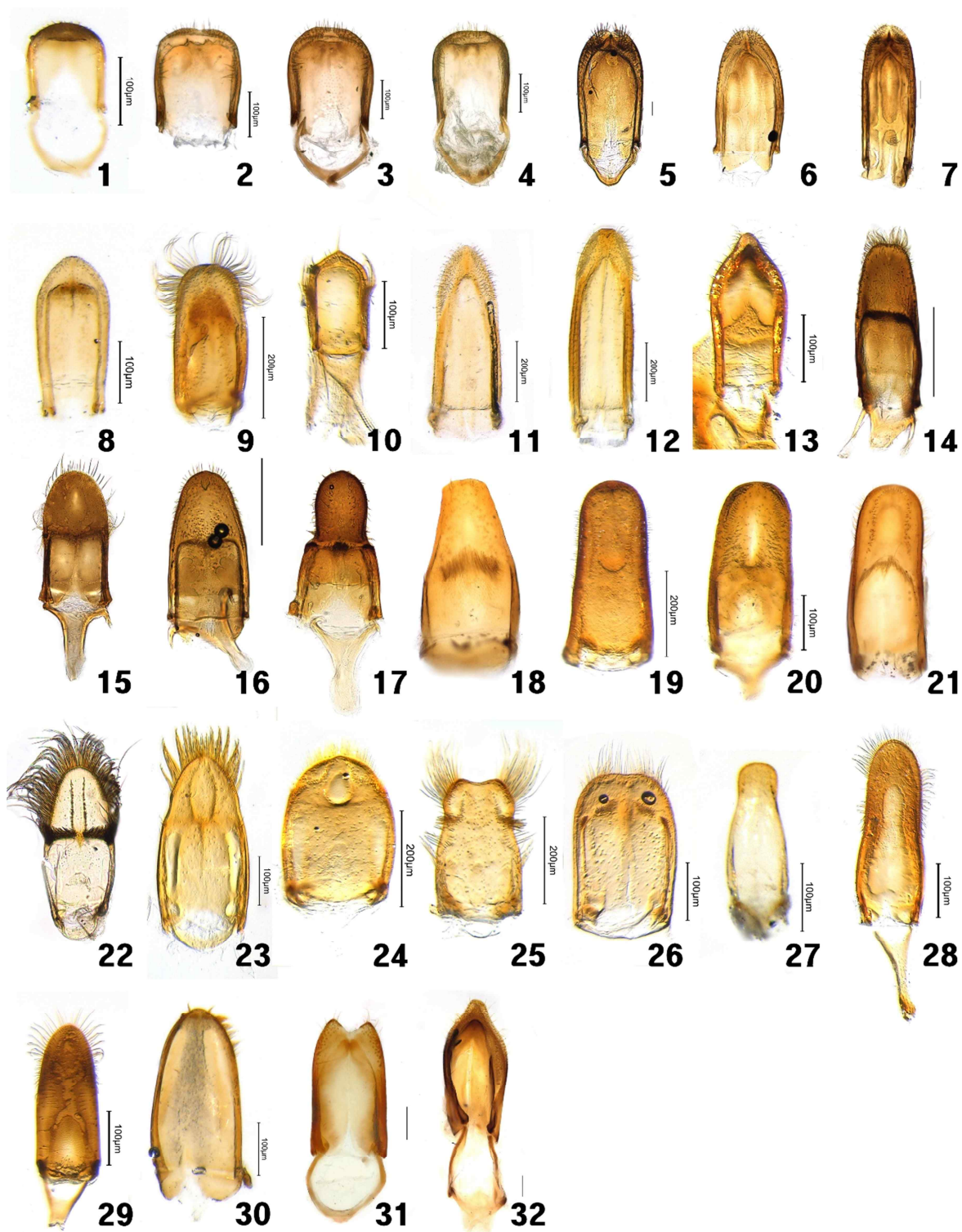


Plate 20 (Female ovipositor)

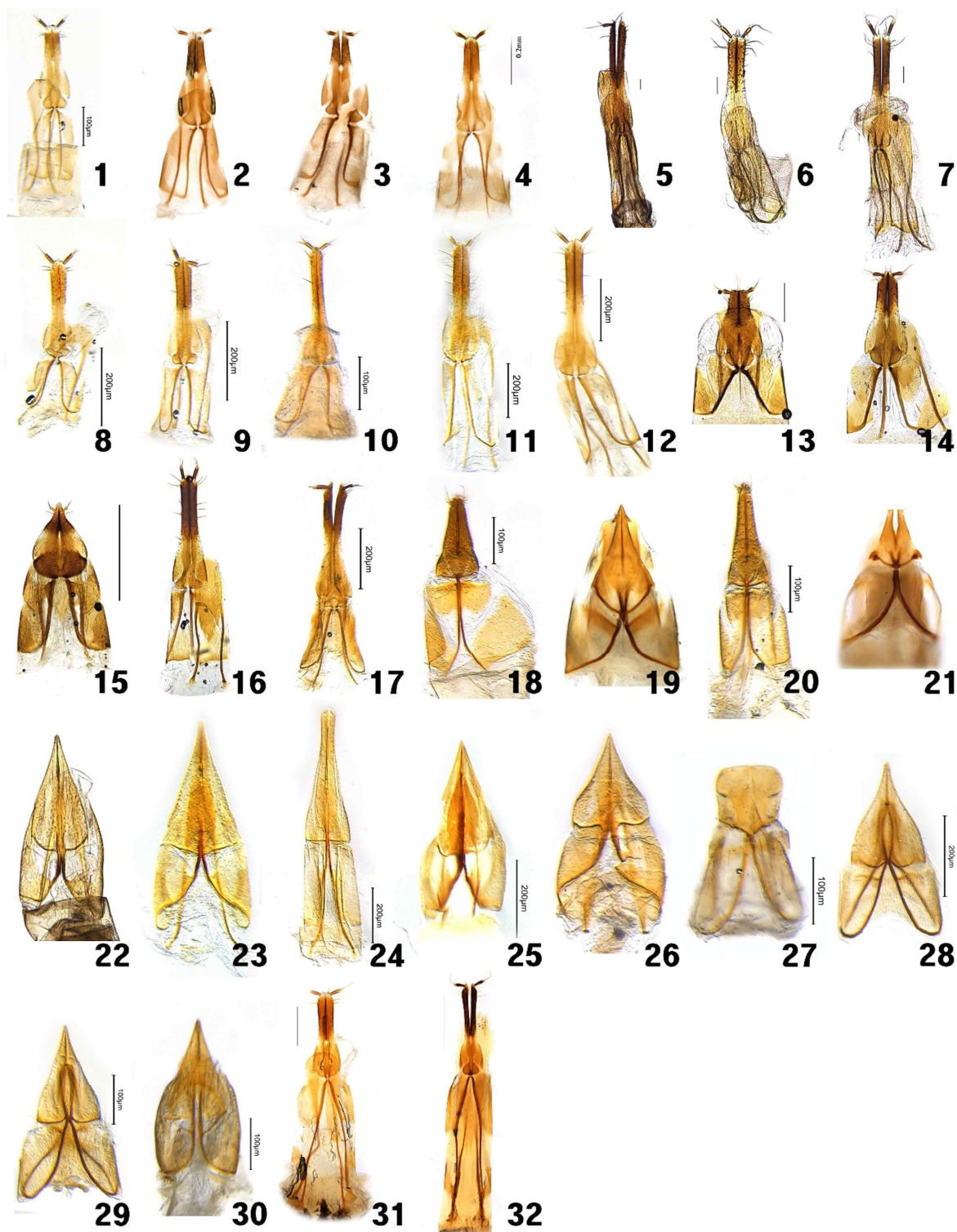


Plate 21 (Habitats of new record species)

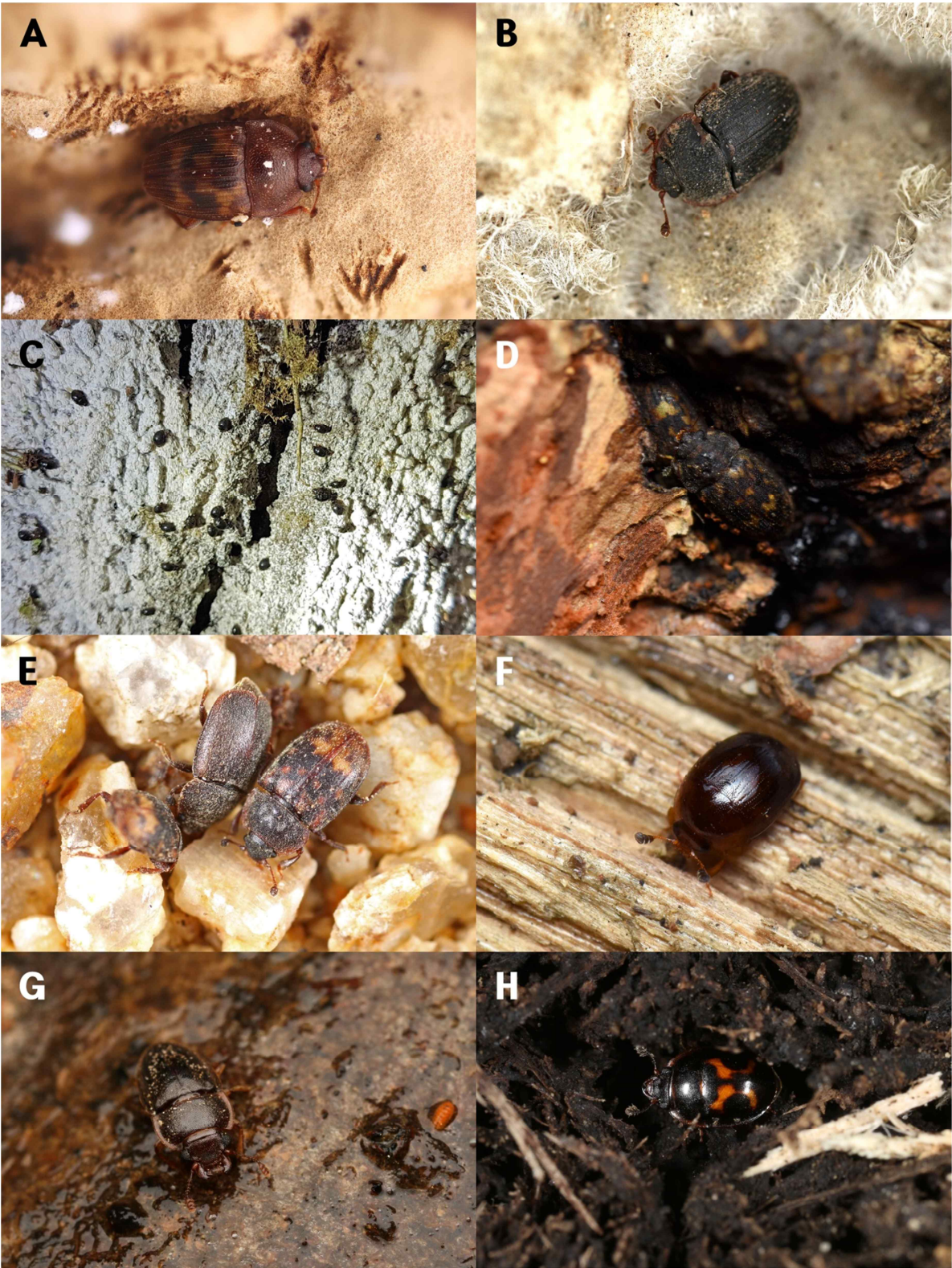
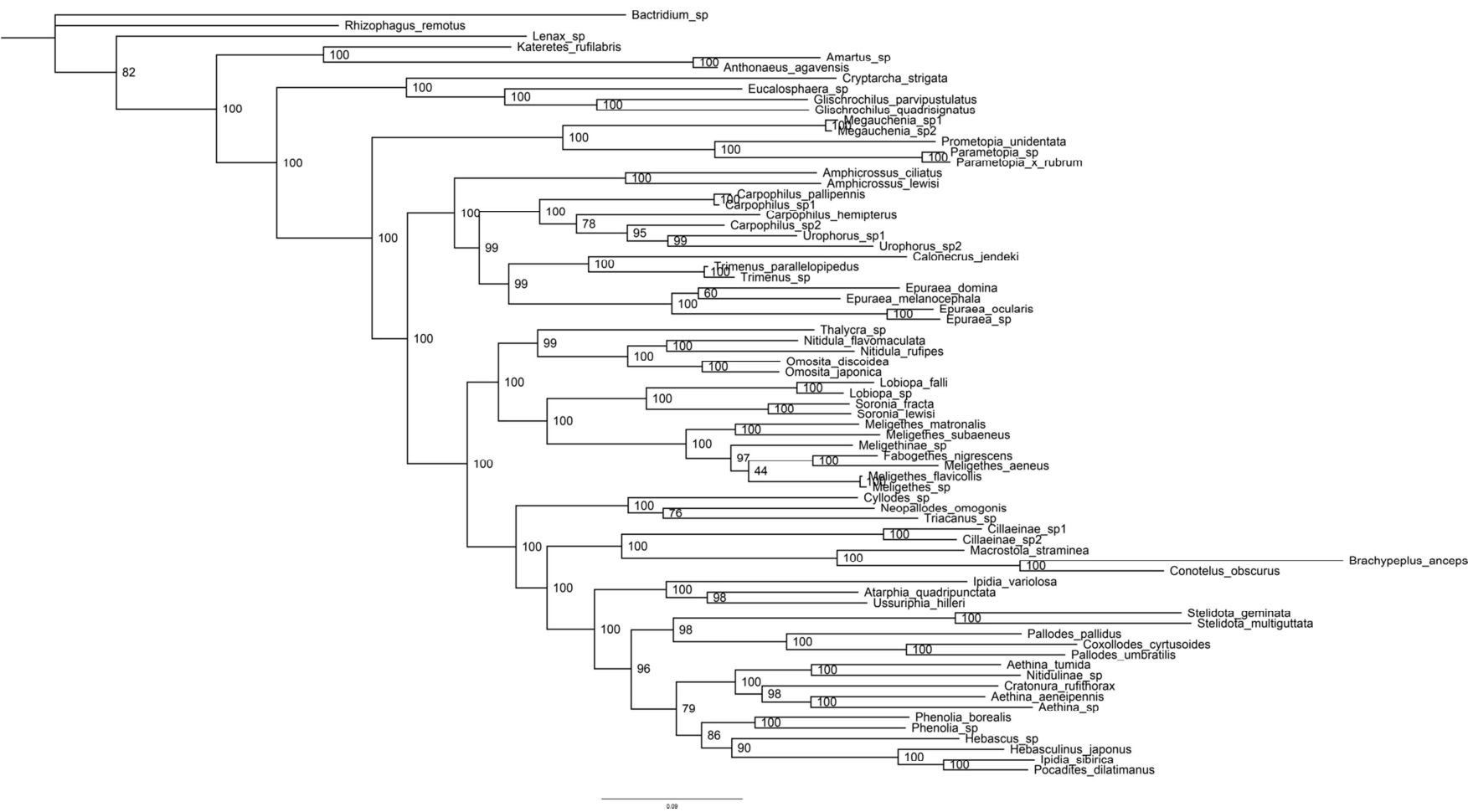


Plate 22 (Phylogenetic tree from the Bayesian Inference)



Phylogenetic tree showing relationships between various species, with bootstrap values indicated at the nodes. The tree is rooted at the top left and branches out to the right. The species names are listed on the right side of the tree. The tree shows a clear division into several major groups, including the suborder Polyphaga and the suborder Stenopodina. The species names are color-coded: black for the root and main branches, and red for the terminal taxa. The tree is a maximum likelihood tree based on the 1000 bootstrap replicates.

Species names (from top to bottom):

- Bactridium_sp
- Lenax_sp
- Rhizophagus_remotus
- Kateretes_rufilabris
- Amartus_sp
- Anthonaeus_agavensis
- Cryptarcha_strigata
- Eucallosphaera_sp
- Glischrochilus_parvipustulatus
- Glischrochilus_quadrisignatus
- Megauchenia_sp2
- Megauchenia_sp1
- Prometopia_unidentata
- Parametopia_sp
- Parametopia_x_rubrum
- Amphicrossus_ciliatus
- Amphicrossus_lewisii
- Carpophilus_sp1
- Carpophilus_pallipennis
- Carpophilus_hemipterus
- Carpophilus_sp2
- Urophorus_sp2
- Urophorus_sp1
- Calonecrus_jendeki
- Trimenus_sp
- Trimenus_parallelipedus
- Epuraea_sp
- Epuraea_ocularis
- Epuraea_melanocephala
- Epuraea_domina
- Thalycra_sp
- Nitidula_flavomaculata
- Nitidula_rufipes
- Omosita_discoidea
- Omosita_japonica
- Lobiopa_falli
- Lobiopa_sp
- Soronia_fracta
- Soronia_lewisii
- Meligethes_matronalis
- Meligethes_subaeneus
- Meligethinae_sp
- Meligethes_aeneus
- Fabogethes_nigrescens
- Meligethes_flavicollis
- Meligethes_sp
- Cyllodes_sp
- Tricacnus_sp
- Neopallodes_omogonis
- Cillaeinae_sp1
- Cillaeinae_sp2
- Macrostola_straminea
- Conotelus_obscurus
- Brachypeplus_anceps
- Ipidia_variolosa
- Ussuriophia_hillieri
- Atarphia_quadripunctata
- Phenolia_borealis
- Phenolia_sp
- Hebascus_sp
- Hebasculinus_japonus
- Ipidia_sibirica
- Pocadites_dilatimanus
- Nitidulinae_sp
- Aethina_tumida
- Cratonura_rufithorax
- Aethina_sp
- Aethina_aeneipennis
- Stelidota_geminata
- Stelidota_multiguttata
- Pallodes_pallidus
- Pallodes_umbratilis
- Coxollobes_cyrtusoides

국문초록

한국산 밀빠진벌레아과, 큰턱밀빠진벌레아과의 분류학적 연구 및 밀빠진벌레과의 계통학적 분석

서울대학교 대학원

농생명공학부 곤충학 전공

이민혁

본 연구는 머리대장상과에 속하는 밀빠진벌레과에 대한 계통분류학적 연구로, 크게 두 가지의 주제로 구성되어 있다. 첫 번째 주제는 한반도에 서식하는 밀빠진벌레아과 및 큰턱밀빠진벌레아과에 대한 분류학적 재검토이며, 두 번째는 분자 마커를 이용한 밀빠진벌레과의 계통에 대한 연구이다.

첫 번째 연구에서는 2아과 (밀빠진벌레아과, 큰턱밀빠진벌레아과), 21속에 속하는 총 40종에 대한 분류학적 및 형태학적 연구가 수행되었다. 2종의 신종 후보종과 11종의 미기록종이 본 연구로부터 국내에 첫 보고되었다.

두 번째 연구에서는 분자마커를 이용하여 밀빠진벌레과의 계통관계를 규명하였다. 베이지안 추론(Bayesian Inference), 최대공산(Maximum Likelihood) 분석에 의한 결과에서, 밀빠진벌레과의 단계통성을 확인할 수 있었다. 또한 기존의 연구에서 제시된 Prometopinae의 아과적 타당성을 재확인 하였다. 밀빠진벌레과의 가장 원시적인 아과는 Cryptarchinae 로 나타났으며, 기존의 연구와 달리 Calonecrinae는 Carpophilinae-lineage에 속하며, 특히 Epuraeinae와 근연한 그룹으로 나타났다. Nitidulinae는 Cillaeinae와 Meligethinae가 내부에 포함되는 다계통으로 나타났다. 이들은 Meligethinae와 Cillaeinae가 Nitidulinae의 tribe로 변경되거나 Nitidulinae가 최소 4개의 분류군으로 나뉘어야 할 것으로 본 연구결과 확인되었다. 밀빠진벌레과의 원시기주는 모호하지만 일관되게 균식성의 확률이 매우 높음을 확인할 수 있었다.

검색어: 밀빠진벌레과, 분류학적 검토, 한반도, 계통분류학, 진화