研究資料（Research record）

Atlas of dung beetles collected in the Sungai Wain Protection Forest and its surroundings in the lowlands of Borneo

Akira UEDA[1)*], Dhian DWIBADRA[2)], Sih KAHONO[2)],
SUGIARTO[3)], Teruo OCHI[4)] and Masahiro KON[5)]

Abstract

Dung beetles (coprophagous groups of Scarabaeoidea) are useful indicators of habitat quality in tropical regions. To evaluate dung beetle diversity in a variety of land use types, we carried out beetle surveys using pitfall traps baited with human excrement and fish meat from 2004 to 2017 in the Sungai Wain Protection Forest and its surroundings located 10–40 km north of Balikpapan in the lowlands of East Kalimantan, Indonesia. From these surveys, we collected 68 dung beetle species. To help identify these species, we presented photographs and diagnoses of all collected species and included photographs of useful characteristics for discriminating similar species. There is no previously published atlas of dung beetles in Indonesia. Despite only covering a small area on Borneo Island, we hope this atlas will help entomologists and insect lovers in Indonesia identify dung beetles.

key word : distribution, East Kalimantan, food habit, identification, habitat preference, photograph, Scarabaeidae

Introduction

It is known that dung beetles (coprophagous groups of Scarabaeoidea, among which Bolboceratidae, Hybosoridae, and certain Scarabaeidae members (Scarabaeinae and Aphodiinae) are considered in the present study) are useful indicators of habitat quality and environmental changes in tropical regions (McGeoch et al. 2002; Aguilar-Amuchastegui and Henebry 2007; Gardner et al. 2008a; Nichols and Gardner 2011). These beetles are known to be relatively easy to collect and identifiable when compared with the majority of other insect groups (Spector 2006). The sampling cost for these beetles was cheapest among 14 other taxa sampled in studies carried out in primary forests in the Brazilian Amazon, and their indicator performance has been found to be second-best after birds (Gardner et al. 2008b; Nichols and Gardner 2011). Moreover, these beetles are known to serve important ecological functions, such as promoting the rapid decomposition of dung and carcasses, accelerating nutrient cycling and bioturbation, enhancing plant growth, facilitating secondary seed dispersal, pollinating carrion-scented plants, and controlling parasites and flies (Davis 1996; Sakai and Inoue 1999; Andressen 2002, 2003; Larsen et al. 2005; Horgan 2005; Slade et al. 2007, 2011; Nichols et al. 2008; Kryger 2009; Ridsdill-Smith and Edwards 2011; Amézquita and Favila 2011; Enari and Enari-Sakamaki 2014; Enari et al. 2016).

Because of their habitat quality indicator ability, low sampling cost, and ecosystem services, we chose to evaluate the influence of land use types on dung beetle diversity in the Sungai Wain Protection Forest (SWPF) and its surroundings, located 10–40 km north of Balikpapan in the lowlands of East Kalimantan, Indonesia (Ueda et al. 2015a, c, d). In these studies, we used baited pitfall traps on which crossed flight intercepting transparent laminas with the roof of a white plastic bowl were set (Ueda et al. 2015b). We set alternately five and five traps baited with human excrement and raw fish meat on a 90 m transect with 10 m intervals for five days at each site in December 2006 and 2007 (Ueda et al. 2015a, c, d). We collected dung beetles from intact natural forests, burnt natural forests, heavily burnt and/or artificially degraded natural forests, *Acasia mangium* plantation forests, *Imperata cylindrica* grasslands, and a cattle pasture (Figs. 1 and 2). In addition to these studies, we collected beetles using the same method as those outlined in verificative studies in December 2008 (Ueda et al. 2017). Details of the site locations and trapping periods are indicated in Table 1 of Ueda et al. (2017). We also collected beetles using the other types of baited pitfall traps as preliminary studies in December – January 2004/2005 and 2005/2006 and in August 2006 (Ueda et al. 2015b) and as

Received 1 December 2021, Accepted 7 March 2022
1) Hokkaido Research Center, Forestry and Forest Products Research Institute (FFPRI)
2) Research Center for Biology, Indonesian Institute of Sciences (RCB-LIPI)
3) East Kutai Agricultural College School (STIPER)
4) Toyono-cho, Toyono-gun, Osaka
5) Sakyo-ku, Kyoto
* Hokkaido Research Center, FFPRI, Hitsujigaoka 7, Toyohira-ku, Sapporo 062-8516, JAPAN; E-mail: akira@ffpri.affrc go.jp

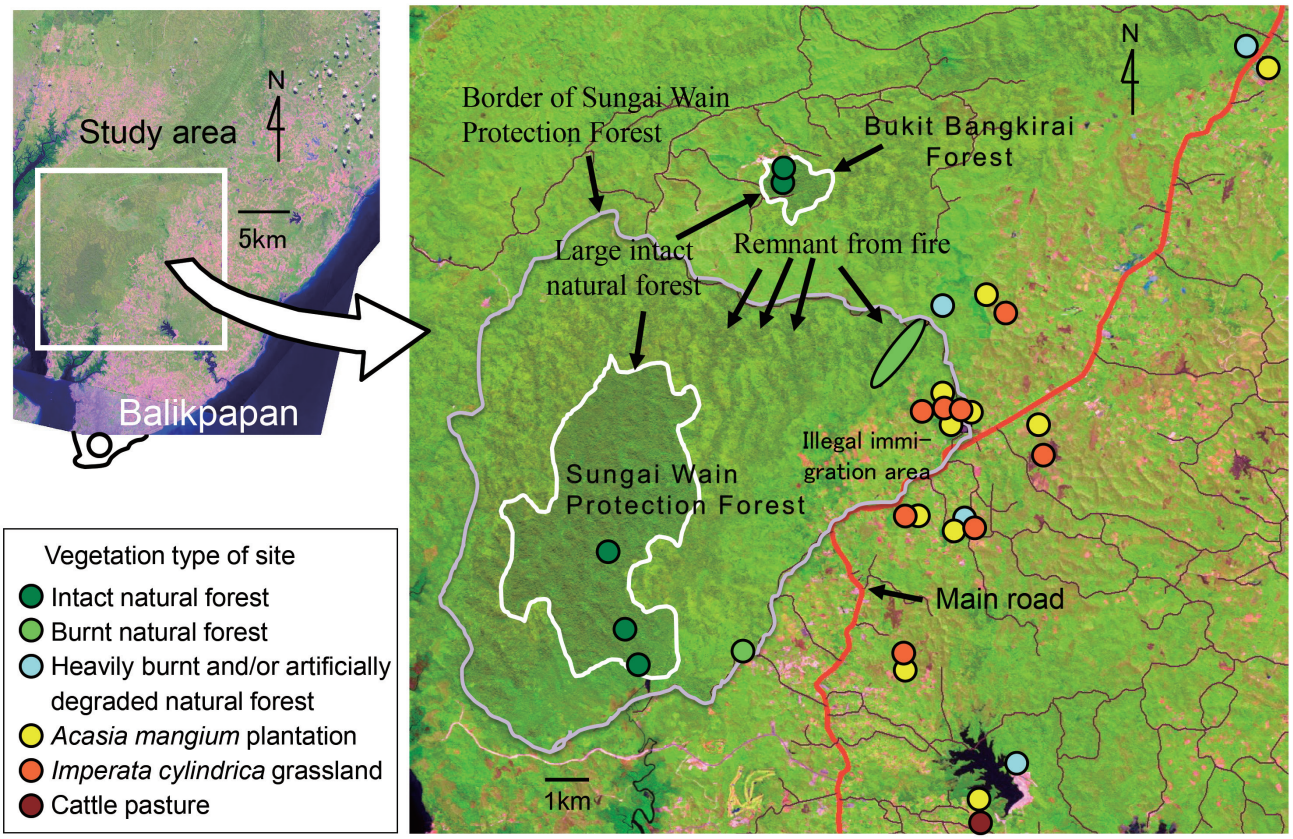

Fig. 1. Satellite image of the study area indicating the distribution of trapping sites and their vegetation types
The 'SPOTS5' satellite took this picture at 2:27:04 (GMT) on 19 June 2005.

Fig. 2. Photograph of each vegetation type
A: intact natural forest, B: burnt natural forest, C: heavily burnt and artificially degraded natural forest (secondary forest), D: *Acasia mangium* plantation forest (5 years old), E: *Imperata cylindrica* grassland, and F: cattle pasture.

post-studies in December 2015–2017. Thus, we accumulated a large collection of dung beetles as well as information regarding both their habitat and diet preferences.

On the other hand, Indonesian entomologists and rangers who work to protect the SWPF have often and eagerly requested that we make an atlas of dung beetles based on our collections, as there is currently no atlas of dung beetles in Indonesia. Here, we took photographs of all the dung beetle species collected in the SWPF and its surroundings and made an atlas of dung beetles. Although our collections were obtained solely from a small area on Borneo Island, we hope this atlas will help entomologists and insect lovers in Indonesia to identify dung beetles.

Overview of the environments of the Sungai Wain Protection Forest (SWPF) and its surroundings

The SWPF is ca. 10,000 ha lowland humid forests protected as the water jar of Balikpapan City (Purwant and Koesoetjahjo 2017). "Sungai" means river in English. The SWPF is also famous as one of the release points of rescued orangutans. The forests mainly consist of intact natural forests and mosaic distributed forests burnt in 1983 and 1998 (Mori et al. 1998; Taylor et al. 1999; Yamaguchi and Tsuyuki 2001; Makihara 2013) (Figs. 1, 2A and B). There is an illegal immigration area near the main road (Fig.1). Selective logging had been partly conducted long ago, but no logging was conducted in these 50 years except for the illegal immigration area. The dominant tree genera are *Shorea* and *Dipterocarpus*. The burnt forests are dominated by the pioneer tree species such as the genus *Macaranga* and the species *Vernonia arborea*. Bukit Bangkirai Forest, the nearest proteced forest included in the study area (Fig. 1), is also dominated by *Shorea* and *Dipterocarpus*. Bangkirai is the local name of *Shorea laevis* (Makihara 2013). The SWPF is mainly surrounded by heavily burnt and/or degraded natural forests (Fig. 2C), *A. mangium* plantation forests (Fig. 2D), farmlands including orchards and oil palm and rubber plantations, and *Imperata cylindrica* grasslands (Fig. 2E) growing after slash-and-burn agriculture. *Falcataria moluccana* plantation forests are sparsely distributed with small areas. Cattle pastures (Fig. 2 F) are rare landscapes in the study area. A variety of vegetation types on the SWPF and its surroundings are suitable for studies on the relationships between biodiversity and changing environments in humid tropical lowlands.

Materials and methods

We took photographs of dung beetle specimens that we borrowed from the Research Center for Biology, Indonesian Institute of Sciences (RCB-LIPI) through formal procedures before returning the specimens. However, for *Onthophagus* (*Onthophagiellus*) *crassicollis*, *Onthophagus* (*Onthophagus*) *pavidus*, and *Onthophagus* (*Onthophagus*) *keikoae*, we used specimens collected from Vietnam, Sumatra, Indonesia and Sarawak, Malaysia because we did not obtain specimen photographs of these species during our collections. The literature that we referred to for the identification and distribution of species is listed at the end of this study as 'Literature cited for identification and distribution'.

The terms defining the characteristics of beetles used in this study are shown in Fig. 3. The variations in the characteristic states of the apical margin of clypeus observed in this study are shown in Fig. 4. Body length was measured from the apex of the head to the apex of the elytron (Fig. 3). We did not indicate the sexes in the dorsal-view or the magnified morphological photographs of the collected species or parts without distinct sexual dimorphisms, as reflected in the legend of Fig. 5.

'Habitat' is determined from data based on number of beetles collected per trap transect at each vegetation type shown in Table 3 of Ueda et al. (2017). Ueda et al. (2017) treated the sites of intact natural forests separately to deep inside sites or near border sites, but we did not separate them in this atlas. Heavily burnt and/or artificially degraded natural forests are described as 'secondary forest'. *Acasia mangium* plantation forests, *Imperata cylindrica* grasslands, and a cattle pasture are described as 'plantation forest', 'grassland', and 'pasture land', respectively. Three of 10 *A. mangium* plantation forests were 5–12 years old in 2006–2008, but the others were unknown in age. The size, density, and trunk basal area of *A. mangium* trees and the distance from the SWPF and the area of the plantation forests are partly shown in Table 1 of Ueda et al. (2015a). Ueda et al. (2015a) indicated that the distances from the SWPF and areas of *A. mangium* plantation forests strongly affected the beetle assemblages compared to the size, density, and trunk basal area of trees.

'Abundance' is determined from the total numbers of beetles collected through the studies that are indicated in Table 3 of Ueda et al. (2017). The beetles of which only one individual was collected were categorized as 'extremely rare', those with 2–10 individuals were categorized as 'rare', those with 11–100 individuals were categorized as 'moderate', and those with more than 100 individuals were categorized as 'abundant'.

'Attractant' is also determined from the total numbers of beetles collected in the traps baited by human excrements and by raw fish meat through the studies that are indicated in Table 3 of Ueda et al. (2017). More than 70 % of the beetles collected by human excrement baited traps were categorized as 'dung', species more than 70 % of the beetles collected by fish meat baited traps were categorized as 'carrion', and 30–70 % were categorized as 'dung and carrion'.

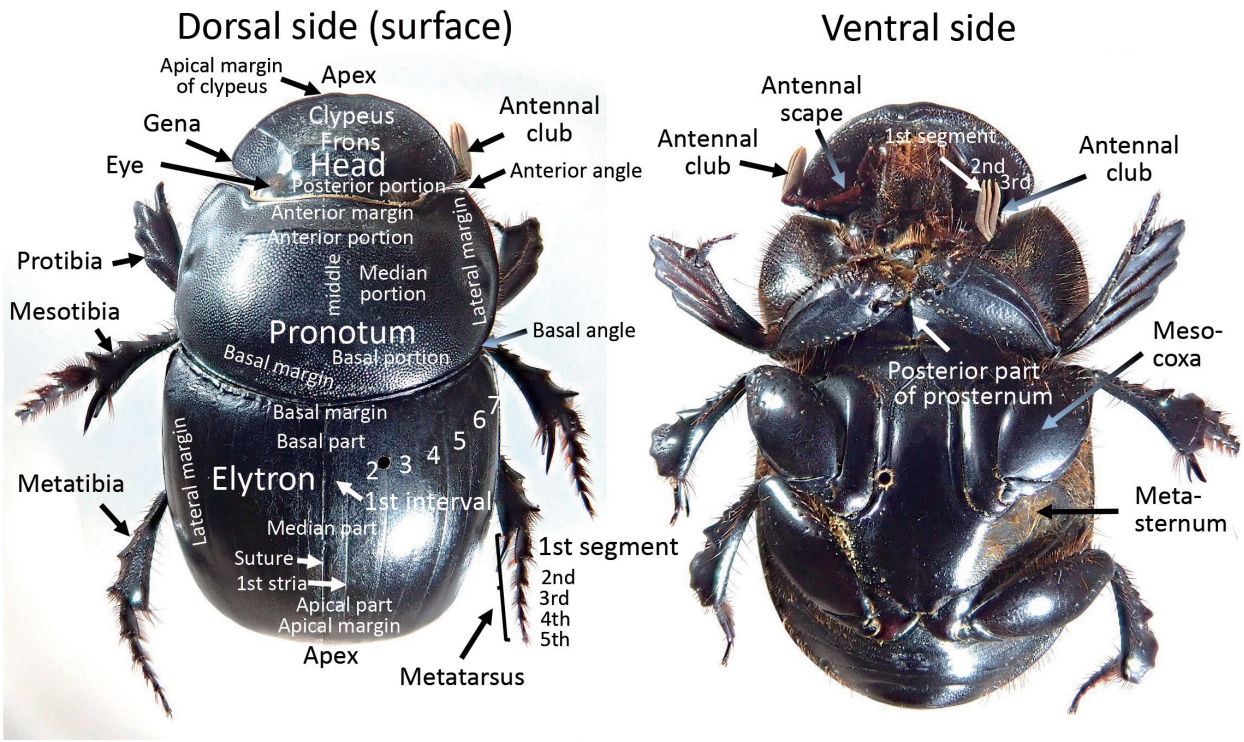

Fig. 3. Terms for the beetle body parts used in this study.

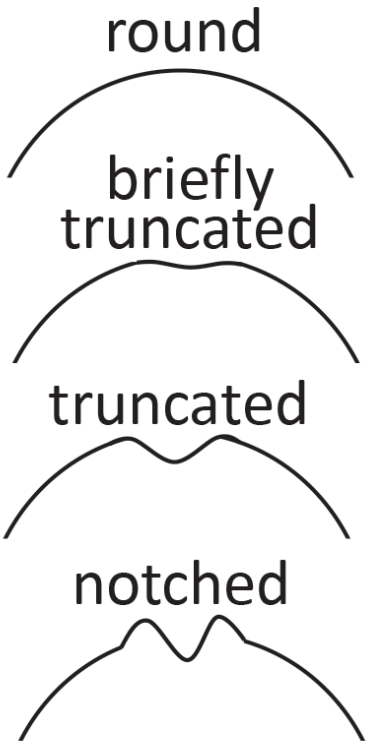

Fig. 4. Terms for the morphological differences in the apical margin of the clypeus used in this study.

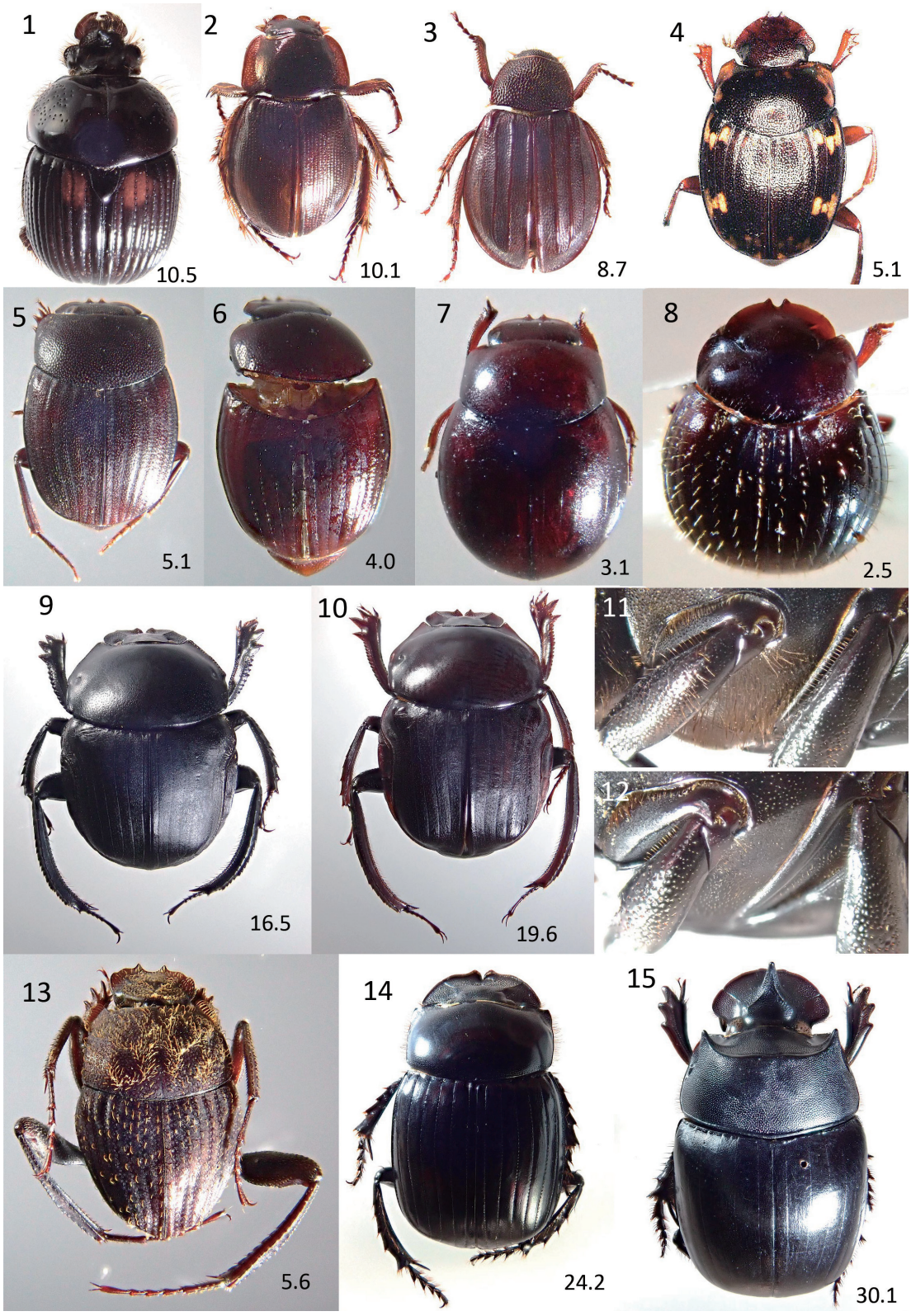

Fig. 5. Photographs of dung beetles. The numerical value on the lower right side of each photograph indicates the body length (the length from the apex of the head to the apex of the elytron) of the specimen in mm. Sexes are not indicated for the species and the morphological parts without distinct sexual dimorphisms.

1: *Bolbochromus catenatus*, 2: *Phaeochrous emarginatus*, 3: *Phaeocroops* sp., 4: *Ochicanthon cambeforti*, 5: *Ochicanthon uedai*, 6: *Ochicanthon woroae*, 7: *Panelus kalimantanicus*, 8: *Haroldius sumatranus*, 9: *Paragymnopleurus maurus*, 10: *Paragymnopleurus striatus*, 11: metasternum of *P. maurus*, 12: metasternum of *P. striatus*, 13: *Sisyphus thoracicus*, 14: *Synapsis ritsemae*, 15: *Catharsius dayacus* (male)

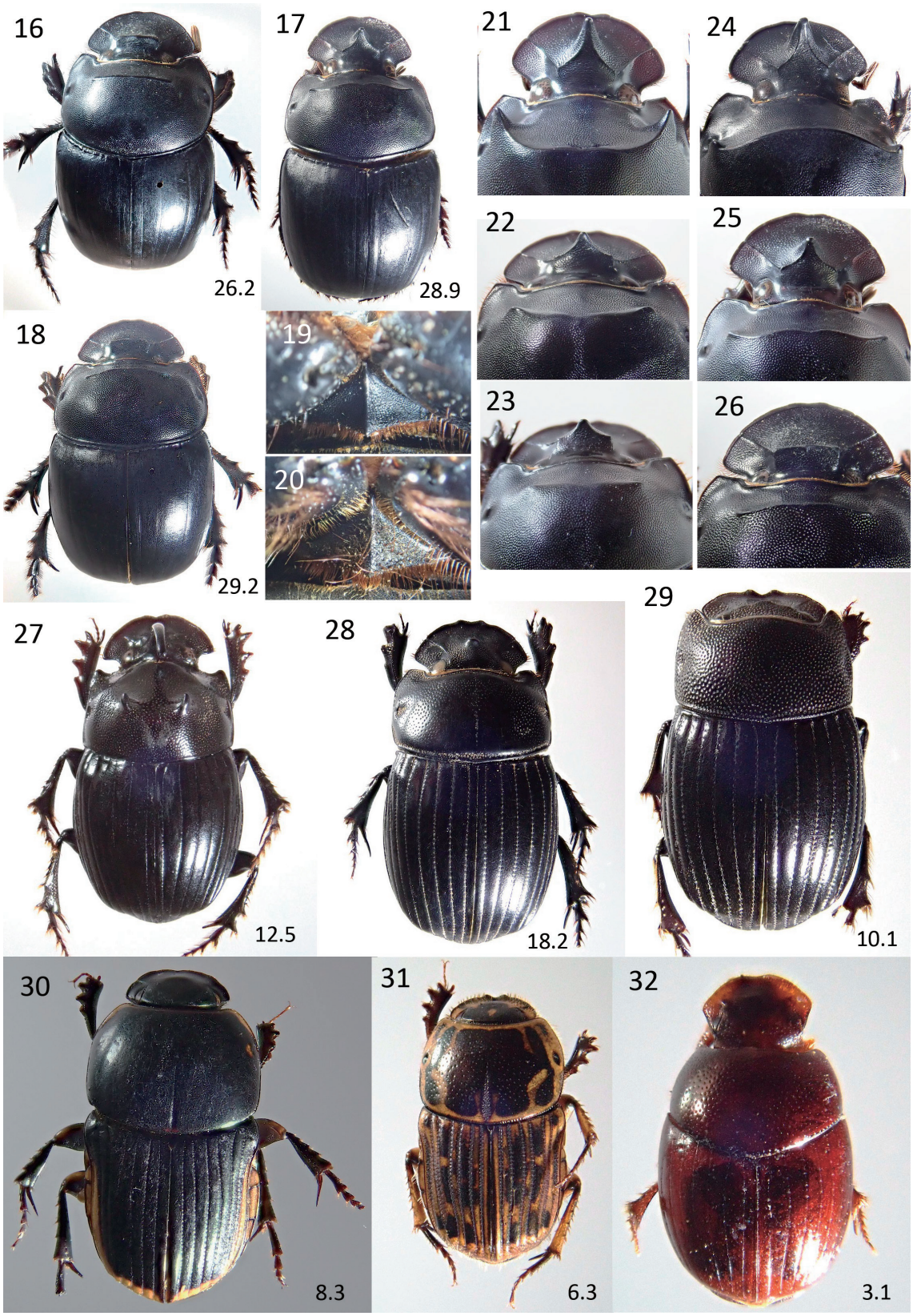

Fig. 5. (continued)

16: *C. dayacus* (female), 17: *Catharsius renaudpauliani* (male), 18: *C. renaudpauliani* (female), 19, 20, 21: male heads and pronota of *C. dayacus*, 22, 23: male heads and pronota of *C. renaudpauliani,* 24: female head and pronotum of *C. renaudpauliani*, 25: posterior part of prosternum of *C. dayacus*, 26: posterior part of prosternum of *C. renaudpauliani*, 27: *Copris (Copris) gibbulus* (male), 28: *Copris (Copris) agnus* (male), 29: *Microcopris fujiokai*, 30: *Oniticellus cinctus*, 31: *Oniticellus tesselatus*, 32: *Caccobius (Caccobius) binodulus*

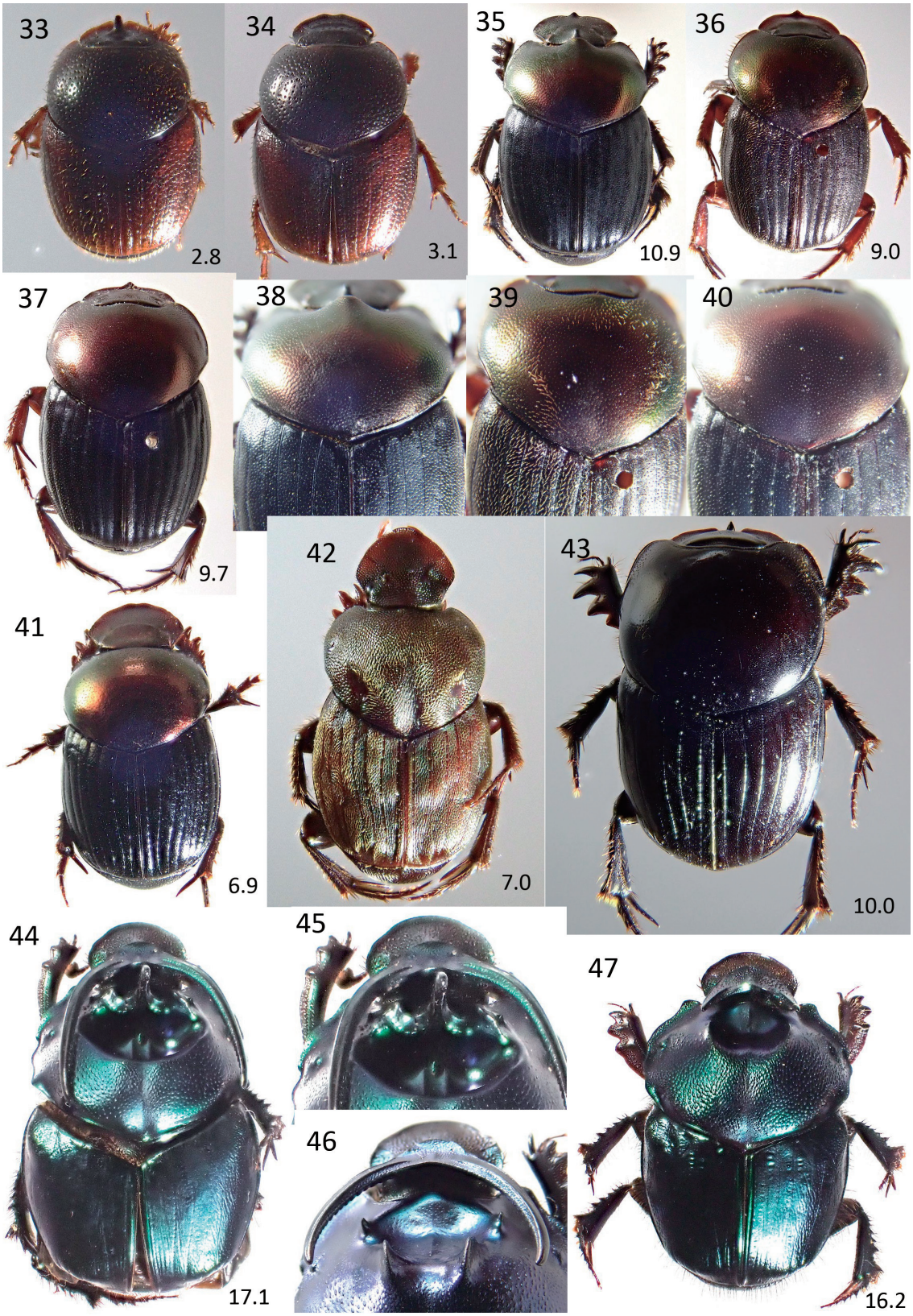

Fig. 5. (continued)

33: *Caccobius* (*Caccophilus*) *unicornis* (male), 34: *C. (C.) unicornis* (female), 35: *Parascatonomus* (*Necramator*) *dux*, 36: *Parascatonomus* (*Necramator*) *aurifex*, 37: *Parascatonomus* (*Necramator*) *semiaureus*, 38, 39, 40: pronota and elytra of *P.* (*N.*) *dux*, *P.* (*N.*) *aurifex*, and *P.* (*N.*) *semiaureus*, respectively, 41: *Parascatonomus* (*Necramator*) *semicupreus*, 42: *Parascatonomu* (*Granulidorsum*) *rudis*, 43: *Parascatonomus* (*Parascatonomus*) *discedens*, 44: *Proagoderus schwaneri* (male), 45, 46: male heads and pronota of *P. schwaneri*, 47: *P. schwaneri* (female)

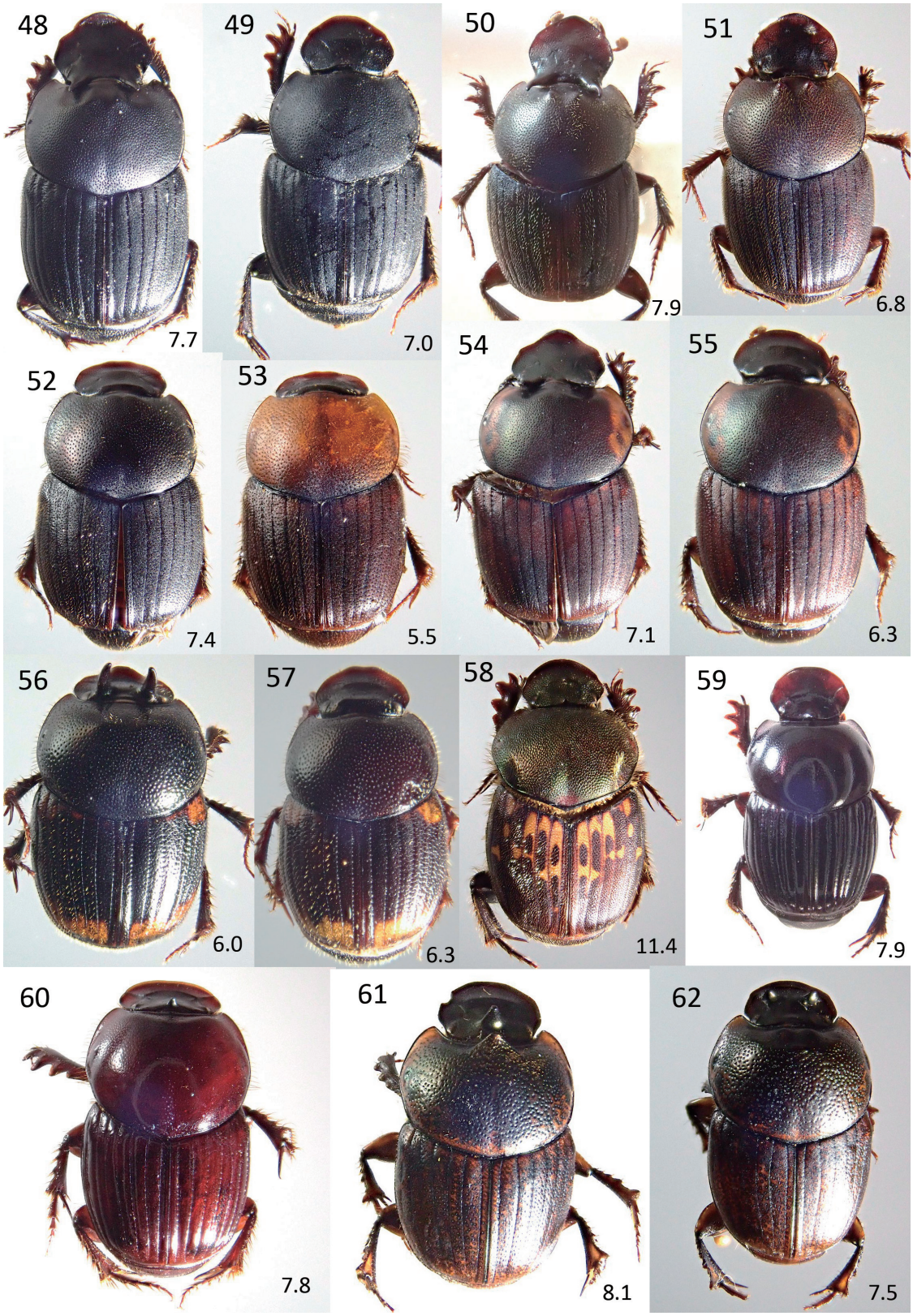

Fig. 5. (continued)

48: *Onthophagus* (*Gibbonthophagus*) *cervicapra* (male), 49: *O.* (*G.*) *cervicapra* (female), 50: *Onthophagus* (*Gibbonthophagus*) *fujiii* (male), 51, 52, 53: *O.* (*G.*) *fujiii* (females), 54: *Onthophagus* (*Gibbonthophagus*) *obscurior* (male), 55: *O.* (*G.*) *obscurior* (female), 56: *Onthophagus* (*Gibbonthophagus*) *limbatus* (male), 57: *O.* (*G.*) *limbatus* (female), 58: *Onthophagus* (*Serrophorus*) *mulleri* (male), 59, 60: *Onthophagus* (*Serrophorus*) *laevis* (males), 61: *Onthophagus* (*Serrophorus*) *sagittarius* (male), 62: *O.* (*S.*) *sagittarius* (female)

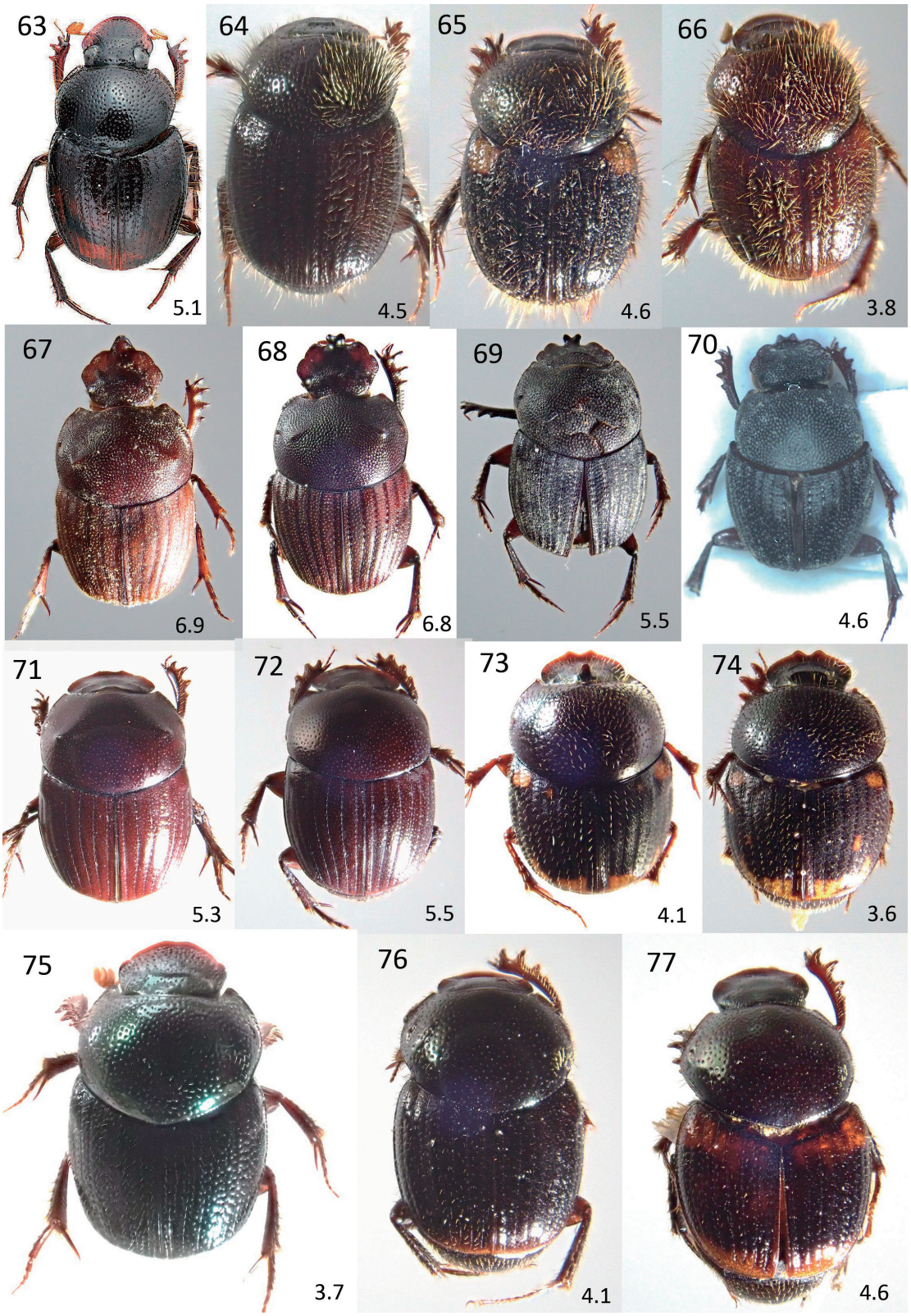

Fig. 5. (continued)

63: *Onthophagus* (*Micronthophagus*) *fukuyamai* (holotype), 64: *Onthophagus* (*Indachorius*) *uedai*, 65: *Onthophagus* (*Indachorius*) *woroae*, 66: *O.* (*I.*) *woroae* (teneral), 67: *Onthophagus* (*Pseudophanaeomophus*) *johkii* (male), 68, 69: *O.* (*P.*) *johkii* (females), 70: *Onthophagus* (*Pseudophanaeomophus*) *sugihartoi* (male) (holotype), 71: *Onthophagus* (*Pseudophanaeomophus*) *chandrai* (male), 72: *O.* (*P.*) *chandrai* (female), 73: *Onthophagus* (*Furconthophagus*) *papulatus* (male), 74: *O.* (*F.*) *papulatus* (female), 75: *Onthophagus* (*Furconthophagus*) *lilliputanus*, 76: *Onthophagus* (*Onthophagiellus*) *hidakai*, 77: *Onthophagus* (*Onthophagiellus*) *deliensis*

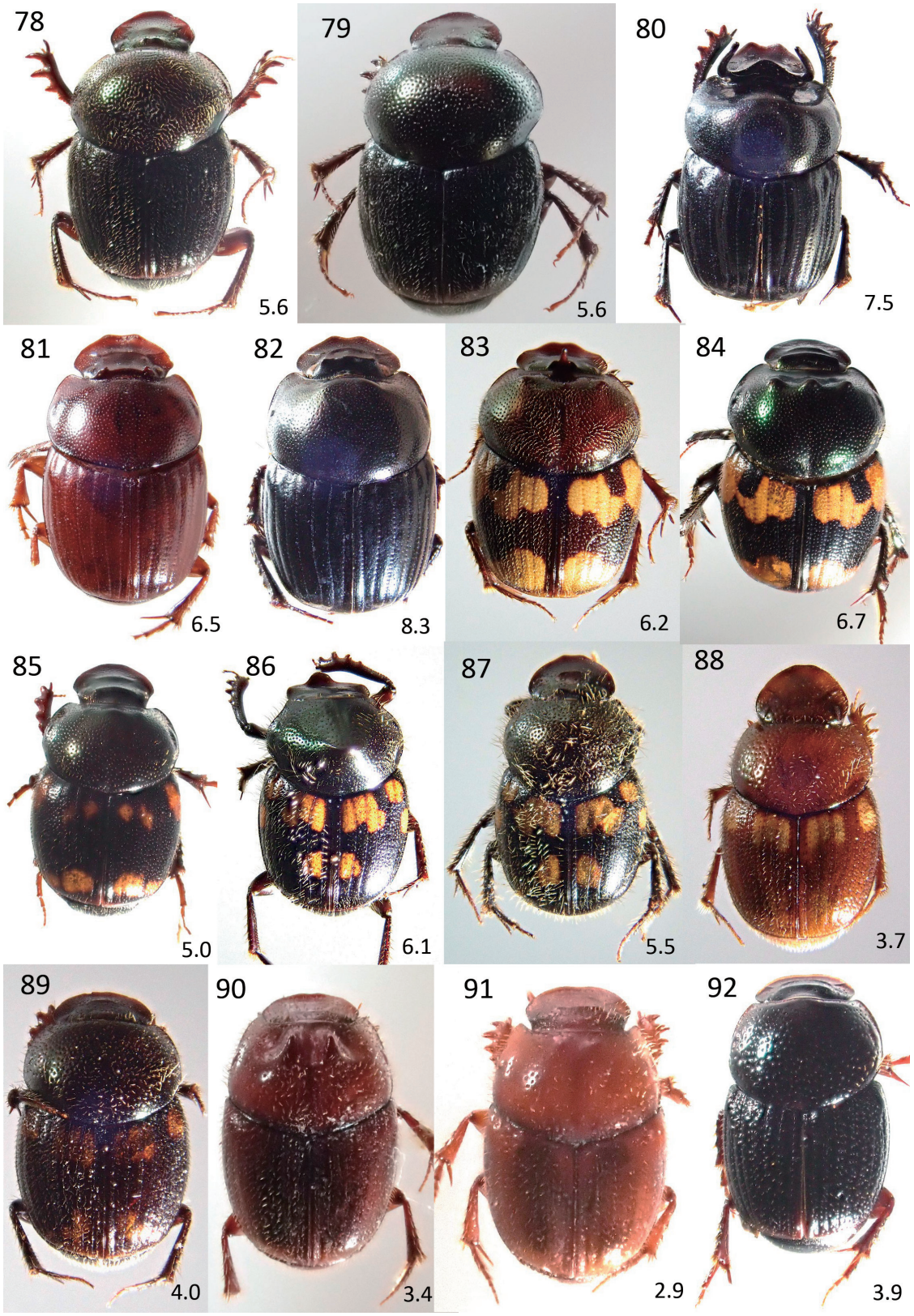

Fig. 5. (continued)

78: *Onthophagus* (*Onthophagiellus*) *crassicollis* (male) (specimen from Vietnam), 79: *O.* (*O.*) *crassicollis* (female) (specimen from Vietnam), 80, 81: *Onthophagus* (*Colobonthophagus*) *armatus* (males), 82: *O.* (*C.*) *armatus* (female), 83: *Onthophagus* (*Paraphanaeomorphus*) *trituber* (male), 84, 85: *O.* (*P.*) *trituber* (females), 86: *Onthophagus* (*Hikidaeus*) *pastillatus* (male), 87: *O.* (*H.*) *pastillatus* (female), 88: *Onthophagus* (*Hikidaeus*) *simboroni* (teneral male), 89: *O.* (*H.*) *simboroni* (female), 90: *Onthophagus* (*Onthophagus*) *vethi* (male), 91: *O.* (*O.*) *vethi* (female), 92: *Onthophagus* (*Onthophagus*) *aphodioides*

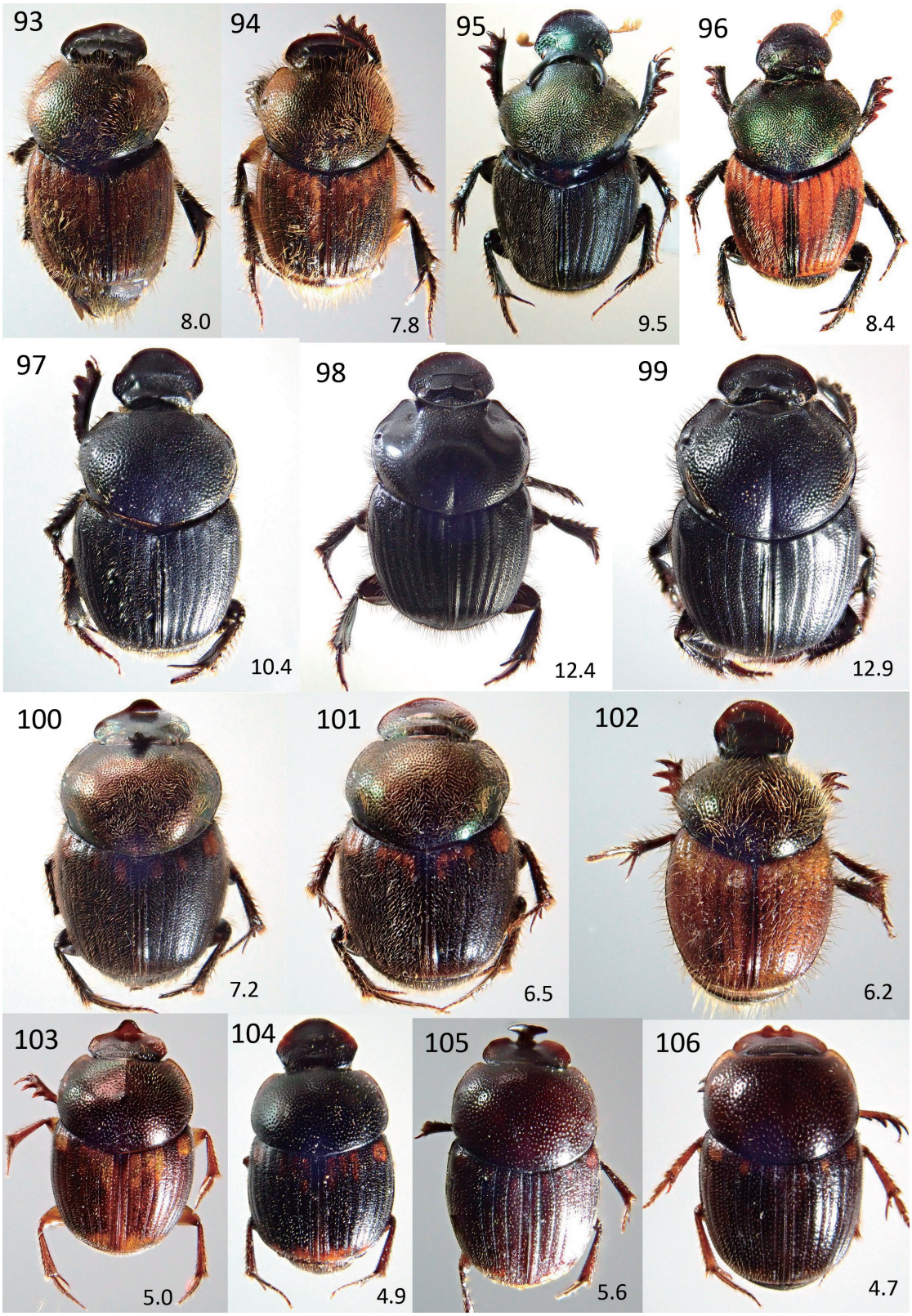

Fig. 5. (continued)

93: *Onthophagus* (*Onthophagus*) *vulpes* (male), 94: *O.* (*O.*) *vulpes* (female), 95: *Onthophagus* (*Onthophagus*) *pavidus* (male) (specimen from Sumatra), 96: *O.* (*O.*) *pavidus* (female) (specimen from Sumatra), 97: *Onthophagus* (*Onthophagus*) *infucatus* (female), 98: *Onthophagus* (*Onthophagus*) *incisus* (male), 99: *O.* (*O.*) *incisus* (female), 100: *Onthophagus* (*Onthophagus*) *waterstradti* (male), 101: *O.* (*O.*) *waterstradti* (female), 102: *Onthophagus* (*Onthophagus*) *ochromerus* (female), 103: *Onthophagus* (*Onthophagus*) *bonorae* (male), 104: *O.* (*O.*) *bonorae* (female), 105: *Onthophagus* (*Onthophagus*) *batillifer* (male), 106: *O.* (*O.*) *batillifer* (female)

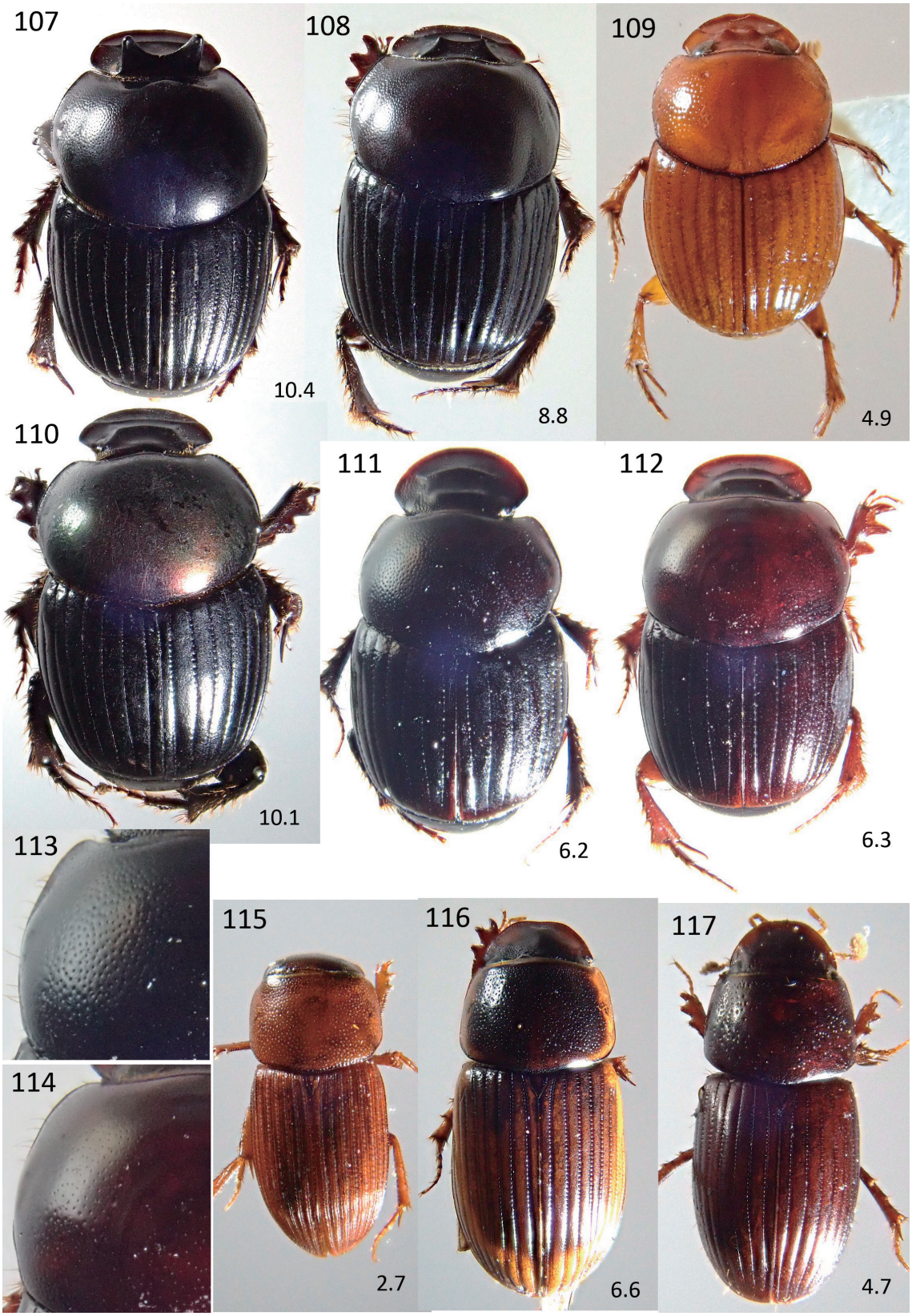

Fig. 5. (continued)

107: *Onthophagus* (*Onthophagus*) *borneensi* (male), 108: *O.* (*O.*) *borneensi* (female), 109: *Onthophagus* (*Onthophagus*) *keikoae* (teneral) (specimen from Sarawak), 110: *Onthophagus* (*Onthophagus*) *rutilans*, 111: *Onthophagus* (*Onthophagus*) *pacificus*, 112: *Onthophagus* (*Onthophagus*) *semipacificus*, 113: pronotum of *O.* (*O.*) *pacificus*, 114: pronotum of *O.* (*O.*) *semipacificus*, 115: *Ataenius* sp., 116: *Aphodius* (*Pharphodius*) *marginellus*, 117: *Aphodius* (*Aganocrossus*) *urostigma*

Diagnosis of each dung beetle (Fig. 5)

Family Bolboceratidae Scholtz & Browne, 1996

One species was collected. Body is strongly convex. Surface is entirely shining and glabrous.

Bolbochromus catenatus (Lansberge, 1886) (Fig. 5-1)
Body length: 9.4–10.5 mm.
Surface is black to dark brown with a pair of orange markings along lateral margin of pronotum and from 2nd to 5th intervals at basal part of elytron. Two horns are on middle of clypeus and posterior portion of head.
Habitat: various types of natural forests.
Attractant: five of 6 individuals were collected by the dung baited traps, however, a species in an allied genus, *Bolbocerosoma nigraoplagiatum*, is known to feed on arbuscular mycorrhiza (Tsukamoto et al. 2017). The captured beetles might have been intercepted their flight for searching arbuscular mycorrhiza by the transparent laminas set on the traps.
Abundance: rare.
Distribution: Borneo, Sumatra, Philippines.

Family Hybosoridae Erichson, 1847

Two species were collected. Mandibles are large and protrude from clypeus.

Phaeochrous emarginatus Castelnau, 1840 (Fig. 5-2)
Body length: 9.7–12.8 mm.
Surface is blackish brown. Elytral intervals wrinkly and weakly rise.
Habitat: various types of natural forests.
Attractant: carrion.
Abundance: moderate.
Distribution: Southeast Asia, Indochina, India, Taiwan, China, Japan (Kyushu, Shikoku, Ryukyu), New Guinea, northern Australia.

Phaeocroops sp. (Fig. 5-3)
Body length: 8.1–9.1 mm.
Surface is blackish brown. Head and pronotum are punctured distinctly. Elytron has four distinct longitudinal ridges including a ridge along suture. This species resembles *Phaeochroops silphoides* Fairmaire, 1898.
Habitat: intact natural forest.
Attractant: carrion.
Abundance: moderate.
Distribution: Borneo (at least).

Family Scarabaeidae Latreille, 1802
Subfamily Scarabaeinae Latreille, 1802

Meso-coxae are separated from each other. Number of spines on end of metatibia is one. The beetles of Scarabaeinae have a unique breeding habit (Hanski and Cambefort 1991). Female makes brood balls from dung or carrion and lay an egg in each of brood balls. Thereafter, the larva feeds on the brood ball from the inside, grows up, and pupates within the ball. The species of Scarabaeinae are classified into three major functional groups based on the location where the brood balls are made: i.e., 1) 'tunneler', 2) 'roller', and 3) 'dweller'. Tunnelers dig tunnels beneath the dung mass and make the brood balls in the tunnels. Rollers build a dung ball and roll it away from the dung mass, and thereafter bury it into the ground for making the brood balls. Dwellers make the brood balls within the dung mass. In the following section, the genera or subgenera of Scarabaeinae were classified into the three functional groups.

Tribe Canthonini Lansberge, 1874

Genus *Ochicanthon* Vaz-de-mello, 2003
Three species were collected. Body is flattened. Apical margin of clypeus is deeply notched at middle. First to 4th segments of meso- and metatarsus are almost the same in width.
Functional group: roller.

Ochicanthon cambeforti (Ochi, Kon et Kikuta, 1997) (Fig. 5-4)
= *Ochicanthon simboroni* Ochi, Ueda et Kon, 2006 (synonymized with O. *cambeforti* by Krikken and Huijbregts (2007))
Body length: 5.1 mm.
Surface is blackish brown with four orange markings: along lateral margin of pronotum, two pairs of orange markings from 5th to 7th intervals at basal and median parts of elytron, respectively, and obscure markings from 2nd to 7th intervals at apical part of elytron. Disk is clearly and densely punctured entirely.
Habitat: an individual was collected from a burnt natural forest.
Attractant: an individual was collected by a carrion baited trap.
Abundance: extremely rare.
Distribution: Borneo.

Ochicanthon uedai Ochi, Kon et Hartini, 2007 (Fig. 5-5)
Body length: 5.0–6.1 mm.
Surface is blackish brown and clearly punctured entirely. Pronotum and elytron are covered with minute yellowish hairs.
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: rare.
Distribution: Borneo.

Ochicanthon woroae Ochi, Ueda et Kon, 2006 (Fig. 5-6)
Body length: 4.0–4.4 mm.
Surface is blackish brown, entirely glabrous, fairly shining, and covered with sparse and small punctures. Body is small, oval and moderately convex for this genus.
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo.

Genus *Panelus* Lewis, 1895
One species was collected. Body is very small and convex. Apical margin of clypeus is deeply notched at middle.
Functional group: roller.

Panelus kalimantanicus Ochi, Kon et Barclay, 2009 (Fig. 5-7)
Body length: 2.8–3.1mm.
Surface is blackish brown to dark reddish brown, entirely shining, glabrous, and finely punctate.
Habitat: all kinds of vegetation types including pastureland.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo.

Genus *Haroldius* Boucomont, 1914
One species was collected. Body is very small, strongly convex, and short-oval. Apical margin of clypeus is deeply notched at middle. Surface is hairy.
Functional group: unknown.

Haroldius sumatranus Paulian et Scheuern, 1994 (Fig. 5-8)
Body length: 2.5–2.7 mm.
Surface is black, shining and finely punctate. Elytron has a row of long hairs on each interval.
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a carrion baited trap.
Abundance: extremely rare.
Distribution: Borneo, Sumatra.

Tribe Gymnopleurini Streubel, 1846

Genus *Paragymnopleurus* Shipp, 1897
Two species were collected. Body is large and flattened. Metatibia is long in order to roll a dung ball.
Functional group: roller.

Paragymnopleurus maurus (Sharp, 1875) (Figs. 5-9 and 11 (metasternum))
Body length: 16.5–21.5mm.
Surface is mat black. Body is moderately oval. Antennal clubs are ivory to yellow. Declivous part of metasternum is covered with dense long hairs (Fig 1-11).
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Sumatra, Malay Peninsula.

Paragymnopleurus striatus (Sharp, 1875) (Figs. 5-10 and 12 (metasternum))
Body length: 19.6–22.3mm.
Surface is black and slightly lustrous, especially on pronotum. Body is moderately squarish. Antennal clubs are reddish brown. Declivous part of metasternum is covered with sparse short hairs (Fig 1-12).
Habitat: intact natural forest.
Attractant: dung.
Abundance: rare.
Distribution: Borneo, Java, Malay Peninsula.

Tribe Sisyphini Mulsant, 1842

Genus *Sisyphus* Latreille, 1807
One species was collected. Body is small and strongly convex. Hind legs are extremely long to roll a dung ball.
Functional group: roller.

Sisyphus thoracicus Sharp, 1875 (Fig. 5-13)
Body length: 5.0–7.0mm.
Surface is brown to reddish brown. Head and pronotum are densely covered with hooked yellowish hairs, whereas elytron sparsely so.
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Java, Sumatra, Malay Peninsula, Indochina.

Tribe Coprini Leach, 1815

Genus *Synapsis* Bates, 1868
One species was collected. Body is large and moderately flattened. Apical margin of clypeus is deeply notched.
Functional group: roller.

Synapsis ritsemae Lansberge, 1874 (Fig. 5-14)
Body length: 22.0–29.1mm.
Surface is black, glabrous, shining, and smooth.
Habitat: intact natural forest.
Attractant: dung.
Abundance: rare.
Distribution: Borneo, Java, Sumatra, Malay Peninsula.

Genus *Catharsius* Hope, 1837
Two species were collected. Body is large and strongly convex. Surface is glabrous. Head and pronotum are densely covered with bosses. Male has a horn and female has a transverse carina on their frons.
Functional group: tunneler.

Catharsius dayacus Lansberge, 1886 (Figs. 5-15 (male), 16 (female), 19 (posterior part of prosternum), 21, 22, and 23 (male heads and pronota))
Body length: 22.3–32.8mm.
Surface is black. Bosses on pronotum are distinctly degraded around highest parts of pronotum, which are somewhat shining. Angle of gena is rounder when compared to that of the next species. Posterior part of prosternum has few or no long hairs (Fig. 5-19). Male has a tubercle on frons and a transverse carina on pronotum which is concave in central portion (Figs. 5-21, 22, and 23).
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Java, Sumatra, Malay Peninsula.

Catharsius renaudpauliani Ochi et Kon, 1996 (Figs. 5-17 (male), 18 (female), 20 (posterior part of prosternum), 24, 25: (male heads and pronota), 26: (female head and pronotum))
Body length: 23.9–35.5mm.
Surface is black. Bosses on pronotum are not degraded at all or weakly degraded around highest parts of pronotum. Angle of gena is moderately acute. Posterior part of prosternum has long hairs (Fig. 5-20). Male has a tubercle on frons and a transverse carina on pronotum which is convex in central portion (Figs. 5-24 and 25).
Habitat: secondary forest and plantation forest.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Sumatra, Malay Peninsula.

Genus *Copris* Geoffroy, 1762
Two species were collected but rare. Body is small to middle sized for the tribe Coprini and strongly convex. Surface is shining and glabrous.
Functional group: tunneler.

Copris (*Copris*) *gibbulus* Lansberge, 1886 (Fig. 5-27)
Body length: 9.0–12.5mm.
Body is small. Surface is black. Protibia has four distinct external teeth. Male has a long (4 mm) horn on frons and two short horns at median portion of pronotum (Fig. 5-27). Female has a conical tubercle on frons.
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a carrion baited trap.
Abundance: extremely rare.
Distribution: Borneo, Java, Sumatra, Malay Peninsula.

Copris (*Copris*) *agnus* Sharp, 1875 (Fig. 5-28)
Body length: 14.1–20.3mm.
Body is large. Surface is black. Protibia has four external teeth but 1st and 2nd teeth are contiguous and 4th one is small. Male only has a short (1 mm) horn on frons like a conical tubercle of female (Fig. 5-28).
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a dung baited trap.
Abundance: extremely rare.
Distribution: Borneo, Malay Peninsula.

Genus *Microcopris* Balthasar, 1958
One species was collected. Body is small and moderately convex. Surface is shining and glabrous.
Functional group: tunneler.

Microcopris fujiokai Ochi et Kon, 1996 (Fig. 5-29)
Body length: 7.7–10.1mm.
Surface is black. Pronotum is wholly and densely covered with coarse punctures. Protibia has four external teeth but fourth tooth is very small. Both male and female have no horn nor tubercle on head.
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo.

Tribe Oniticellini La Peletier & Serville, 1828

Genus *Oniticellus* Dejean, 1821
Two species were collected in the cattle pasture. Body is flattened and surface is shining and glabrous except for long hairs on apical margin of elytron. Yellow to yellowish brown parts are distributed on black or blackish brown body.
Functional group: dweller.

Oniticellus cinctus (Fabricius, 1775) (Fig. 5-30)
Body length: 8.0–12.0mm.
Surface is black. Yellow parts are distributed along lateral margin of body except for head.
Habitat: an individual was collected from the pastureland.
Attractant: an individual was collected by a carrion baited trap.
Abundance: extremely rare.
Distribution: Borneo, Java, Malay Peninsula, Indochina, India,

South China.

Oniticellus tesselatus (Harold, 1879) (Fig. 5-31)
Body length: 6.0–8.4mm.
Surface is bi-colored in blackish brown and yellowish brown.
Habitat: two individuals were collected from the pastureland
Attractant: two individuals were collected; one by a dung baited trap whereas the other by a carrion baited one.
Abundance: rare.
Distribution: Borneo, Java, Sumatra Indochina.

Tribe Onthophagini Streubel, 1846

Genus *Caccobius* Thomson, 1859
Two species were collected. Body is small and convex. Protibia is transversely truncated, inner angle of distal end is nearly right-angled, and 1st tooth protrudes sideward (Fig. 6).
Functional group: tunneler.

Caccobius (*Caccobius*) *binodulus* Harold, 1877 (Fig. 5-32)
Body length: 2.8–3.1mm.
Surface is black to reddish brown, entirely glabrous, and shining. Apical margin of clypeus is weakly truncated.
Habitat: intact natural forest.
Attractant: dung.
Abundance: rare.
Distribution: Borneo.

Caccobius (*Caccophilus*) *unicornis* (Fabricius, 1798) (Figs. 5-33 (male) and 34 (female))
Body length: 2.6–3.6mm.
Surface is black, punctured entirely, and covered with short yellow hairs. Elytron is often blackish brown. Apical margin of clypeus is truncated. Male has a short horn behind notch of clypeal margin (Fig. 5-33).
Habitat: plantation forest, grassland, and pastureland.

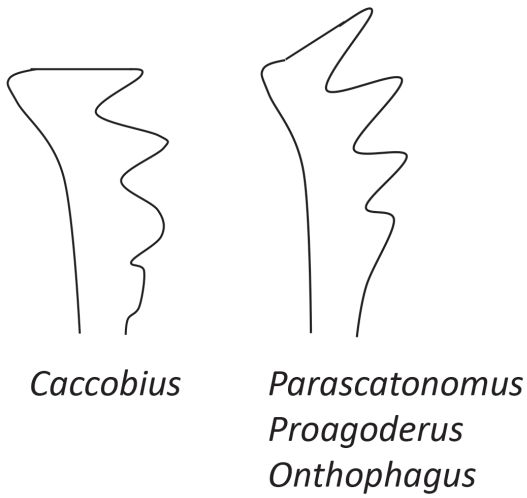

Fig. 6. Protibia of tribe Onthophagini.

Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Java, Sumatra, Philippines, India, Sri Lanka, Indochina, China, Taiwan, Korea, Southern Japan.

Genus *Parascatonomus* Paulian, 1932
Six species were collected. Body is small to middle-sized and surface is convex. In this genus and next two genera (*Proagoderus* and *Onthophagus*), inner angle of distal end of protibia is obtuse-angled and 1st tooth protrudes antero-diagonally (Fig. 6). First segment of antennal club is thicker than 2nd and 3rd ones at least on base.
Functional group: tunneler.

Parascatonomus (*Necramator*) *dux* (Sharp, 1875) (Figs. 5-35 and 38 (pronotum and elytra))
Body length: 10.2–16.0mm.
Head and pronotum are usually copper-colored but rarely dark purple. Elytron is black. Pronotum is densely covered with scaly granules, anterior margin is distinctly sinuate, and antero-middle part largely protrudes forward (Fig. 5-38). Head has a conical tubercle at middle of posterior portion.
Habitat: various types of natural forests.
Attractant: carrion.
Abundance: abundant.
Distribution: Borneo.

Parascatonomus (*Necramator*) *aurifex* (Harold, 1877) (Figs. 5-36 and 39 (pronotum and elytra))
Body length: 7.9–12.0mm.
Head and pronotum are copper-colored. Pronotum is entirely punctate and partly covered with yellowish hairs, and anterior margin is weakly sinuate (Fig. 5-39). Elytron is covered with yellowish hairs (Fig. 5-39).
Habitat: various types of natural forests.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo.

Parascatonomus (*Necramator*) *semiaureus* (Lansberge, 1883) (Figs. 5-37 and 40 (pronotum and elytra))
Body length: 7.0–11.6mm.
Head and pronotum are copper-colored. Pronotum is entirely punctate and mostly glabrous, and anterior margin is weakly sinuate (Fig. 5-40). Elytron is sparsely covered with short yellowish hairs, especially no or very short hairs on 1 - 4 intervals (Fig. 5-40).
Habitat: various types of forests including plantation forest.
Attractant: carrion.
Abundance: moderate.

Distribution: Borneo, Java, Sumatra, Bali.

Parascatonomus (*Necramator*) *semicupreus* (Harold, 1877) (Fig. 5-41)
Body length: 5.0–8.1mm.
Head and pronotum are copper-colored. This species resembles to the preceding three species but can be distinguished from them by the following characteristics: small body; truncated apical margin of clypeus; round anterior margin of pronotum.
Habitat: various types of forests including plantation forest.
Attractant: carrion.
Abundance: abundant.
Distribution: Borneo, Java, Sumatra, Malay Peninsula, Palawan.

Parascatonomus (*Granulidorsum*) *rudis* (Sharp, 1875) (Fig. 5-42)
Body length: 5.5–7.1mm.
Surface is dark brown tinged with copper-colored to golden luster, and entirely covered with scaly granules. Pronotum and elytra are densely covered with short inclining yellowish hairs.
Habitat: various types of natural forests.
Attractant: carrion.
Abundance: moderate.
Distribution: Borneo, Java, Sumatra, Nias, Lombok, Malay Peninsula, Palawan, Indochina, northern India, southern China.

Parascatonomus (*Parascatonomus*) *discedens* (Sharp, 1875) (Fig. 5-43)
Body length 9.0–13.0mm.
Surface is black, strongly shining, glabrous except for lateral margins of pronotum and elytron, and covered with minute punctures. Apical margin of clypeus is deeply notched with an upturned tooth at middle. Anterior angles of pronotum produce broadly and roundly. Two individuals were collected in the preliminary study conducted in 2005/2006, an individual in the post study in 2017, and they were not listed in Ueda et al. (2017).
Habitat: intact natural forest.
Attractant: carrion.
Abundance: rare.
Distribution: Borneo, Sumatra, Malay Peninsula, Palawan.

Genus *Proagoderus* Lansberge, 1883
One species was collected. Body is large and surface is strongly convex and shining. Meso- and metatibiae distinctly tri-lobed on outer distal end. Basal margin of pronotum is very strongly angulate at middle. In this genus and the next one (*Onthophagus*), 1st segment of antenna has the same thickness as 2nd one and is slightly thicker than 3rd one.
Functional group: tunneler.

Proagoderus schwaneri (Lansberge, 1864) (Figs. 5-44 (male), 45, 46 (male heads and pronota), and 47 (female))
Body length: 14.8–19.3mm.
Body is tinged with dark blue to dark greenish luster. Surface is almost glabrous except for clypeus with yellowish hairs. There are three types of males. Major male with a pair of very long slender horns on head has a horn on anterior margin of pronotal excavation in middle (Fig. 5-45). Medium-sized male with a pair of moderately long horns on head has a pair of tubercles on lateral edges of pronotal excavation, which is moderately shallow, and a pair of longitudinal parallel carinae on posterior margin (Fig. 5-46). Minor male with short triangular processes on head instead of horns has a pair of longitudinal parallel carinae on lateral margins of shallow hollow on pronotum. Female has short horns on head and a shallow hollow on pronotum (Fig. 5-47).
Habitat: various types of forests including plantation forest.
Attractant: dung and carrion.
Abundance: abundant.
Distribution: Borneo, Sumatra, Sulawesi.

Genus *Onthophagus* Latreille, 1802
Eleven subgenera and 36 species were collected. Meso- and metatibiae are not distinctly tri-lobed on outer distal end. Body is usually small to middle-sized and usually convex.

Subgenus *Gibbonthophagus* Balthasar, 1935
Four species were collected. Antennal scape (basal segment of antenna) is finely serrate (like blade of knife) on anterior side (Fig. 7). Body is moderately depressed except for *Onthophagus* (*Gibbonthophagus*) *limbatus*
Functional group: tunneler.

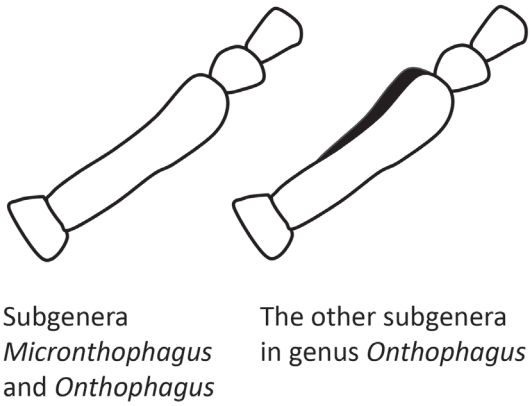

Fig. 7. Antennal scape (basal segment of antenna) of genus *Onthophagus*.

Onthophagus (*Gibbonthophagus*) *cervicapra* Boucomont, 1914 (Figs. 5-48 (male) and 49 (female))
Body length: 6.4–9.4mm.
Surface is black and entirely opaque. Head and pronotum are glabrous. Apical and lateral portion of elytron is covered with short whitish hairs. Male has a pair of short inclining horns on posterior portion of head, and pronotum is concave along horns (Fig. 5-48).
Habitat: various types of forests including plantation forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Java, Sumatra.

Onthophagus (*Gibbonthophagus*) *fujiii* Ochi et Kon, 1995 (Figs. 5-50 (male), 51, 52, and 53 (females))
Body length: 5.5–8.1mm.
Surface is blackish brown to brown and entirely opaque. Rarely, there are individuals with reddish pronota (Fig. 5-53). Head is glabrous but pronotum and elytron are densely covered with yellowish short hairs. Male has a pair of short inclining horns on posterior portion of head, and pronotum is concave along horns (Fig. 5-50). Large female has a pair of tubercles on anterior portion of pronotum (Fig. 5-51).
Habitat: various types of natural forests.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo.

Onthophagus (*Gibbonthophagus*) *obscurior* Boucomont, 1914 (Figs. 5-54 (male) and 55 (female))
Body length: 6.1–8.1mm.
Surface is blackish brown to brown and entirely opaque. Lateral margins of pronotum, some intervals of elytron, and ventral side are orange. Head and pronotum are glabrous. Apical and lateral parts of elytron are covered with short whitish hairs. Male has a pair of short inclining horns on posterior portion of head, and pronotum is concave along horns (Fig. 5-54).
Habitat: all kinds of vegetation types including pastureland.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo, Sumatra, Malay Peninsula, Indochina.

Onthophagus (*Gibbonthophagus*) *limbatus* (Herbst, 1789) (Figs. 5-56 (male) and 57 (female))
Body length: 5.0–8.1mm.
Surface is black to brownish brown, shining, and sparsely covered with short whitish hairs. Elytron has orange bands on basal part (from 4th to 7th intervals) and on apical part (from 2nd to 8th intervals). Body is strongly convex for the subgenus. Male has a pair of short vertical horns on posterior portion of head but pronotum is not concave along horns (Fig. 5-56).
Habitat: pastureland (some individuals were also collected from plantation forests and grasslands).
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Java, Sumatra, Indochina, China.

Subgenus *Serrophorus* Balthasar, 1963
Three species were collected. Body is moderately large. Apical margin of clypeus is round. Antennal scape is roughly serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Serrophorus*) *mulleri* Lansberge, 1883 (Fig. 5-58 (male))
Body length: 8.0–12.1mm.
Surfaces of head and pronotum are tinged with bronze luster and granulated. Elytron is blackish brown, bearing orange patches between basal and median parts (from 2nd to 7th intervals), and densely covered with yellowish hairs. Male has a short tubercle on posterior portion of head (Fig. 5-58).
Habitat: various types of natural forests.
Attractant: dung.
Abundance: rare.
Distribution: Borneo, Java, Sumatra.

Onthophagus (*Serrophorus*) *laevis* Harold, 1880 (Figs. 5-59 and 60 (males))
Body length: 7.8–10.0mm.
Surface is black to reddish brown, strongly shining, smooth, and entirely glabrous. Male has a short horn on posterior portion of head (Figs. 5-59 and 60).
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Java, Sumatra.

Onthophagus (*Serrophorus*) *sagittarius* (Fabricius, 1775) (Figs. 5-61 (male) and 62 (female))
Body length: 7.5–11.0mm.
Surface is blackish brown with orange parts present around lateral and basal margins of pronotum and scattered on elytron. Disk is weakly shining but elytron is opaque. Pronotum is covered with dense and large punctures. Elytron is sparsely covered with setae, which become long on apical part. Male has a conical sharp horn between eyes, and anterior margin of pronotum is distinctly sinuate and largely protrudes forward in middle (Fig. 5-61). Female has a pair of conical short horns on

clypeus transversely and a pair of tubercles on anterior portion of pronotum (Fig. 5-62).
Habitat: two individuals were collected; one from a burnt natural forest whereas the other from the pastureland.
Attractant: one by a dung baited trap whereas the other by a carrion baited one.
Abundance: rare.
Distribution: Borneo, Java, Sumatra, Timor, Malay Peninsula, Philippines, Indochina, India, South China.

Subgenus *Micronthophagus* Balthasar, 1963
One species was newly collected in 2016 and not listed in Ueda et al. (2017). Body is small. Eyes are large and distance between eyes is less than 3 times as wide as an eye (one exception: eyes of *Onthophagus* (*Onthophagus*) *keikoae* are large like this subgenus). Antennal scape is not serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Micronthophagus*) *fukuyamai* Ochi, Kon et Ueda 2018 (Fig. 5-63)
Body length: 5.1–5.3mm.
Surface is dark brown, strongly shining, and sparsely covered with long erect hairs. Apical margin of clypeus is almost round. Pronotum is distinctly covered with punctures, each of which bears a long hair, and impunctate along middle line. Elytron is somewhat depressed compared with pronotum.
Habitat: two individuals were collected from intact natural forests.
Attractant: one by a dung baited trap whereas the other by a carrion baited one.
Abundance: rare.
Distribution: Borneo

Subgenus *Indachorius* Balthasar, 1941
Two species were collected. Body is small. Surface is densely covered with long hairs. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Indachorius*) *uedai* Ochi et Kon, 2006 (Fig. 5-64)
Body length: 4.5–5.7mm.
Head and pronotum are tinged with dark greenish luster. Surface is somewhat sparsely covered with erect, long, and yellowish hairs. Apical margin of clypeus is truncate or almost round. Pronotum is densely covered with strong and large punctures.
Habitat: grassland.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo.

Onthophagus (*Indachorius*) *woroae* Ochi et Kon, 2006 (Fig. 5-65 and 66 (teneral))
Body length: 4.4–6.0mm.
Surface is black with orange markings at basal part of elytron (from 2nd or 5th to 7th intervals), and covered with erect, remarkably long, and yellowish hairs. Apical margin of clypeus is round. Pronotum is densely covered with strong and large punctures.
Habitat: intact and burnt natural forests.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo.

Subgenus *Pseudophanaeomophus* Ochi, 2007
Three species were collected. Pronotum mostly has a pair of tubercles transversely at median portion. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Pseudophanaeomophus*) *johkii* Ochi et Kon, 1994 (Figs. 5-67 (male), 68, and 69 (females))
Body length: 5.5–8.0mm.
Surface is blackish brown to brown and opaque. Pronotum and elytron are covered with very short yellowish hairs. Pronotum is densely covered with strong and large punctures. Male and large female have a pair of tubercles at median portion of pronotum (Figs. 5-67 and 68). In large male, apical margin of clypeus is elongated triangularly and strongly upturned (Fig. 5-67), but in small male, it is weakly upturned and truncated. In female, apical margin of clypeus is widely truncated with a heart-shaped projection at middle (Figs. 5-68 and 69). One individual was collected in the preliminary study conducted in August, 2006 and two individuals in post study in 2017, respectively, and not listed in Ueda et al. (2017).
Habitat: intact natural forest.
Attractant: carrion.
Abundance: rare.
Distribution: Borneo.

Onthophagus (*Pseudophanaeomophus*) *sugihartoi* Ochi, 2007 (Fig. 5-70 (male))
Body length: 4.6mm.
Surface is blackish brown to greyish black and opaque. Body is oval and short. Pronotum is widest near basal margin and densely covered with strong and large punctures. Pronotum and elytron are covered with short yellowish hairs. In male, apical margin of clypeus is widely truncated with a M-shaped

projection at middle. Female is unknown.
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a dung baited trap.
Abundance: extremely rare.
Distribution: Borneo.

Onthophagus (*Pseudophanaeomophus*) *chandrai* Ochi, 2006 (Fig. 5-71 (male) and 72 (female))
Body length: 4.8–6.4mm.
Surface is black to reddish brown, strongly convex, strongly shining, and glabrous. Apical margin of clypeus is truncated. Pronotum is covered with shallow and moderately small punctures. Male has a pair of tubercles at median portion of pronotum near lateral margins and a pair of weak ridges from tubercles toward middle of anterior margin forming a triangular disk (Fig. 5-71).
Habitat: intact natural forest.
Attractant: carrion.
Abundance: moderate.
Distribution: Borneo.

Subgenus *Furconthophagus* Zunino, 1979
Two species were collected. Body is small. Surface is distinctly covered with short erect hairs. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Furconthophagus*) *papulatus* Boucomont, 1914 (Figs. 5-73 (male) and 74 (female)
Body length: 3.6–5.0mm.
Surface is brownish black, weakly shining, and entirely covered with short, erect, and yellowish hairs sparsely. Elytron bears orange markings at basal part (on 4th, 6th, and 7th intervals), near median part (on 5th and 6th intervals), and at apical part (from 2nd to 9th intervals). Apical margin of clypeus is notched. Male has an erect short horn between eyes (Fig. 5-73).
Habitat: pastureland (a few individuals were also collected from grasslands).
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Indochina.

Onthophagus (*Furconthophagus*) *lilliputanus* Lansberge, 1883 (Fig. 5-75)
Body length: 3.5–4.5mm.
Head and pronotum are tinged with greenish luster. Surface is shining and entirely covered with short, erect, stout, and whitish hairs densely. Apical margin of clypeus is truncated.
Habitat: grassland.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Java, Philippines, Myanmar, India.

Subgenus *Onthophagiellus* Balthasar, 1935
Three species were collected. Body is small. First segment of metatarsus is extremely long (more than 4 times as long as 2nd segment). Head is transversely wide. Elytron is moderately depressed. Apical margin of clypeus is round. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: roller.

Onthophagus (*Onthophagiellus*) *hidakai* Ochi et Kon, 1995 (Fig. 5-76)
Body length: 4.1–5.5mm.
Surface is black and shining. Head and pronotum are tinged with weakly metallic luster. Apical end of elytron is reddish brown. Pronotum is densely covered with strong punctures. Pronotum and elytron are sparsely covered with short yellowish hairs. Elytron is moderately depressed and flattened.
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: rare.
Distribution: Borneo, Indochina.

Onthophagus (*Onthophagiellus*) *deliensis* Lansberge, 1885 (Fig. 5-77)
Body length 4.6–5.9mm.
Surface is blackish brown to dark reddish brown and shining. Head and pronotum are tinged with brownish to greenish luster. Elytron has transverse orange bands from 2nd interval to lateral margin at basal part and entirely at apical part. Pronotum is densely covered with strong punctures. Pronotum and elytron are sparsely covered with short yellowish hairs. Elytron is moderately depressed and flattened. An individual was collected in the preliminary study conducted in 2004/2005 and not listed in Ueda et al. (2017).
Habitat: an individual was collected from a secondary forest.
Attractant: an individual was collected by a dung baited trap.
Abundance: extremely rare.
Distribution: Borneo, Sumatra, Malay Peninsula.

Onthophagus (*Onthophagiellus*) *crassicollis* Boucomont, 1913 (Figs. 5-78 (male) and 79 (female))
Body length: 3.5–5.6mm.
Surface is black and shining. Head and pronotum are tinged with brownish to greenish luster. Apical end of elytron is dark brown. Pronotum is densely covered with strong punctures and with short yellowish hairs. Elytron is depressed and flattened

and this makes conspicuous rise of pronotum. Elytron is covered with erect short yellowish hairs and with punctures. Male has a distinct short transverse ridge on posterior portion of head (Fig. 5-78). In female, short ridge on head is weak and inconspicuous (Fig. 5-79).
Habitat: burnt natural forest.
Attractant: three individuals were collected; two by dung baited traps whereas one by a carrion baited one.
Abundance: rare.
Distribution: Borneo, Sumatra, Indochina.

Subgenus *Colobonthophagus* Balthasar, 1935
One species is collected. Body is middle-sized. Surface is entirely glabrous and shining. Apical margin of clypeus is reflexed and truncated. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Colobonthophagus*) *armatus* Blanchard, 1853 (Figs. 5-80, 81 (males), and 82 (female))
Body length: 6.5–8.2mm.
Surface is black to reddish brown, entirely glabrous, and shining. Head and pronotum are tinged with weakly metallic luster. Pronotum and elytron are covered with small punctures. Large male has a pair of buffalo like horns on posterior portion of head, and pronotum is concave along horns (Fig. 5-80). Small male has a pair of small triangular processes, and pronotum is not concave (Fig. 5-81). Female has a distinct transverse carina on posterior portion of head and pronotum strongly elevates on anterior portion in middle (Fig. 5-82).
Habitat: grassland.
Attractant: dung.
Abundance: rare.
Distribution: Borneo, Sumatra, Java, Philippines, Myanmar, India.

Subgenus *Paraphanaeomorphus* Balthasar, 1959
One species is collected. Body is small to middle-sized. Surface is shining. Pronotum and elytron are densely covered with short inclining hairs. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Paraphanaeomorphus*) *trituber* (Widemann, 1823) (Figs. 5-83 (male), 84, and 85 (females))
Body length: 4.5–8.0mm.
Surface is black to dark brown, shining, and covered with short inclining yellowish hairs. Head and pronotum are tinged with greenish or brownish luster. Elytron has two orange bands, one of which is at basal part (from 2nd to 8th intervals) whereas another at apical part (from 2nd to 8th intervals). Rarely, bands are discontinuous in some individuals (Fig. 5-85). Apical margin of clypeus is reflexed and truncated. Pronotum has distinct three tubercles in anterior portion (indistinct in small individuals) and is covered with distinct punctures, each of which bears a hair. Male has a lamina with a short horn or a tubercle on posterior portion of head (Fig. 5-83).
Habitat: grassland and pastureland.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Sumatra, Java, Malay Peninsula, Philippines, Indochina, China, Taiwan, Korea, Japan (Hyogo, Okayama, and Miyako Is.).

Subgenus *Hikidaeus* Ochi & Kon, 2016
Two species were collected. Body is small to middle-sized. Surface is shining and covered with erect hairs. Elytron is somewhat depressed. Antennal scape is serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Hikidaeus*) *pastillatus* Boucomont, 1914 (Figs. 86 (male) and 87 (female))
Body length: 4.2–8.0mm.
Surface is black to blackish brown, weakly shining and sparsely (head) or densely (pronotum and elytron) covered with long yellowish hairs. Head and pronotum are tinged with greenish luster. Elytron has four orange markings at basal part (from 2nd to 5th intervals and from 6th to 7th ones), at inter-basal-median part of 7th interval, and at median part (from 2nd to 3rd intervals). Front-lateral margins of pronotum are straight and converging anteriorly. Anterior angles of pronotum protrude. In male, apical margin of clypeus is elongated triangularly and strongly upturned, and pronotum rises prominently at center (Fig. 5-86). In female, apical margin of clypeus is truncated (Fig. 5-87).
Habitat: intact natural forest.
Attractant: dung and carrion.
Abundance: moderate.
Distribution: Borneo, Philippines.

Onthophagus (*Hikidaeus*) *simboroni* Ochi et Kon, 2006 (Figs. 5-88 (teneral male) and 89 (female))
Body length: 3.7–4.8mm.
Surface is black to blackish brown, shining, and covered with short, erect and yellowish hairs. Head and pronotum are tinged with greenish luster. Elytron has three inconspicuous brown markings at basal part (from 2nd to 4th interval and from 6th to 7th ones), and at apical part (from 2nd to 7th intervals). Apical margin of clypeus is briefly truncated. In male, clypeus

is elongated (Fig. 5-88).
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo.

Subgenus *Onthophagus Latreille*, 1802
Fifteen species were collected. There are considerable diversities in body size, shape, coloration, degree of shining, hairs, and punctation. Most species inhabit in natural forests. Antennal scape is not serrate on anterior side (Fig. 7).
Functional group: tunneler.

Onthophagus (*Onthophagus*) *vethi* Krikken, 1977 (Figs. 5-90 (male) and 91 (female))
Body length: 2.9–4.0mm.
Body is very small. Surface is dark brown to reddish brown, shining, and covered with distinct, short, erect, and yellowish hairs. Apical margin of clypeus is briefly truncated. Pronotum is widest near basal margin, and anterior angles protrude. Male has a pair of parallel triangular protrusions on anterior half of pronotum on both sides of midline (Fig. 5-90). Female has a pair of small tubercles on anterior portion of pronotum (Fig. 5-91). Two individuals were collected in the post study conducted in 2016 and not listed in Ueda et al. (2017).
Habitat: two individuals were collected from an intact natural forest.
Attractant: two individuals were collected by dung baited traps.
Abundance: rare.
Distribution: Borneo, Sumatra.

Onthophagus (*Onthophagus*) *aphodioides* Lansberge, 1883 (Fig. 5-92)
Body length: 3.9–5.2mm.
Body is small. Surface is black, shining, and sparsely covered with distinct, very short, erect, and yellowish hairs. Apical margin of clypeus is briefly truncated. Pronotum is covered with 2 types of punctures (large ones and minute ones). Elytron is somewhat depressed and suture part is concave at basal part.
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Java, Sulawesi.

Onthophagus (*Onthophagus*) *vulpes* Harold, 1877 (Figs. 5-93 (male) and 94 (female))
Body length: 6.8–9.0mm.
Surface is brown to yellowish brown. Head and middle portion of pronotum are tinged with greenish or purplish luster. Apical two third of elytron is black with a mosaic pattern. Head is shining and glabrous. Apical margin of clypeus is round. Pronotum is densely covered with strong punctures. Pronotum and elytron are mat and densely covered with very long, erect, and yellowish hairs. Male has somewhat elongated clypeus, a pair of short slightly inclined horns on posterior portion of head, and a lamina between horns (Fig. 5-93).
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo, Java, Sumatra, Sulawesi, Malay Peninsula.

Onthophagus (*Onthophagus*) *pavidus* Harold, 1877 (Figs. 5-95 (male) and 96 (female))
Body length: 7.9–9.5mm.
Basal half of head and pronotum are tinged with greenish or rarely brownish luster. Elytron is yellowish brown to blackish brown. Head is weakly shining and almost glabrous. Pronotum is densely covered with asperate punctures. Pronotum and elytron are mat and densely covered with somewhat inclining yellowish hairs. Male has a pair of inclining horns on posterior portion of head and horns are connected by a lamina at base (Fig. 5-95).
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a dung baited trap.
Abundance: extremely rare.
Distribution: Borneo, Sumatra, Malay Peninsula.

Onthophagus (*Onthophagus*) *infucatus* Harold, 1877 (Fig. 5-97 (female))
Body length: 10.4–14.0mm.
Body is large and black. Surface is entirely opaque. Apical margin of clypeus is briefly truncated. Pronotum is densely covered with strong punctures and anterior angles protrude. Pronotum and elytron are sparsely covered with short to long reddish hairs. Male has a pair of inclining horns on posterior portion of head and in large male, pronotum is concave along horns. In female, anterior portion of pronotum is elevated in central portion (Fig. 5-97).
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Thailand.

Onthophagus (*Onthophagus*) *incisus* Harold, 1877 (Figs. 5-98 (male) and 99 (female))
Body length: 9.2–14.0mm.
Body is large and black. Surface is shining, sparsely covered

with short yellowish hairs, and densely covered with strong punctures. Apical margin of clypeus is briefly truncated. Middle line of pronotum is distinctly concave from median to basal portion. Male has a pair of strong tubercles on anterior half of pronotum at middle portion, tubercles are acutely produced outward and connected inside each other forming a transverse arched ridge and disk, and both sides of tubercles are strongly and roundly excavated (Fig. 5-98). Female has a transverse arched carina at anterior portion of pronotum (Fig. 5-99).
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Sumatra, Java.

Onthophagus (*Onthophagus*) *waterstradti* Boucomont, 1914 (Figs. 5-100 (male) and 101 (female))
Body length: 5.0–8.2mm.
Surface is black to brownish black and weakly shining. Head and pronotum are tinged with brownish to greenish luster. Elytron has two orange markings at basal part (one is continuously or discontinuously from 2nd to 4th intervals and another from 6th to 7th ones). Pronotum is distinctly depressed, glabrous, smooth, and impunctate near basal angles. Pronotum and elytron are densely covered with erect long yellowish hairs and punctures. In male, clypeus is triangularly elongated and distinctly reflexed upward, and an inclining short horn arises on posterior portion of head (Fig. 5-100).
Habitat: various types of forests including plantation forest.
Attractant: dung.
Abundance: abundant.
Distribution: Borneo.

Onthophagus (*Onthophagus*) *ochromerus* Harold, 1877 (Fig. 5-102 (female))
Body length: 6.2–9.0mm.
Head and pronotum are black to blackish brown and tinged with greenish luster. Elytron is wholly yellowish brown. Pronotum and elytron are densely covered with very long yellowish hairs and punctures. Male has an inclining short horn on posterior portion of head.
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a carrion baited trap.
Abundance: extremely rare.
Distribution: Borneo.

Onthophagus (*Onthophagus*) *bonorae* Zunino, 1976 (Figs. 5-103 (male) and 104 (female))
Body length: 4.0–6.0mm.
Body is small. Surface is blackish brown to brown, shining, and densely covered with strong punctures. Head and pronotum are tinged with greenish to purplish luster. Parts of clypeus are reddish and lateral margins of pronotum are orange. Elytron has three orange markings at basal part (from 2nd to 4th intervals and from 6th to 7th ones) and at apical part (from suture to 7th interval). Pronotum and elytron are densely covered with erect, stout, short, and whitish hairs. In male, clypeus is triangularly elongated and distinctly reflexed upward, and pronotum rises distinctly as a tubercle on center (Fig. 5-103). In female, apical margin of clypeus is almost round or truncated (Fig. 5-104).
Habitat: intact natural forest.
Attractant: carrion.
Abundance: moderate.
Distribution: Borneo, Sumatra, Malay Peninsula, Thailand.

Onthophagus (*Onthophagus*) *batillifer* Harold, 1875 (Figs. 5-105 (male) and 106 (female))
Body length: 4.0–6.1mm.
Body is small. Surface is blackish brown, shining, and densely covered with strong punctures. Head and pronotum are tinged with greenish to purplish luster. Elytron has four inconspicuous brown markings at basal part (at 2nd and 4th intervals and from 6th to 7th ones) and at apical part (from suture to 7th interval). Pronotum and elytron are sparsely covered with erect, short, and whitish hairs. In male, apical margin of clypeus is deeply truncated with an upturned mushroom-like projection at middle (Fig. 5-105). In female, apical margin of clypeus is notched at middle (Fig. 5-106).
Habitat: two individuals were collected; one from an intact natural forest whereas the other from a burnt natural forest.
Attractant: one by a dung baited trap whereas the other by a carrion baited one.
Abundance: rare.
Distribution: Borneo, Java, Malay Peninsula, Indochina.

Onthophagus (*Onthophagus*) *borneensis* Harold, 1877 (Figs. 5-107 (male) and 108 (female))
Body length: 8.0–12.1mm.
Body is large. Surface is black, weakly shining, entirely glabrous, and covered with small punctures. Male has a pair of erect short horns transversely on posterior portion of head that connected by a carina, and anterior portion of pronotum concave along horns (Fig. 5-107). Female has a carina on the same position as in male (Fig. 5-108).
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Java, Sumatra, Nias.

Onthophagus (*Onthophagus*) *keikoae* Ochi et Kon, 2014 (Fig. 5-109 (teneral))
Body length: 4.9–5.8mm.
Surface is dark brown, shining, entirely glabrous, and covered with small punctures. Eyes are very large and distance between eyes is almost 2 times as wide as an eye. Both male and female has a pair of tubercles arranged transversely on frons.
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by a carrion baited trap.
Abundance: extremely rare.
Distribution: Borneo.

Onthophagus (*Onthophagus*) *rutilans* Sharp, 1875 (Fig. 5-110)
Body length: 7.0–10.9mm.
Body is large. Surface is black, shining, and entirely glabrous. Head and pronotum are tinged with distinctly copper luster and sparsely covered with minute punctures. Elytron is covered with indefinite punctures.
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Sumatra, Malay Peninsula, Indochina, China.

Onthophagus (*Onthophagus*) *pacificus* Lansberge, 1885 (Figs. 5-111 and 113 (pronotum))
Body length: 5.6–7.6mm.
Surface is black, strongly shining, and entirely glabrous. Head and pronotum are covered with distinct punctures (Fig. 5-113). Elytron is covered with indefinite punctures.
Habitat: intact and burnt natural forests.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo, Java, Sumatra, Malay Peninsula, Indochina, India.

Onthophagus (*Onthophagus*) *semipacificus* Ochi et Kon, 2006 (Figs. 5-112 and 114 (pronotum))
Body length: 5.3–7.0mm.
Surface is black, strongly shining, entirely glabrous, and covered with minute punctures. This species closely resembles the former species but can be distinguished from *O. pacificus* by head and pronotum covered with sparser and smaller punctures (Fig. 5-114).
Habitat: intact natural forest.
Attractant: dung.
Abundance: moderate.
Distribution: Borneo.

Subfamily Aphodiinae Arrow, 1909

Body is elongated, and meso-coxae are connected each other. Number of spines on end of metatibia is two.

Tribe Eupariini Schmidt, 1910

Genus *Ataenius* Harold, 1867
One species was collected. In this tribe and the next one, head and pronotum are smooth without granules, vertical linear ridges, or transverse linear grooves. In this tribe, meso- and metatibia are almost smooth without large teeth on outer sides. In this genus, 1st segments of meso- and metatarsus are extremely long (more than 2.5 times as long as 2nd segment).

Ataenius sp. (Fig. 5-115)
Body length: 2.7mm.
Surface is light brown with dark brown on head except for clypeus. Apical margin of clypeus is truncated. Head and pronotum are shining and densely covered with punctures. Intervals of elytron are narrowed and rise as linear ridges. This species was collected by an un-baited trap in 2007 and not listed in Ueda et al (2017).
Habitat: an individual was collected from an intact natural forest.
Attractant: an individual was collected by an un-baited trap.
Abundance: extremely rare.
Distribution: Borneo (at least).

Tribe Aphodiini Reitter, 1892

Genus *Aphodius* Hellwig, 1798
Two widespread species were collected. In this tribe, elytron is not marginated entirely at base. In this genus, lateral margin of pronotum is smooth without serration (saw teeth), elytron is smooth, and its intervals do not become linear ridges.

Aphodius (*Pharphodius*) *marginellus* (Fabricius, 1781) (Fig. 5-116)
Body length: 4.5–8.0mm.
Surface is dark brown with yellowish brown areas in lateral and basal portions of pronotum and lateral and apical parts of elytron (sometimes parts of clypeus and entire elytron). Disk is shining and glabrous. Head is covered with punctures that become strong gradually towards posterior portion. Apical margin of clypeus is briefly truncated. Pronotum is covered with both small and large punctures. Elytron is covered with weak punctures.
Habitat: pastureland.
Attractant: carrion.
Abundance: moderate.
Distribution: Southeast Asia, India, New Guinea, China, Taiwan, Japan (southwest islands), Africa.

Aphodius (*Aganocrossus*) *urostigma* Harold, 1862 (Fig. 5-117)
Body length: 4.0–5.0mm.
Surface is black to blackish brown and shining. Apical margin of clypeus is almost round. Head and pronotum are glabrous and covered entirely with weak punctures and partly with large punctures. Elytron is entirely covered with weak punctures and has sparse long hairs on apical part.
Habitat: two individuals were collected from the pastureland.
Attractant: two individuals were collected by carrion baited traps.
Abundance: rare.
Distribution: Southeast Asia, Indochina, India, Nepal, Sri Lanka, China, Japan.

Acknowledgement

We wish to thank Kazuma Matsumoto (Tokyo), Hiroshi Makihara (FFPRI), Kaoru Maeto (Kobe University), Kenji Fukuyama (FFPRI), Masayoshi Takahashi (FFPRI), Hisatomo Taki (FFPRI), Takeshi Toma (FFPRI), Atsushi Sakai (Tohoku Res. Ctr., FFPRI), and Teruki Oka (Shikoku Res. Ctr., FFPRI), who advised us to conduct this study, the late Herwint Simbolon (RCB-LIPI), Woro A. Noerdjito (RCB-LIPI), Chandradewana Boer (Mulawarman University), Arbain (STIPER), Agusdin (SWPF), Agus (SWPF), and the people of Sungai Wain Village, who helped us to conduct the field work, and anonymous referees, who made comments that led to considerable improvement of the text. This study was supported by a grant from Japan's Ministry of the Environment (Environmental Research by National Research Institutes of Government Ministries and Agencies, 2004–2008), and from JSPS KAKENHI (Grant Number 26304028 and 19KK0164).

References

Aguilar-Amuchastegui, N. and Henebry, G. M. (2007) Assessing sustainability indicators for tropical forests: Spatio-temporal heterogeneity, logging intensity, and dung beetle communities. For. Ecol. Manage., 253, 56–67.

Amézquita, S. and Favila, M. E. (2011) Carrion removal rates and diel activity of necrophagous beetles (Coleoptera: Scarabaeinae) in a fragmented tropical rain forest. Environ. Entmol., 40, 239–246.

Andresen, E. (2002) Dung beetles in a Central Amazonian rainforest and their ecological role as secondary seed dispersers. Ecol. Entomol., 27, 257–270.

Andresen, E. (2003) Effect of forest fragmentation on dung beetle communities and functional consequences for plant regeneration. Ecography, 26, 87–97.

Davis, A. L. V. (1996) Seasonal dung beetle activity and dung dispersal in selected South African habitats: implications for pasture improvement in Australia. Agri. Eco. Environ. 58, 157–169.

Enari, H. and Enari-Sakamaki, H. (2014) Synergistic effects of primates and dung beetles on soil seed accumulation in snow regions. Ecol. Res., 29, 653–660.

Enari, H., Koike, S. and Enari-Sakamaki, H. (2016) Ecological implications of mammal feces buried in snow through dung beetle activities. J. For. Res., 21, 92–98.

Gardner, T. A., Hernández, M. I. M., Barlow, J. and Peres, C. A. (2008a) Understanding the biodiversity consequences of habitat change: the value of secondary and plantation forests for neotropical dung beetles. J. Appl. Ecol., 45, 883–893.

Gardner, T. A., Barlow J. and the other 22 authors (2008b) The cost-effectiveness of biodiversity surveys in tropical forests. Ecol. Lett., 11, 139–150.

Hanski, I. and Cambefort, Y. (1991) Dung Beetle Ecology. Princeton University Press, Princeton, 481pp.

Horgan, F. G. (2005) Effects of deforestation on diversity, biomass and function of dung beetles on the eastern slopes of the Peruvian Andes. For. Ecol. Manage., 216, 117–133.

Kryger, U. (2009) Importance of dung beetles in ecosystems. In Scholtz, C. H., Davis A. L. V. and Kryger, U. (eds): Evolutionary biology and conservation of dung beetles. Pensoft, Sofia, p. 389–412.

Larsen, T. H., Williams, N. M. and Kremen, C. (2005) Extinction order and altered community structure rapidly disrupt ecosystem functioning. Ecol. Lett., 8, 538–547.

Makihara, H. (2013) Longhorn beetles in tropical rain forests. In Niizato, T. (ed): Introduction for studies on longhorn beetles. Kaiyuusha, Tokyo, p. 125–190. (in Japanese)

McGeoch, M. A., Rensburg, B. J. V., and Botes, A. (2002) The verification and application of bioindicators: a case study of dung beetles in a savanna ecosystem. J. Appl. Ecol., 39, 661–672.

Mori, T., Toma, T. and Makihara, H. (1998) Exceptional droughts and forests fires in East Kalimantan. Tropical forestry, 43, 2–13. (in Japanese)

Nichols, E. S. and Gardner, T. A. (2011) Dung beetles as a candidate study taxon in applied biodiversity conservation research. In Simmons, L. W. and Ridsdill-Smith, T. J. (eds): Ecology and evolution of dung beetles. Wiley-Blackwell, West Sussex, p. 267–291.

Nichols, E., Spector, S., Louzada, J., Larsen, T., Amezquita, S., Favila, M. E. and The Scarabaeinae Research Network (2008) Ecological functions and ecosystem services provided by Scarabaeinae dung beetles. Biol. Conserv., 141, 1461–1474.

Purwant, E. and Koesoetjahjo, I. (2017) Lsssons-learnt from Sungai Wain Protection Forest. Tropenbos Indonesia,

Bogor, 41pp. (in Indonesian)

Ridsdill-Smith, T. J. and Edwards, P. B. (2011) Biological control: ecosystem functions provided by dung beetles. In Simmons, L. W. and Ridsdill-Smith, T. J. (eds): Ecology and evolution of dung beetles. Wiley-Blackwell, West Sussex, p. 245–266.

Roslin, T. and Viljanen, H. (2011) Dung beetle populations: structure and consequences. In Simmons, L. W. and Ridsdill-Smith, T. J. (eds): Ecology and evolution of dung beetles. Wiley-Blackwell, West Sussex, p. 220–244.

Sakai, S. and Inoue, T. (1999) A new pollination system: dung-beetle pollination discovered in *Orchidantha inouei* (Lowiaceae, Zingiberales) in Sarawak, Malaysia. Am. J. Botany, 86, 56–61.

Slade, E. M., Mann, D. J. and Lewis, O. T. (2011) Biodiversity and ecosystem function of tropical forest dung beetles under constractiong logging regimes. Biol. Conserv., 144, 166–174.

Slade, E. M., Mann, D. J., Villanueva, J. F. and Lewis, O. T. (2007) Experimental evidence for the effects of dung beetle functional group richness and composition on ecosystem function in a tropical forest. J. Animal Ecol., 76, 1094–1104.

Spector, S. (2006) Scarabaeine dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae): An invertebrate focal taxon for biodiversity research and conservation. Coleo. Bull., 60, 71–83.

Taylor, D., Saksena, P., Sanderson, P. G. and Kucera, K. (1999) Environmental change and rain forests on the Sunda shelf of Southeast Asia: drought, fire and the biological cooling of biodiversity hotspots. Biodiv. Conserv., 8, 1159–1177.

Tsukamoto, K., Inagaki, M., Kawahara, M. and Mori, M. (2017) Geotrupidae and its relatives in Japan. Mushisha, Tokyo, 115pp. (in Japanese)

Ueda, A., Dwibadra, D., Noerdjito, W. A., Sugiarto, Kon, M., Ochi, T., Takahashi, M. and Fukuyama, K. (2015a) Effect of habitat transformation from grassland to *Acacia mangium* plantation on dung beetle assemblage in East Kalimantan, Indonesia. J. Insect Conserv., 19, 765–780.

Ueda, A., Dwibadra, D., Noerdjito, W. A., Kon, M. and Fukuyama, K. (2015b) Comparison of baits and types of pitfall traps for capturing dung and carrion scarabaeoid beetles in East Kalimantan. Bull. For. Forest Prod. Res. Inst., 14, 15–28.

Ueda, A., Dwibadra, D., Noerdjito, W. A., Sugiarto, Kon, M., Ochi, T., Takahashi, M., Igarashi, T. and Fukuyama, K. (2015c) Buffer zones for placing baited traps in grasslands bordering forests and availability of riparian reserves of trees in grasslands: A preliminary study for dung beetle assemblages in East Kalimantan, Indonesia. Bull. For. Forest Prod. Res. Inst., 14, 125–134.

Ueda, A., Dwibadra, D., Noerdjito, W. A., Sugiarto, Kon, M., Ochi, T., Takahashi, M., Igarashi, T. and Fukuyama, K. (2015d) Effects of distance from devastated forests and topography on dung beetle assemblages in burned forests of East Kalimantan, Indonesia. Bull. For. Forest Prod. Res. Inst., 14, 135–144.

Ueda, A., Dwibadra, D., Noerdjito, W. A., Sugiarto, Kon, M., Ochi, T., Takahashi, M., and Fukuyama, K. (2017) List of dung beetles (Coleoptera: Coprophagous group of Scarabaeoidea) collected in lowland near Balikpapan, East Kalimantan, Indonesia. Bull. For. Forest Prod. Res. Inst., 16, 109–119.

Yamaguchi, T. and Tsuyuki, S. (2001) Assessment of forest fire in East Kalimantan, Indonesia, based on remote sensing and GIS. Bull. Tokyo Univ. Forests, 106, 17–48. (in Japanese with English summary)

Literatures cited for identification and distribution

Balthasar, V. (1963a) Monographie der Scarabaeidae und Aphodidae der palaearktischen und Orientalischen Region. Tschechoslowakische Akademie der Wissenschaften Prag, 1, 1–391.

Balthasar, V. (1963b) Monographie der Scarabaeidae und Aphodidae der palaearktischen und Orientalischen Region (Coprinae Onitini Oniticellini Onthophagini). Tschechoslowakische Akademie der Wissenschaften Prag, 2, 1–627.

Kon, M., Sakai, S. and Ochi, T. (2000) A new species of the genus *Onthophagus* (Coleoptera: Scarabaeidae) from Sarawak, Borneo. Entomol. Sci., 3, 367–371.

Krikken, J. (1977) Some new and otherwise noteworthy species of *Onthophagus* Latreille from the Indo-Australian archipelago (Coleoptera: Scarabaeidae). Zoologische Mededelingen, 52, 169–184.

Krikken, J. and Huijbregts, J. (2007) Taxonomic diversity of the genus *Ochicanthon* in Sundaland (Coleoptera: Scarabaeidae: Scarabaeinae). Tijd. Vo. Entomol., 150, 421–479.

Krikken, J. and Huijbregts, J. (2008) Distinguishing the Sundaland species in the *Onthophagus* (*Parascatonomus*) *aurifex* group (Coleoptera: Scarabaeidae: Scarabaeinae). Tijd. Vo. Entomol., 151, 173–185.

Kuijten, P. J. (1981) Revision of the genus *Phaeochroops* Candèze (Coleoptera: Scarabaeidae, Hybosorinae). Zoologische Verhandelingen, 183, 3–76.

Li, C.-L., Yang, P.-S., Krikken, J. and Wang, C.-C. (2013) Three new species of *Bolbochromus boucomont* (Coleoptera, Geotrupidae, Bolboceratinae) from Southeast Asia. Zookeys, 290, 39–54.

Li, C.-L., Krikken, J. and Wang, C.-C. (2019) Review of the genus *Bolbochromus* (Coleoptera, Scarabaeoidea, Geotrupidae, Bolboceratinae) in the Philippines. ZooKeys, 842, 135–152.

Masumoto K., Ochi, T. and Hanboonsong, Y. (2008a) New species of the genus *Onthophagus* from Thailand. Part 3. Entomol. Rev. Jap., 63, 43–55.

Masumoto K., Ochi, T. and Hanboonsong, Y. (2008b) New species of the genus *Onthophagus* from Thailand. Part 4. Entomol. Rev. Jap., 63, 155–169.

Ochi, T. (2007) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia (XIV). A new subgenus and four new species of *Onthophagus* from Borneo. Entomol. Rev. Jap., 62, 91–102.

Ochi, T. and Kon, M. (1994) Dung beetles (Coleoptera, Scarabaeoidea) collected from Sabah, Borneo (I). Elytra, Tokyo, 22, 281–298.

Ochi, T. and Kon, M. (1995) Dung beetles (Coleoptera, Scarabaeoidae) collected from Sabah, Borneo (II). Elytra, Tokyo, 23, 43–60.

Ochi, T. and Kon, M. (1996a) Studies on the coprophagous scarab beetles from East Asia. IV (Coleoptera, Scarabaeidae). Giornale italiano di Entomologia, 8, 17–28.

Ochi, T. and Kon, M. (1996b) Studies on the coprophagous scarab beetles from East Asia. V (Coleoptera, Scarabaeidae). Giornale italiano di Entomologia, 8, 29–35.

Ochi, T. and Kon, M. (1997) Studies on the coprophagous scarab beetles from East Asia. VI Descriptions of new taxa of the genus *Paragymnopleurus* (Coleoptera, Scarabaeidae). Giornale italiano di Entomologia, 8, 235–238.

Ochi, T. and Kon, M. (2002) A new horned species of the genus *Onthophagus* (Coleoptera, Scarabaeidae) from Sabah, Borneo. Spec. Bull. Jpn. Soc. Coleopterol., Tokyo, 5, 305–312.

Ochi, T. and Kon, M. (2006a) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia (X). Four new species of the genus *Onthophagus* (*Onthophagus*) from Borneo. Entmol. Rev. Jap., 61, 1–10.

Ochi, T. and Kon, M. (2006b) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia (XII). Six new species of *Onthophagus* (*Indachorius*) from Borneo. Entomol. Rev. Jap., 61, 169–180.

Ochi, T. and Kon, M. (2006c) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia (XIII). Seven new species of *Onthophagus* (*Onthophagus*) from Borneo. Entomol. Rev. Jap., 61, 181–194.

Ochi, T. and Kon, M. (2014) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia (XXIV). Four new species of *Onthophagus* from Malaysia. Jap. J. System. Entomol., 20, 341–346.

Ochi, T., Kon, M. and Barclay, M. V. L. (2009) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia (XXII). A new species of *Haroldius* and four new species of *Panelus* from Borneo. Entomol. Rev. Jap., 64, 237–246.

Ochi, T., Kon, M. and Hartini, S. (2008) Three new species of the genus *Ochicanthon* (Coleoptera: Scarabaeidae) from Java and Borneo. Entomol. Rev. Jap., 62, 243–253.

Ochi, T., Kon, M. and Kikuta, T. (1996) Studies on the family Scarabaeidae (Coleoptera) from Borneo I. Identification keys to subfamilies, Tribes and Genera. Giornale italiano di Entomologia, 8, 37–54.

Ochi, T., Kon, M. and Kikuta, T. (1997) Studies on the family Scarabaeidae (Coleoptera) from Borneo 2. The genera *Paragymnopleurus* and *Sisyphus*. Giornale italiano di Entomologia, 8, 239–250.

Ochi, T., Kon, M. and Kikuta, T. (1997) Studies on the family Scarabaeidae (Coleoptera) from Borneo 4. The genus *Caccobius* Thomson, with description of a new species. Giornale italiano di Entomologia, 8, 261–264.

Ochi, T., Kon, M. and Tsubaki, Y. (2009) Notes on the coprophagous scarab-beetles (Coleoptera: Scarabaeidae) from Southeast Asia (XXI). Nine new species and two new subspecies of *Onthophagus* from the Malay Peninsula, Sumatra and Borneo. Entomol. Rev. Japan, 64, 217–236.

Ochi, T., Kon, M. and Ueda, A. (2018) Notes on the coprophagous scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia XXX. A new *Onthophagus* species from Borneo. Elytra, Tokyo, New Series, 8, 369–372.

Ochi, T., Ueda, A. and Kon, M. (2006) *Ochicanthon* (Coleoptera, Scarabaeidae) from Borneo, with descriptions of four new species and a key to the Bornean species. Elytra, Tokyo, 34, 309–325.

Okajima, H. and Araya, K. (eds.) (2012) The standard of Scarabaeoid beetles in Japan. Gakken, Tokyo, 444pp. (in Japanese)

Zidek, J. and Pokorny, S. (2010) Review of *Synapsis* Bates, with description of a new species. Insecta Mundi, 142, 1–21.

Zunino, M. (1976) Revisione delle species paleartiche del sottogenere *Onthophagus* (sensu stricto) Latr. In Bates, H. W., Fairmaire, L., Harold, E. V., Lansberge, G. V., Marseul, S. A. D., Reiche, L. and Sharp, D. (eds.): Muséum National d'Histoire Naturelle di Parigi. Boll. Mus. Zool. Univ. Torino, Torino, p 71–110.

ボルネオ島低地のスンガイワイン保護林とその周辺で捕獲された糞虫の図鑑

上田 明良[1)*]、ディアン・ドウィバドラ[2)]、シ・カホノ[2)]、
スギアルト[3)]、越智 輝雄[4)]、近 雅博[5)]

要 旨

糞虫（コガネムシ上科食糞群）は、熱帯地域において生息環境特性の有用な指標群として知られている。様々な土地利用タイプにおける糞虫の多様性を評価するために、インドネシア共和国東カリマンタン州バリクパパン市の北方 10 ～ 40 km の低地に広がるスンガイワイン保護林とその周辺において 2004 年から 2017 年の間、人糞と魚肉を誘引餌とした落とし穴トラップを用いて糞虫調査を行った。この調査では 68 種の糞虫が捕獲された。これらの種を同定する手助けとして、全種の写真と標徴および、よく似た種を区別するための有用な特徴の写真を提示した。インドネシアではこれまで糞虫の図鑑はなかった。本図鑑はボルネオ島のわずかな地域をカバーしたものに過ぎないが、本図鑑がインドネシアの昆虫研究者や昆虫愛好家が糞虫を種同定する際の手助けになることを切に願う。

キーワード: 分布、東カリマンタン州、食性、種同定、生息地選好性、写真、コガネムシ科

原稿受付：令和 3 年 12 月 1 日　原稿受理：令和 4 年 3 月 7 日
1) 森林総合研究所 北海道支所
2) インドネシア科学院生物学研究所
3) 東クタイ農業大学
4) 大阪府豊能町
5) 京都府京都市左京区
* 森林総合研究所北海道支所　〒 062-8516 北海道札幌市豊平区羊ヶ丘 7、E-mail: akira@ffpri.affrc go.jp