

Sulawesi *Onthophagus* with paraocular protrusions: ten new species, with a key (Coleoptera: Scarabaeidae: Scarabaeinae)

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Numerous representatives of the scarab genus *Onthophagus* Latreille, 1802 are characterized by a pair of protrusions between their eyes; in the Sulawesi fauna several operational groups of these “two-horned” species are recognized. In this paper the Sulawesi groups and their included species are listed and keyed. Ten presumably closely related new species are described in the newly proposed *Onthophagus lindu* group, all from Sulawesi: *Onthophagus batui*, *O. kolaka*, *O. lindu*, *O. lore*, *O. matanyo*, *O. mekara*, *O. moajat*, *O. sanggona*, *O. sibkahonoi*, and *O. transvestitus*. The group members have, in both sexes, a pair of isolated paraocular protrusions. The development of these protrusions is in some species stronger in females than in males, which is unusual. Most of the *O. lindu* group individuals were collected in dung-baited traps on forest sites. Outside the *O. lindu* group, attention is drawn to the occurrence of the equally two-horned *O. limbatus* (Herbst, 1789) and its relatives in Sulawesi, possibly representing western invaders of man-made non-forest habitats.

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Introduction

The Scarabaeinae of the Indonesian island of Sulawesi have always been marginally treated, the only two directly relevant synopses being Boucomont (1914) and Balthasar (1963a, b), the latter author leaning heavily on his French predecessor as far as Sulawesi taxa are concerned. This applies also to the major ingredient of the subfamily, the subcosmopolitan genus *Onthophagus* Latreille, 1802. Splitting up this megagenus (ca 2000 named species, depending on one's opinion on subgenera, see below) into smaller, regionally limited operational units – only few well-founded subgeneric names being available – has been common practice to make its complex taxonomic diversity more manageable. Recently we published the first of a series of reviews on Sulawesi *Onthophagus* groups (Krikken & Huijbregts 2008).

In the present review we treat the Sulawesi species having – in both sexes – a pair of unconnected, upright paraocular protrusions, and unite them in what is here called the *Onthophagus lindu* group. In this group ten species are recognized, all new, which are keyed, described, and illustrated below.

Seven species with paraocular protrusions from Sulawesi are not included in the *O. lindu* group since one or more of the following attributes, absent from the *O. lindu* group, justify a position in other known groups:

- (1) paraocular protrusions connected by a distinct ridge or lamina;
- (2) ridge delimiting pygidium from propygidium absent;
- (3) base of the first elytral interstria with swelling;
- (4) eye foramina (in full-face view) very broad,

separated by less than five times their single width;

- (5) antennal scapus serrate;
- (6) very large, generally metallic body (length over 15 mm, blue, green, cupreous);
- (7) females lack the pair of isolated paraocular protrusions.

The novelties of the *Onthophagus lindu* group and the seven other *Onthophagus* species with paraocular protrusions confirmed from Sulawesi are all listed below (with any relevant post-Balthasar references), and included in the key. The non-*lindu*-group taxa from Sulawesi, including some unlikely, unconfirmed records, are dealt with in companion papers (see also the note on erroneous records in Krikken & Huijbregts 2007); only *O. limbatus* (Herbst, 1789), the males of which are very similar to *lindu* group species, is briefly described and illustrated.

Since Balthasar (1963b), an increasing number of Oriental *Onthophagus* species with a pair of paraocular protrusions are referred to the subgenus *Gibbonthophagus* Balthasar, 1963 (see, for instance, Kabakov 1998). In the present context we just repeat our view that, although several onthophagine genus-group taxa undoubtedly represent phylogenetic realities, the delimitations currently applied to the majority of them (including *Gibbonthophagus*) remain flimsy in the absence of a comprehensive supraspecific analysis. In a regionally limited effort like the present paper we therefore advocate the pragmatic groupwise operational approach indicated above.

Based on our overall analysis of the taxonomic diversity of Southeast Asian *Onthophagus* species with paraocular protrusions, our hypothesis is that the *lindu* group, as here conceived, has evolved on and is endemic to Sulawesi and nearby smaller islands.

Two interrelated points should be kept in mind with regard to the Sulawesi fauna, one specific and one general, to avoid any confusion of other two-horned species with those in the *lindu* group:

- (i) *Onthophagus limbatus* is reputedly very widespread in the Oriental Region, and its males resemble some species in the *lindu* group. The correct identity of *O. limbatus* remains unsettled: to our knowledge, the type has not (yet) been recovered, the precise type-locality is uncertain, heterogeneity cannot be excluded, and no nomenclatorial action has been undertaken. Sulawesi material recorded in this paper appears similar to published descriptions of *O. limbatus* and to non-Sulawesi Southeast Asian material seen by us, and consequently the species is tentatively recorded from the island (see species account at the end of this paper).

- (ii) The Sulawesi fauna remains incompletely surveyed; cultivated and other more open landscapes may have more unrecorded invasive as well as endemic two-horned *Onthophagus* species, the invasive element probably coming from the Sundaland-Philippine side (as with *O. limbatus*). Caution in dealing with these *Onthophagus* is required, as the taxonomic resolution of the two-horned species from the Sundaland-Philippine area is very incomplete.

This study is primarily based on material we collected in the context of Project Wallace 1985 and follow-up work. It is part of ongoing work on the dung and carrion scarab fauna of the Southeast Asian islands. A synopsis of the Wallacean fauna is in preparation.

Technical remarks

In the descriptions the qualification *abundant* for multiple (micro)sculptural units (like punctures) means: generally separated by 2–5 diameters, *dense*: 1–2 diameters, *crowded*: less than 1 diameter; *sparse*: more than 5 diameters. The prefix *micro-* usually denotes sculpture and pilosity distinct at magnifications of $\times 40$ and higher. The type of punctuation is qualified only if decidedly and predominantly different from a simple punctuation and not due to associated (micro)pilosity (punctures may look ocellate due to presence of a central microstubble); any quantitative data related to punctuation are estimates (heavily dependent on lighting, images may be more informative!). Microstubbles and microscales occur in the *lindu* group: they are shorter than their punctural diameter, and more or less embedded; setae are defined as being distinctly longer – glabrous here means: without setae (i.e. may have microstubbles). The qualification *sericeous* means that light reflection from a particular surface is silky, being neither distinctly shining, nor distinctly matt (usually this intermediate state is due to a more superficial microreticulation or -striolation). *Semiconical*, for the paraocular protrusions, means that the posterior half of the cone is flattened. Estimated length proportions of the metatibial spur and five respective hind tarsal segments are given as: *s//a/b/c/d/e*. Measurements in mm, as given in the holotype descriptions, have been estimated with a calibrated micrometer through the microscope, focussed in dorsal view.

The terminology employed for the various body parts follows conventional usage, and does not imply broader homologies (we use metasternum = metaventricle, abdominal sternites = abdominal ventrites). The term *interstria* is applied to the longitudinal spaces between the elytral striae, counted from the suture.

Beware of potentially deceptive individual polymorphism and sexual dimorphism (check median length of abdominal sternites to determine sex: these are foreshortened in males); some *lindu* group species show aberrant sexual dimorphism in their cephalic ornamentation.

The key and the diagnoses emphasize the morphological attributes of larger (major) individuals; we have not cluttered the key with references to images – these are systematically grouped and self-evident in the plates. In our experience the identification of most *lindu* group species, in spite of variation, presents no problems where good comparative series are available; singletons, however, may be very hard to identify, and questions may remain – this is why some specimens were excluded from the type series. Always compare the identification result from the key with the species diagnoses concerned, plus the relevant images. Some specimens tentatively named here are explicitly excluded from the type series concerned (in the Material examined paragraphs).

The following minimum set of images is given for each species: habitus (oblique view), head (full-face), pronotum (dorsal), left elytron (dorsal), protibia (upper side), metatibia (underside), and parameres. Sexual dimorphism, polymorphism, and certain details (paraocular protrusions, axial view from front) required additional images. The expression *full-face* view is applied where the surface aspect of the element concerned is maximally parallel to the plane cutting through apex and base (i.e. different from *dorsal* view). For magnifications and relevant measurements, see the descriptions.

Sundaland is here understood to include Borneo, Java, Sumatra, and the Malay Peninsula, i.e. excluding Sulawesi. The various geographic parts of Sulawesi are roughly indicated as N (North), E (East), SE (Southeast), S (South), C (Central), in principal corresponding to the four narrower island arms and the central land mass (administratively East is part of the Central Sulawesi province). These five parts have more or less different geological and ecological histories, and consequently different biotas. Much of the biogeographic literature, however, is limited to large-scale distribution patterns and dispersal events, not immediately explaining the diversity of *Onthophagus* and other scarabaeines over parts of Sulawesi (reviews include Whitten et al. 1987, and Hall & Holloway 1998).

In our papers the term *upland* usually refers to sites at > 1000 m altitude, *lowland* < 1000 m. Abbreviations on the labels include: multistr(atal) evergr(een) forest, excr(ement), cult(ivated) area. Sample codes are preceded by a # symbol. Most of these samples were collected with the usual baited ground traps,

installed in sets of four, at the angles of a virtual square with a side of ca 4 meter; two baited with human faeces and two with fish; occasionally other types of bait were used. Flight interception traps also yielded some *lindu* group individuals.

Of the *O. lindu* group we studied 10 species, from 44 records, in 245 specimens, plus additional material placed in the *limbatus* group (q.v.). Present location of material examined: National Museum of Natural History Naturalis, Leiden, The Netherlands (abbreviated RMNH).

List of *Onthophagus lindu* group and other two-horned Sulawesi species

LS = reference to latest group synopsis

Onthophagus Latreille, 1802

Onthophagus lindu group

formally placed in nominate subgenus

O. lindu sp. n. – C Sulawesi

O. lore sp. n. – C Sulawesi

O. kolaka sp. n. – SE Sulawesi

O. transvestitus sp. n. – N, C, SE Sulawesi

O. sibkahonoi sp. n. – SE Sulawesi

O. sanggona sp. n. – N, SE Sulawesi

O. moajat sp. n. – N, C? Sulawesi

O. batui sp. n. – SE Sulawesi

O. matanyo sp. n. – E, N Sulawesi

O. mekara sp. n. – SE Sulawesi

Species in other groups

added to the key; some placed in non-nominate subgenus

O. limbatus (Herbst, 1789, *Scarabaeus*) – N, C Sulawesi, Sundaland, Lesser Sundas, to S, C China, India

(*limbatus* group, sometimes placed in *Gibbonthophagus* Balthasar, 1963, species discussed in this paper)

O. gestroi Harold, 1877 – C, S Sulawesi, Moluccas, Lesser Sundas, Philippines, Sumatra (*limbatus* group)

O. tragus Fabricius, 1792 – S Sulawesi, Java, Lesser Sundas, to India, China (subgenus *Colobonthophagus* Balthasar, 1935, LS Scheuern 1995)

O. aureopilosus Boucomont, 1914 – N, C, S Sulawesi (*orientalis* group, LS Krikken & Huijbregts 2010)

O. rectecornutus Lansberge, 1883 – N, C Sulawesi, Sundaland, West to India (subgenus *Serrophorus* Balthasar, 1963)

O. watuwila Krikken & Huijbregts, 2008— SE Sulawesi
(*watuwila* group, LS Krikken & Huijbregts 2008)

O. schwaneri Vollenhoven, 1864 – N Sulawesi
(subgenus *Proagoderus* Lansberge, 1883, LS Ochi & Kon 2002)

The *Onthophagus lindu* group

Definition

Frontovertex in both sexes with pair of protrusions between eyes, well separated at base, not connected by distinct ridge or lamina (occipital collar opposite prothorax aside); these paraocular protrusions more or less upright, usually (semi)conical at base, strongly varying in length (if long, more or less tapering and/or curved); no distinct intermediate protrusion(s) or cavity present. Dorsal side virtually glabrous. Ridge delimiting base of pygidium distinct. Basal surface of first elytral interstria even, unmodified. Eye foramina (in full-face view) narrow, separated by at least six times their (single) width. Antennal scapus entire (not serrate); lamellae not particularly modified. Pronotum lacking strong projection(s) and impression(s), like horns or cavities (anterior declivity may be deplanate or very slightly concave behind paraocular protrusions, and have midline ridge). Basic dorsal colour usually dark (black or brown), with or without lighter (yellow to orange) pattern, which is usually limited to elytra; not largely metallic blue, green, or cupreous (at most with local metallic lustre, one small patterned species has a bronzy pronotum). Clypeal tip varying from feebly bisinuate to evenly rounded, never with distinct projection(s), margin at most narrowly, slightly reflexed; border widely rounded to lateral tip of genae (at most very slightly interrupted at clypeogenal transition); genal tip widely rounded. Clypeal surface transversely rugulate. Clypeofrontal ridge generally transverse, straight or slightly arcuate (medially frequently protuberant), ridge occasionally lost in rugulation. Metasternum unmodified, not protuberant between mesocoxae. Protibia with 3 distinct, pointed external denticles, plus short proximal one; proximal serration from denticles to tibial base distinct; apico-internal angle obtuse, non-penicillate; apico-external denticle oblique to tibial axis. Protibial spur long, slender, with tapering tip. Pronotum and elytral interstriae not granulate and not crowded with large annulate punctures. Posterior end of gena reaching occipital side. Scutellum indistinct. Propectoral surface behind eyes at most very shallowly concave,

generally unmodified; ridge from procoxa running to lateral prothoracic edge. Apical margin of pronotum medially usually slightly expanded-sinuate (behind vertex). Pronotal sides in dorsal outline evenly rounded; base at most with very slight median angle; posterolateral section at most slightly sinuate (in full-face view), posterolateral angle very obtuse or rounded off; basal margination at most slight, usually limited to median section (distinct and complete in one species). Basal curve of elytron usually slight, with humeral angle moderately acute in dorsal view; elytral stria 7 sinuate behind humeral umbone. Dilated meso- and metatibial apex with transverse, simply elongate-subelliptic (non-lobate) crest, lined with fringe of spines. Tarsal claws fine, sickle-shaped, unmodified. Parameres symmetric, with more or less “bulbous” upper side flap, and with narrow, downward apico-lateral, more or less spatuliform tip; without other distinct projections. Mentum scarcely longer than wide, with median longitudinal impression. Body length varies considerably, 4–15 mm.

Discussion

The above characters are arranged in their estimated order of importance in the Sulawesi context.

The species in the *O. lindu* group are all morphologically very similar, and, while not showing any obvious synapomorphies for the group as such, they are undoubtedly closely related, presumably having all evolved on and/or near Sulawesi. Studies of their relationships with two-horned *Onthophagus* elsewhere in the Southeast Asian archipelago are under way, but thus far these yielded no signals of immediate relationships (see also Introduction). There are, however, superficially similar species, like one of the endemic large-eyed Sulawesi species, *O. watuwila* Krikken & Huijbregts, 2008; this species has paraocular horns in both sexes, but, eye characters aside, there are distinct differences, for instance in the parameres. The occurrence on Sulawesi of *O. limbatus* group is in our view a case of “two-horned” invaders (diagnosis and further comments given below).

Some of the *O. lindu* group species available in series show a considerable degree of individual polymorphism, which is particularly visible in the development of the paraocular horns, the clypeofrontal ridge, and the anterior side of the pronotum. Both sexes have the paraocular horns (which may indeed be a synapomorphy), but notice what appears to be a male-female reversal phenomenon in certain species (*O. transvestitus* is a good example): individuals with a more strongly developed ornamentation (longer horns) turn out to be females, contrary to what one expects in *Onthophagus* and other horned scarabaeines. While the presence or absence of a

pattern of yellow-orange markings may be constant for most species, the colour patterns as such vary considerably. Characters of punctuation, microsculpture, and consequent light reflection, may also be prone to individual variation.

Variation in some characters may be interpreted as populational instead of individual, and eventually this variation may turn out to be subspecific or clinal. The general conclusion with respect to variation in the *lindu* group is simple: some considered assumptions can be made, but more material is needed to reach firmer conclusions. The parameters of the *lindu* group species do not show salient features, but there are differences, and checking is always required; consequently, they are depicted for all species. For more on characters, see the list in the next section.

The fact that all *O. lindu* group species are new to science, and that several are available only in limited series, reflects our ignorance of the Sulawesi fauna. We predict that more exploration of certain regions (for instance, S Sulawesi) and habitats (for instance, upland and limestone forest) will double the number of species (see also the note on invasive species in the Introduction). Some species appear to be sympatric – we found them in the same traps; whether they actually meet is not certain: nothing is known about diel cycles. Most *lindu* group individuals were collected in dung-baited pitfall traps, set in a forest environment; only a single individual did fall into the equally numerous fish-baited traps, set at the same sites. Nevertheless, we are not sure which resource actually is the natural mainstay of the *lindu* group members, i.e., are they indeed using excrements from particular animals as food and/or for reproduction, or are they perhaps using completely different substances?

Characters distinguishing species in the *lindu* group

The following list sums up, just for guidance, character items which we have found useful in species identification. They recur in the paragraphs headed Diagnosis, for each of the ten *lindu* group species. Slashes denote contrasting character states (thus more or less equalling the term *versus*).

- Clypeofrontal ridge (arcuate / straight; full-face: continued angularly / straight onto clypeogenal margin; complete / reduced; medially unmodified / pointed-tuberculate).
- Protrusions between eyes (short-semiconical / long-tapering; long and straight / generally curved / sinuate / only tip slightly curved) – note sexual differences.
- Anterior pronotal declivity (low, evenly convex / steep-abrupt; surface evenly deplanate / with

midline ridge / topped by (sub)transverse ridge; topping ridge bisinuate / arcuate / straight).

- Pronotal base (evenly arcuate / medially subangular; immarginate / marginate; posterolaterally angular / rounded; posterolaterally scarcely / distinctly sinuate / not sinuate at all).
- Colour of head and pronotum (black-brown with / without bronzy lustre)
- Elytral colour (uniform / patterned; predominantly black-brown / yellow-orange).
- Elytral lighter markings present (at base / apex / on humerus / specks on disc / extensive-contiguous on disc).
- Pygidial colour (predominantly brown-black / yellow-orange / dark markings on yellow-orange).
- Surface reflection, of pronotum, elytra, pygidium, respectively (shining / matt; strength of any microreticulation; sericeous).
- Pronotal, elytral, pygidial punctuation (types, sizes, densities; interstriae, striae).
- Protibial shape (external dentation and serration).
- Habitus (dorsum moderately convex / high-convex / deplanate).
- Size (body length range in mm).

Key to *lindu* group and other two-horned Sulawesi *Onthophagus* species (males)

1. Basal surface of elytral interstria 1 with callosity. Protibial spur spatuliform. Frontal ridge almost semicircular. Generally shining black-brown. Length 7–9.5 mm *tragus*
- Basal surface of elytral interstria 1 unmodified, even. Protibial spur not spatuliform, usually slender, tapering 2
2. Base of pygidium immarginate. Black and brown, matt, dorsum heavily punctate-setose. Upright paraocular horns connected by lamina. Length 9–10 mm *aureopilosus*
- Base of pygidium marginate 3
3. Antennal scapus finely serrate. Dorsum matt, patterned, yellow with black, punctures infuscated. Dorsum setose. Length 7–10 mm *rectecornutus*
- Antennal scapus entire, not serrate 4
4. Colour largely metallic. Pronotum with deep cavities and basomedian angle. Length 14–18 mm *schwaneri*
- At most pronotum with metallic lustre (only in some small species, up to 8 mm long). Pronotum at most very shallowly depressed in front. Length up to 15 mm 5

5. Eye foramina very broad ("large-eyed"), separated by less than 5 times (single) eye width. Parameral tip broad, with protrusion on top. Black and brown. Length 4–6 mm ... *watuwila*
- Eye foramina narrow, separated by more than 6 times (single) eye width. Parameres with slender, tapering tip 6
6. Elytra and pronotum distinctly setose. Clypeus with abruptly reflexed apicomedian lobe (anterior side upright, forming clypeopleuron). Protibia with spiniform apico-internal angle. Clypeofrontal ridge fine, simple, transverse, straight, or completely effaced. Clypeal surface non-rugulate. Paraocular horns frequently connected by ridge or lamina. Pronotum, elytra and other parts with more or less symmetric yellow-orange patches *limbatus* group, 7
- Elytra and pronotum at most with inconspicuous microstubbles. Clypeus at most slightly, narrowly reflexed along (nearly) entire margin. Protibia with obtuse apico-internal angle. Clypeofrontal ridge usually distinct, curvilinear, frequently with median protrusion. Clypeal surface transversely rugulate. Paraocular protrusions wide apart, never distinctly connected *lindu* group, 8
7. Horns on head connected by bridge, usually a distinct lamina. Length 5–7.5 mm *gestroi* or near
- Horns on head at most connected by slight ridge. Paraocular horns frequently connected by slight ridge at base, internal outline between horns (in axial view) U-shaped. Length 5–8 mm *limbatus* or near
8. Pronotum shining, metallic (usually bronzy or greenish), with entirely marginate-punctate base. Pygidium remarkably matt, due to heavy microreticulation, punctures with fine bristles. Elytra shining, with various yellow-orange markings; interstriae convex, with very vague punctures. Small, ca 4–5 mm long *mekara*
- Pronotum not metallic, but simply black or brown, with only median section of base very finely marginate. Pygidium glabrous, with numerous punctures in a more superficial background microreticulation. Elytra of patterned species matt; discal interstriae more deplanate 9
9. Elytra black or brown, with several larger or smaller yellow-orange markings, occasionally largely yellow-orange 15
- Dorsal side (nearly) uniformly black or brown. Femora never orange-yellow. Pygidium usually black or brown (not yellow) 10
10. Dorsum entirely matt, black, pronotum virtually evenly convex, almost entirely with fine, well-defined, crowded punctation. Protrusions between eyes of the two specimens available short. Length ca 8.5 mm ... *sibkahonoi*
- Dorsum, at least forebody, different, more or less shining, pronotum may be densely punctate, but punctation never evenly crowded over entire surface. Protrusions between eyes frequently longer 11
11. Larger, length 8.5–15 mm. Horns between eyes long (major males!), frequently curved. Pronotum strongly convex, with high, steep anterior declivity 12
- Smaller, length usually less than 8.5 mm. Protrusions between eyes usually much shorter (more or less conical in males! horns may be much longer in females). Pronotum less strongly raised, anterior declivity low, at most shallowly depressed behind longer paraocular protrusions 14
12. Clypeofrontal ridge arcuate, angularly connected to clypeogenal ridge (full-face view) ... 13
- Clypeofrontal ridge almost rectilinear, extending straight to side of clypeogenal surface. Length 11–12 mm *kolaka*
13. Pronotal disc finely, distinctly punctate. Horns (major males and females!) between eyes long, simply curved. Elytral striae very vaguely punctate. Smaller, 8.5–12 mm long. *lindu*
- Pronotal disc micropunctate. Horns between eyes very long, slightly divergent, more or less sinuate (distinctly so in females). Elytral striae distinctly punctate. Larger, 14–15 mm long *lore*
14. Generally shining brown-black. Elytral interstriae abundantly, distinctly punctate. Length 5–7.5 mm *transvestitus*
- Generally matt brown-black. Elytral interstriae sparsely micropunctate on microreticulate background. Length 5.5–7 mm ... *sanggona*
15. Elytra, any basal and apical yellow-orange markings aside, with numerous scattered discal specks. Generally matt. Length 8–8.5 mm *batui*
- Elytra lacking discal specks, basal and apical markings may in one species contiguously extend from base to apex 16
16. Clypeofrontal ridge (full-face view) roughly sinuate (nearly straight) to clypeogenal ridge. Horns between eyes longer (very long in major females), anterior pronotal declivity

usually distinct (high in major females).

Elytral pattern variable, from largely yellow-orange to hardly spotted. Usually larger,

6–8.5 mm long *moajat*

- Clypeofrontal ridge angular to vague clypeogenal suture. Protrusions between eyes usually shorter, anterior pronotal declivity low. Elytra with apical and basal (including humeral) markings. Usually smaller, 4.5–6 mm long *matanyo*

Species accounts

The *Onthophagus lindu* group

Onthophagus lindu sp.n.

Figs 1–2, 13–18, 83

Type material. Holotype: male Sulawesi: Lore Lindu NP: Danau Taming forest, 5–9.xii.1985, Krikken #pw51a, 1600 m, multistr evergr forest, human excr trap (RMNH). **Paratypes:** same data as holotype, 41 exx. (RMNH).

Diagnosis

O. lindu is one of the more robust species in the group (length 8.5–12 mm). Its colour is generally shining black. Paraocular horns vary from low-conical to long, slender, in females usually longer and more curved than in males, distal section then slightly tapering and reclined forward. Clypeofrontal ridge arcuate, medially protuberant (particularly in females), angularly connected to clypeogenal ridge, angle very wide (full-face view). Pronotal disc punctate up to discal midline impression,

Pronotum strongly convex in larger individuals, anterior side abruptly, steeply declivous, surface deplanate-concave on either side of variably developed midline elevation (more distinct in female, but absent in minor males), top of this elevation more or less angularly protruding. Pronotal base arcuate, slightly marginate only along vague median angle; anterolateral angle distinctly rounded, posterolateral angle very widely rounded. Pronotal anterior declivity in larger individuals almost smooth, micropunctate only. Elytral interstriae more or less sericeous, with vague, scattered micropunctuation. Strial punctuation fine, vague on disc. Pygidium matt, finely, densely punctate. Proximal protibial denticle expanded.

This species and the two described immediately hereafter are closely related, and for a long time we felt ambiguous about their status. *O. lindu* and *lore*

were found together in C Sulawesi, and, although the differences are slight, there is no overlap in their size and in the shape of their horns; contrary to *lore*, the numerous *lindu* all have a punctate pronotal disc.

O. kolaka, from SE Sulawesi, is about the same size as *lindu*, but its transverse clypeofrontal-clypeogenal ridges are virtually collinear. Be aware that the smallest *lindu* may be confused with some of the non-patterned smaller species.

Description (holotype, male)

Body length ca 10 mm. Colour generally black, shining. Pilosity pale yellow, whitish on underside, dorsal side virtually glabrous.

Clypeus anteromedially rounded, margin very slightly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge slightly arcuate, medially protuberant, angularly connected with low clypeogenal ridge, which reaches lateral border; clypeal surface densely, transversely rugulate; frons entirely superficially, finely, abundantly punctate (punctures change locally in transverse striae). Genal surface distinctly, finely, abundantly to densely punctate; lateral tip widely rounded. Vertex between posterior borders of eyes with pair of widely separated, very slightly divergent, tapering horns, rounded in front, posterior side flat. Eyes with ca 8 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 10.1.

Pronotum strongly convex, discal midline shallowly impressed; anterior declivity slightly depressed on either side behind cephalic horns (= midline slightly raised), disc with vague median protrusion in front; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, shortly rounded, anterior section of lateral border straight; posterior section scarcely sinuate, posterolateral angle rounded off; apical border marginate, medially sinuate; basal border very finely marginate along vague median angle; anterior declivity and median surface of disc micropunctate, rest of pronotal surface with abundant, very fine, simple punctures, many with microstubble; punctural diameters ca 0.02 mm, mostly separated by 2–3 diameters.

Elytra generally sericeous, moderately shining, with 8 distinct striae, stria 7 slightly sinuous, ending at humerus. Striae well-defined, with indistinct punctures, mostly separated by 3–5 diameters, not crenulating interstriae; interstriae almost flat, all with abundant, scattered, superficial micropunctuation and microreticulation. Epipleuron with row of long setae behind humerus

Antennal club light-brown, scapus unmodified. Metasternum posteriorly with indistinct midline

impression; metasternal disc sparsely micropunctate, shining; apex of anteromedian lobe, and lateral wings microreticulate, with numerous seta-bearing punctures. Abdominal sternites moderately shining, laterally each with transverse row of seta-bearing punctures; sides of sternites 3–5 yellow-brown. Pygidium almost glabrous, with dense, superficial, fine punctures, and microreticulation, matt; base marginate, apex broadly marginate.

Protibia with 3+1 larger external denticles (proximal denticle with extended base), with some intervening small teeth, and proximal serration (4 small teeth); terminal spur long, subparallel, apex acuminate; protarsus slender, unmodified. Profemur robust, underside shining, with numerous, strong large seta-bearing punctures and additional micropunctuation. Meso- and metafemora complanate, underside shining, with few seta-bearing punctures and with sparse fine micropunctuation. Meso- and metatibiae strongly dilated distad (elongate-subtriangular), external side with ca 5 slight, spine-bearing fossorial elevations; tibial apex with elongate-subelliptic crest, fringed with fossorial spines; terminal spurs long, with acuminate apex, unmodified. Segment 1 of metatarsus slightly about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 41//45/20/13/10/15.

Parameres, fig. 83.

Measurements in mm. Maximum width of head 3.3. Median length of pronotum 3.3, maximum width 5.6. Sutural length of elytra 4.5, maximum width combined 5.9.

Variation and sexual dimorphism

Length 8.5–12 mm. Length of paraocular horns very variable, the longest distally slightly curved near apex, inclined inward and forward, especially in females, which have a concordantly higher anterior pronotal declivity. The smallest males have very short, subconical paraocular protrusions, and an almost evenly convex pronotal surface (male in fig. 2 is 9 mm long).

Range and ecology

Upland forest in C Sulawesi, attracted to dung.

Etymology

Named after the type region, to be treated as noun.

Onthophagus lore sp. n.

Figs 3, 19–24, 84

Type material. Holotype male Sulawesi: Lore Lindu NP: Danau Taming forest, 5–9.xii.1985, Krikken

#pw51a, 1600 m, multistr evergr forest, human excrement trap (RMNH). **Paratypes:** same data as holotype, 4 exx (RMNH).

Diagnosis

With a length of up to about 15 mm, *O. lore* is the largest species in the *lindu* group. Its colour is uniformly brown-black, largely shining. Clypeofrontal ridge arcuate, medially protuberant, angularly connected to clypeogenal ridge (full-face view), angle very wide. Paraocular horns very long, slightly divergent, sinuate (axial view), tapering, particularly in females (watch out for any, as yet unknown, minor males or females). Pronotal punctation fine, abundant to dense; anterior declivity and much of disc, however, almost smooth, sparsely micropunctate only.

Pronotum strongly convex, anterior side abruptly, steeply declivous, declivity deplanate-concave on either side of variably developed midline ridge (well defined in females), top of this ridge angularly protruding. Pronotal disc with impressed midline. Pronotal base arcuate, slightly marginate only along vague median angle; anterolateral angle distinctly rounded, posterolateral angle very widely rounded. Elytral interstriae more or less sericeous, with vague, scattered micropunctuation, interstria 2 virtually impunctate. Strial punctation fine, distinct. Pygidium matt, finely, densely punctate. Proximal protibial denticle expanded.

Description (holotype, male)

Body length ca 14 mm. Colour generally brown-black, shining. Pilosity brownish, very pale on underside, dorsal side virtually glabrous.

Clypeus anteromedially rounded, margin slightly, narrowly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge slightly arcuate, medially conspicuously protuberant, angularly connected with low clypeogenal ridge, which reaches lateral border; clypeal surface densely, finely, transversely rugulate; frons entirely vaguely, finely micropunctate (and scratched). Vertex between posterior borders of eyes with pair of strongly reclined, widely separated, divergent horns, distally curved inwards, tapering; anterior side rounded, posterior side flat. Eyes with ca 8 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 7.7.

Pronotum strongly convex, discal midline impressed; extensive anterior declivity with pair of shallow concavities behind cephalic horns (= midline distinctly raised); lateral border finely marginate, anterolateral angle (full-face view) rather widely rounded, anterior section of lateral border virtually straight; posterior

section scarcely sinuate, posterolateral angle widely rounded; apically medially sinuate, marginate; base indistinctly marginate, medially vaguely angular; anterior declivity and median part of disc sparsely micropunctate (scratched), remainder of pronotal surface with abundant, fine, evenly distributed punctures, mostly containing a brownish microscale; punctural diameters ca 0.02 mm, mostly separated by 2–4 diameters.

Elytra generally sericeous, moderately shining, with 8 distinct striae, stria 7 slightly sinuate, ending at humeral umbone. Striae well defined, with distinct punctures, mostly separated by 4–7 diameters, scarcely crenulating interstriae; interstriae slightly convex, interstria 2 wide, flatter than others and almost impunctate; other interstriae with abundant, scattered micropunctuation, all with microreticulation. Epileuron with distinct row of long setae behind humerus.

Antennal club brown. Metasternum posteriorly with distinct midline impression; metasternal disc sparsely micropunctate, shining; anteromedian lobe and lateral wings with numerous seta-bearing punctures, on microreticulate surface. Abdominal sternites moderately shining medially, matt laterally due to microreticulation, laterally each with transverse row of seta-bearing punctures, setae long; sides of sternites 4–6 and lateral corners of pygidium yellow-brown. Pygidium almost glabrous, with dense, superficial, fine punctures and microreticulation, matt; base marginate, apex broadly marginate.

Protibia with 3+1 larger external denticles (proximal denticle with extended base), some intervening small teeth, and proximal serration (ca 6 small denticles); terminal spur long, parallel-sided, apex acuminate; protarsus long, slender, unmodified. Meso- and metatibiae robust, strongly dilated at apex (elongate-subtriangular); apex elongate-subelliptic, its crest fringed with fossorial spines; external side with ca 6 spine-bearing fossorial elevations; terminal spurs long, with acuminate apex, unmodified. Profemur robust, underside shining, with numerous strong seta-bearing punctures and sparse micropunctuation; meso- and metafemora complanate, underside shining, largely glabrous, also sparsely micropunctate. Segment 1 of metatarsus about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 55//60/27/18/14/20.

Parameres, fig. 84.

Measurements in mm. Maximum width of head 4.2. Median length of pronotum 4.4, maximum width 7.5. Sutural length of elytra 6.2, maximum width combined 7.8.

Variation and sexual dimorphism

Length 14–15 mm. Only few individuals available, so, variation may be considerably larger.

Female very similar to male. Clypeal border slightly emarginate or truncate anteromedially. Paraocular horns much longer and distinctly sinuate. Ridge on anterior declivity of pronotum variably pronounced, may be distinctly rectilinear, then disc with more distinct anteromedian angle.

Range and ecology

Upland forest in C Sulawesi, attracted to dung.

Etymology

Named after the type region, to be treated as noun.

Onthophagus kolaka sp. n.

Figs 4, 25–30, 85

Type material. Holotype male **Sulawesi:** Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw11a, 1150 m, multistr evergr forest, human excr trap (RMNH). **Paratypes:** same data as holotype 3 exx. (RMNH).

Diagnosis

O. kolaka is another of the more robust species in the *lindu* group (length 11–12 mm). Its colour is again almost entirely black, and largely shining. Contrary to its relatives, the medially protuberant clypeofrontal ridge of *kolaka* is virtually straight, not arcuate, and continues straight into the clypeogenal ridge. Paraocular horns long in the material available, in females apparently longer than in males, distally slightly curved inward, tapering.

Pronotum strongly convex, anterior pronotal declivity steep, its surface slightly deplanate-concave on either side of very slightly raised midline elevation (which seems more pronounced in females), top of this elevation slightly protruding. Pronotal base arcuate, very slightly marginate only along vague median angle; anterolateral angle distinctly rounded, posterolateral angle very widely rounded. Pronotal punctation fine, laterally dense, vague, minute, sparser near shallow midline impression; anterior declivity almost smooth, sparsely micropunctate only. Elytral interstriae more or less sericeous, with vague, scattered micropunctuation. Strial punctation fine. Pygidium matt, finely, densely punctate. Proximal protibial denticle expanded.

Description (holotype, male)

Body length ca 11 mm. Colour generally black, shining. Pilosity brown, dorsal side virtually glabrous.

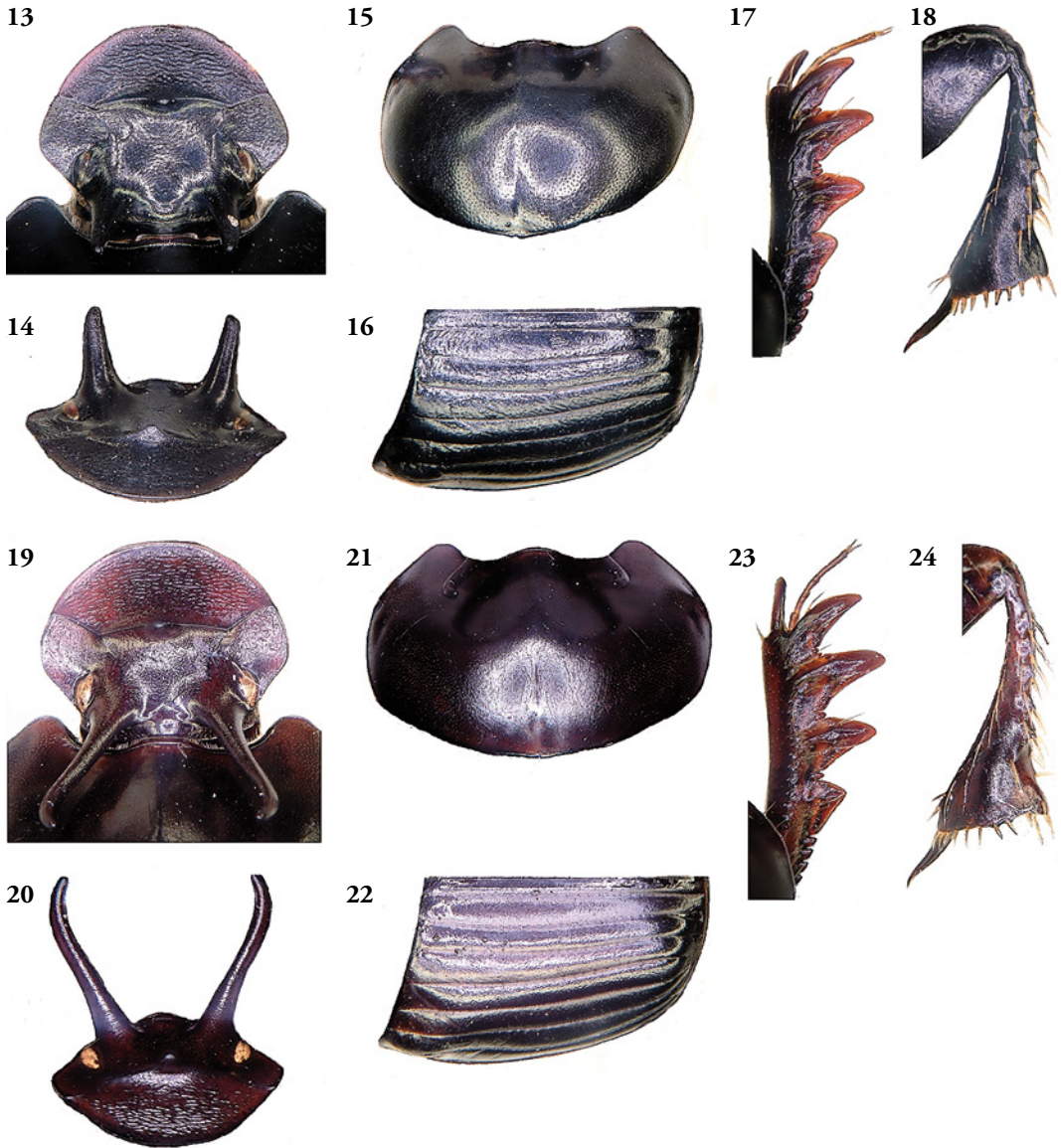


Figs 1-12. Habitus of *Ontophagus*, oblique view, male holotypes, except 2, 12. – 1-2, *O. lindu* (2, minor male paratype, length 9 mm), 3, *O. lore*, 4, *O. kolaka*, 5, *O. transvestitus*, 6, *O. sibkahonoi*, 7, *O. sanggona*, 8, *O. moajat*, 9, *O. batui*, 10, *O. matanyo*, 11, *O. mekara*, 12, *O. limbatus* (male N Sulawesi)

Clypeus anteromedially slightly truncate; margin very slightly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge rectilinear, medially protuberant, directly (without angle) continuing laterad, as low clypeogenal ridge, which reaches lateral border; clypeal surface densely, transversely rugulate; frons entirely superficially, abundantly micropunctate. Genal surface distinctly, abundantly, vaguely micropunctate; lateral tip widely rounded. Vertex between posterior borders of eyes with pair of widely separated, very slightly divergent, slightly curved, slightly tapering

horns, their surface rounded in front, flat posteriorly. Eyes with ca 10 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 10.1.

Pronotum strongly convex, discal midline shallowly impressed; anterior declivity slightly depressed on either side behind cephalic horns (= midline slightly raised), disc with vague median protrusion in front; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, shortly rounded, anterior section of lateral border straight; posterior section scarcely sinuate, posterolateral angle rounded



Figs 13-24. Contours of parts of *Onthopagus*, male holotypes. 13-18, *O. lindu*; 19-24, *O. lore*. – Head full-face (13, 19), axial (14, 20); pronotum, dorsal (15, 21); left elytron, dorsal (16, 22); protibia, upper side (17, 23); metatibia, underside (18, 24).

off; apical border marginate, medially sinuate; basal border very finely marginate along vague median angle; anterior declivity and median surface of disc sparsely micropunctate, rest of pronotal surface with abundant to dense, very fine, simple punctures, many with microstubble; punctural diameters ca 0.02 mm, mostly separated by 3–5 diameters. Elytra generally shining, somewhat sericeous on disc,

with 8 distinct striae, stria 7 slightly sinuous, ending at humerus. Striae discally well defined, with indistinct punctures, mostly separated by 4–6 diameters, not crenulating interstriae; interstriae almost flat; all with abundant, scattered, superficial micropunctuation, and microreticulation. Epipleuron with row of long setae behind humerus. Antennal club yellow-brown, scapus unmodified.

Metasternum posteriorly with indistinct midline impression; metasternal disc sparsely micropunctate, shining; apex of anteromedian lobe and lateral wings microreticulate, with numerous seta-bearing punctures. Abdominal sternites moderately shining, laterally each with transverse row of seta-bearing punctures; sides of sternites 3–5 yellow-brown. Pygidium almost glabrous, with dense, superficial, fine punctures, and microreticulation, matt; base marginate, apex broadly marginate.

Protibia with 3+1 larger external denticles (proximal denticle with extended base), with some intervening small teeth, and proximal serration (5 small teeth); terminal spur long, subparallel, apex worn off; protarsus slender, unmodified. Profemur robust, underside shining, with numerous, strong, large seta-bearing punctures and additional sparse micropunctuation. Meso- and metafemora complanate, underside shining, with few seta-bearing punctures and with sparse micropunctuation. Meso- and metatibiae strongly dilated distad (elongate-subtriangular), external side with ca 5 slight, spine-bearing fossorial elevations; tibial apex with elongate-subelliptic crest, fringed with fossorial spines; terminal spurs long, with acuminate apex (tip worn off), unmodified. Segment 1 of metatarsus about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 60//65/30/18/14/21.

Parameres, fig. 85.

Measurements in mm. Maximum width of head 3.5. Median length of pronotum 3.8, maximum width 6.0. Sutural length of elytra 4.5, maximum width combined 6.5.

Variation and sexual dimorphism

Length 11–12 mm. Represented by a small series only: it cannot be excluded that this species is as variable in its size and ornamentation as *O. lindu*. Length of paraocular horns certainly variable. Females with clypeal margin more reflexed, horns longer, distally curved inwards; anterior declivity of pronotum more extensive.

Range and ecology

Upland forest in SE Sulawesi, attracted to dung.

Etymology

Named after the type region, to be treated as noun.

Onthophagus transvestitus sp. n.

Figs 5, 31–36, 86

Type material. Holotype male **Sulawesi:** Dumoga Bone NP: Toraut R3, 8–10.v.1985, Huijbregts

#hh311, 245 m, multistr evergr forest, human excr trap (RMNH). **Paratypes:** **Sulawesi:** Dumoga Bone NP: Edwards Subcamp, 2–6.vi.1985, Huijbregts #hh352, 664 m, multistr evergr forest, human excr trap, 1 ex.; Dumoga Bone NP: Mt Mogogonipa, 22–26.viii.1985, Huijbregts #hh424, 400 m, multistr evergr forest, fish trap, 1 ex.; Dumoga Bone NP: Mt Mogogonipa, 22–26.viii.1985, Huijbregts #hh427a, 1000 m, multistr evergr forest, human excr trap, 2 exx.; Dumoga Bone NP: Toraut, 27–31.v.1985, Huijbregts #hh344, 234 m, multistr evergr forest, flight interception trap, 1 ex.; Dumoga Bone NP: Toraut R3, 8–10.v.1985, Huijbregts #hh311, 245 m, multistr evergr forest, human excr trap, 2 exx.; Dumoga Bone NP: Toraut R3, 16–20.viii.1985, Huijbregts #hh422, 245 m, multistr evergr forest, human excr bbc trap 0m, 1 ex.; Dumoga Bone NP: Toraut: Maze, 2–9.xi.1985, Krikken #pw16a, 220 m, multistr evergr forest, human excr trap, 2 exx.; Dumoga Bone NP: Toraut: Maze, 9–15.xi.1985, Krikken #pw23, 220 m, multistr evergr forest, human excr trap, 17 exx.; Lore Lindu NP: Dongi Dongi Shelter, 4–8.xii.1985, Krikken #pw48a, 940 m, multistr evergr forest, human excr trap, 2 exx.; Lore Lindu NP: Marena forest (nr river), 14–17.xii.1985, Krikken #pw64a, 600 m, multistr evergr forest, human excr trap, 2 exx.; Lore Lindu NP: Sopu River bank, 8.xii.1985, Krikken & van Tol #pw49, 930 m, multistr evergr forest vicinity, at light, 1 ex.; Palu region: Tawaeli-Toboli rd (km34), 20–22.xii.1985, Krikken #pw69a, 500 m, multistr evergr forest, degraded, human excr trap, 11 exx. (RMNH).

Excluded from type series. **Sulawesi:** Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw11a, 1150 m, multistr evergr forest, human excr trap, 2 exx. (RMNH).

Diagnosis

O. transvestitus is a small, uniformly brown-black, very shining species (length 5–7.5 mm). Pronotal disc usually with distinct, abundant to dense punctuation; punctures fine, well defined, on lateral declivities denser, but never crowded (as in the next species). Anterior declivity of pronotum may be depressed, much higher and deplanate in major females with long paraocular protrusions.

Clypeal apex truncate or feebly sinuate. Clypeo-frontal ridge feebly arcuate, in males laterally nearly effaced and usually more or less pointed medially; clypeogenal suture distinct, slightly raised. Paraocular protrusions short, semiconical (males and females) to long, slightly tapering (females only). Pronotal base arcuate, finely marginate only along vague basomedian angle; basomedian surface

deplanate; posterolateral angle obtuse, but distinct; posterior section of lateral border sinuate. Elytral interstriae, with fine, laterally almost dense, scattered punctation; interstitial surface slightly convex, distinctly shining. Striae well-defined, their punctation fine, very slightly crenulating interstriae. Pygidium brown-black, matt, densely, shallowly punctate. Legs brown or black. Proximal external denticle of protibia with base short compared to the three preceding large species.

In some ways this species is similar to the equally small, uniformly brown-black *O. sanggona*, but that species has distinctly matt, sparsely micropunctate elytral interstriae. The preceding three species are largely shining, like *transvestitus*, but even their smallest individuals are larger than *transvestitus*.

Description (holotype, male)

Body length ca 6 mm. Colour generally black, very shining, margins of head, underside, legs brown. Pilosity brownish, dorsal side glabrous.

Clypeus anteromedially feebly sinuate, margin slightly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge curvilinear, medially protuberant, pointed, angularly, and only just, connected with fine clypeogenal ridge, which reaches lateral border; clypeal surface densely, transversely rugulate. Genal surface crowdedly rugulate-punctate, lateral tip short, widely, evenly rounded. Frons vaguely, densely rugulate-punctate. Vertex between posterior part of eyes with pair of short, semiconical, pointed tubercles. Eyes with ca 8 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 10.2.

Pronotum evenly convex, disc slightly deplanate, midline vaguely impressed near base; surface behind paraocular protrusions very slightly deplanate; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, very shortly rounded; anterior section of lateral border nearly straight; posterior section slightly sinuate, posterolateral angle obtuse; apical border finely marginate, medially hardly sinuate; basal border widely rounded, medially very finely marginate, very vaguely angular (adjacent surface microreticulate). Pronotal disc abundantly, finely, simply punctate, punctures well defined, their diameters decreasing rostrad, increasing to posterolateral surface; many punctures with indistinct microstubble; disc basomedially with some microreticulation ($\times 60$); punctural diameters 0.02–0.03 mm, mostly separated by 2–4 diameters.

Elytra generally very shining black, with 8 distinct striae, stria 7 slightly sinuate, ending at humeral umbone. Striae well-defined, with distinct punctures,

mostly separated by 2–4 diameters, slightly crenulating interstriae; interstriae slightly convex, all with abundant, scattered, very fine, shallowly rugulate punctation.

Antennal club light-brown, scapus unmodified. Metasternum posteriorly with vague midline impression; metasternal disc with sparse micropunctation, lateral wings with moderately abundant, seta-bearing, well-defined punctures and additional microreticulation. Abdominal sternites slightly sericeous, laterally each with transverse row of seta-bearing, fine punctures; abdominal sides rufous. Pygidium brown, matt, with dense, fine, shallow punctation, and microreticulation, glabrous; base marginate, apex with thickened margin.

Protibia with 3+1 larger external denticles, with some intervening small teeth, and proximal serration (6 small teeth); terminal spur long, subparallel, apex acuminate (somewhat knife-shaped); protarsus slender, unmodified. Profemur robust, underside shining, with numerous large seta-bearing punctures over middle from base to apex, separated by 1–3 diameters, setae long. Meso- and metafemoral underside shining, with several seta-bearing punctures in front and near apex. Meso- and metatibiae robust, strongly dilated distad (elongate-triangular), externally with ca 5 slight fossorial, spine-bearing elevations; apex with elongate-subelliptic crest, fringed with fossorial spines. Meso- and metatibiae and terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 38//35/18/11/8/11.

Parameres, fig. 86.

Measurements in mm. Maximum width of head 2.1. Median length of pronotum 2.3, maximum width 3.5. Sutural length of elytra 2.4, maximum width 3.7.

Variation and sexual dimorphism

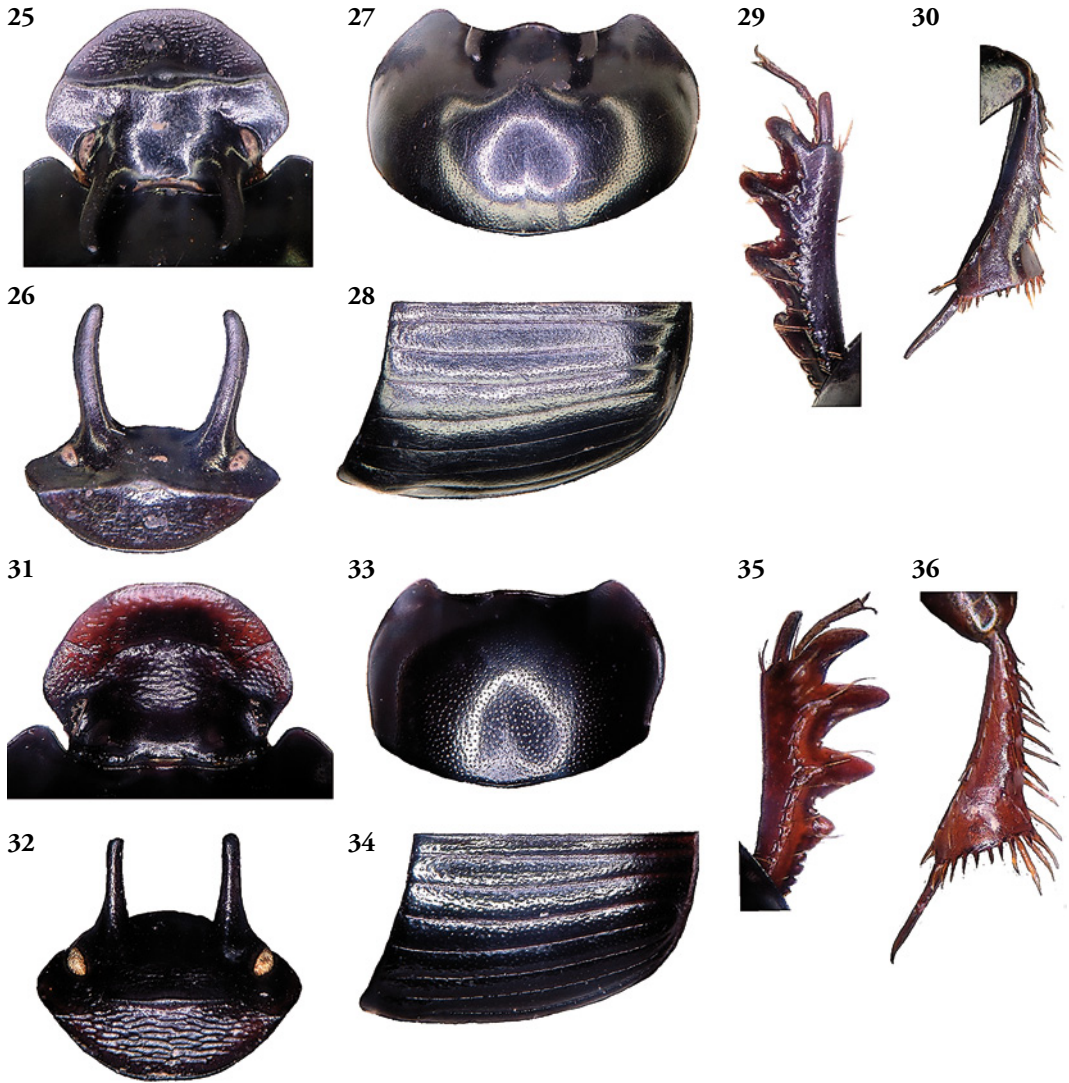
Length 5–7.5 mm. Pronotal punctation apparently varies considerably.

Females with curvilinear clypeofrontal ridge, adjacent surface slightly more generally elevated; frontal surface entirely distinctly rugulate-punctate; paraocular horns slender, very long, and somewhat convergent distally. Pronotal declivity deplanate, impunctate, topped by feebly bisinuate crest.

Maximum width of head of female in fig. 32 ca 2.2 mm.

Comment

Two females from SE Sulawesi excluded from type series, local males being required to establish conspecificity.



Figs 25-36. Contours of parts of *Onthophagus*, male holotypes (except 32). 25-30, *O. kolaka*; 31-36, *O. transvestitus*. – Head full-face (25, 31), axial (26, 32, female paratype); pronotum, dorsal (27, 33); left elytron, dorsal (28, 34); protibia, upper side (29, 35); metatibia, underside (30, 36).

Range and ecology

Apparently a wide-ranging lowland Sulawesi forest species, attracted mainly to dung.

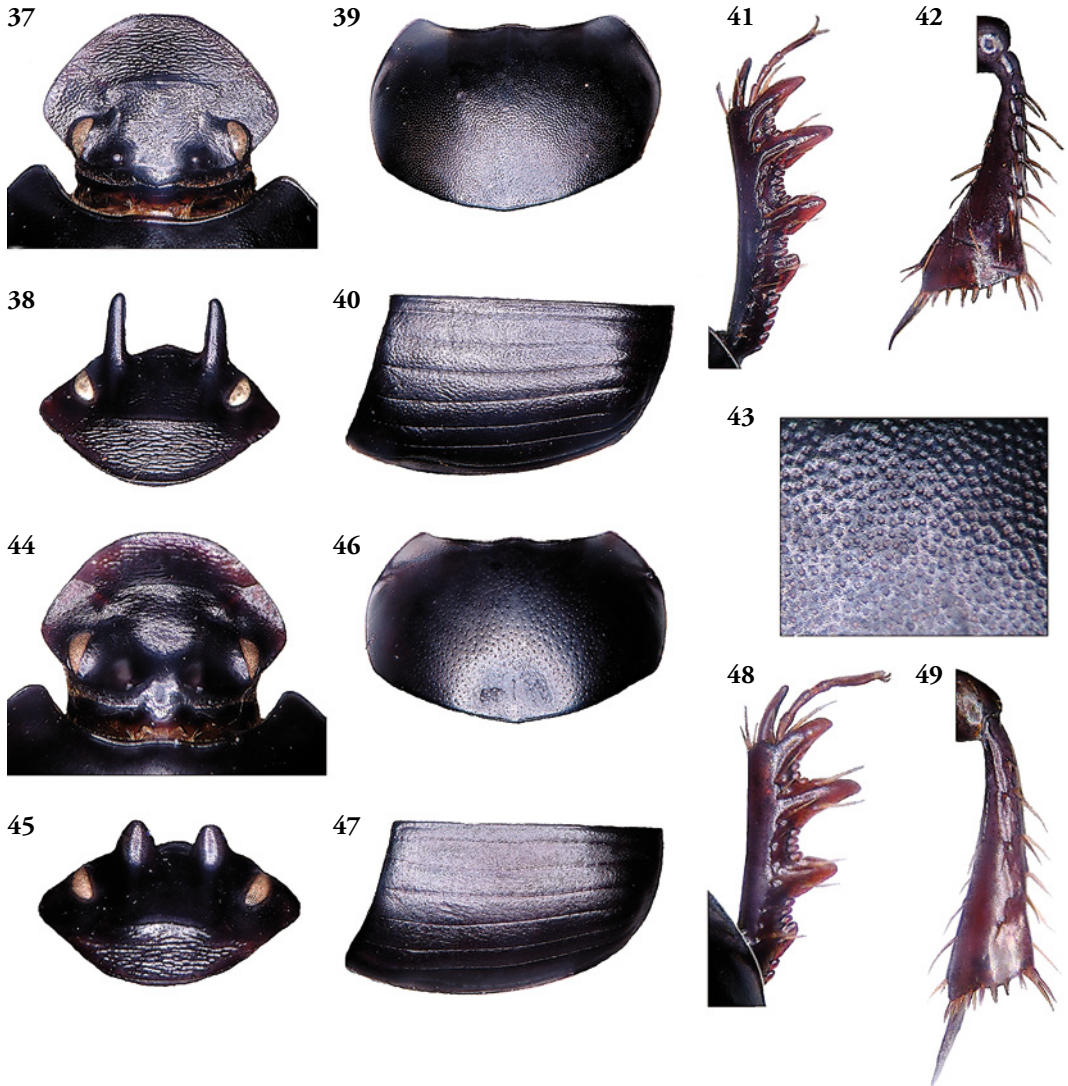
Etymology

Name due to the male-like appearance of major females, a *lindu* group phenomenon which we first noticed in this species; to be treated as noun.

Onthophagus sibkahonoi sp. n.

Figs 6, 37–43, 87

Type material. Holotype male Sulawesi: Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw11a, 1150 m, multistr evergr forest, human excre trap (RMNH). **Paratype:** female, same data as holotype (RMNH).



Figs 37-49. Contours of parts of *Onthophagus*, male holotypes (except 38). 37-43, *O. sibkahonoi*; 44-49, *O. sanggona*. – Head full-face (37, 44), axial (38, female paratype; 45); pronotum, dorsal (39, 46); left elytron, dorsal (40, 47); protibia, upper side (41, 48); metatibia, underside (42, 49); punctation, from centre of pronotal disc (43), base of rectangle = ca 1 mm.

Diagnosis

O. sibkahonoi is medium-sized in the *lindu* group (known length 8.5 mm), deplanate, uniformly black, and generally matt. Contrary to close relatives, like *sanggona*, its pronotum is mattified, not by micro-reticulation, but primarily by a distinct, fine, very crowded, almost rugular punctation, unique in the group (fig. 43).

Clypeofrontal ridge very feebly arcuate, median point hardly pronounced, if distinct at all (as in female);

clypeogenal suture just distinct, but not raised. Clypeal rugulation more or less extending onto frons. Paraocular horns of male very short, low-conical, much longer in female, distally slightly tapering. Crowded pronotal punctures fine, well defined, and evenly distributed over almost entire, evenly convex pronotal surface (male); less dense and finer on low, depressed anterior declivity (particularly in female); no midline impression on pronotal base. Pronotal base arcuate, very finely marginate only along

very vague basomedian angle; posterolateral angle rounded. Striae narrow, their punctation fine, very slightly crenulating interstriae. Elytral interstriae matt, discally flat, with abundant, scattered, discally very vague micropunctation. Pygidium black, matt, entirely distinctly, densely punctate. Legs black.

Description (holotype, male)

Body length ca 8.5 mm. Colour generally black, dorsal side entirely matt, due to dense microsculpture; abdominal sides rufous. Pilosity brownish, dorsal side virtually glabrous.

Clypeal apex very slightly truncate, margin hardly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge slightly curvilinear, medially slightly protuberant, pointed, clypeogenal suture hardly distinct; clypeal surface densely, transversely rugulate. Genal surface densely, finely rugulate, lateral tip rounded. Frons densely, finely, transversely rugulate. Vertex between posterior part of eyes with pair of short, subconical, pointed tubercles; surface between tubercles with some very fine punctures. Eyes with ca 10 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 8.4.

Pronotum evenly convex, disc slightly deplanate, anterior declivity on either side shallowly depressed behind paraocular protrusions, midline slightly protruding; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, shortly rounded; anterior section nearly straight, posterior section hardly sinuate, posterolateral angle rounded off; apical border finely marginate, medially sinuate; basal border widely rounded, hardly marginate along very vague median angle. Pronotal disc almost entirely crowdedly, finely, evenly, simply punctate, and consequently matt, punctures all well defined, showing microscales; punctural diameters ca 0.02 mm, mostly separated by less than one diameter.

Elytra generally matt, due to distinct microreticulation, with 8 distinct striae, stria 7 slightly sinuate, ending at humeral umbone. Striae well defined, with fine punctures, mostly separated by 2–5 diameters, very slightly crenulating interstriae; interstriae very slightly convex, all with abundant, fine, superficial punctation, lateral interstriae vaguely rugulate-punctate.

Antennal club yellow-brown, scapus unmodified. Metasternum posteriorly with vague midline impression; metasternal disc with abundant micropunctation, lateral wings with moderately abundant, seta-bearing, well-defined, subannulate punctures and additional microreticulation. Abdominal sternites laterally each with transverse row of seta-bearing,

well-defined, subannulate punctures, those on anal sternite contiguous; abdominal sides rufous. Pygidium matt, microreticulate, with dense, fine punctation, individual punctures moderately defined; glabrous; base marginate, apex with thickened margin.

Protibia with 3+1 larger external denticles, with some intervening small teeth, and proximal serration (5–6 small teeth); terminal spur long, subparallel, apex acuminate; protarsus slender, unmodified. Profemur robust, underside shining, with numerous large seta-bearing punctures over middle from base to apex, separated by 1–3 diameters, setae long. Meso- and metafemora broad, complanate, underside shining, with few seta-bearing punctures in front and near apex. Meso- and metatibiae robust, strongly dilated distad (elongate-triangular), externally with ca 5 slight fossorial, spine-bearing elevations; apex with elongate-subelliptic crest, fringed with (mostly short) fossorial spines. Meso- and metatibial terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 34//30/15/8/6/9.

Parameres, fig. 87.

Measurements in mm. Maximum width of head 2.8. Median length of pronotum 2.8, maximum width 4.5. Sutural length of elytra 3.8, maximum width combined 5.0.

Variation and sexual dimorphism

Length of the single known male and female both ca 8.5 mm. Female with arcuate clypeofrontal ridge, adjacent surface more generally elevated; frontal surface entirely distinctly rugulate-punctate; paraocular horns upright, roundish in front, flattened behind, slightly tapering, slender, very long, and somewhat convergent distally. Pronotal declivity of female deplanate, sparsely micropunctate, midline very slightly raised, declivity topped by feebly bisinuate crest.

Maximum width of head of female (fig. 38) ca 2.9 mm.

Range and ecology

Only two individuals known from forest in SE Sulawesi, attracted to dung.

Etymology

Dedicated to our sympathetic and most helpful colleague, Sih Kahono, from Bogor (Indonesia).

Onthophagus sanggona sp. n.

Figs 7, 44–49, 88

Type material. Holotype male Sulawesi: Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw11a, 1150 m, multistr evergr forest, human excr trap (RMNH). **Paratypes:** Sulawesi: Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw10a, 1150 m, multistr evergr forest, human excr trap, 1 ex.; Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw11a, 1150 m, multistr evergr forest, human excr trap, 6 exx.; Kolaka Distr: Watuwila Mosquito Camp, 13–15.x.1989, Krikken & van der Blom #sw11b, 1150 m, multistr evergr forest, fish trap, 1 ex. (RMNH);

Excluded from type series. Sulawesi: Dumoga Bone NP: Mt Mogogonipa, 22–26.viii.1985, Huijbregts #hh427a, 1000 m, multistr evergr forest, human excr trap, 6 exx.; Dumoga Bone NP: Mt Mogogonipa, 23–26.viii.1985, Huijbregts #hh431, 1000 m, multistr evergr forest, rat excr trap, 1 ex.; Mt Ambang NR: Kotamobagu, 20 km E of, 5–8.xi.1985, Krikken #pw09, 1210 m, multistr evergr forest, flight interception trap, 1 ex. (RMNH).

Diagnosis

O. sanggona is a small species (length 5.5–7 mm), dorsally deplanate, uniformly black, matt. Pronotal disc abundantly, distinctly punctate, with superficial midline impression only on base; punctation on lateral declivities denser, but never crowded in any way, as in *sibkahonoi*. Anterior pronotal declivity only slightly depressed behind paraocular protrusions.

Clypeofrontal ridge fine, widely, evenly arcuate, median point indistinct, if present at all; clypeo-genal suture distinct, but not raised. Paraocular protrusions relatively short, semiconical, upright, height variable, more or less triangular in axial view. Pronotal base arcuate, very finely marginate, more distinctly so along very vague basomedian angle; posterolateral angle rounded, posterior section of lateral border virtually straight. Discal interstriae flat, distinctly matt, with sparse, scattered micropunctation. Striae narrow, shining, their punctation fine, very slightly crenulating interstriae. Pygidium black, matt, abundantly, finely punctate. Protibia with two slender, acuminate distal denticles, proximal (fourth) denticle very small. Leg colour brown-black.

In some ways similar to *O. moajat*, but smaller, and entirely lacking the yellow-orange elytral markings; initially we considered the material from N Sulawesi, which occurs there together with *moajat*, a black variant of that species. A uniformly brown-black

relative is *transvestitus*, which is distinctly more shining than *sanggona*.

Description (holotype, male)

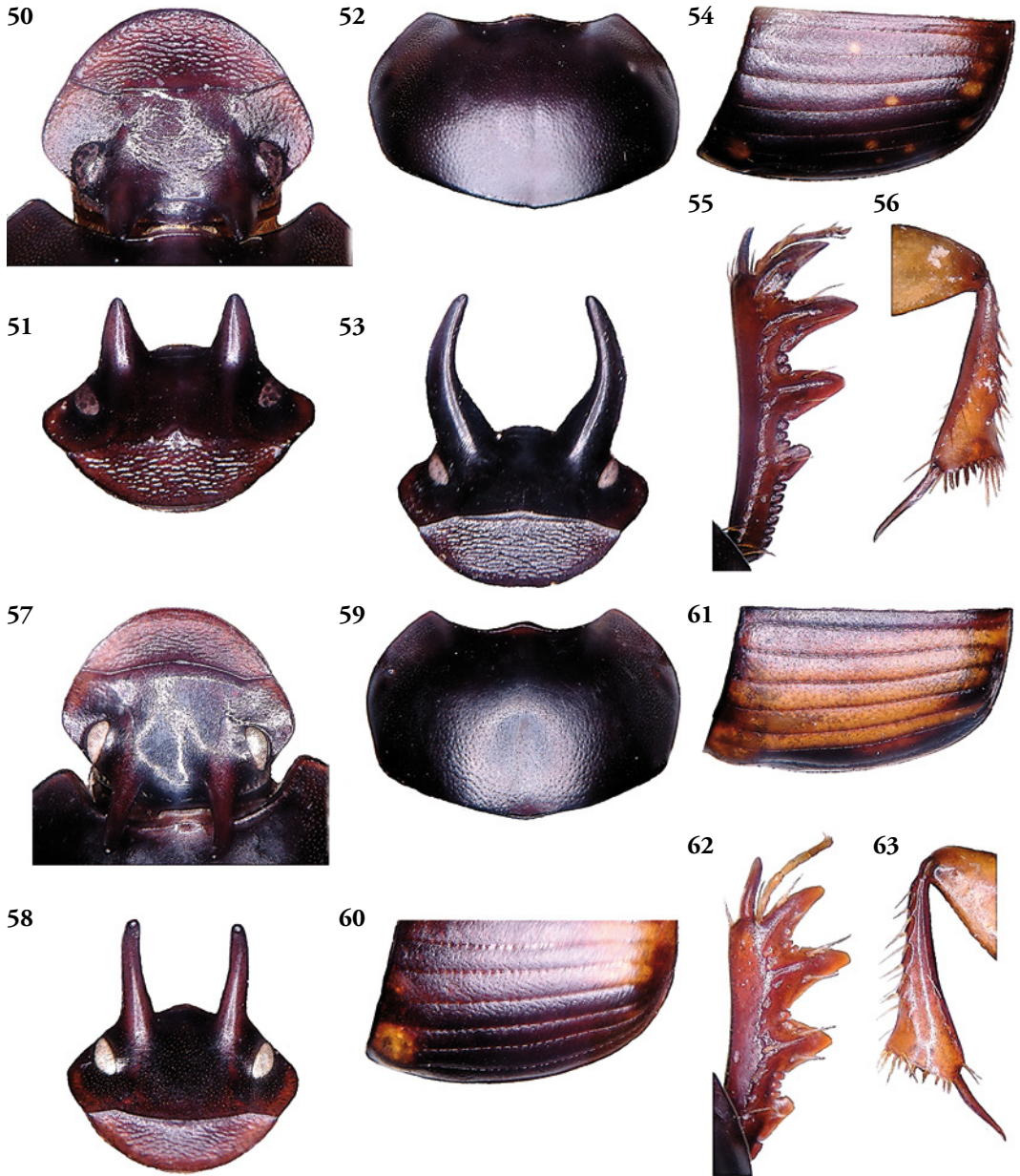
Length ca 5.5 mm. Colour generally brown-black, dorsal side with forebody moderately shining, elytra matt. Pilosity brownish, dorsal side virtually glabrous.

Clypeus widely rounded, margin slightly reflexed; clypeo-genal transition at border virtually continuous; clypeofrontal ridge very slightly curvilinear, medially hardly protuberant, clypeo-genal suture fine, distinct, not raised; clypeal surface densely, transversely rugulate. Genal surface sparsely micropunctate, lateral tip widely rounded. Frons sparsely micropunctate to finely punctate, some punctures transverse. Vertex between posterior part of eyes with pair of short, semiconical, pointed tubercles; surface between tubercles with some micropunctures. Eyes with ca 8 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 7.2.

Pronotum evenly convex, disc slightly deplanate, anterior declivity on either side very shallowly depressed behind paraocular protrusions; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, very shortly rounded; lateral border finely marginate, anterior section nearly straight; posterior section almost straight, posterolateral angle rounded off; apical border finely marginate, medially sinuate; basal border widely rounded, quasi-marginate due to row of fine punctures, medially extremely vaguely angular; midline vaguely depressed near base. Pronotal disc very abundantly, almost densely punctate, with some interspersed micropunctation, punctation shallower on anterolateral surface, finer basomedially; punctural diameters 0.02–0.03 mm, away from midline mostly separated by 2–4 diameters.

Elytra generally sericeous due to microreticulation, with 8 distinct striae, stria 7 slightly sinuate, ending at humeral umbone. Striae rather ill defined, with fine punctures, mostly separated by 2–4 diameters, slightly crenulating interstriae; discal interstriae virtually flat, all interstriae with abundant, scattered micropunctation.

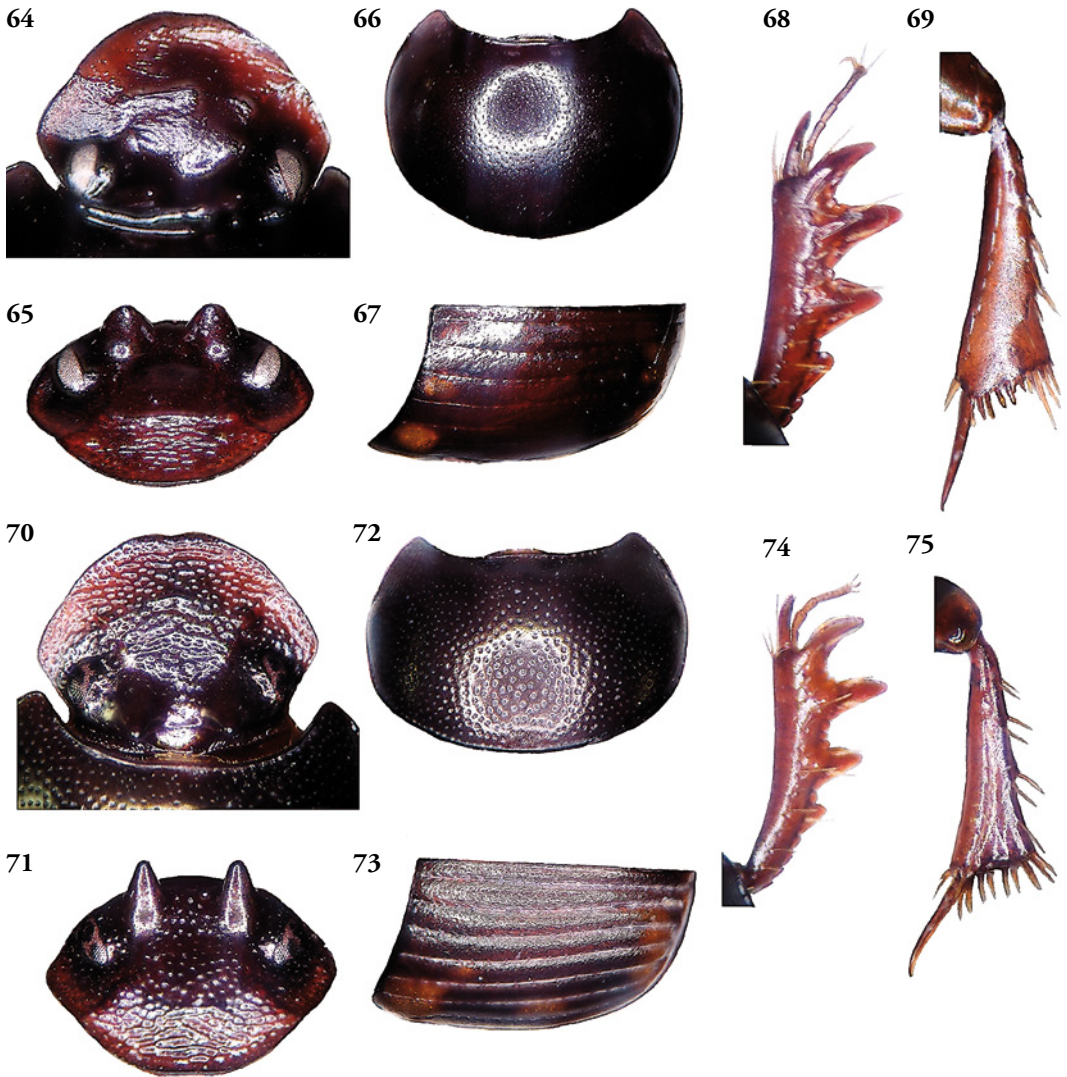
Antennal club light-brown, scapus unmodified. Metasternum posteriorly with vague midline impression; metasternal disc with abundant micropunctation, lateral wings with moderately abundant, seta-bearing, well-defined, subannulate punctures and additional microreticulation. Abdominal sternites laterally each with transverse row of seta-bearing, subannulate punctures, on microreticulate surface; sides rufous. Pygidium brownish black, matt,



Figs 50-63. Contours of parts of *Ontophagus*, male holotypes (except 53, 61). 50-56, *O. batui*; 57-63, *O. moajat*. – Head full-face (50, 57), axial (51, 53, female paratype; 58); pronotum, dorsal (52, 59); left elytron, dorsal (54, 60, 61, female paratype); protibia, upper side (55, 62); metatibia, underside (56, 63).

microreticulate, with very abundant, distinct punctation, individual punctures rather well defined; glabrous; base marginate, apex with thickened margin. Protibia with 3+1 external denticles (proximal denticle very short), with some intervening small teeth, and proximal serration (6 small teeth); terminal spur

long, subparallel, apex acuminate; protarsus slender, unmodified. Profemur robust, underside shining, with numerous large seta-bearing punctures over middle from base to apex, and some finer punctation. Meso- and metafemora broad, complanate, underside shining, with few seta-bearing punctures,



Figs 64-75. Contours of parts of *Onthophagus*, male holotypes. 64-69, *O. matanyo*; 70-75, *O. mekara*. – Head full-face (64, 70), axial (65, 71); pronotum, dorsal (66, 72); left elytron, dorsal (67, 73); protibia, upper side (68, 74); metatibia, underside (69), upper side (75).

and abundant finer punctation. Meso- and metatibiae robust, strongly dilated distad (elongate-triangular), externally with 3 very slight fossorial, spine-bearing elevations; apex with elongate-subelliptic crest, fringed with short fossorial spines. Meso- and metatibial terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus slightly longer than segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 40//38/16/10/8/11.

Parameres, fig. 88.

Measurements in mm. Maximum width of head 2.0. Median length of pronotum 2.1, maximum width 3.5. Sutural length of elytra 2.8, maximum width combined 3.7.

Variation and sexual dimorphism

Length 5.5–7 mm. Variation slight, most evident in length of paraocular horns; females similar to males. Some presumably immature specimens are brown.

Range and ecology

SE and possibly N Sulawesi, in forest, attracted to dung.

Comments

Material from N Sulawesi excluded from type series – its conspecificity has to be confirmed on more material.

Etymology

Named after a village in the type region, to be treated as noun.

Onthophagus moajat sp. n.

Figs 8, 57–63, 89

Type material. Holotype male **Sulawesi:** Mt Ambang NR: Mt Moajat, 15–16.ix.1985, Huijbregts #hh454a, 1660 m, multistr evergr forest, human excr trap (RMNH). **Paratypes: Sulawesi:** Dumoga Bone NP: Mt Mogonipa, 22–26.viii.1985, Huijbregts #hh428, 1000 m, multistr evergr forest, flight interception trap, 1 ex.; Dumoga Bone NP: Page Subcamp, 3–8.ix.1985, Huijbregts #hh439, 302 m, multistr evergr forest, human excr bbc trap 0m, 1 ex.; Dumoga Bone NP: Toraut, 27–31.v.1985, Huijbregts #hh344, 234 m, multistr evergr forest, flight interception trap, 1 ex.; Dumoga Bone NP: Zebra, 10–20.xi.1985, Van Stalle, dung trap, 2 exx.; Mt Ambang NR: Kotamobagu, 20km E of, 9–13.ix.1985, Huijbregts #hh443a, 1120 m, multistr evergr forest, human excr trap, 4 exx.; Mt Ambang NR: Kotamobagu, 20km E of, 10–13.ix.1985, Huijbregts #hh448a, 1230 m, multistr evergr forest, human excr trap, 1 ex.; Mt Ambang NR: Kotamobagu, 20km E of, 4–8.xi.1985, Krikken #pw13a, 1340 m, multistr evergr forest, human excr trap, 1 ex.; Mt Ambang NR: Kotamobagu, 20km E of, 5–8.xi.1985, Krikken #pw11, 1200 m, multistr evergr forest edge, human excr trap, 3 exx.; Mt Ambang NR: Mt Moajat, 13–16.ix.1985, Huijbregts #hh451a, 1780 m, multistr evergr forest, human excr trap, 24 exx.; Mt Ambang NR: Mt Moajat, 13–16.ix.1985, Huijbregts #hh452, 1780 m, multistr evergr forest, hand coll, 1 ex.; Mt Ambang NR: Mt Moajat, 15–16.ix.1985, Huijbregts #hh454a, 1660 m, multistr evergr forest, human excr trap, 23 exx. (RMNH).

Excluded from type series. **Sulawesi:** Lore Lindu NP: Danau Taming forest, 5–9.xii.1985, Krikken #pw51a, 1600 m, multistr evergr forest, human excr trap, 1 ex. (RMNH).

Diagnosis

O. moajat is a small, usually patterned species (length usually 6–8 mm). Its colour is generally black to brown and patterned, moderately shining, with lighter brown legs; elytra with symmetric yellow-orange markings on, at least, the base of interstriae 6–7 (humerus); other markings variable, frequently also present on apex of interstriae 2–4; elytra in some individuals even largely yellow-orange, with variably broad, dark medial and lateral zone; elytra rarely entirely black. Pronotum moderately shining black, with generally fine punctation, abundant on disc, larger and denser laterally, usually effaced on anterior declivity (particularly the deplanate surface in long-horned individuals). Pygidium yellow, frequently with variably extensive dark markings; matt, glabrous, with dense, shallow punctation.

Clypeal apex rounded. Clypeofrontal ridge feebly arcuate-sinuate, usually continuing laterally into clypeogenal ridge, variably pointed medially. Frons usually rather smooth, shining. Paraocular protrusions varying from short, semiconical, to long, tapering, curved, slightly reclined forward. Height of anterior pronotal declivity varying with development of paraocular protrusions, higher declivities deplanate on either side of slightly protruding midline. Pronotal base only medially finely marginate, disc with vaguely impressed midline. Elytral interstriae very slightly convex, matt, with sparse, scattered micropunctation in microreticulate surface. Strial punctation fine, slightly crenulating interstriae. Leg colour light brown to yellow.

Smaller *O. moajat* individuals with a limited yellow-orange elytral pattern are superficially similar to the equally patterned *matanyo*; *moajat*, however, usually has a rather feebly sinuate, transverse ridge between the clypeogenal borders on either side, and is mostly larger, while *matanyo* never has long paraocular projections, nor the concordantly high, steep anterior pronotal declivity. *O. batui* is different by the numerous, small, scattered yellow-orange markings on its elytra. *O. sanggona* has uniformly black or brown elytra, and a fine, evenly arcuate clypeofrontal ridge.

Description (holotype, male)

Body length ca 7 mm. Colour generally black-brown; elytra distinctly patterned with orange-yellow, abdominal sternites, pygidium, legs, partly light brown to yellow; generally moderately shining. Pilosity pale-yellow, dorsal side virtually glabrous. Clypeus rounded, margin slightly, narrowly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge very slightly arcuate, medially more prominent; ridge on either side almost sinuate with clypeogenal ridge, distinctly reaching lateral border;

clypeal surface densely, finely, transversely rugulate; frons shining, very surficially, vaguely punctate, also with sparse micropunctuation bearing microstubbles. Genal surface with microreticulation, lateral tip widely rounded. Vertex with pair of upright, forward-curved, tapering horns; these are roundish on cross-section. Eyes with ca 9 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 8.1.

Pronotum moderately convex, anterior declivity deplanate behind horns, ridge topping anterior declivity feebly sinuate; discal midline shallowly impressed; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, shortly rounded, anterior section of lateral border virtually straight; posterior section scarcely sinuate, posterolateral angle rounded off; apical border marginate, medially sinuate; base medially very indistinctly marginate, vaguely angular. Anterior declivity of pronotum sparsely micropunctate, shining; pronotal disc rather abundantly, finely, simply punctate, punctural diameters (and hence density) increasing laterad, many punctures with microstubble; disc with microreticulation, fading out rostrad and laterad; punctural diameters 0.02–0.03 mm, away from basomedian midline separated by 3–5 diameters.

Elytra general black-brown with humeral and apical markings, with 8 distinct striae, stria 7 slightly sinuous, ending at umeral umbone. Striae discally well-defined, with fine punctures, mostly separated by 3–5 diameters, hardly crenulating interstriae; interstriae very slightly convex, sericeous, all with moderately abundant micropunctuation and microreticulation; large orange-yellow markings at base of interstriae 6–7, vague light spot at base of 4, large markings at apex of 2–4, small one at apex of 6; apical margin and adjacent epipleuron also light-coloured.

Antennal club pale-brown, scapus unmodified. Metasternum posteriorly with vague midline impression; disc glabrous, shining, with sparse micropunctuation, lateral wings with moderately abundant, seta-bearing annulate punctures and with microreticulation. Abdominal sternites shining, vaguely microreticulate, laterally each with transverse row of seta-bearing annulate punctures, their sides yellow. Pygidium yellow, matt, with abundant, shallow, fine punctuation and microreticulation; base marginate, apex broadly marginate.

Protibia with 3+1 larger external denticles, small intervening teeth, and proximal serration (ca 4 small teeth); terminal spur long, subparallel, apex acuminate. Profemur robust, underside shining, with numerous, strong seta-bearing punctures, and with sparse micropunctuation; meso- and metafemora

complanate, yellow-brown, underside largely glabrous, with sparse micropunctuation. Meso- and metatibiae strongly dilated distad (elongate-subtriangular), with ca 5 slight, spine-bearing fossorial elevations; apex elongate-subelliptic, its crest fringed with fossorial spines; terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus almost as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 35//34/17/11/8/14.

Parameres, fig. 89.

Measurements in mm. Maximum width of head 2.4. Median length of pronotum 2.5, maximum width 4.1. Sutural length of elytra 3.4, maximum width combined 4.5.

Variation and sexual dimorphism

Length usually 6–8 mm, some immature (brown) specimens 5.5 mm. Pygidium may vary from yellow to largely black. Orange-yellow markings on elytra may be much more extended than described for holotype (see pictures); very occasionally the dorsal side is entirely black. Females usually have shorter paraocular horns than males.

There is a single, slender-horned female from upland C Sulawesi, lacking the distinctive elytral markings and with the clypeofrontal ridge widely evenly rounded; its pygidium is yellow. This female may represent a different species, close to *moajat*, but, in the absence of males, we defer drawing conclusions. It is excluded from the type series.

Range and ecology

Apparently an altitudinally ubiquitous species from N Sulawesi, usually in forests, attracted to dung. Also collected several times in flight interception traps, indicating it being an active flyer. Possibly also in C Sulawesi.

Etymology

Named after the type locality, to be treated as noun.

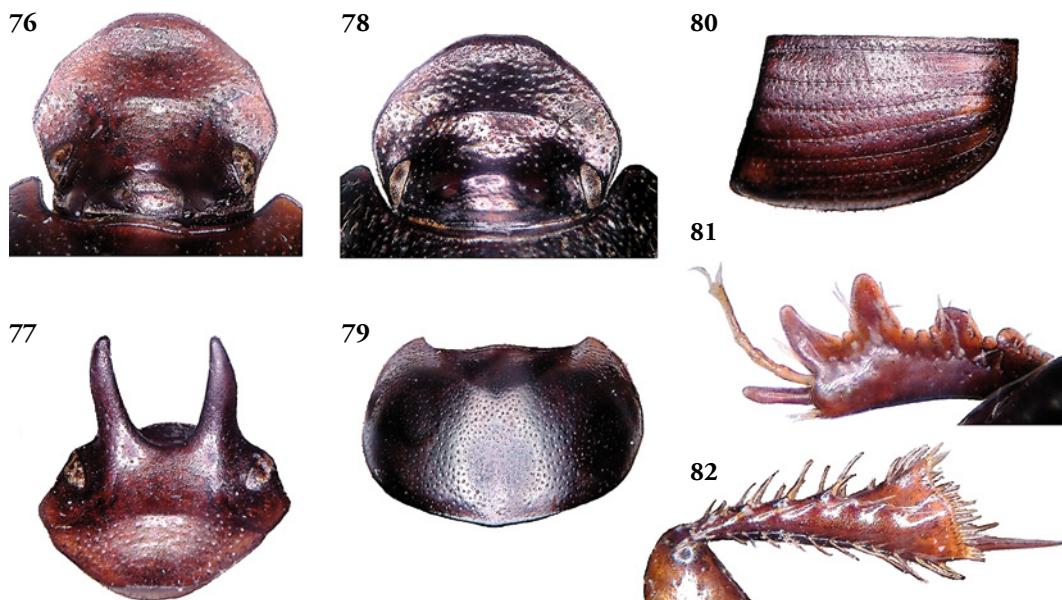
Onthophagus batui sp. n.

Figs 9, 50–56, 90

Type material. Holotype male Sulawesi: Banggai Distr: Batui: Seseba Estate, 6–9.xi.1989, Krikken & van der Blom #sw30a, 80 m, multistr evergr forest, human excrement trap (RMNH). **Paratype.** Female, same data as holotype (RMNH).

Diagnosis

O. batui is, with *moajat*, the largest among the patterned species (length up to ca 9 mm). The colour of



Figs 76-82. Contours of parts of *Onthophagus limbatus*, male N Sulawesi (76-77, 79-82), female N Sulawesi (78). – Head full-face (76, 78), axial (77); pronotum, dorsal (79); left elytron, dorsal (80); protibia, upper side (81); metatibia, underside (82).

batui is generally blackish, with the elytra matt; legs brown; elytra characteristically scattered with numerous small yellow-orange markings, pattern presumably quite variable. Pronotum with fine, abundant to dense punctation, effaced on anterior declivity (which is more shining than rest of pronotum); disc with vague, less punctate midline impression. Pygidium yellow, with black markings, very matt, surface sparsely micropunctate, glabrous.

Clypeal apex virtually rounded. Clypeofrontal ridge transverse, straight, medially slightly pointed, angularly connected to low clypeogenal ridge. Paraocular protrusions long, elongate-semiconical in male, very long, robust, evenly curved, tapering in female. Height of anterior pronotal declivity apparently varying with development of paraocular protrusions, with higher declivity of female deplanate on either side of very slightly elevated midline. Pronotal base only medially very finely marginate. Elytral interstriae very slightly convex, with sparse, scattered micropunctation on microreticulate surface. Striae shining, punctation fine, slightly crenulating interstriae. Femora yellow-orange.

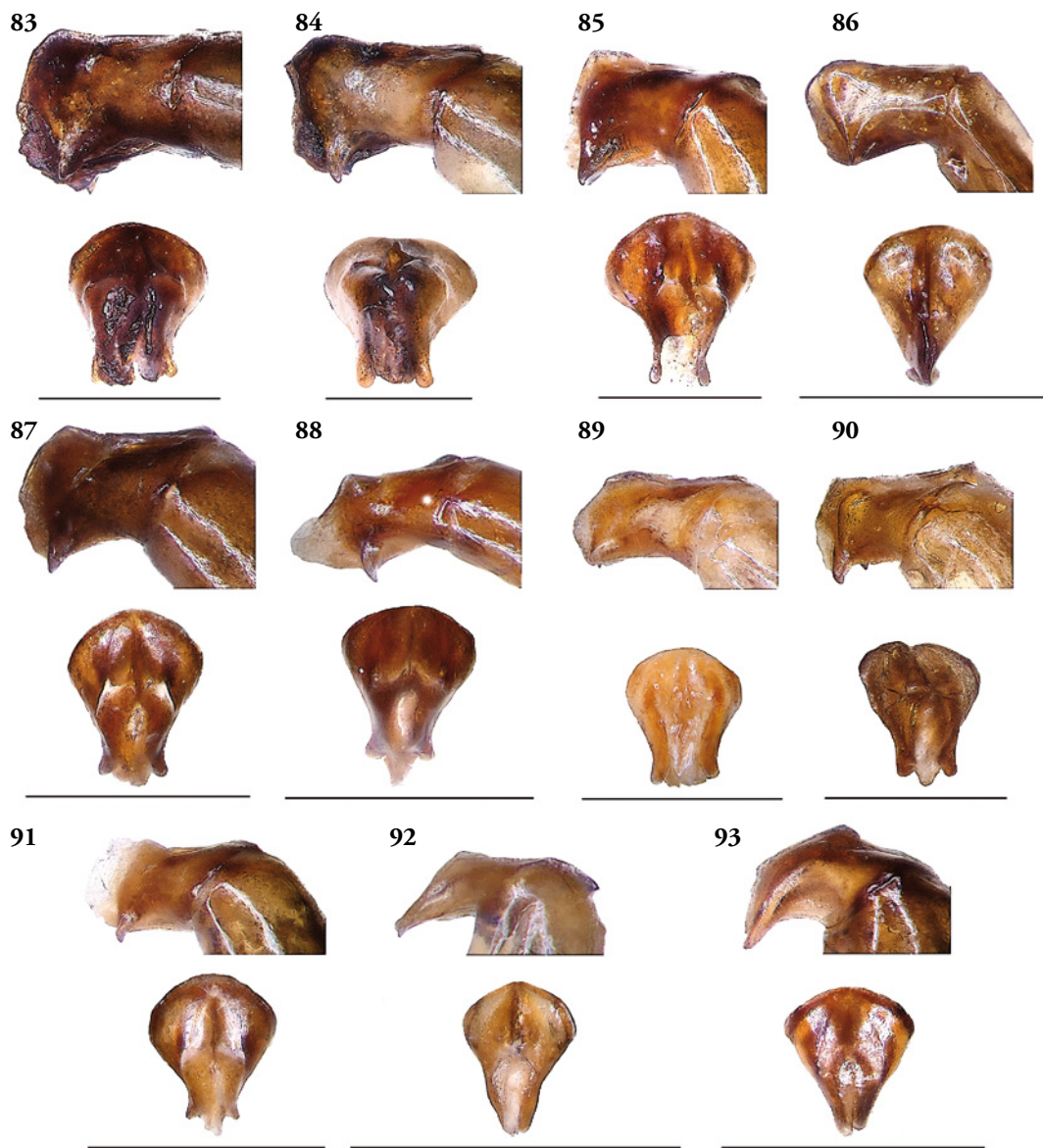
The patterned relatives of *O. batui* have a more symmetric pattern of larger lighter markings. No other patterned *lindu* group species has such broad, robust, evenly curved paraocular horns as the single available *batui* female.

Description (holotype, male)

Body length ca 8 mm. Colour generally brown-black, dorsally sericeous, largely matt; elytra with small yellow markings; abdomen and legs brown, with yellow (femora largely yellow). Pilosity brownish, dorsal side virtually glabrous.

Clypeus anteromedially virtually evenly rounded, margin slightly reflexed; clypeogenal transition at border virtually continuous; clypeofrontal ridge almost rectilinear, medially protuberant, angularly connected (almost straight) to low, but distinct clypeogenal ridge, which reaches lateral border; clypeal surface densely, transversely rugulate. Genal surface matt, microreticulate and vaguely, sparsely micropunctate (locally microstriolate); lateral tip short, widely, evenly rounded. Frons vaguely rugulate, with numerous indistinct, fine transverse striolate (nearly rugulate). Vertex between posterior part of eyes with pair of short, upright, pointed tubercles, their anterior side convex, posterior side flat; their base in front broadly sloping down along eyes. Eyes with ca 10 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 8.6.

Pronotum generally strongly, evenly convex, with steep anterior declivity (behind horns slightly impressed, sparsely punctate, somewhat shiny), midline shallowly impressed on basal half; lateral



Figs 83-93. Parameral contours, lateral, of *Onthophagus*, holotypes, except 93. 83, *O. lindu*; 84, *O. lore*; 85, *O. kolaka*; 86, *O. transvestitus*; 87, *O. sibkahono*; 88, *O. sanggona*; 89, *O. moajat*; 90, *O. batui*; 91, *O. matanyo*; 92, *O. mekara*; 93, *O. limbatus*, N Sulawesi. – Scale line equal 1 mm.

border finely marginate, anterolateral angle (full-face view) slightly obtuse (ca 100°), very shortly rounded, anterior section nearly straight; posterior section very slightly sinuate, posterolateral angle rounded off; apical border finely marginate, medially slightly sinuate; basal border widely rounded, marginate along medially very vaguely angle. Pronotal disc abundantly, simply punctate, punctures

ill-defined, shallow, their densities increasing laterad, to crowded, well-defined punctation (for instance in anterolateral corners), which have microscales; discal surface sericeous, due to microreticulation; punctural diameters ca 0.02–0.03 mm, away from discal midline mostly separated by 1–3 diameters.

Elytra generally matt compared to pronotum, with 8 distinct, fine striae, stria 7 slightly sinuate, ending at

humeral umbone. Striae shallow, shining, rather ill defined, with shallow punctures, mostly separated by 3–6 diameters, slightly crenulating interstriae; interstriae very slightly convex; all with vague, sparse, distally abundant and more distinct, scattered micropunctation; humerus (base of interstriae 6 & 7) with yellowish patch; apex of several interstriae also yellowish, and ca 7 additional small, round yellowish spots scattered on disc of either elytron.

Antennal club light-brown, scapus unmodified. Metasternum posteriorly with vague midline impression; metasternal disc with abundant micropunctation, lateral wings with moderately abundant, distinct, seta-bearing punctures and additional microreticulation. Abdominal sternites laterally each with transverse row of distinct, seta-bearing punctures, and additional microreticulation, medially shiny; abdominal sides yellowish. Pygidium virtually impunctate, glabrous, matt due to strong microreticulation; base marginate, apex with thickened margin; pygidial colour yellow, with pair of large brown patches.

Protibia with 3+1 larger external denticles, with some intervening small teeth, and proximal serration (ca 7 small teeth); terminal spur long, subparallel, apex acuminate; protarsus slender, unmodified. Profemur robust, underside shining, with numerous large seta-bearing punctures over middle from base to apex, these separated by 1–3 diameters, setae long. Meso- and metafemora complanate, their underside shining, with several seta-bearing punctures in front and near apex. Meso- and metatibiae robust, strongly dilated distad (outline elongate-triangular), externally with ca 5 slight, spine-bearing fossorial elevations; apex with elongate-subelliptic crest, fringed with fossorial spines. Meso- and metatibial terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus almost as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 50//48/25/15/11/17.

Parameres, fig. 90.

Measurements in mm. Maximum width of head 2.5. Median length of pronotum 2.5, maximum width 4.2. Sutural length of elytra 3.4, maximum width combined 4.5.

Variation and sexual dimorphism

Only a single pair of this species available, female slightly over 8.5 mm. Female with elytral yellow-orange markings much more numerous than in male (up to ca 50 on each elytron), and with strongly developed, curved, tapering paraocular horns, as in fig. 53 (maximum width of head of this female ca 2.9 mm). Given these differences, the actual variation may be considerable.

Range and ecology

The two specimens are from lowland forest in E Sulawesi, attracted to dung.

Etymology

Named after the type locality, to be treated as noun.

Onthophagus matanyo sp. n.

Figs 10, 64–69, 91

Type material. Holotype male **Sulawesi:** Banggai Distr: Matanyo Forest, N of Kayutanyo, 30–4.xi.1989, Krikken & van der Blom #sw18a, 170 m, multistr evergr forest, human excr trap (RMNH).

Paratypes. **Sulawesi:** Banggai Distr: Batui: Seseba Estate, 6–9.xi.1989, Krikken & van der Blom #sw30a, 80 m, multistr evergr forest, human excr trap, 7 exx.; Banggai Distr: Matanyo Forest, N of Kayutanyo, 2–4.xi.1989, Krikken & van der Blom #sw19a, 110 m, multistr evergr forest, river beach, human excr trap, 1 ex.; Banggai Distr: Matanyo Forest, N of Kayutanyo, 30–4.xi.1989, Krikken & van der Blom #sw16a, 120 m, multistr evergr forest, human excr trap, 4 exx.; Banggai Distr: Matanyo Forest, N of Kayutanyo, 30–4.xi.1989, Krikken & van der Blom #sw18a, 170 m, multistr evergr forest, human excr trap, 1 ex. (RMNH).

Excluded from type series. **Sulawesi:** Dumoga Bone NP: Edwards Subcamp, 2–5.vi.1985, Huijbregts #hh350, 664 m, multistr evergr forest, flight interception trap, 1 ex. (RMNH).

Diagnosis

O. matanyo is a small patterned species (length usually 5–6 mm). Dorsum generally black, sericeous, with brown underside and legs; elytra with yellow-orange markings on, at least, the base of interstriae 6–7 (humerus); other markings may be present on base of interstriae 2 and 4 and on apex of interstriae 2–7. Pronotum largely shining black, not metallic, with generally fine, abundant punctation. Pygidium yellow to nearly entirely black-brown, matt, with fine, abundant punctation, glabrous.

Clypeal apex very shallowly bisinuate. Clypeofrontal ridge feebly arcuate, not, or very vaguely, pointed medially; clypeogenal suture hardly distinct, not ridged. Paraocular protrusions plump, short, semi-conical. Anterior pronotal declivity very low, very slightly deplanate. Pronotal base only medially very finely marginate. Pronotal punctation abundant, evenly distributed, distinct, finer on deplanate basomedian surface, which lacks midline impression. Basal border of elytra (in dorsal view) strongly curved. Elytral interstriae very slightly convex, matt,

with sparse, scattered micropunctuation in superficially microreticulate surface. Strial punctuation fine, distinctly crenulating interstriae.

Superficially similar to the generally smaller *O. mekara*, but lacking margination of pronotal base and metallic lustre of the pronotal surface; *moajat* is usually larger, and has a different cephalic ornamentation, like an almost rectilinear clypeofrontal-clypeogenital ridge. The single male of *matanyo* from N Sulawesi, indeed considered conspecific, was initially thought to be a small *moajat*; so, beware of any mixed series.

Description (holotype, male)

Body length ca 5.5 mm. Colour largely black-brown, generally moderately shining; pronotum blackish, elytra dark brown, with symmetrically placed yellowish markings; underside and legs brown. Pilosity yellow-brown, dorsal side virtually glabrous.

Clypeal apex shallowly bisinuate, margin slightly reflexed; clypeogenital transition at border virtually continuous; transverse clypeofrontal ridge very widely curved, low, slightly pointed medially; clypeal surface densely, transversely rugulate; clypeogenital sutures vague, not raised. Genal lateral tip short, widely rounded, genal surface abundantly micropunctate. Frontal surface vague, sparsely rugulate-punctate. Vertex between posterior part of eyes with pair of short, robust, semiconical, in axial view subtriangular protrusions. Eyes with ca 9 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 7.3.

Pronotum moderately, evenly convex, anterior declivity steep, very slightly depressed behind paraocular protrusions, discal surface slightly deplanate, midline scarcely impressed; lateral border finely marginate, anterolateral angle (full-face view) subrectangular, very shortly rounded; lateral border finely marginate, anterior section nearly straight; posterior section very slightly, posterolateral angle rounded off; apical border hardly sinuate, finely marginate; basal border strongly rounded, medially vaguely angular, quasi-marginate due to crenulating fine punctures. Pronotal disc and sides abundantly, distinctly, simply punctate, punctures well-defined, interspersed with some micropunctures; punctuation more or less effaced on anterolateral and basomedian surface; background microreticulation weak, more distinct on basal surface (which is matt); punctural diameters ca 0.02 mm, punctures mostly separated by 2–4 diameters.

Elytra moderately shining brown, sericeous due to slight microreticulation; yellowish markings as follows: near base of interstria 4, at base of 6

& 7 (humerus), at apex of 3 & 4 and 6 & 7; as usual, 8 striae present, narrow but distinct, stria 7 very slightly sinuate near humeral umbone; elytral base strongly curved. Striae well defined, with fine punctures, mostly separated by 5–10 diameters, crenulating interstriae; interstriae scarcely convex, with sparse to abundant, scattered micropunctuation.

Antennal club brown, scapus unmodified. Metasternum posteriorly with vague midline impression; metasternal disc with sparse, scattered, fine punctuation, lateral wings microreticulate, with numerous seta-bearing, subannulate punctures. Abdominal sternites laterally each with transverse row of seta-bearing, subannulate punctures; sides and anal sternite yellowish. Pygidium yellowish with pair of large brown markings, glabrous, matt due to distinct microreticulation, with abundant, distinct, but shallow punctures; pygidial base marginate, apex with shining, thickened margin.

Protibia with 3+1 acuminate external denticles, with some intervening small teeth, and proximal serration (4 small teeth); terminal spur long, subparallel, apex acuminate; protarsus slender, unmodified. Profemur robust, underside shining, with numerous seta-bearing punctures over middle from base to apex, separated by several diameters, setae long, micropunctuation sparse. Meso- and metafemora complanate, their underside shining, with few seta-bearing punctures, sparsely micropunctate. Meso- and metatibiae robust, strongly dilated distad (elongate-triangular), externally with ca 4 slight fossorial, spine-bearing elevations; apex with elongate-subelliptic crest, fringed with long fossorial spines. Meso- and metatibial terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 30//29/13/9/6/10.

Parameres, fig. 91.

Measurements in mm. Maximum width of head 1.8. Median length of pronotum 1.9, maximum width 3.0. Sutural length of elytra 2.5, maximum width combined 3.2.

Variation and sexual dimorphism

Length usually 5–6 mm. Paraocular tubercles variable, tips may be slightly inclined to midline (distinct in axial view); curve of clypeofrontal ridge and median point also variable. Elytral yellow-orange pattern of holotype seems quite complete, other specimens, however, with limited and/or vaguer pattern. Sexual dimorphism apparently slight. One individual is very small: 4.5 mm.

Comment

Male from N Sulawesi excluded from type series; more material is needed to confirm conspecificity.

Range and ecology

Only known from SE and possibly N Sulawesi; from dung traps in lowland forest.

Etymology

Named after the type locality, to be treated as noun.

***Onthophagus mekara* sp. n.**

Figs 11, 70–75, 92

Type material. Holotype male **Sulawesi:** Kendari Distr: Mekara, 7km S of Lambuya, 15–18.xi.1989, Krikken & van der Blom #sw34a, 70 m, Pinus-Acacia forest plantation, human excr trap (RMNH). **Paratypes. Sulawesi:** Kabaena Island: Mt Sawom-polulu, 1–4.xi.1989, Kahono, 1075 m, grass open area near forest, human excr trap, 34 exx.; Kendari Distr: Mekara, 7km S of Lambuya, 15–18.xi.1989, Krikken & van der Blom #sw34a, 70 m, Pinus-Acacia forest plantation, human excr trap, 12 exx.; Kolaka Distr: Sanggona Base Camp, 9–12.x.1989, Krikken & van der Blom #sw01a, 200 m, second-growth forest, human excr trap, 1 ex. (RMNH).

Diagnosis

O. mekara is the smallest species in the *lindu* group (length 4–5 mm). It is usually patterned, generally brownish, with yellow-orange elytral markings on, at least, the base of interstriae 6–7 (humerus), and usually also the apex of interstriae 3–6, and in between. Remarkable are the shining metallic brownish or greenish lustre of the pronotum and its completely marginate basal border – both features are absent in other group members. Pygidium brown, fully matt, remarkably strongly microreticulate, with numerous minute, bristle-bearing punctures.

Clypeal apex shallowly bisinuate. Clypeofrontal ridge arcuate (hardly pointed medially, if at all); ridge frequently reduced, or even completely lost in rugulation; clypeogenal suture distinct, continuing along frons. Paraoctular protrusions short, semiconical, with variably extended, tapering tip. Anterior pronotal declivity low, more or less deplanate behind paraocular protrusions. Pronotal punctation rather dense, evenly distributed, very distinct; basomedian surface deplanate, lacking midline impression. Elytral interstriae slightly but distinctly convex, punctation vague, discally almost effaced in shining, superficially microreticulate integument. Strial punctation fine, distinctly crenulating interstriae. Legs brown.

Similar to *O. mekara* is the equally small, patterned *matanyo*, but characters like the marginate pronotal base and the heavy pygidial microreticulation sets *mekara* immediately apart, not only from *matanyo*, but from all other *lindu* group species.

Description (holotype, male)

Body length ca 4.5 mm. Colour largely dark brownish, generally shining; pronotum bronzy, elytra with symmetrically placed yellowish markings; legs brown. Pilosity yellow-brown, dorsal side virtually glabrous.

Clypeal apex shallowly bisinuate, margin slightly reflexed; clypeogenal transition at border virtually continuous; transverse clypeofrontal ridge only slightly indicated medially, somewhat pointed, laterally fully effaced, lost in densely, transversely rugulate-punctate surface, which extends caudad (though less dense) over most of head surface to base of paraocular horns; clypeogenal suture fine, extending caudad, along gena. Genal lateral tip short, subangular, shortly rounded. Vertex between posterior part of eyes with pair of long, tapering, upright, more or less isodiametric horns (issuing from semiconical base, at short distance from eye border); surface between horns shining, with some fine punctures. Eyes with ca 7 facet rows across widest point. Ratio maximum (single, transverse) width of eye foramen / distance between eyes ca 6.4.

Pronotum strongly convex, anterior declivity steep, slightly deplanate, topped by vague ridge; basomedian surface of disc slightly deplanate, midline not impressed; anterolateral angle (full-face view) subrectangular, very shortly rounded; lateral border finely marginate, anterior section nearly straight; posterior section very slightly sinuate, posterolateral angle very obtuse, virtually rounded; apical border finely marginate, medially sinuate; basal border widely rounded, distinctly marginate, lined with row of closely set punctures. Pronotal entirely, densely, evenly, distinctly, simply punctate (less dense on anterior declivity and over discal midline), punctures well-defined; punctural diameters ca 0.03 mm, punctures away from midline mostly separated by 1–2, along midline 2–4 diameters.

Elytra generally shining brown, sericeous due to microreticulation; yellowish markings as follows: near base of interstria 5, at base of 6 & 7 (humerus), halfway 7, at apex of 3–7; eight narrow but distinct striae present, stria 7 very slightly sinuate, ending at humeral umbone. Striae discally well defined, with fine punctures, mostly separated by 3–6 diameters, distinctly crenulating interstriae; interstriae shining (microreticulation most superficial), slightly convex,

vaguely wrinkled, due to very superficial, uneven, scattered micropunctuation.

Antennal club yellow-brown, scapus unmodified. Metasternum posteriorly with vague midline impression; metasternal disc with sparse, scattered, fine punctuation, lateral wings shining, with numerous fine, seta-bearing, subannulate punctures on superficially microreticulate surface. Abdominal sternites laterally each with transverse row of seta-bearing, subannulate punctures; sides yellowish. Pygidium brown, conspicuously matt due to heavy microreticulation; surface also with abundant, fine punctuation, many punctures with short yellowish seta; pygidial base marginate, apex with shining, thickened margin.

Protibia with 3+1 acuminate external denticles, with some intervening small teeth, and proximal serration (5–6 small teeth); terminal spur long, subparallel, apex acuminate; protarsus slender, unmodified. Profemur robust, underside shining, with numerous seta-bearing punctures over middle from base to apex, separated by several diameters, setae long. Meso- and metafemora complanate, their underside shining, generally sparsely punctate. Meso- and metatibiae robust, strongly dilated distad (elongate-triangular), externally with ca 4 slight fossorial, spine-bearing elevations; apex with elongate-subelliptic crest, fringed with fossorial spines. Meso- and metatibial terminal spurs elongate-acuminate, unmodified. Segment 1 of metatarsus about as long as segments 2–4 combined; approximate length proportions of metatibial spur // tarsal segments 1–5: 26//25/11/8/6/10.

Parameres, fig. 92.

Measurements in mm. Maximum width of head 1.5. Median length of pronotum 1.4, maximum width 2.3. Sutural length of elytra 2.0, maximum width combined 2.6.

Variation and sexual dimorphism

Length 4–5 mm. Paraocular tubercles variable, from short, simply semiconical to long, tapering (as in the holotype). Development of clypeofrontal ridge variable, median protrusion usually not noticeable, ridge may be virtually obsolete in transverse rugulation. Metallic luster of pronotum varying from bronze to green. Elytral yellow-orange pattern of holotype seems quite complete, other specimens (including immatures) have more limited and/or vaguer pattern.

Sexual dimorphism slight. Some very small (4 mm long), lighter brown individuals with obsolescent paraocular protrusions may be poorly developed.

There seem to be slight differences between the series from Kabaena Island and mainland SE Sulawesi (for

instance in elytral microsculpture), but with the material at hand we refrain from further taxonomic action.

Range and ecology

An apparently altitudinally ubiquitous species from various types of forest in SE Sulawesi, including Kabaena Island, attracted to dung.

Etymology

Named after the type locality, to be treated as noun.

The *Onthophagus limbatus* group

Onthophagus limbatus Herbst, 1789

Figs 12, 76–82, 93

Diagnosis

Unlike the *Onthophagus lindu* group members, *O. limbatus* has numerous fine, distinct, recurved setae on both pronotum and elytra. The paraocular horns of the males are upright, slightly tapering, unmodified, but connected by a slight, simply transverse ridge; longer horns are jointly U-shaped in axial view; female paraocular protrusions short, also with connecting ridge. Males have a slight, transverse clypeofrontal ridge, which may be obsolete, ridge of female stronger. Clypeal tip of male with short, abruptly reflexed lobe. Anterior pronotal declivity of males steep, more or less deplanate, topped by widely rounded, (in dorsal view) more or less sinuate ridge. Colour of pronotum largely dark brown, usually with metallic lustre; elytra lighter brown, with pattern of basal and apical yellow-orange markings, which are usually ill defined.

Measurements of male figured (N Sulawesi) in mm. Body length ca 7.5. Maximum width of head 2.2. Median length of pronotum 2.4, maximum width 3.8. Sutural length of elytra 2.9, maximum width combined 4.0. Maximum width of head of female figured (N Sulawesi) 2.8.

Range and ecology

Sulawesi, Sundaland, the Lesser Sundas, and possibly throughout the Oriental Region, in open, usually man-made habitats, frequently in cattle and horse dung. We have seen ca 70 *limbatus*-like specimens in ca 10 records from Sulawesi, plus material from other Southeast Asian locations, up to Vietnam.

Comments

O. limbatus is here formally recorded from Sulawesi for the first time. The attention given here to this species is due to the fact that its males may be confused with members of the *O. lindu* group. The diagnosis above summarizes the primary characters of *O. limbatus* in the Sulawesi context. The species seems widespread in the Oriental Region and adjacent areas, but is not recorded from the islands East of Sulawesi. Our material from Sulawesi agrees with that from other regions in Southeast Asia, as well as with current descriptions of *O. limbatus* (including Balthasar 1963b), and is tentatively considered to belong to *limbatus*. Kabakov (1998) placed *O. limbatus* in the subgenus *Gibbonthophagus* (see Introduction). As indicated in the Introduction the records of *O. limbatus* from Sulawesi likely concern relatively recent invaders from the West and their conspecificity with the original *limbatus* of Herbst (1789) is not absolutely certain.

Onthophagus gestroi Harold, 1877, as well as related, possibly conspecific forms endemic to Sulawesi, belong in the same group of species as *limbatus*, differing in the more distinctly connected paraocular horns of the males and other characters from both *limbatus* as here conceived, and from the *lindu* group species. We return to the taxonomy of the *limbatus* group later in this series of papers.

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References

- Balthasar, V., 1963a. Monographie der Scarabaeidae und Aphodiidae der palaearktischen und orientalischen Region (Coleoptera Lamellicornia). Vol. 1. – Tschechoslowakische Akademie der Wissenschaften, Prague, 391 pp.
- Balthasar, V., 1963b. Monographie der Scarabaeidae und Aphodiidae der palaearktischen und orientalischen Region (Coleoptera Lamellicornia). Vol. 2. – Tschechoslowakische Akademie der Wissenschaften, Prague, 627 pp.
- Boucomont, A., 1914. Les Coprophages de l'Archipel malais (Coléopt.). – Annales de la Société Entomologique de France 73: 238–350.
- Hall, R. & J.D. Holloway. 1998. Biogeography and geological evolution of SE Asia. – Backhuys Publishers, Leiden, ii + 417 pp.
- Herbst, J.F.W., 1789. Natursystem aller bekannten in- und ausländischen Insekten [etc.]. Der Käfer zweyter Theil. – Joachim Pauli, Berlin, lxiv + 330 pp [+ 6pp, pls 7–20].
- Kabakov, O.N., 1998. Studies on the coprophagous scarab beetles (Coleoptera, Scarabaeidae) from Vietnam in the collections of Zoological Institute St. Petersburg and of the Naturkundemuseum Erfurt. – Veröffentlichungen Naturkundemuseum Erfurt 1998: 39–58.
- Krikken, J. & Huijbregts, J., 2007. Taxonomic diversity of the genus *Ochicanthon* in Sundaland (Coleoptera: Scarabaeidae: Scarabaeinae). – Tijdschrift voor Entomologie 150: 421–479.
- Krikken, J. & Huijbregts, J., 2008. Sulawesi large-eyed *Onthophagus* and their relatives: seven new species, with a key (Coleoptera: Scarabaeidae: Scarabaeinae). – Tijdschrift voor Entomologie 151: 155–171.
- Krikken, J. & Huijbregts, J., 2010. Sulawesi *Onthophagus* with an immarginate pygidial base: seven new species, with a key (Coleoptera: Scarabaeidae: Scarabaeinae). – Tijdschrift voor Entomologie, forthcoming.
- Ochi, T. & Kon, M., 2002. A new horned species of the genus *Onthophagus* (Coleoptera, Scarabaeidae) from Sabah, Borneo. – Special Bulletin of the Japanese Society of Coleopterology 5: 305–312.
- Scheuern, J., 1995. Taxonomie, Sexualdimorphismus und Neubeschreibungen orientalischer *Onthophagus*-Arten unter besonderer Berücksichtigung des Subgenus *Colobonthophagus* Balthasar 1935 (Coleoptera, Scarabaeidae). – Entomologica Basiliensia 18: 413–453.
- Whitten, A.J., Mustafa, M. & Henderson, G.S., 1987. The ecology of Sulawesi. – Gadjah Mada University Press, Yogyakarta, xxi + 778 pp [+ corrections].

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