Macrophelid mites (Acari: Mesostigmata) associated with dung beetles in Mount Gede-Pangrango National Park, West Java, Indonesia

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INTRODUCTION

Mount Gede-Pangrango National Park is located in West Java, Indonesia and is inhabited by endangered animal species that are now threatened with extinction. These endangered species include the Javan gibbon (*Hylobates moloch*), Javan leaf monkey (*Presbytis comata comata*), chony leaf monkey (*Trachypithecus auratus auratus*), panther (*Panthera pardus*), leopard cat (*Prionailurus bengalensis javanensis*), barking deer (*Muntiacus muntjak muntjak*), lesser Malay mouse deer (*Tragulus javanicus*), Asian wild dog (*Cuon alpinus javanicus*), southeast Asian porcupine (*Hystrix brachyura brachyura*), stink badger (*Mydaus javanicus*), and yellow-throated marten (*Martes flavigula*) (PHPA team, 2003). The dung of large animals is often a food source or serves as habitat for other animals. These animals include Coleopterans such as scarabaeid beetles, Dipterans (flies), and macrochelid mites. Mites in the family Macrochelidae (Acari) are predators of eggs and larvae of some fly species (Blake, 1981; Halliday, 2000). Macrochelid mites are associated with scarabaeid dung beetles and flies, which serve as a means of dispersal from one dung substrate to another.

In Java, 43 species in four genera (*Holostaspella, Neopodocinum, Glypholasps* and *Macrocheles*) of macrochelid mites have been reported (Hartini and Takaku, 2003a; 2003b; 2012; Hartini et al., 2009; 2012; 2013; 2015; Hartini and Dwibadra, 2011). In the present study, one new species is described from Mount Gede-Pangrango.

MATERIALS AND METHODS

Mite specimens were collected from four locations in Mount Gede-Pangrango National Park i.e: Cibodas, Selabintana, Situgunung and Gunung Putri at various times between 2004-2010. Mites associated with dung beetles were collected by pitfall traps baited with human dung. The dung beetles were captured in traps, and then fixed in 70% ethanol. Mite specimens were detached from the body of dung beetles and were mounted on prepared slides in PVA (Polyvinyl alcohol-lactic acid) medium, after being cleared in 60% lactic acid. All measurements are given
in micrometers (μm) and if more than two specimens were measured average and range are provided in parentheses. Dorsal chaetotaxy and other terminology follow Krantz (1967), Walter and Krantz (1986a; 1986b), Halliday (1987), Takaku (2001), Hartini and Takaku (2003a; 2003b; 2010) and Hartini et al. (2007; 2009). All specimens, including holotype and paratypes of the new species, were deposited in the collection of the Museum Zoologicum Bogoriense, Cibinong, Bogor, Indonesia (MZB).

**Systematic Account**

Family Macrochelidae Vitzthum, 1930

Macrocheles gedeensis sp. nov. (Figs. 1-6)

**Type series**: Holotype: female (MZB. Acar.7091.2) 1130 m above sea level (a.s.l.), Selabintana, Mount Gede-Pangrango, Sukabumi, West Java, S 06°52′14″ E 106°57′09″, 15 May 2010, Hartini and Dwibadra leg., ex *Synapsis ritsemae* (Coleoptera: Scarabaeidae). Paratype: 14 ♀♀, other data same as holotype.

**Female**: Length of dorsal shield 1021 (880-1110), width at level of coxae II 613 (500-690) (n = 15). Specimens reddish brown.

**Dorsum** (Fig. 1): Dorsal shield oval, attenuated posteriorly, surface ornamented with distinct reticulate pattern and punctuation; lateral margin smooth; shield with 28 pairs of dorsal setae and 22 pairs of pores; setae j1-4

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Figs. 1-6. *Macrocheles gedeensis* sp. nov., holotype female (MZB.Acar.7091.2). 1, dorsum; 2, venter; 3, ventral view of gnathosoma; 4, epistome; 5, chelicerae; 6, sacculus foemineus.
pilose distally; J5, J6, z1, z5, z6, and J2 simple, but in some cases z1 and z6 slightly pilose; J5 bipinate entirely; other dorsal setae pilose in distal half to distal 2/3.

**Venter** (Fig. 2): Length of sternal shield, length 192 (170-207.5), width at level of coxae II 167 (150-175) \((n = 15)\); shield ornamented with lines and punctations; linea angulata (l.ang.), linea media transversa (l.m.t.) present and with punctations; l.m.t. not straight; anterior l.arc. faint; linea oblique posteriore (l.o.p.) distinct, with punctation, bifurcated, and connect to l.m.t. Epigynial shield ornamented with arched lines and punctations; shield with a pair of pilose distally setae on posterior corner. Length of epigynial shield 180 (162.5-195), width 216 (185-237.5) \((n = 15)\).

Ventrianal shield pentagonal, shield ornamented with semiconcentric line punctations; length 329 (267.5-370), width 311 (247.5-365) \((n = 15)\); shield with 3 pairs of preanal simple setae, pair of paranal simple setae, and 1 postanal pilose seta. Cribrum located posterior to postanal seta. Ophisthogastric setae simple and pilose. A pair of metapodal shield oblong. Postcoxal pore free from podal shield. Anterior extremities of peritreme located at level of setae z1.

**Gnathosoma** (Fig. 3): Developed and sclerotized. Epistome (Fig. 4) and chelicera (Fig. 5) fixed digit with simple dorsal seta, robust median tooth, a distal tooth, pilus dentilis and terminal hook; movable digit with bidentate tooth, small distal tooth and terminal hook. Length of fixed digit 259 (225-272.5), and movable digit 105 (100-112.5) \((n = 15)\).

**Legs:** Most leg segments with simple, pilose, and plumose setae, except for coxa, trochanter, and tarsus I with simple setae; and coxa, genu IV with pilose setae. Leg length (except ambulacrum, \(n = 15\)); leg I, 763 (640-930); leg II, 720 (580-850); leg III, 738 (680-800); leg IV, 1159 (1040-1260).

**Sacculus foemineus:** (Fig. 6). Pair of sacculi fused; small cornu rounded distally and sclerotized; spermateca oval.

**Male and other stage:** Unknown.

**Etymology:** The species name is derived from type locality.

**Remarks:** This species is very similar to *Macrocheles persimilis* Hartini, Dwibadra and Takaku, 2007 from Sulawesi, Indonesia, in its dorsal setae and sternal ornamentation. However, *Macrocheles gedeensis* is distinguishable from *M. persimilis* by the following characters as shown in Figs. 7 and 8: (corresponding conditions of *M. persimilis* in parentheses): 1) epigynial setae pilose (simple); 2) linea oblique posterior (l.o.p.) bifurcated and connected to linea media transversa (l.m.t.) (not bifurcated and disjunct to l.m.t.; 3) length of dorsal shield more than 1000 \(\mu\)m (less than 1000 \(\mu\)m).

The species also resembles *Macrocheles monticola* Takaku and Hartini, 2001, recorded from Bali, Indonesia in the sternal ornamentation but it differs from the latter in the following characteristics of the female (corresponding conditions of *M. monticola* in parentheses), 1) epigynial setae pilose (simple), as are shown in Fig. 7; 2) most of dorsal setae pilose (simple), as are shown in Fig. 9.

**Macrocheles dispar** (Berlese, 1910)

*Macrocheles dispar* has been recorded from Viet Nam, the Philippines, China (Szechuan Province), Taiwan and Indonesia (Java, Sumatra, Kalimantan, Sulawesi, Lombok, and Papua).


*Macrocheles dispar* has been collected from scarabaeid beetle *Catharsius molossus*, *Copris sinicus*, *Onthophagus cervicapra*, *O. hirustulus*, *O. luridipenis*, *O. rudis*, *O. schwaneri*, *O. semiaureus*, *O. tricornis*, *O. trituber,*...

Macrocheles entetiensis Hartini and Takaku, 2003

This species has been recorded only from Indonesia (Lesser Sunda and Java) (Hartini et al., 2005; Hartini and Dwibadra, 2011).

Material examined: 2♀♂, 1130 m a.s.l., Selabintana, Mount Gede-Pangrango National Park, West Java, S 06°52′14″ E 106°57′09″, 24-25 May 2006, Hartini, Rofik and Darmawan leg., ex O. (O.) malangensis.

Macrocheles entetiensis has been collected from scarabaeid beetles C. molossus, O. limbatis, O. schwaneri, O. uedai, O. (O.) cribratus, O. (O.) javaecola, O. (O.) malangensis, O. (G.) fuscopunctatus, O. (S.) mulleri, P. s. javanus, S. thoracicus, and unidentified species of genera Aphodius, Catharsius, and Onthophagus (Scarabaeidae).

Macrocheles hallidayi Walter and Krantz, 1986

This species was described by Walter and Krantz (1986a), and has been recorded from Thailand, Cambodia, Malaysia (Sarawak), India and Indonesia (Java, Madura, Sumatra, Kalimantan, Sulawesi, Bali, Lombok, Sumbawa, Flores, Sumba and Papua).

Material examined: 1♀, Cibodas, Mount Gede-Pangrango National Park, S 06°44′30″ E 107°00′19″, 20 May 2010, Hartini and Dwibadra leg., ex Onthophagus.
This species has been collected from the scarabaeid beetles C. molossus, C. saagax, Heliocoris bucephalus, Onthophagus cervicrapa, O. liliputanus, O. limbatis, O. obscurior, O. schweneri, O. (O.) javensis, O. (O.) orientalis, Microcopris hidakai, Paragynooleurus maurus, and nest of Apis dorsata dorsata (Hymenoptera) and unidentified species of genera Aphodius, Catharsius, Copris, Heliocoris, Microcopris, Oniticellus, Onitis, Onthophagus, Paragynooleurus (Scarabaeidae) and trogid beetles.

Macrocheles jabarensis Hartini and Takaku, 2003

This species was described from Indonesia (Hartini and Takaku, 2003a) and has been recorded from Java, Sumatra, Kalimantan, Sulawesi, Lombok, and Sumba-
wa.


Macrocheles kraepelini (Berlese, 1905)

This species was described by Berlese (1905). Krantz and Filipponi (1964) redescribed and illustrated this species. The male and immature stages were described by Halliday (1986) and Walter and Krantz (1986a). Macrocheles kraepelini distributed widely in Pakistan, India, Thailand, Viet Nam, Malaya, Singapore, the Philippines, Samoa, Fiji, Caroline Island, Australia and Indonesia (Java, Sumatra, Kalimantan, Madura, Flores and Kupang).


Macrocheles kraepelini has been collected from the scarabaeid beetles C. dayacus, C. molossus, Copris incertus, C. punctipennis, Coptodactyla ducalis, Onitis fulcatus, Onthophagus dux, O. laevis, O. lamiatus, O. schweneri, O. (O.) cribratus, O. (O.) javaeola, O. (O.) javensis, O. (O.) malangensis, O. (O.) orientalis, O. (P.) accedens, O. (S.) mulleri, Paragynooleurus maurus, Pachylister chinensis (Histeridae), and unidentified species of genera Catharsius, Copris, Onitis, Onthophagus, Paragynooleurus (Scarabaeidae), compost, and decaying forest litter.

Macrocheles pumilus Hartini, Dwibadra and Takaku, 2009

Macrocheles pumilus distributed only in Indonesia (West and Central Java) (Hartini et al., 2009).

Material examined: 7♀♂, Selabintana, Mount Gede-Pangrango National Park, S 06°52′14″ E 106°57′09″, 15 May 2010, Hartini and Dwibadra leg.; Situgunung, S 06°49′58″ E 106°55′18″, 18-19 April 2004, Kahono, Lilik and Agus leg., ex Onthophagus sp.

This species has been collected from scarabaeid dung beetles O. (O.) javensis and unidentified species of the genus Onthophagus.

Macrocheles sukabumiensis Hartini and Takaku, 2003

This species has been recorded from Indonesia (Java and Kalimantan) (Hartini and Takaku, 2003a).

Material examined: 3♀♂, 1130 m a.s.l., Selabintana, Mount Gede-Pangrango National Park, West Java, S 06°52′14″ E 106°57′09″, 24-25 May 2006, Hartini, Rofik and Darmawan leg.; Situgunung, S 06°49′58″ E 106°55′18″, 18-19 April 2004, Kahono, Lilik and Agus leg., ex O. (S.) blumei and unidentified species of the genus Onthophagus.

Macrocheles sukabumiensis has been collected from scarabaeid dung beetles O. accedens, O. hirsutulus, O. (O.) javensis and unidentified species of the genus Onthophagus.

Macrocheles sukaramiensis Takaku, 2001

This species was described by Takaku (2001) and has
been recorded from Indonesia (Java, Sumatra and Kalimantan) (Takaku, 2001; Hartini and Dwibadra, 2011).

**Material examined**: 2♀♂, Situgunung, Mount Gede-Pangrango National Park, S 06°49’58” E 106°55’18”, 18-19 April 2004, Kahono, Lilik and Agus leg., *ex Onthophagus* sp.

*Macrocheles sukaramiensis* has been collected from the scarabaeid beetle belonging to genera *Catharsius*, *Copris*, *Onthophagus*, and *Paragymnopleurus*.

*Macrocheles turgoensis* Hartini, Dwibadra and Takaku, 2009

*Macrocheles turgoensis* was described by Hartini *et al.*, 2009 and distributed only in Indonesia (West and Central Java).

**Material examined**: 3♀♀, Selabintana, Mount Gede-Pangrango National Park, S 06°52’14” E 106°57’09”, 15 May 2010, Hartini and Dwibadra leg., *ex Onthophagus* sp.

This species has been collected from scarabaeid dung beetles *C. molossus*, *O. (O.) javensis* and species belonging to Scarabaeidae.

**Holostaspella katakurai** Hartini and Takaku, 2003.

This species was described by Hartini and Takaku, 2003 and distributed only in Indonesia (Kalimantan, Sumatra and Java).

**Material examined**: 1♀♂, 1130 m a.s.l., Selabintana, Mount Gede-Pangrango National Park, West Java, S 06°52’14” E 106°57’09”, 24-25 May 2006, Hartini, Rofik and Darmawan leg., *ex O. (S.) blumei, Synapsis ritsemae* and species of the genus *Onthophagus*.

*Holostaspella katakurai* has been collected from scarabaeid dung beetles *C. molossus*, *O. (O.) blumei*, *P. maurus* and unidentified species of the genus *Onthophagus*.

**Holostaspella oblonga** Hartini and Takaku, 2010

*Holostaspella oblonga* was recorded from Indonesia (Java and Sulawesi) (Hartini and Takaku, 2010).

**Material examined**: 1♀, Selabintana, Mount Gede-Pangrango National Park, West Java, S 06°52’14” E 106°57’09”, 24-25 May 2006, Hartini, Rofik and Darmawan leg., *ex O. (O.) javensis*.

This species has been collected from *C. molossus*, *M. hidakai*, *O. (O.) javensis* and unidentified species of the genus *Copris*.

**Holostaspella villosa** Hartini and Takaku, 2010

*Holostaspella villosa* was described by Hartini and Takaku, 2010 and recorded from Indonesia (West Java).

**Material examined**: 1♀, Selabintana, Mount Gede-Pangrango National Park, West Java, S 06°52’14” E 106°57’09”, 24-25 May 2006, Hartini, Rofik and Darmawan leg., *ex O. (O.) malangensis*.

This species has been collected from scarabaeid dung beetles *O. (O.) malangensis* and *O. (M.) meneiri*.

**Neopodocinum halimunense** Hartini and Takaku, 2003

This species was described by Hartini and Takaku, 2003 and recorded in Indonesia (Java and Kalimantan).


*Neopodocinum halimunense* has been collected from *C. molossus* and unidentified species of the genus *Onthophagus*.

**Neopodocinum subjaspersi** Hartini and Takaku, 2003

*Neopodocinum subjaspersi* was described from Indonesia (Hartini and Takaku, 2003).


This species has been collected from scarabaeid dung beetles *C. molossus* and unidentified species of the genus *Onthophagus*.

**Neopodocinum sp.**

**Material examined**: 1♂, 1130 m a.s.l., Selabintana, Mount Gede-Pangrango National Park, West Java, Indonesia, S 06°52’14” E 106°57’09”, 24-25 May 2006, Hartini, Rofik and Darmawan leg., *ex Onthophagus* sp.

**Remarks**: The specimen of *Neopodocinum sp.* has a
unipartite epistome, which is a specific character of the genus *Neopodocinum*. The hypostomal setae (internal posterior hypostomal setae) are pilose and thick at base of its setae which clearly differentiates it from two other *Neopodocinum* species that were found in this project. Unfortunately, we could not identify this species because we only found a male specimen and most of the dorsal setae of the specimen were broken.

**Discussion**

In total, we collected 410 macrochelid mites belonging to three genera (*Macrocheles*, *Holostaspella* and *Neopodocinum*). The number of *Macrocheles dispers* specimens collected during this investigation was the largest (129 specimens) of any other species. *Macrocheles dispers* is a common species of macrochelid mite in Indonesia and is distributed widely on large islands of Indonesia (Hartini, 2005).

In this research, we found two genera of scarab beetles: *Onthophagus* and *Synapsis*. Five beetle species belonged to the genus *Onthophagus* (*Onthophagus* (Onthophagus) *cribatus*, *O. (O.) malangensis*, *O. (O.) semigranosus*, *O. (Suenga) blumei*, and *O. (O.) javensis*), whereas only one, *Synapsis ritsemae* Lansberge, 1874, was in the *Synapsis* genus. This species belongs to family Scarabaeidae, subfamily Scarabaeinae, tribe Coprini, which is distributed in the Greater Sunda Islands (i.e. Java, Sumatra and Borneo) (Zidek and Pokorny, 2010). This is the first report of an association between macrochelid mites and *Synapsis* in Indonesia. Two mite species, *Holostaspella katakurai* and *Macrocheles gedeensis*, were found on *Synapsis ritsemae*, while the other mite species were found on beetle species in the genus *Onthophagus*.

More than 90% of the beetles collected belonged to the genus *Onthophagus*, which suggests that phoretic macrochelid mites may prefer beetles that are abundant in terms of number of individuals in a dung community. This observation supports previous research by Niogret et al. (2006) which suggested thatoverflow populations of *Onthophagus* beetles in a habitat may explain why *Onthophagus* is an effective host for macrochelid mites.

*Holostaspella oblonga* Hartini and Takaku, 2010 and *H. villosa* Hartini and Takaku, 2010 were associated with only one species of dung beetle each, *O. (O.) javensis* and *O. (O.) malangensis*, respectively. However, we could not conclude that this association is a specific host type association, since these species were collected from other species of beetles as well. Hartini and Takaku (2010) collected *H. oblonga* from *Catharsius molorus*, *Microcopris hidakai* and *O. (O.) javensis*, while *H. villosa* was found on *O. (M.) meneiri* in Mount Ciremai National Park, West Java, Indonesia (Hartini, 2015).

A specific host type association may be exhibited by *Macrocheles gedeensis* sp. nov., which associated with one species of dung beetle, *Synapsis ritsemae*. The specialization of the mites is influenced by various factors such as environment determinants and the biology of the host (Hunter and Rosario, 1988, Schwarz et al., 1996). A previous study reported that there were some morphological differences between specialist and generalist mites when morphometric comparisons were taken into account. Specialist mites had a larger body size and longer legs than generalist species. *Macrocheles gedeensis* exhibited the morphological character of the specialist mite in having larger body length (1021 μm) compared to generalist species such as *Macrocheles jabarensis* (736 μm) and *M. dispers* (698 μm).

Information regarding the basic biology, including behavior, of *Synapsis ritsemae* is limited. Therefore, further research is needed in order to determine the exact nature of the relationship between *Macrocheles gedeensis* and its host.

**Key to macrochelid mites species associated with scarabaeid dung beetles in Mount Gede-Pangrango National Park (female only)**

1. Epistome unipartite ......................... 2
   – Epistome tripartite .......................... 3
   – Anal shield not expanded and surface of shield smooth .......... *Neopodocinum subjaspersi* Hartini and Takaku, 2003
3. Anterior dorsal setae inserted on anterior protuberance of shield, femur II with spur .................... 4
   – Not as above ..................................... 6
   – Ventrianal shield longer than wide, Jv2-Zv2 not as above ......................................... 5
5. Base of coxae IV with fringe, preanal, paranal and postanal setae simple ................................ *Holostaspella oblonga* Hartini and Takaku, 2010
   – Base of coxae IV without fringe; preanal and postanal setae pilose .................................. *Holostaspella villosa* Hartini and Takaku, 2010
6. Dorsal setae 29 pairs; most of dorsal setae plumose .......... *M. turgoensis* Hartini, Dwibadra and Takaku, 2009
   – Dorsal setae 28 pairs ................................ 7
7. Some dorsal setae entirely pilose or pectinate ........ 8
   – Dorsal setae simple or pilose distally except for J5, which is pilose over its entire length ............ 10
8. Dorsal setae pectinate; except z1 simple; surface of dorsal shield with areolate pattern  
   
   ........................... M. sukabumiensis Hartini and Takaku, 2003
   – Most of dorsal setae entirely pilose  

9. Genu IV with seven setae. Most of dorsal setae pilose, except for simple j5, j6, z1, z5, z6 and J2; z1 not reaching insertions of j2; sternal shield with two l.arc., bifurcate l.o.p., and distinct punctations  
   
   ........................... M. hallidayi Walter and Krantz, 1986
   – Genu IV with six setae. Most of dorsal setae pilose; j5 with pilosity in most case; j6, z1, z5, z6, and J2 simple; sternal shield with two l.arc., bifurcate l.o.p., and distinct punctations  
   
   ........................... M. kraepelini (Berlese, 1910)

10. Most of dorsal setae simple  

11. Dorsal setae j1, j4, Z5, and S5 pilose distally; J5 pilose entirely; other setae simple  
   
   ........................... M. jabarensis Hartini and Takaku, 2003
   – Dorsal setae j1, r2, r3, Z4, Z5, S4, S5 pilose in distal half & two third; and J5 entirely pilose; other setae simple  

   ........................... M. pumilus Hartini, Dwibadra and Takaku, 2009

12. Anterior half of sternal shield ornamented with symmetric weak reticulate pattern  
   
   ........................... M. sukaramiensis Takaku, 2001
   – Anterior half of sternal shield with one or two l.arc.  

13. Sternal shield with two l.arc.; epigynial setae pilose  
   
   ........................... M. gedeensis sp. nov.
   – Sternal shield with one l.arc.  

14. Dorsal setae Z1, Z3, S1, and S2 pilose distally  
   
   ........................... M. entetiensis Hartini and Takaku, 2005
   – Dorsal setae Z1, Z3, S1, and S2 simple  

   ........................... M. dispar (Berlese, 1910)

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