

A new species of *Lopaphus* Westwood, described from Borneo (Insecta: Phasmida: Heteronemiidae: Necrosiinae)

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Key words: *Lopaphus borneensis*; Borneo; Brunei; Kalimantan; Sabah.

The genus *Lopaphus* is recorded from Borneo for the first time. The species, *L. borneensis* spec. nov. is described from a series of seven males and five females which were collected in Kalimantan in 1925, two specimens from Sabah, a female collected in 1986 and a male in 1987, and a male which was collected by the author in Brunei in 1991. The female resembles *L. brachypterus* (de Haan) but is more slender and is readily distinguished by the shape of the mesonotum. The male, female and egg are all illustrated. A modification of Redtenbacher's key to the genus is provided.

Introduction

The genus *Lopaphus* Westwood has been recorded from the Malay peninsula, Vietnam, Mindanao (Philippines), Java, Sumatra, and New Guinea but has not previously been recorded from Borneo. A single male specimen was collected by the author in Brunei in 1991. Examination of collections in various European museums lead to the discovery of a series of specimens in the Nationaal Natuurhistorisch Museum at Leiden (RMNH) where they had been placed with *L. brachypterus* (de Haan). Although the general appearance is very similar to this species, the Bornean specimens were easily distinguished as they were all more slender. A further specimen was borrowed from the collection of Mr C.L. Chan of Kota Kinabalu, Sabah.

Lopaphus Westwood 1859

Lopaphus Westwood, 1859: 99; Stål, 1875: 43; Wood-Mason, 1877: 347; Kirby, 1904a: 433; Kirby, 1904b: 360; Karny, 1923: 242. [not *Lopaphus*, Redtenbacher, 1908: 491]. Type species *L. brachypterus* (de Haan) [*Phasma brachypterus* de Haan], by designation of Kirby (1904a: 433) [Although Kirby's designation was based on elimination by Wood-Mason, Kirby's selection is acceptable under Article 68a, iv of the International Code of Zoological Nomenclature].

Candaules, Redtenbacher, 1908: 538 [not Stål 1875].

Redtenbacher (1908: 538) combined *Lopaphus* Westwood and *Candaules* Stål under the name *Candaules*. He incorrectly used the name *Lopaphus* for a species of *Orxines* Stål (Redtenbacher, 1908: 491). This was rectified by Karny (1923: 242) in his paper dealing with many of the errors in Brunner von Wattenwyl (1907) and Redtenbacher's (1906, 1908) three part monograph.

The following keys to *Lopaphus* Westwood are modified from Redtenbacher's keys (1908: 538-539). The modifications, including the addition of *L. buegersi* Günther (1928: 697), have been made by reference to published descriptions only; specimens have not been examined and the keys should be used with caution.

Key to males of the genus *Lopaphus*

1. Wings not longer than the metanotum. Apices of the four hind femora very dark *L. muticus* (Redtenbacher, 1908)
- Wings longer than the second abdominal segment 2
2. Mesonotum covered with transverse scratches and large dark granules. Apices of femora very dark *L. caesius* (Redtenbacher, 1908)
- Mesonotum finely and evenly granulose, without transverse scratches. Apices of femora only slightly darkened 3
3. Mid and hind femora unarmed except for a small rounded lobe on the underside near the apices. Apices of femora not darkened. Cerci straight *L. borneensis* spec. nov.
- Underside of mid and hind femora armed with a small tooth near the apices. Apices of femora slightly darkened. Cerci inward curving *L. transiens* (Redtenbacher, 1908)

Key to females of the genus *Lopaphus*

1. Wings not longer than the metanotum 2
- Wings at least as long as the median segment 3
2. Underside of middle and hind femora armed with a pair of spines *L. transiens* (Redtenbacher, 1908)
- Underside of middle and hind femora not armed with spines *L. buegersi* Günther, 1928
3. Wings only just as long as the median segment. Mesonotum granulose, not carinate *L. pedestris* (Redtenbacher, 1908)
- Wings as long as the third abdominal segment. Mesonotum with a very finely longitudinal carina and densely granulose 4
4. Mesonotum length / width ratio < 6.0 (measured at the mid point) *L. brachypterus* (de Haan, 1842)
- Mesonotum length / width ratio > 7.0 *L. borneensis* spec. nov.

Lopaphus borneensis spec. nov.

Material.— Holotype: ♀ (RMNH), Central Eastern Borneo [Midden O-Borneo], 12.x.1925, H.C. Siebers. Paratypes 5 ♀♀, 9 ♂♂: 1 ♂ (PEB-971), BRUNEI, Temburong district, Bukit Belalong, 910 m, 10.viii.1991, P.E. Bragg; 1 ♂ (RMNH), SABAH, 24 km on road Keningau-Kimanis (N. side), 1350 m, 116°03'E 5°27'N, 19.xi.1987, J. Huisman & R. de Jong; 1 ♀ (C.L. Chan's collection), 01.v.1986, SABAH, Mt Kinabalu National Park, 5200 ft, C.L. Chan & M.Y. Chan; 4 ♀♀ (RMNH), 28.ix.1925, 28.ix.1925, 02.x.1925, 2-11.x.1925, Central Eastern Borneo [Midden O-Borneo], H.C. Siebers; 7 ♂♂ (RMNH), 07.ix.1925, 28.ix.1925, 30.ix.1925, 02.x.1925, 02.x.1925, 2-11.x.1925, 11.x.1925, Central Eastern Borneo [Midden O-Borneo], H.C. Siebers.

Female similar to *L. brachypterus* (de Haan), but more slender. Measurements have been taken from de Haan's holotype, a photograph of two other specimens at RMNH, and two captive reared specimens from West Malaysia; these give a ratio of mesonotal length to mesonotal width (measured at the mid point) ranging from 4.6

to 5.3. For the new species these values range from 7.5 to 11.5. Male similar to *L. transiens* (Redtenbacher) but may be distinguished by the cerci which are straight in *L. borneensis* and curved in *L. transiens*.

The description of this species is based on the preserved material and two colour transparencies of the Brunei male which were taken *in situ* at the time of capture. Size ranges, taken from the longest and shortest (body length) specimens, are given in table 1. The largest measurements for females are those taken from the holotype (length 106 mm), except for lengths of tibiae and tarsi which were, in some cases, longer in one of the other specimens from Kalimantan. The smallest female is the specimen from Sabah (92 mm); those from Kalimantan show little variation in size (100-106 mm).

The description of the egg is based on specimens laid by the female from Sabah. These were found to agree with material removed from the body of one of the paratypes from Kalimantan.

Description of the female (fig. 1)

Body, legs and fore margin of wing light to mid brown; slightly mottled in some specimens. Hind portion of wing clear with brown veins. Head sparingly granulose dorsally, thorax densely granulose throughout (except metanotum); abdomen and legs smooth. A very fine carina runs longitudinally along the thorax.

Head flat, oblong, longer than wide. Antennae long and slender, reaching the end of the 4th abdominal segment.

Pronotum more than twice as long as wide, with a central transverse groove. Mesonotum long and slender, almost of even width, widening only slightly towards

Table 1. *Lopaphus borneensis*, measurements taken from the longest and shortest specimens (the antennae of the shortest male are broken).

Lengths (mm)	Female	Male
Total	92-106	62-74
Antennae	66-72	>63-80
Head	4	2.5-3
Pronotum	4-4.5	2.5-3.5
Mesonotum	22.5-28	19-21
Metanotum	4-4.5	2.5
Median Segment	5	4-4.5
Elytra	6-6.5	3-3
Wing	25-30	14-18
Fore femora	28.5-29	19-26
Fore tibiae	22-28	24-28
Fore tarsi	12-13	12
Mid femora	16-20	18-19.5
Mid tibiae	14-18	15-18
Mid tarsi	9-10	8
Hind femora	22.5-27	24-28
Hind tibiae	22-27	25-28
Hind tarsi	11-13	12

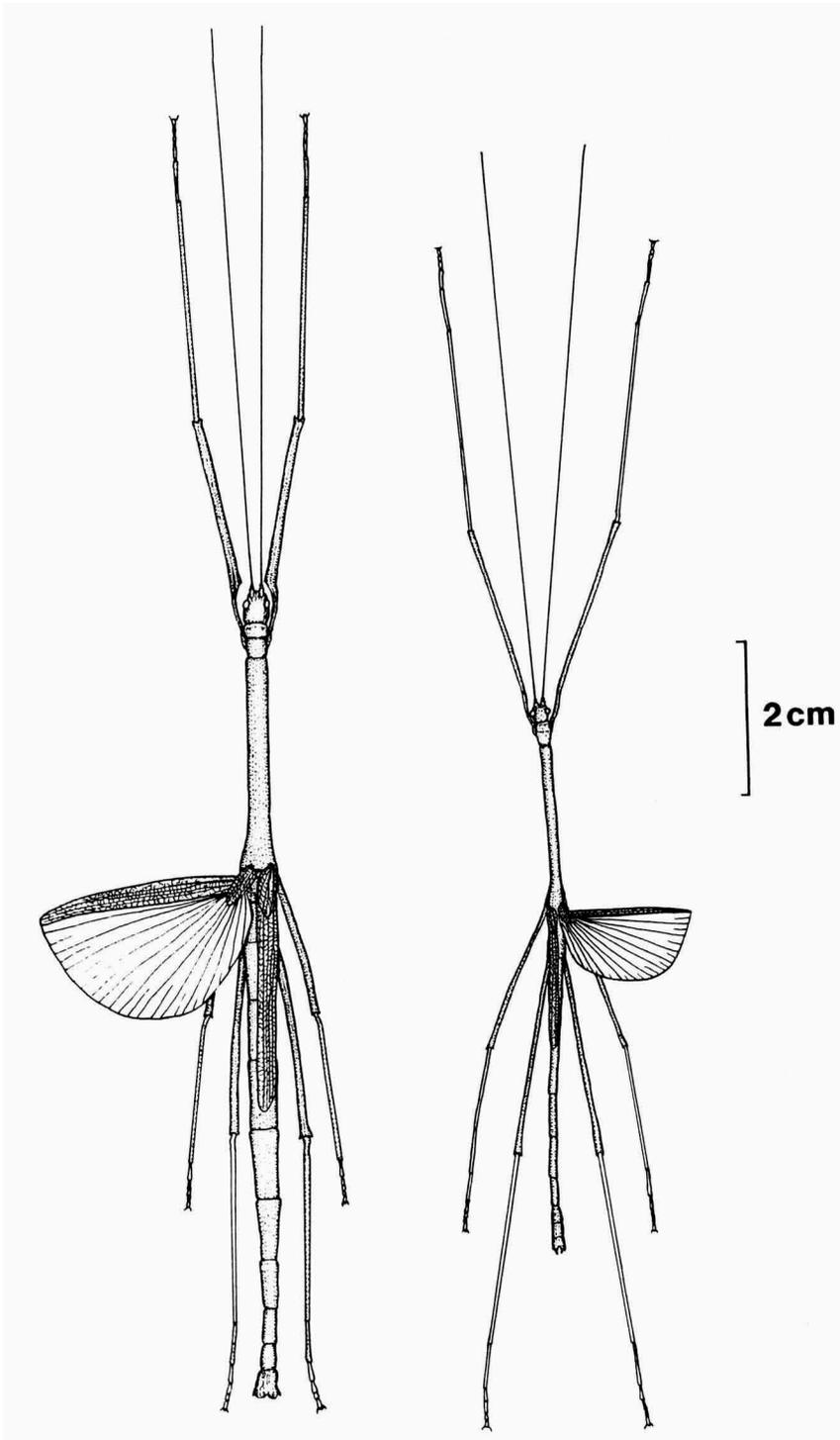


Fig. 1. Left, female *Lopaphus borneensis* spec. nov. (holotype); right, male.

the posterior. Metanotum smooth; short, slightly longer than wide. Metasternum and metapleural plates granulose.

Median segment longer than metanotum. Sides of abdomen tapering very gradually. Tenth segment slightly flattened, with a fine longitudinal carina; hind margin rounded and with a curved indentation. Operculum deep, with a fine longitudinal carina; ending in a slight point. Cerci straight, slender, of uniform thickness, rounded at the end.

Elytra almost flat, twice as long as wide. Hind wings reach half to two thirds of the way along the 4th abdominal segment.

Fore femora narrowing and curving at the base. Femora and tibiae all with distinct setose carinae; smooth except for a small lobe on the underside of the apex of all femora. Tarsi long; first tarsomere longer than tarsomeres 2-4. Hind tarsi reach just beyond the end of the abdomen.

Description of the male (fig. 1)

Head very dark green, pronotum very light brown, mesonotum dark green, rest of body mid brown. Elytra and fore margins of wings green anteriorly, brown posteriorly; hind portion of wing clear with brown veins. Head and thorax densely granulose throughout (except metanotum); abdomen and legs smooth. A very fine carina runs longitudinally along the thorax.

Head flat, oblong, longer than wide. Antennae long and slender, reaching beyond the end of the abdomen.

Pronotum one and a half times as long as wide, with a central transverse groove. Mesonotum long and slender, almost of even width, widening only slightly at each end. Metanotum smooth; short, as long as wide. Metasternum and metapleural plates granulose.

Median segment longer than metanotum. Abdomen slender, of almost uniform width. Abdominal segments 2-7 long, 8-10 only half as long. Tenth abdominal segment slightly flattened; hind margin with a deep, curved, indentation at the apex. Cerci straight, long, slender, with rounded apices. Operculum short, triangular.

Elytra almost flat, twice as long as wide, reaching beyond the end of the metanotum. Hind wings reach to end of third abdominal segment.

Femora and tibiae as in the female. First tarsomere of mid leg as long as tarsomeres 2-5. First tarsomere of fore and hind legs longer than tarsomeres 2-5. Mid legs reach to the end of abdomen. Hind legs much longer than abdomen.

Description of the egg (fig. 2)

Light to mid brown. Capsule cylindrical; twice as long as wide; granulose. Lateral and ventral surfaces with a few raised longitudinal ridges which run most, or all, the length of the capsule. Micropylar plate closer to the polar end; oval, slightly pointed at the opercular end. Operculum and polar end both circular, flat, rugose. Opercular angle 0°. At each end of the capsule are long fibres which branch near the tips and are connected by a thin layer of material. The fibres are slightly longer at the opercular end and almost half the length of the capsule. Capsule length 2.3 mm, height 1.4 mm, width 1.3 mm, overall length 4.2 mm.

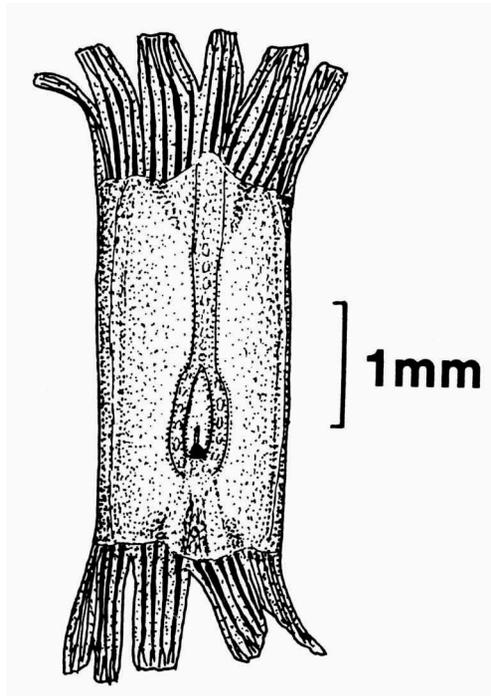


Fig. 2. Egg, dorsal view.

Discussion

The adults of *L. borneensis* and *L. brachypterus* agree closely with each other but the basic shape of the eggs differ greatly; those of *L. brachypterus* are almost spherical while those of *L. borneensis* are cylindrical. Knowledge of egg structure of the Necrosiinae is limited to a few species in scattered genera, and its value in establishing phylogenetic relationships is unclear. Such a difference in egg shape appears to cast some doubt on the generic affinity of these species; however considerable variation in the shape of eggs produced by individual insects has been found in several species in other subfamilies. The egg of *L. brachypterus* has a ring of short fibres surrounding the operculum, these are probably homologous with the longer fibres of *L. borneensis*. In view of this, the difference between a cylindrical egg and spherical egg within a genus may not be significant. Apart from the eggs, there is no evidence to suggest that *L. borneensis* is not closely related to *L. brachypterus*.

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