EUMASTACIDAE (ORTHOPTERA) FROM THE PROJECT WALLACE EXPEDITION TO SULAWESI (INDONESIA)

by

R. K. BUTLIN, R. E. BLACKITH & R. M. BLACKITH

ABSTRACT


All six eumastacid species found in or near the Dumoga-Bone National Park (North Sulawesi) belong to the subfamily Mnesicleinae. Four species, in the genera Pseudomnesides Descamps, Karnydia C. Bolivar, and Samariella Descamps are new to science. The male of Karnydia celebesica Ramme, hitherto known only from the female, is described. All the species are endemic to Sulawesi, although Samariella is represented in the Philippines.

Key words. — Mnesicleinae; taxonomy; karyotype; ecology.

Dr. R. E. Blackith, Zoology Department, Trinity College, Dublin-2, Ireland.

INTRODUCTION

Wallace (1869) comments on the general paucity of animal species on Sulawesi, and despite intensive collecting, few individual eumastacids were found. The finding of nymphs of Karnydia gracilipes Ramme feeding on Selaginella ferns and of adult Pseudomnesides species inhabiting the Gnetosperm Gnetum L. was recorded by Blackith (1987). Ramme (1940) described K. gracilipes from N. Sulawesi (Minahassa) and C. Bolivar (1930) described K. celebesica from the same region. Three species of Pseudomnesides were previously described from Sulawesi; P. roeosignatus (Brunner) from Toli-Toli in the north of the island but some 350 km west of the Dumoga-Bone National Park within which Project Wallace operated. P. plagiator (Ramme) and P. milleri (Ramme) were both described from the south of the island. All three form, as Ramme (1940) notes, a close-knit group of species, and the similarity of their male genitalia as figured by Descamps (1974a) confirms this view; the terminalia are the means by which most eumastacid species can be distinguished.

MATERIALS AND METHODS

Nymphs and some adults were collected by sweeping vegetation near the ground. Eumastacids in rain forest appear to be mainly canopy dwellers and collecting them involved reaching a fallen tree within hours of the crash or picking up specimens brought down from the canopy by oggling with an insect-paralysing solution, organised by a team from the British Museum (Natural History). Both methods yielded meagre numbers of eumastacids. One eumastacid was taken in a Malaise trap run by the same team.

Abbreviation. — BMNH = British Museum (Natural History).

RESULTS

Mnesicleinae

Pseudomnesides rhodopeplus sp. n.

(fig. 1)


Virtually identical with P. roeosignatus Brunner, except for the phallic complex, whose dorsal view is shown in fig. 1 (cf. figs 47, 49 and 54 of Descamps (1974a) for the phallic complexes of
the other described species in this genus). The shaft of the penis valves of *P. rhodopeplus* is at least 4 times as long as in other species.

Dimensions. — Elytron length 11.0 mm; pronotum length 2.9 mm; hind femoral length 10.9 mm, width 2.8 mm.

Females almost indistinguishable from those of *P. roseosignatus* figured by Ramme (1940) except that the lateral processes of the trid subgenital plate extend as far back as the median one, whereas in *P. roseosignatus* they are shorter.

Dimensions of female — elytron length 13.7 mm: pronotum length 4.1 mm; hind femoral length 13.8 mm, width 3.4 mm.

A putative food-plant for this species (*Gnetum sp.*) is noted by Blackith (1987). The name *rhodopeplus* signifies bearing a roseate shroud. The red flush at the base of the elytra, notable in this genus, is much less marked on females in life.

**Samariella aulaeiadventa** sp. n. (figs. 2-3)

Holotype ♂: Indonesia, Sulawesi Utara, Toraut Forest, 13.ii.1985 (BMNH fogging team) (BMNH).

Head as in fig. 2, distal 5 antennal segments compressed, pubescent. Scape produced into boss forwards, with clear patch at tip. Face rugged. Elytra reaching genicular region of hind legs. Outer dorsal margin of hind tibiae with ca. 18 strongly unequal teeth; inner margin with ca. 18 more regular teeth. These margins fuse into a wide (ca. 1 mm) tooth subequal to longest tibial teeth. Terminalia as in fig. 3; phallic complex relatively unsclerotised, penis carried at right angles to body as in *S. bakeri* Descamps (cf. Descamps 1974b, fig. 68).

Dimensions. — Elytron length 9 mm; pronaotum length 2 mm; hind femoral length 8 mm.

The name *aulaeiadventa* describes one who descends from the canopy, originally of a Roman theatre. The two species previously described in this genus are both endemic to the Philippines. The only specimen of *S. bakeri* known is a male whose phallic complex differs from that of *S. aulaeiadventa*. The other species (*vidnata* Descamps) was described from a female. The vertex in *aulaeiadventa* sets it apart from the other two known species.

**Karnydia celebesica** C. Bolivar, 1930 (fig. 4)

The genus *Karnydia*, of which *K. celebesica* is the type species, is endemic to Sulawesi. It was described from a female, and since specific distinctions depend mainly on the male terminalia we include a description of the male.


Fastigium truncated distally as in Bolivar’s description of the female. Antennae set well below midpoint of eyes, almost as low as unpaired ocellus (i.e. lower than in Ramme’s (1940) figures for *K. gracilis* Ramme). Antennal organ prominent conical, projecting distally from 10th of 12 segments. Body fulvous, abdominal tergites 1—3 and 8—10, scape, underside of fastigium and genae in subocular region and teeth and dorsal carena of hind femora fuscous. Fragae on hind femora weak. Hind tibiae with 19 teeth (longest 0.15 mm) on outer carena and 15 on inner (longest 0.7 mm). Hind femora with 5 teeth on mid-dorsal carena. Fore- and hind-tibiae clad with at least 50 golden setae. Male terminalia as in fig. 4; subgenital plate and its lateral lobes, seen from rear, enclosing roughly equilateral triangle.

Dimensions. — Pronotum length 1.8 mm; hind femoral length 10.5 mm, width 2.0 mm. Because no material was taken in copula we cannot be certain that this male is *K. celebesica*, and even if a pair were obtained identification of the female might be ambiguous.

**Karnydia monki** sp. n. (fig. 5)


Very similar to *K. celebesica* except for the genitalia, the more compressed and raised dorsal carena of the abdominal tergites, and the red flush on the postero-lateral angle of the episternum, the proximal half of the fore- and mid-femora, and on the distal parts of the hind legs. First two flagellar segments pale, remainder fuscous. Fragae on outer flanks of hind femora more strongly developed than in *K. celebesica*, dorsal carena of hind femora with 7 teeth. Hind tibiae have 19 teeth on outer carenae (longest 0.2 mm) and 5 on inner (longest 0.6 mm).

Terminalia as in fig. 5; the subgenital plate, seen from the rear, forms a V-shaped slot or inverted triangle quite distinct from that of *K. celebesica*.

Dimensions. — Pronotum length 2.3 mm; hind femoral length 11.5 mm, width 1.9 mm.

**Karnydia latilava** sp. n. (fig. 6)

Holotype ♂: Indonesia, Sulawesi Utara, Gunung Mua-

Lowest scale bar for figs. 1, 4, 5 and 6.
The outer carena.


Similar to K. celebesica. Antennal organ exceptionally thick and prominent. Flagellar segments dark brown, scape, pedicel, and proximal fifth of first segment white. Integument translucent, except for opaque yellow disc underlying basiconic sensilla. Hind tibiae with 16 teeth (longest 0.8 mm) on inner carena, 17 teeth (longest 0.1 mm) on outer carena. Terminalia as in fig. 6, subgenital plate tridif with 2 hooked lateral process and arrow-head median process.

Dimensions. — Pronotum length 2.4 mm; hind femoral length 10.2 mm, width 2.3 mm.

Female. As for male, but mouthparts, cerci, distal parts of ovipositor valves, subgenital plate, and legs livid green. Lateral carenae of pronotum pink, underlined with fuscous. Hind femora with 11 teeth on dorsal carena, hind tibiae with 19 teeth (longest 0.8 mm) on inner carena, and 19 teeth (longest 0.2 mm) on outer carena.

Dimensions. — Pronotum length 2.8 mm; hind femoral length 14.6 mm, width 2.5 mm.

The name latilava describes the broad, distally spatulate, cerci of the male.

Karnydia gracilipes Ramme, 1940

Nymphs and adults were collected at two localities; Gunung Mogogonipa (altitude 1000 m) and Gunung Ambang (altitude 1200 m). Both mountains have abundant ground cover of mosses and ferns. The species was taken from several ferns including Cyathea spp. (Cyathaceae), Dennstaedtia sp. (Dennstaedtiaceae), Nephrolepis sp. (Nephrolepidaceae) and a species of Athyrium or Diplazium (Athyriaceae). It was also taken from an angiosperm Elatostema sp. (Urticaceae). The role of ferns in the nutrition of tropical grasshoppers has been documented by Rowell et al. (1983). Palatability tests of these tropical plants were conducted in the laboratory at Base Camp using 5 nymphs of K. gracilipes for each test, which lasted for 24 hr.

The results are shown in table 1. Nymphs of K. gracilipes evidently prefer Elatostema but also eat several ferns, though not Dennstaedtia. This result accords with feeding tests by Blackith and Blackith (1966) on Australian eumastacid grasshoppers (Morabinae). These are generalist feeders but consume several ferns, as do K. gracilipes. Rowell et al. tested the palatability of ferns of the genera Dennstaedtia, Cyathea and Diplazium for the Costa Rican eumastacid Homeomastax dentata (Sausure). Interpretation of their results is complicated by strong specific differences within plant genera. Diplazium expansum being highly palatable whereas D. aff. herbaceum was among the least palatable. Cyathea multiflora and Dennstaedtia obtusifolia are also relatively unpalatable. These authors note that even if the grasshoppers prefer a diet of a single plant species, the structure of rain forests makes general feeding almost obligatory.

Caryotypic studies

Although not all the species taken could be examined, testis squash preparations of two of them were made. K. gracilipes proved to have a diploid number of 21 (2n = 20 + X) which is common in the Eumastacidae. There are ten pairs of acrocentric chromosomes graded in size with a medium sized X. K. latilava, however, proved to have 2n = 19 (18 + X) including a very large autosomal pair, probably by fusion of two of the larger autosomes of the closely related gracilipes. As is common in other eumastacid subfamilies, speciation in these Mnesicleinae seems to be accompanied by chromosomal rearrangements (White 1977).

Discussion

Our findings support the view that only one subfamily of the Eumastacidae has reached Su-

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Gunung Mogogonipa Palatability*</th>
<th>Locality</th>
<th>Gunung Ambang Palatability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elatostema sp.</td>
<td>16</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Cyathea sp. 1</td>
<td>8</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Cyathea sp. 2</td>
<td>0</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Dennstaedtia sp.</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Nephrolepis sp.</td>
<td>9</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

*) Palatability is defined as the percentage of the available leaf consumed by the eumastacids, out of approximately 20 sq. cm offered to batches of 5 nymphs.
lawesi. Speciation in this subfamily, the Mnesicleinae, follows the pattern for the family of close-knit genera, species within genera differing little except in the male genitalia and, where investigated, in the caryotype. As all 9 species known from Sulawesi are endemic, and only one of the 3 genera has representatives elsewhere (on the nearby Philippines) little biogeographic information can be gleaned from Sulawesian eumastacids.

Although collecting from rain forest canopies is usually difficult, the small number of adults of species other than *K. gracilipes* collected by members of the expedition is striking, amounting to roughly one specimen per person-month of collecting, even when aided by fogging equipment rarely available to collectors. As collecting was spread over most of 1985, seasonal effects are unlikely to be responsible. We are forced to the conclusion that eumastacids occur at very low densities in these rain forests, possibly partly because the great diversity of host plants may mean that acceptable hosts are themselves thinly dispersed.

It is hardly surprising that, under conditions favouring sibling mating for lack of much opportunity to meet unrelated individuals, speciation in this group involves chromosomal rearrangements. Sibling mating has been suggested (White 1977) as a way of allowing such rearrangements to reach homozygosity despite the often demonstrably unfavourable effects on the heterozygote. Virtually all eumastacid species whose caryotype has been investigated differ cytogenetically from one another.

With the discovery of two further species of *Karnydia* a sequence of changes in the structure of the male genitalia becomes apparent. This sequence runs through *celebesica* — *monki* — *laticlava* — *gracilipes* such that the postero-lateral processes of the 9th tergite are reduced, tergite 10 becomes less sclerotised, and the postero-lateral processes of the subgenital plate become elongated and contorted. The terminalia as a whole become broader and the cerci distally more strongly sclerotised and spatulate from *celebesica* to *laticlava* although *gracilipes* has cerci comparable with those of *celebesica*. So far as we can judge, the morphological contrast between *celebesica* and *laticlava* corresponds to the fusion of two autosomes in the caryotype.

**Acknowledgements**

We are grateful to all those concerned with Project Wallace, particularly the support teams, and to Dr. K. Monk and members of the British Museum (Natural History) fogging team for permission to examine their hard-won material. RKB acknowledges with gratitude facilities and advice provided by Prof. G. Hewitt and financial support from the Percy Sladen Memorial Fund. This paper is based on material collected whilst the authors were participants in project Wallace, sponsored by the Royal Entomological Society of London and the Indonesian Institute of Science (Results of Project Wallace no. 24).

**References**


Received: 23 January 1989

Accepted: 16 March 1989