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THE TAXONOMY AND BIOGEOGRAPHY OF THE *CONVIVA* GROUP OF THE GENUS *BAETURIA* STÅL, 1866 (HOMOPTERA, TIBICINIDAE)

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ABSTRACT

The name *conviva* group is proposed for a group of five species of the genus *Baeturia* Stål, 1866, from the Moluccas and the Vogelkop peninsula (= Tjendrawasih), New Guinea. The monophyletic origin of this group is made plausible. Three of the species (*B. conviva*, *B. quadrifida* and *B. schulzi*) are redescribed, while two (*B. laureli* and *B. hardyi*) are described as new. For *B. schulzi* a lectotype is designated. *B. hirsuta* Blöte, 1960 is brought into the synonymy of *B. quadrifida* Walker, 1868. A key to the males and a map of the distributions are presented. Biogeographical data of this group suggest an Outer Melanesian Arc distribution.

INTRODUCTION

Historic island arcs are considered to have been important routes of dispersal for animals and plants which invaded Melanesia and Polynesia (Holloway, 1984). The present distribution patterns of these groups can to some extent be seen as reflecting a historic island arc relationship, especially in those groups with poor means of dispersal.

In geological time, during the late Cretaceous and early Tertiary, two island arcs were formed in the interaction zone of the Australian and Pacific plates. The remnants of these historic arcs can still be recognized in present geography. It is well accepted now, that New Guinea was formed after the collision of parts of these two arcs in late Miocene-Pliocene. The remnants of the oceanic Outer Melanesian Arc are: North Maluku, the northern part of the Vogelkop peninsula (Tjendrawasih), Biak and Yapen islands in the Geelvink Bay, the north-coast mountain ranges of New Guinea, the Bismarck archipelago, Solomon Islands, Vanuatu, Fiji and Tonga. The Inner Melanesian Arc is of continental origin and roughly consists of: the central mountain ranges of New Guinea, New Caledonia, and New Zealand. For reviews of this subject the reader is referred to Holloway (1979, 1984), Hamilton (1979), Coleman (1980), Crook (1981) and Duffels (1983).

The cicada genus *Baeturia* Stål, 1866 presents a promising group for a historical biogeographic study of the Australian-Pacific interaction zone, since it is widely distributed throughout the Outer, and the western part of the Inner Melanesian Arc. Records of *Baeturia* species are known from Maluku in the west, to Samoa in the east, and further from Japan, Ryukyu and Queensland (Metcalf, 1963).

Fragmentary biogeographic data of this genus are available from the studies of Blöte (1960) on New Guinean species, Boulard (1979) on species from Vanuatu and De Boer (1982), on a monophyletic group from central New Guinea.

This publication is the second in an intended series of articles, dealing with the taxonomy and biogeography of monophyletic groups, that can be recognized within the genus *Baeturia*. The distribution of the groups will be discussed on the basis of phylogenetic taxon-analysis, the recognition of areas of endemism and comparison of taxon-area cladograms, while a historic explanation in regard to the two arcs distribution will be dwelled upon.

In the following pages a revision is presented of a probably monophyletic group, that is distributed mainly in north Maluku and western New Guinea. The group is centred around *B. conviva* Stål, 1861, the type-species of this genus.

MATERIAL AND METHODS

The material used for this study comes from the following institutions:

BPBM	Bernice P. Bishop Museum, Honolulu
BMNH	British Museum (Natural History), London
NRS	Naturhistoriska Riksmuseet, Stockholm
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden
ZMA	Instituut voor Taxonomische Zoölogie (Zoölogisch Museum), Amsterdam

The geographic sources used to trace the localities are: Atlas van Tropisch Nederland (1983), The Times Atlas of the World (1968) and Toxopeus "A short description of the localities on the island of Buru..." (1924).

Terminology used and the methods for examination of the male genitalia, follow Duffels (1977).

All specimens were measured, as far as their state of preservation allowed. The specimens of the various species at my disposal, were too small in number to allow statistical treatment.

PHYLOGENY

The monophyly of the *conviva* group

In historical biogeography, it is essential to work with monophyletic groups, since only monophyletic groups have a history as a group. In the following paragraph an attempt is made to establish the monophyly of the *conviva* group.

A number of either six or six-and-a-half sclerotized tymbal ridges is regarded synapomorphic for the species of this group. Six ridges run from the dorsal to the ventral margin of the tymbal, and in some species the onset of a 7th ridge running from the dorsal margin to about halfway the tymbal can be discerned. The *nasuta* group is characterized by four tymbal ridges (De Boer, 1982). A number of 7-8 ridges, as occurs in many other species of *Baeturia*, must probably be regarded as the plesiomorphic state. Several species which are presently attributed to *Baeturia*, share the presence of six tymbal ridges with the *conviva* group. However, these species are so clearly different in other respects like: shape of postclypeus, operculum, pygofer and aedeagus, that the monophyly of the genus *Baeturia* in its present concept becomes highly improbable. These species should therefore not be taken into consideration, while establishing the monophyly of the *conviva* group.

Other characters of the *conviva* group show a wider distribution and occur in one or more other groups of the genus. In fact several of these characters, for example the conical protuberances on the lateral pygofer lobes and the oval shape of male opercula, also occur in similar form in the *nasuta* group. These facts possibly indicate a close relationship between both groups.

Here we come to a drawback in supposing the six tymbal ridges establishing monophyly for the *conviva* group. On account of the character distributions it might also be possible that the *nasuta* group, regarded as monophyletic, is a subgroup of a larger *conviva* group. In that

case the *conviva* group plus the *nasuta* group would form one monophyletic group, while the *conviva* group as described here would be paraphyletic. Further study on other groups of *Baeturia* may lead to the recognition of additional synapomorphies and a better evaluation of the characters available.

Phylogeny of the species of the *conviva* group

Though I must refrain from presenting a cladogram for the *conviva* group until other groups of *Baeturia* have been studied, some remarks on ingroup phylogeny can be made.

Three species (*B. conviva*, *B. schulzi* and *B. laureli*) can be grouped together on account of the supposed synapomorphic number of six tymbal ridges. The other two species of the *conviva* group show the remnants of a 7th ridge. Their tymbals are considerably smaller in size.

A probable synapomorphy of *B. conviva* and *B. laureli* is found in the shape of the protuberances on their lateral pygofer lobes, which are bluntly rounded and hardly extending beyond the pygofer margin. This particular shape distinctly differs from the more triangular form as found in most other *Baeturia* species.

The remaining two species (*B. quadrifida* and *B. hardyi*) are very similar and, except for their clasper shape, almost identical; they are probably sister species. Apart from the above mentioned similarity in tymbal size and number of tymbal ridges these species share the following male characters: an erect operculum; conical, apically pointed protuberances on the lateral pygofer lobes and a 1st tergite that is partly hidden under the metanotum. These characters also occur in several species of the *nasuta* group. A possible synapomorphy grouping these two species together, is the rather long and apically pointed caudodorsal beak. In other *Baeturia* the caudodorsal beak is shorter, shorter than the claspers, or, if longer than the claspers, truncate at the apex.

BIOGEOGRAPHY

The distribution of the *conviva* group is restricted to the north Maluku islands of Bacan, Halmahera and Obi, Buru island, and the Vogelkop peninsula (Tjendrawasih) of New Guinea, including the nearby Aru islands, and Roon island in Geelvink Bay. No specimens belonging to the *conviva* group were found yet on the New Guinean mainland. When the monophyly of the *conviva* group is established beyond doubt, this distribution area can be regarded as an area of endemism for this group. North Maluku and the Vogelkop peninsula form likewise an area of endemism for the cicada genus *Rhadinopyga* (Duffels, 1985).

The historic geography of Maluku, the Vogelkop and the islands of Geelvink Bay is very complex and opinions about it are still controversial.

North Maluku either rifted from the New Guinea-Australian plate or formed part of the Pacific Cordillera, regarded as a western extension of the Outer Melanesian Arc (Hamilton, 1979).

The Vogelkop peninsula takes an isolated position in relation to the other parts of New Guinea. It is supposed that, during the expansion of the Banda Sea, the Vogelkop rotated clockwise northward from a more southern position near the edge of the Australian plate. Only the northern part of Vogelkop would have been a fragment of the historic Outer Melanesian Arc (Holloway, 1984), while the southern part is considered of continental origin (Hamilton, 1979), and possibly a remnant of the Inner Arc (Holloway, 1984). Roon island must probably be regarded part of north Vogelkop. The Aru islands are widely accepted as parts of the New Guinean-Australian plate.

Biogeographical conclusions, regarding the *conviva* group are hampered by the small number of specimens at hand and the small number of species (5) involved. However, some remarks can be made in relation to the geological reconstructions outlined above. First, except for *B. schulzi* from Buru and the occurrence of *B. quadrifida* on Aru, the species of this group are distributed in alleged parts of the Outer Melanesian Arc. The distribution of *B. conviva* and *B. laureli*, probable sister species, suggests a close relation between Bacan-Obi

and Halmahera. The distribution of *B. quadrifida* on Aru and Vogelkop suggests a relationship between these areas, whereas the island of Roon with *B. hardyi* seems to hold a separate position.

TAXONOMY

The genus *Baeturia*

The greater part of the *Baeturia* species is very uniform at first sight. In the majority of species the males are ochraceous with a brown to red-brown mediodorsal band on the abdomen while the posterior margins of the abdominal segments are bright-red or orange. The abdomen has a ventrolateral row of dark spots, usually extending from segm. 3 to 7 or 8. The females of this genus are of a more greyish brown colour, heavily speckled all over. Red segmental margins are in general lacking, while the ventrolateral row of dark spots is only vaguely discernable.

Description of the *conviva* group

The general aspect of the species of the *conviva* group is in accordance with the above description for the greater part of the *Baeturia* species. On closer examination some more specific characters can be discerned however.

Postclypeus (fig. 1): Distinctly swollen in lateral view, frontal margin broadly rounded. In dorsal view 1.5-3.1 × as wide as long.

Tymbals (figs. 5 and 25): Six sclerotized transverse ridges run across the tymbals, from the dorsal to the ventral margin. The most proximal of these ridges narrows considerably towards the ventral margin. Two species (*B. quadrifida* and *B. hardyi*) have the onset of a 7th ridge close on the proximal tymbal margin, reaching to about halfway the tymbal. A row of six short intercalary ridges in between the proximal margin and each successive ridge seems to form a band across the tymbals. Traces of bright-red are usually visible in between the dorsal ends of the ridges.

Male operculum: Oval shaped and quite narrow compared with that in other *Baeturia* species. In some species erect, in others flat against the body and in that case the distal operculum margin just reaches the 2nd abdominal sternite, while the operculum extends beyond the apex of the meracanthus.

Tegmina and wings: Hyaline and slender, without special markings. Veins bright-red or with traces of red. Tegmina of males 0.9-1.2 × as long as body length, in females 1.3-1.4 ×. Eight apical area in males 2.8-4.2 × as long as wide, in females 2.8-3.5 ×. Third ulnar area in males 2.8-5.4 × as long as wide, in females 3.2-5.1 ×.

Male genitalia: Pygofer stout and broadly rounded dorsally; dorsal rounding continuous with rounding of caudodorsal beak. Ventral margin of caudodorsal beak almost right angled on main part of pygofer. Lateral lobes of pygofer with rounded protuberances, which extend more or less distinctly beyond the pygofer margin. Claspers rather straight, narrow at their bases and not bending downwards towards the apices, so that the clasper hollow is in one straight line with the ventral margin. Aedeagus S-shaped, broadened towards its base, pointed and dorsally flattened at apex. Two small lobes are situated laterally at base of S-curve.

Key to the males

In the following section a key to the males of the *conviva* group is presented. The females of this group are very uniform, so that determination to species level is usually impossible.

1a. Lateral lobes of pygofer bear rounded protuberances, that hardly extend beyond the pygofer margin (figs. 3 and 10); caudodorsal beak short, reaching to halfway the claspers 2

b. Lateral lobes of pygofer bear conical protuberances, that distinctly extend beyond the pygofer margin; caudodorsal beak almost as long as or longer than the claspers 3

2a. Clasper with distinct bend at half the length of the dorsal margin; postclypeus strongly protruding, 1.5-2.1 × as wide as long; protuberance on lateral lobe of pygofer well developed, broadly rounded, almost globular at is apex (fig. 3); Maluku Is.: Obi and Bacan ..... *B. conviva*

b. Clasper more straight; postclypeus broadly rounded frontally, 2.4-3.1 × as wide as long; protuberance on lateral lobe of pygofer poorly developed, narrowly rounded and slightly upcurved at its apex (fig. 10); Maluku Is.: Halmahera..... ..... *B. laureli*

3a. Protuberances on lateral lobes of pygofer sharply pointed apically (figs. 19 and 26); tymbals with six sclerotized ridges and remnants of a 7th ridge close on the proximal tymbal margin; operculum erect, not covering the tymbal cavity in ventral view; first abdominal tergite partly hidden under the metanotum 4

b. Protuberances on lateral lobes of pygofer bluntly rounded apically (fig. 16); tymbals with six sclerotized ridges only; operculum flat against the body, covering most of the tymbal cavity in ventral view; first abdominal tergite not extending under the metanotum; Maluku Is.: Buru. *B. schulzi*

4a. Clasper with a wing-like crest along its dorsal margin (fig. 19); Aru Is.; Vogelkop (Tjendrawasih) ..... *B. quadrifida*

b. Clasper with a rounded crest along its dorsal margin (fig. 26); Roon Id., Geelvink Bay ..... *B. hardyi*

Description of the species

Baeturia conviva (Stål, 1861)
(Figs. 1-9, 28)

Cicada conviva Stål, 1861a: 152; Stål, 1861b: 618; Stål, 1862: 483 (in synonymy of *Cicada hastipennis* Walker); Walker, 1868: 92 (partim: Bacan; in synonymy of *Cicada exhausta* Guérin).

Baeturia conviva; Stål, 1866: 172; Dallas, 1867: 557; Distant, 1892: XIV, 148, pl. XIV fig. 25, 25a-b (partim: Bacan); Horváth, 1900: 642; Distant, 1905: 214; Distant, 1906: 156; Kirkaldy, 1907: 308 (partim: Bacan); Myers, 1928: 60 (partim: Bacan); Haupt, 1929: 278, fig. 80; Kato, 1931: 49; Kato, 1932: 184, 383; Blöte, 1958: 263, 265, 267, 268, figs. 3-4; Metcalf, 1963: 247 (partim: Bacan); Duffels & Van der Laan, 1985: 252.

In the following publications the name *B. conviva* is mentioned, but the geographical data give reason to suspect that another species is indicated.

Baeturia conviva; Distant, 1912: 599 (Dutch New Guinea); Kirkaldy, 1913: 8 (Ambon, Austromalayan islands, Larat, Papua New Guinea); Distant, 1914: 346 (Dutch New Guinea); Schmidt, 1926: 222, 257 (Buru); Schmidt, 1928: 110 (Dutch New Guinea); Lallemand, 1931: 77 (Japen, Saroei); Lallemand, 1935: 677 (Solomon islands).

Identity of *B. conviva*: *Baeturia conviva* was described after a female from Batschian (Bacan), now in Naturhistoriska Riksmuseet, Stockholm. The difficulty in identifying females is already mentioned. For this reason Blöte (1958) designated a male from the same locality as "lecto-allotype". This specimen, also in the Stockholm museum, bears the following labels (labels are separated by a semi colon): "Batjan" (print); "18" (written) "69" (print, red label); "collectio Haglund" (print); "Riksmuseum Stockholm" (print, green label). I agree with Blöte, that this specimen belongs to *B. conviva*.

The female holotype bears the following labels: "Batschian" (print); "Stevens" (print); "Typus" (red label, black cadre); "*conviva* Stål" (written); "28" (written) "69" (print, red label); "*hastipennis* Walk./suppl. [and two illegible words]" (written, blue label); "Riksmuseum Stockholm" (print, green label).

Material examined: BACAN: Batjan, coll. Haglund, 1♂, 1♂ lecto-allotype Blöte, NRS; Batschian, Stevens, Det. *conviva* Stål, Det. *B. hastipennis* Walk., ♀ holotype of *Cicada conviva*, NRS; Gn. Bibimoi, 2 km SSW Ake Songa, 50-150 m, 9.vii.1985, F. G. Rozendaal, 1♀, RMNH; Gn. Sibela trib. Ake Wayaua, 850-1000 m, 1.vii.1985, F. G. Rozendaal, 1♀,

RMNH; OBI: Obi island, 1♂, BMNH; Obi is. Moluccas, 2♀, BMNH.

Description

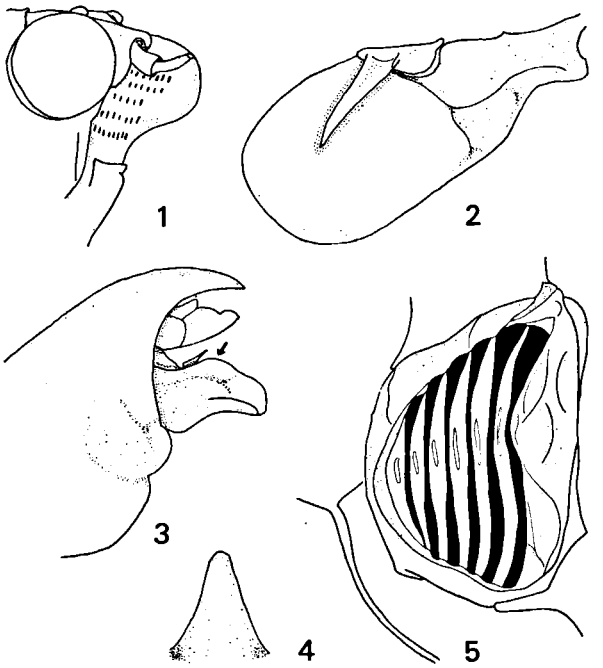
Body of males reddish brown, on Bacan more grey-brown; females brown to grey-brown. Abdomen in males 1.6-1.9 × as long as head and thorax, in females 1.1-1.2 ×. Tegmina in males 0.9-1.0 × as long as total body length, in females 1.6-2.2 ×. Head 0.8 × as wide as pronotum collar. Females distinctly smaller than males, but with a slightly larger, more robust head and thorax.

Head: Reddish brown to more greyish, with dark blots on vertex lobes between eyes and ocelli and, though less conspicuous, on postclypeus. Postclypeus in dorsal view, broadly, almost triangularly protruding (though in females more flattened and wider) and with a distinct dent in the dorsal plane. In males the postclypeus is 1.5-2.1 × as wide as long, in females 1.6-2.2 ×. In lateral view postclypeus distinctly swollen (fig. 1) with a broadly rounded frontal margin. Female head distinctly broader than that of male. Distance between lateral ocelli 1.1-1.5 × as long as distance between eye and lateral ocellus. Eyes in males 1.2-1.3 × as wide as vertex width between the eyes, in females 1.4-1.5 ×. Head 0.9-1.1 × as long as vertex width between the eyes. Male head 0.4 × as wide as width of vertex between the eyes, in females 0.4-0.5 ×.

Thorax: Pronotum chestnut to greyish brown, frontal margin and collar sometimes slightly reddened. Brown speckling, most densely in a medial band between medial furrows, on pronotum collar and in a lateral band. Pronotum 0.4-0.5 × as long as width of pronotum collar. Mesonotum more grey, irregularly speckled all over, a red tinged cruciform elevation and two clear dark spots in front of the elevation. Mesonotum 0.6-0.8 × as long as width of pronotum collar.

Legs: Reddish brown, unspeckled.

Tegmina and wings: Hyaline, veins red. The 8th apical area of tegmen 2.8-3.5 × as long as wide, 3rd ulnar area 3.1-4.1 × as long as wide.



Figs. 1-5. *Baeturia conviva*; male from Obi: 1, head in lateral view; 2, operculum in ventral view; 3, genitalia in lateral view; 4, caudodorsal beak in dorsal view; 5, tymbal in lateral view.

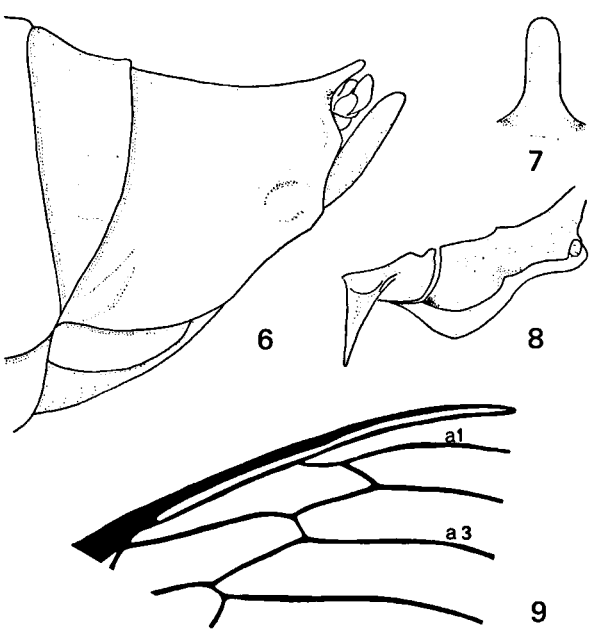
Base of third apical area of tegmen distinctly proximad to that of the first (fig. 9).

Tymbal organs (fig. 5): Six sclerotized ridges run across the whole tymbal from the dorsal to the ventral tymbal margin. The most proximal ridge narrows considerably towards the ventral tymbal margin. Six short intercalary ridges in between the proximal margin and each successive ridge seem to form a band across the tymbal. Traces of red dorsally between the ridges.

Opercula: Male operculum (fig. 2) oval, almost square angled, flattened against the body and partly covering the tymbal cavity; its medial margin just reaching the 2nd abdominal sternite. A clearly distinguishable crest runs along the almost straight posterior margin. Medial margin broadly rounded. Lateral part of the right-angled lateral crest rising fairly high above basal part of operculum. Female operculum (fig. 8) rudimentary, sickle shaped and erect. A distinct crest runs along its posterior margin.

Abdomen: Male abdomen reddish to greyish brown, sternites distinctly reddish. Mediodorsal line darkened with brown speckling. Posterior margins of segm. 3-8 bright red, in the Obi specimens margins of segm. 3-6 ochraceous. A very clear ventrolateral line of dark spots extends from segm. 3-8. Length of tergite 1 mediodorsally about 1/3 that of tergite 2. Tergite 1 not extending under the metanotum. Female abdomen (fig. 6) chestnut brown, dark brown speckled all over. Segmental margins ochraceous to vaguely red and ventrolateral spots on segm. 3-8 hardly visible. Caudodorsal beak (fig. 7) long, slender and rounded at its apex. Ovipositor sheaths reaching just beyond apex of caudodorsal beak. Only one specimen has traces of red on the sternites.

Male genitalia (figs. 3-4): Caudodorsal beak stout, broad at its base, distinctly shorter than the claspers and pointed at its apex. The lateral lobes of the pygofer bear well developed protuberances, that are broadly rounded, almost globular at the apex and do hardly extend beyond the pygofer margin. Clasper in lateral view shows a distinct bend halfway the dorsal margin, giving rise to a small hump (see arrow), which is almost absent in one specimen. The clasper widens gradually to its base. Ventral margin concave, dorsal margin, between hump and clasperbase, convex.



Figs. 6-9. *Baeturia conviva*; female holotype: 6, 9th abdominal segment in lateral view; 7, caudodorsal beak in dorsal view; 8, operculum in ventral view; 9, part of right tegmen. Lettering: a1 = first apical area, a3 = third apical area.

Measurements: Body length ♂: 18.9-21.5 mm ($\bar{x}$ 20.3 mm) ♀: 16.5-18.0 mm ($\bar{x}$ 17.4 mm); tegmen length ♂: 18.7-20.6 mm ($\bar{x}$ 19.8 mm) ♀: 21.8-24.8 mm ($\bar{x}$ 23.2 mm); pronotum length ♂: 2.2-2.5 mm ($\bar{x}$ 2.3 mm) ♀: 2.4-2.6 mm ($\bar{x}$ 2.5 mm); mesonotum length ♂: 3.2-3.9 mm ($\bar{x}$ 3.6 mm); ♀: 3.6-4.0 mm ($\bar{x}$ 3.8 mm); head width ♂: 3.9-4.3 mm ($\bar{x}$ 4.0 mm) ♀: 4.3-4.5 mm ($\bar{x}$ 4.4 mm); width pronotum collar ♂: 4.9-5.6 mm ($\bar{x}$ 5.1 mm) ♀: 5.7-5.9 mm ($\bar{x}$ 5.8 mm).

Distribution: The distribution of this species is limited to the Maluku islands Bacan and Obi. In the literature however, a much wider distribution is indicated: Metcalf's catalogue records this species from Timor to the Solomon islands. This can easily be explained, if we realize that the original description of *B. conviva* is that of a female. Consequently, the description fits almost every female *Baeturia*.

Remarks: *B. conviva* has often been confused with *Baeturia exhausta* Guérin, another species with doubtful records. According to Distant (1892) and Myers (1928) these two species can be separated on account of two characters: the greater average size of *B. exhausta* and the relative positions of the first and third apical areas of tegmina. In *B. exhausta* the base of apical area 3 is said to lie proximad to that of apical area 1, whereas in *B. conviva* these points are said to be opposite, that is at the same distance from the tegmen base. Study of the *conviva* holotype reveals that here the base of apical area 3 lies proximad to that of apical area 1, which is thus in contradiction with the literature.

Baeturia laureli n. sp.
(Figs. 10-15, 28)

This species is very similar to *B. conviva*, but it can easily be distinguished by the less promi-

nent protuberance on the lateral pygofer-lobe, almost straight clasper, shorter and broader postclypeus and possibly darker colour.

Types: Holotype: "Halmahera" (written); "coll. Dr. D. McGillavry" (print), ♂, ZMA. Paratypes: same data as holotype, 1♂, 1♀, ZMA. Other material: Halmahera, coll. Haglund, 2♂, NRS; Halmahera (Gilolo), 60/113, 1♀, BMNH; Halmahera (North Moluccas), Akelamo env., 23.vii. & 5.viii.1985, F. G. Rozendaal, 2♂, RMNH.

Description

Body of males dark reddish-brown, females dull grey-brown. Abdomen in males 1.5-1.9 × as long as head and thorax, in females 1.0 and 1.3 ×. Tegmina in males 0.9-1.0 × as long as total body length, in females 1.3 ×. Head 0.8-0.9 × as wide as pronotum collar. Females on average slightly smaller than males, but larger than the smallest male. Female head and thorax on average slightly larger than in males. Differences between males and females less prominent than in *B. conviva.*

Head: Reddish-brown with dark blots all over vertex and postclypeus, more ochraceous in females. Postclypeus in dorsal view broadly rounded, shorter and broader than in *B. conviva*, with a distinct dint in the dorsal plane. Male postclypeus 2.4-3.1 × as wide as long. Female postclypeus little longer: 1.9-2.1 × as wide as long. In lateral view postclypeus distinctly swollen, with a broadly rounded frontal margin. Female head (on average) hardly broader than that of male. Distance between lateral ocelli 0.9-1.4 × as long as distance between eye and lateral ocellus. Eyes 1.2-1.4 × as wide as vertex width between the eyes. Head 0.9-1.1 × as long, and 0.4 × as broad as vertex width between the eyes.

Thorax: Pronotum greenish brown, more red-brown in a medial band between medial fissures, dark speckled all over, though more intense in medial band, on the pronotum collar and in between the fissures. Pronotum 0.4-0.5 × as long as width of pronotum collar. Female pronotum little longer than that of male. Mesonotum greyish green, red tinged medially in front of the cruciform elevation and in lateral bands. Cruciform elevation reddish. Some specimens have two clear dark spots in front of this elevation, in others, these spots are hardly conspicuous. Mesonotum irregularly speckled all over. Mesonotum 0.6-1.0 × as long as width of pronotum collar.

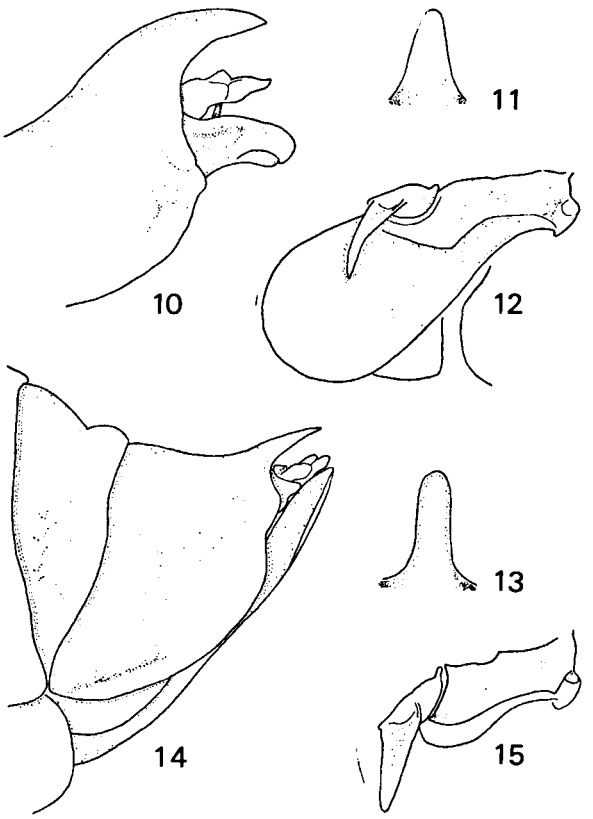
Legs: Reddish brown, unspeckled.

Tegmina and wings: Hyaline, veins red. The 8th apical area of tegmen 3.0-4.2 × as long as wide, 3rd ulnar area 2.8-3.9 × as long as wide. In males the base of the 3rd apical area of tegmen lies proximad to the base of the first apical area; in the females the bases of these areas are at the same distance from the tegmen base.

Tymbal organs: As in *conviva.* Six sclerotized transverse ridges run across the whole tymbal. The most proximal ridge narrows considerably towards the ventral tymbal margin. Six short intercalary ridges, between the proximal tymbal margin and each successive ridge, seem to form a band across the tymbal. Traces of red dorsally in between the ridges.

Opercula: Male operculum (fig. 12) oval and flat against the body, partly covering the tymbal cavity. Operculum a little narrower than in *conviva.* Its distal margin only just reaching the 2nd abdominal sternite. A weak crest runs along the almost straight posterior margin, medial margin broadly rounded. Lateral part of right-angled lateral crest very prominent, rising high over basal part of operculum; and longer than in *conviva.* Female operculum (fig. 15) rudimentary, sickle shaped and erect. A vague crest runs along the posterior margin. Lateral part of right angled lateral crest very prominent.

Abdomen: Male abdomen red-brown to brown, sternites distinctly reddish. Darkened mediodorsal line more prominent than in *conviva.* Margins of segm. 3-8 ochraceous to light red. A very clear ventrolateral row of dark spots extends from segm. 3 to 8. Length of tergite 1 mediodorsally about 1/3 of that of tergite 2. Tergite 1 does not extend under the metanotum. Female abdomen light brown,



Figs. 10-15. *Baeturia laureli*; 10-12, male holotype: 10, genitalia in lateral view; 11, caudodorsal beak in dorsal view; 12, operculum in ventral view; 13-15, female paratype: 13, caudodorsal beak in dorsal view; 14, 9th abdominal segment in lateral view; 15, operculum in ventral view.

dark brown speckled all over. Segmental margins ochraceous to vaguely red and ventrolateral row of dark spots on segm. 3-8 hardly visible. Caudodorsal beak (fig. 13) slender, pointed at its apex and reaching just beyond ovipositor sheaths.

Male genitalia (figs. 10-11): Caudodorsal beak stout, broad at its base, distinctly shorter than the claspers and pointed at its apex. Lateral lobes of pygofer bear small rounded protuberances, that are slightly upcurved at the apex and do hardly extend beyond the pygofer margin. Clasper in lateral view more straight than in *conviva*, with a less prominent dorsal hump and a distinct crest along the dorsal margin. Apical part of clasper, the part including the clasper hollow, tends to make a slight angle with the more basal part. The clasper broadens gradually to its base, dorsal and ventral margin convex.

Measurements: Body length ♂: 17.8-21.3 mm ($\bar{x}$ 19.8 mm) ♀: 18.1 and 18.5 mm; tegmen length ♂: 17.3-20.6 mm ($\bar{x}$ 19.3 mm) ♀: 22.8 and 23.4 mm; pronotum length ♂: 1.8-2.9 mm ($\bar{x}$ 2.2 mm) ♀: 2.4 and 2.5 mm; mesonotum length ♂: 3.2-3.9 mm ($\bar{x}$ 3.7 mm) ♀: 3.9 and 4.6 mm; head width ♂: 3.6-4.1 mm ($\bar{x}$ 3.8 mm) ♀: 4.0 and 4.3 mm; width of pronotum collar ♂: 4.6-5.2 mm ($\bar{x}$ 4.8 mm) ♀: 4.7 and 5.6 mm.

Distribution: Maluku: Halmahera Island.

Etymology: This species and *B. hardyi* described below, were named after the two American film comics: Stan Laurel and Oliver Hardy. Without their films, who could face days of staring through the microscope at dead cicadas? Furthermore, Mr. Hardy's favourite line: "there's another nice mess you've gotten me into" frequently leaps to the mind when studying the species of the genus *Baeturia*.

Baeturia schulzi Schmidt, 1926.
(Figs. 16-18, 28)

Baeturia schulzi Schmidt, 1926: 222, 257; Myers, 1928: 63; Blöte, 1958: 267, fig. 12; Metcalf, 1963: 251; Duffels & Van der Laan, 1985: 254.

Lectotype designation

B. schulzi was decribed after a series of seven specimens, males and females, collected by L. J. Toxopeus c.s. in 1921. Of this series four males are at present stored at the Leiden museum, all bearing a red "Typus" label. The remaining three specimens of this series, probably females, could not be located.

From the series in the Leiden museum, one was designated lectotype. This specimen bears the following labels: "Typus" (print, red label, black cadre); "*Baeturia schulzi* Schmidt ♂" (written); "Edm. Schmidt determ. 1925" (print); "Buru 1921 station" (print) "I" (writ-

ten) "leg. L. J. Toxopeus" (print) "VII" (written); "Leiden" (print). Consequently, the other specimens with a "Typus" label are paralectotypes.

Material examined: BURU: Burou, [W.] Doherty, Det. *Baeturia famulus* Dist. Stål n.s., 1♂, BMNH; Buru, 1♂, BMNH; Buru, Station 1 [Leksula and vicinity, Mrs. Estrin, 0-650 ft], v.1921, 1♂ paralectotype, RMNH; same data but, vii.1921, ♂ lectotype, RMNH; Station 7 [Ehu road between Mnges'waen and Leksula, 1050-3900 ft], L. J. Toxopeus, ix.1921, 1♂ paralectotype, RMNH; same data but, 25.x.1921, 1♂ paralectotype, RMNH.

Description

Body red-brown in one specimen, to pale greenish in all others. Abdomen 1.5-1.9 × as long as head and thorax. Tegmen 1.0-1.1 × as long as total body length. Head 0.7-0.8 × as wide as pronotum collar.

Head: Pale greenish, unspeckled, in one specimen red tinged ochraceous and brown speckled on vertex lobes. Postclypeus in dorsal view, broadly rounded, not dinted in the dorsal plane and 1.8-2.4 × as wide as long. Postclypeus in lateral view distinctly swollen, with a broadly rounded frontal margin. Head shaped as in the foregoing species. Distance between lateral ocelli 0.9-1.1 × as long as distance between eye and lateral ocellus. Head 1.0-1.2 × as long and 0.4 × as wide as vertex lobes between the eyes.

Thorax: Pronotum light ochraceous unspeckled, greenish in a medial band and on pronotum collar, though reddish brown, brown speckled between the medial fissures in one of the specimens. Pronotum 0.4-0.5 × as long as width of pronotum collar. Mesonotum grey-green with ochraceous cruciform elevation and unspeckled. In the red-brown specimen mesonotum red tinged in front of the reddish cruciform elevation and in two lateral bands, brown speckled all over, two clear dark spots in front of the elevation. Length of mesonotum 1.7-1.8 × as long as width of pronotum collar.

Legs: Ochraceous, unspeckled.

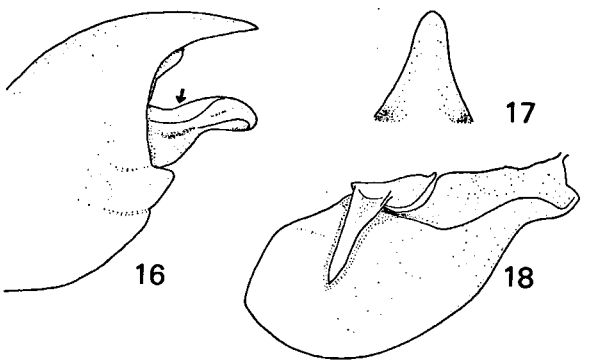
Tegmina and wings: Hyaline, veins ochraceous with traces of red in the red-brown specimen only. The 8th apical area of tegmen 3.4-3.8 × as long as wide, 3rd ulnar area 3.3-4.2 × as long as wide. The base of the 3rd apical area of tegmen slightly proximad to that of the first.

Tymbal organs: Six sclerotized transverse ridges run across the whole tymbal from the dorsal to the ventral margin. The most proximal ridge narrows considerably towards the ventral tymbal margin. Six short intercalary ridges seem to form a band across the tymbal. Traces of bright red dorsally between the ridges visible in the red-brown specimen only.

Opercula (fig. 18): Oval, flat against the body and almost completely covering the tymbal cavity, its medial margin reaching the 2nd abdominal sternite. A vague crest runs to about halfway along the broadly rounded posterior margin. The posterior margin turns medially abruptly back towards the base of the operculum so that the operculum is slightly pointed mediad. Lateral part of the right-angled lateral crest very short and rising high over the basal part of operculum.

Abdomen: Pale green almost unspeckled, the posterior margins of segments light ochraceous. The ventrolateral row of dark spots absent or vaguely visible as lighter coloured blots. No, or very vague, darkened mediodorsal band, but a very clear grey medioventral band. The red-brown specimen however, does show all characteristics of this group; the margins of segm. 3-7 are bright red while the ventrolateral row of dark spots on segm. 3-8 is, though only vaguely visible, present. In this specimen too, the ventromedial line slightly darkened. Length of tergite 1 mediodorsally about 1/3 of that of tergite 2. Tergite 1 not extending under the metanotum.

Genitalia (figs. 16-17): The caudodorsal beak is stout, broad at its base, pointed at its apex and about as long as the claspers. The lateral lobes of the pygofer bear almost conical, but apically bluntly rounded protuberances, that distinctly extend beyond the pygofer margin. The clasper in lateral view is slender and almost



Figs. 16-18. *Baeturia schulzi*; Male lectotype: 16, genitalia in lateral view; 17, caudodorsal beak in dorsal view; 18, operculum in ventral view.

straight towards its apex. At about one third from its apex the dorsal margin is inflated laterally, giving rise to an almost flat area on the dorsolateral edge of the clasper (see arrow). Dorsally, proximad to this area, and ventrally the clasper broadens gradually to its base, dorsal margin concave and ventral margin convex.

Measurements: Body length: 19.8-22.0 mm ($\bar{x}$ 21.0 mm); tegmen length: 19.8-23.6 mm ($\bar{x}$ 21.9 mm); pronotum length: 2.3-2.8 mm ($\bar{x}$ 2.4 mm); mesonotun length: 3.7-4.3 mm ($\bar{x}$ 4.0 mm); head width: 3.7-4.1 mm ($\bar{x}$ 4.0 mm); width of pronotum collar: 5.0-5.6 mm ($\bar{x}$ 5.3 mm).

Distribution: Maluku, Buru Island.

Remarks: *Baeturia schulzi* was originally described as greenish. Though Schmidt recognized a colour difference from green to pale ochraceous, he decided that the green colour was original and considered the pale ochraceous variety largely due to decoloration in alcohol. Those parts Schmidt described as green are only pale greenish now, of course further decolouration by influence of light might have taken place during the last 60 years. The reddish brown specimen in the British Museum however, though in all morphological characters identical to the *B. schulzi* types, shows all of the colour patterns characteristic of this group of *Baeturia*. The colouration of this specimen must probably be regarded more natural and any green colouration due to colour changes. The fact that the most intensely coloured parts in this specimen correspond with the lightest parts in the green specimens is in accordance with this supposition.

Baeturia quadrifida (Walker, 1868)
(Figs. 19-23, 28)

Cicada quadrifida Walker, 1868: 93; Distant, 1892: XIV, 148, 149 (in synonymy of *B. conviva*); Horváth, 1900: 642 (in synonymy of *B. conviva*); Distant, 1906: 156 (in synonymy of *B. conviva*); Metcalf, 1963: 247 (in synonymy of *B. conviva*);

Baeturia quadrifida; Blöte, 1958: 266-268, fig. 6; Duffels & Van der Laan, 1985: 254;

Baeturia hirsuta Blöte, 1960: 69, fig. 16 (partim: Etnabaai and Dor[eh]) (n. syn.); Duffels & Van der Laan, 1985: 252.

Synonymy: *Baeturia quadrifida* has frequently been synonymized with *B. conviva*. From the here presented descriptions however, it will be clear that we deal with two distinct species.

B. hirsuta Blöte was described after two male specimens. Comparison of the holotypes of *quadrifida* and *hirsuta* revealed that *hirsuta* is identical with *quadrifida*. The paratype of *B. hirsuta* from "Dor" also belongs to *quadrifida*. A third specimen without locality label mentioned by Blöte as belonging to *B. hirsuta* but not included in the type series, was found to belong to *B. hardyi*, a new species from Roon island described in the next pages.

Material examined: IRIAN: ARU: Aroe eilanden, Manoembai en omgeving, Snellius exp., 11-14.x.1929, 1♂, 1♀, RMNH; "Aru" (written, round label)/"67/66" (written, round label)/"Wallace" (print)/"*quadrifida*" (written) /"Type" (print, round label, green margin), ♂ holotype *Cicada quadrifida* Walker, BMNH; Aru, Wallace, det. *exhausta*, det. *Parnisa*, 1♂, BMNH; Isole Aru, Wokam, O. Beccari, 1873, 1♂, BMNH; NEW GUINEA (W): New Guinea, 29.x.1944, 1♂, BPBM; Dor [Manokwari], Wallace, 1♂ paratype *B. hirsuta* Blöte, BMNH; Etnabaai, New Guinea exp. KNAG [Koninklijk Nederlands Aardrijkskundig Ge-

nootschap], 21.xi.1939, ♂ holotype *Baeturia hirsuta* Blöte, RMNH.

Description

Body of males yellow-greenish, in the Etnabaai specimen dark brown; the female more ochraceous. Abdomen in males 1.2-1.6 × as long as head and thorax, in the female 1.4 ×. Tegmen in males 0.1 to 0.2 × as long as total body length, in the female 0.4 ×. Head 0.8 × as wide as pronotum collar. Female slightly smaller than males, but with a larger, more robust, head and thorax and larger tegmina.

Head: Light ochraceous, unspeckled in some, to slightly speckled on vertex lobes between eyes and lateral ocelli and on postclypeus in others. Postclypeus in dorsal view broadly rounded, almost triangular and not dinted in the dorsal plane. Postclypeus 2.2-2.4 × as wide as long, in lateral view distinctly swollen, with a broadly rounded frontal margin. Female head distinctly broader than that of male. Distance between lateral ocelli 1.1-1.2 × as long as distance between eye and lateral ocellus. Eyes 1.4-1.5 × as wide as vertex width between the eyes. Head 1.1-1.3 × as long and 0.4 × as wide as vertex width between the eyes.

Thorax: Pronotum ochraceous, unspeckled or slightly brown speckled in a medial band between the medial furrows. Collar a little lighter coloured. Pronotum 0.4 × as long as width of pronotum collar. Mesonotum castaneous to grey-green, dark blots in two mediolateral bands. Two dark spots in front of cruciform elevation vaguely discernable in some of the specimens only. Mesonotum 0.6-0.8 × as long as width of pronotum collar.

Legs: Ochres-green, unspeckled.

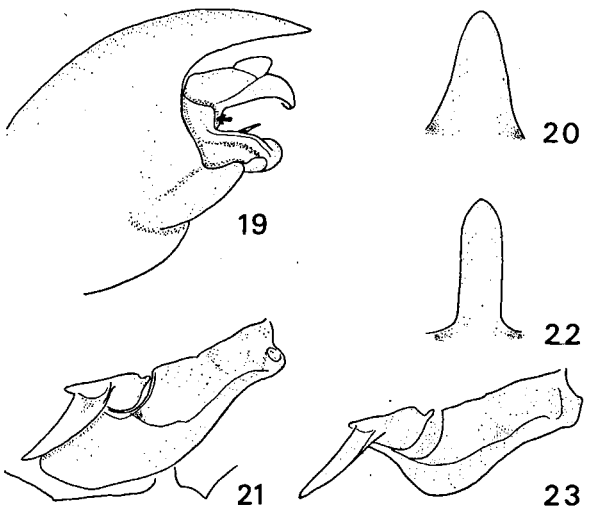
Tegmina and wings: Hyaline, veins ochraceous. The 8th apical area of tegmen 2.8-3.1 × as long as wide. 3rd ulnar area 4.3-5.4 × as long as wide. The base of the 3rd apical area of tegmen lies laterad to that of the first.

Tymbal organs: Six sclerotized transverse ridges run across the whole tymbal from the dorsal to the ventral margin. The most proximal of these ridges narrows considerably towards the ventral tymbal margin. A 7th ridge is discernable close on and hardly separated from the frontal tymbal margin; this ridge only runs to about halfway the tymbal and does not reach the ventral margin. The short intercalary ridges are only vaguely visible. The specimen from Etnabaai shows large dark blots on its tymbals, these blots extend over the ridges. Traces of red visible dorsally between the ridges. Tymbal organ distinctly smaller than in the foregoing species, about 2/3 the size.

Opercula: Male operculum (fig. 21) short, oval and erect, not covering the tymbal cavity. Operculum does not reach the 2nd abdominal sternite in most specimens. Medial margin narrowly rounded, operculum almost pointed medially. Posterior margin straight, abruptly bending towards medial tip of operculum. Lateral part of the right-angled lateral crest very short and distinctly rising from the basal part of operculum. Meracanthus distinctly longer than operculum. The female operculum (fig. 23) is rudimentary, sickle shaped, erect and slightly longer than in *B. conviva*. A distinct crest runs along its posterior margin.

Abdomen: Male abdomen light yellow-greenish, almost transparent, but chestnut in the Etnabaai specimen. A mediodorsal line slightly darkened with brown speckles, in one of the specimens only. The posterior margins of segm. 2-8 darker ochraceous coloured. The ventrolateral row of dark spots only vaguely discernible; one of the Aru specimens shows only one very clear spot on segm. 3. Length of tergite 1 mediodorsally about 1/3 that of tergite 2. Tergite 1 partly, to almost completely hidden under metanotum. Female abdomen yellowish brown, almost unspeckled. Segmental margins darker ochraceous and ventrolateral row of dark spots not visible. Caudodorsal beak (fig. 22) slender, pointed at the apex. Ovipositor sheaths reaching just beyond caudodorsal beak.

Male genitalia (figs. 19-20): Caudodorsal beak stout, broad at its base, about as long as the claspers and pointed at the apex. The lateral lobes of the pygofer bear conical, slightly upcurved protuberances, that distinctly extend



Figs. 19-23. *Baeturia quadrifida*; 19-21, male from Aru: 19, genitalia in lateral view; 20, caudodorsal beak in dorsal view; 21, operculum in ventral view; 22-23 female from Aru: 22, caudodorsal beak in dorsal view; 23, operculum in ventral view.

beyond the pygofer margin and are pointed at the apex. Clasper in lateral view characterized by the almost wing-like expansion of its dorsal crest. This feature is most clear in the specimen from Manoembai, which is depicted in fig. 19 and, though not so conspicuous, c[illegible] recognizable in all other specimens. The clasper is straight towards, and globularly rounded at its apex. Dorsally the clasper broadens abruptly at its base, giving rise to a heel-like structure (see arrow).

Measurements: Body length ♂: 16.8-20.0 mm ($\bar{x}$ 18.0 mm) ♀: 16.0 mm; tegmen length ♂: 18.5-20.1 mm ($\bar{x}$ 19.5 mm) ♀: 22.9 mm; pronotum length ♂: 2.3-2.5 mm ($\bar{x}$ 2.4 mm) ♀: 2.6 mm; mesonotum length ♂: 3.6-3.9 mm ($\bar{x}$ 3.8 mm) ♀: 3.7 mm; head width ♂: 4.0-4.3 mm ($\bar{x}$ 4.2 mm) ♀: 4.3 mm; width of pronotum collar ♂: 5.1-5.4 mm ($\bar{x}$ 5.2 mm) ♀: 5.8 mm.

Distribution: Aru islands and the Vogelkop peninsula of New Guinea.

Baeturia hardyi n. sp.
(Figs. 24-28)

This species is very similar to *B. quadrifida*. It can only be distinguished from *quadrifida* by its clasper-shape and the narrower, more erect operculum. The clasper lacks the wing-like structure characteristic of *B. quadrifida*, but has instead a more rounded dorsal crest along its dorsal margin.

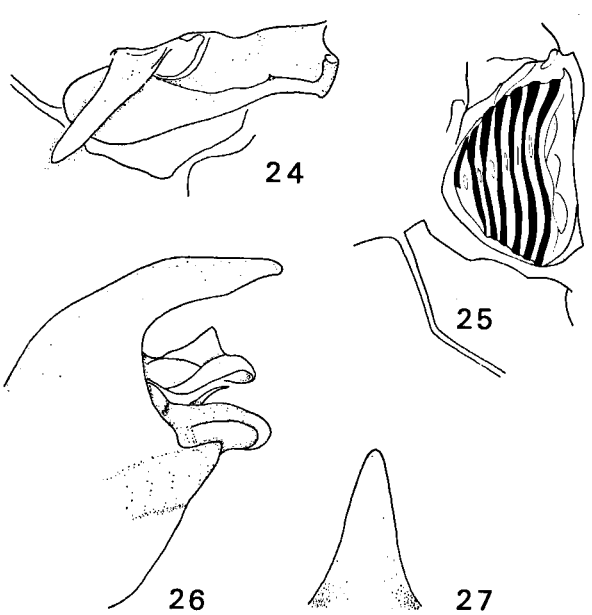
This species is described after two specimens only: the holotype from Roon island, Geelvink Bay and a specimen without locality.

Types: Holotype: "Roon" (written) "Fruhstorfer" (print); "Distant coll. 1911-383" (print); "12" (print), ♂, BMNH; paratype: without locality label, Det. *B. hirsuta* [by Blöte], 1 ♂, RMNH.

Description

Body red to greenish. Abdomen 1.4 × as long as head and thorax. Tegmina 1.1 × as long as total body length. Head 0.7-0.8 × as wide as width of pronotum collar.

Head: Light ochraceous, orange-tinged, unspeckled in holotype but with some dark blots on vertex and postclypeus in the paratype. Postclypeus on dorsal view broadly rounded, almost flattened frontally, not dented in the dorsal plane. The postclypeus is 1.9-2.1 × as



Figs. 24-27. *Baeturia hardyi*; male holotype: 24, operculum in ventral view; 25, tymbal in lateral view; 26, genitalia in lateral view; 27, caudodorsal beak in dorsal view.

wide as long. In lateral view postclypeus distinctly swollen, with broadly rounded frontal margin. Shape of head as in *B. qudrifida*. Distance between lateral ocelli 0.9-1.1 × the distance between eye and lateral ocellus. Eyes 1.5 × as wide as vertex width between the eyes. Head 1.2-1.3 × as long and 0.4 × as broad as vertex width between eyes.

Thorax: Pronotum ochraceous, reddish tinged, unspeckled in holotype. Slightly speckled in medial band and on pronotum collar in paratype. Pronotum 0.5 × as long as width of pronotum collar. Mesonotum grey-brown, red-tinged in front of reddish cruciform elevation and in lateral bands. Two dark spots in front of this elevation most clear in paratype. Mesonotum 0.6-0.8 × as long as width of pronotum collar.

Legs: Ochraceous, unspeckled.

Tegmina and wings: Hyaline, veins reddish. The 8th apical area of tegmen 3.0-3.1 × and 3rd ulnar area 4.4-4.8 × as long as wide. The bases of the first and 3rd apical area of tegmen at the same distance from the tegmen base.

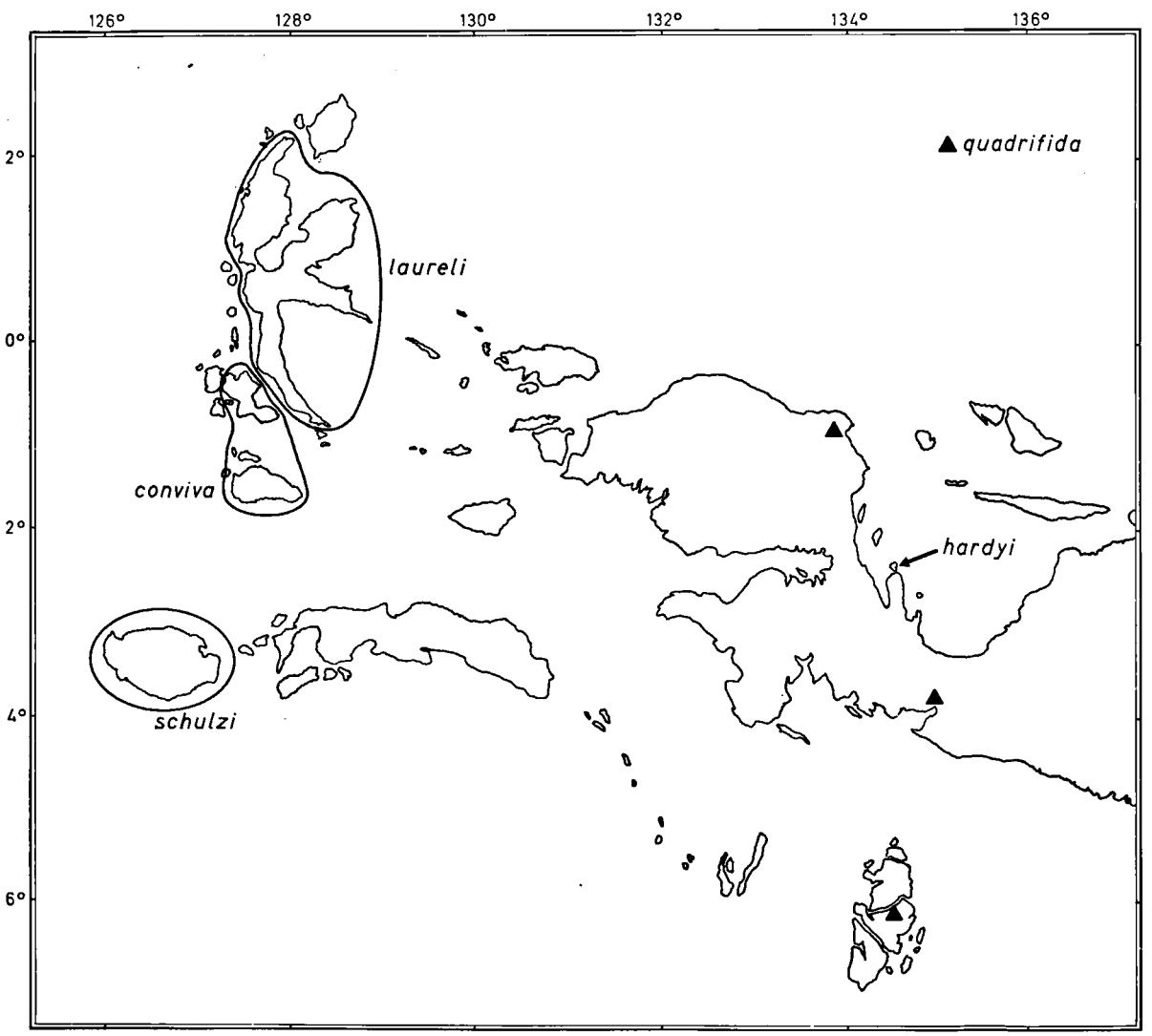


Fig. 28. Distributions of the species belonging to the *conviva* group: *B. conviva*, *B. laureli*, *B. schulzi*, *B. quadrifida* and *B. hardyi*.

Tymbal organs (fig. 25): as in *B. quadrifida*. Six sclerotized ridges run across the tymbal from the dorsal to the ventral margin. The most proximal of these ridges narrows considerably towards the ventral tymbal margin. A 7th ridge, close on and hardly separated from the proximal tymbal margin, runs only to about halfway the tymbal and does not reach the ventral margin. Six short intercalary ridges in between the frontal tymbal margin and each successive ridge, seem to form a band on the tymbal. Traces of bright red visible dorsally between the ridges. Like in *quadrifida*, the tymbal is smaller, about 2/3 the size, than in the first three species described.

Operculum (fig. 24): Closely resembling that of *B. quadrifida*, seeming somewhat narrower and more erect however. The operculum does not reach the 2nd abdominal sternite, does not cover the tymbal cavity and is shorter than the meracanthus. Its posterior margin almost straight to a point where it abruptly bends to the straight medial margin. Lateral part of the right-angled lateral crest long and distinctly rising from the basal part of operculum.

Abdomen: Reddish to greenish brown and almost transparent. Mediodorsal line slightly darkened with brown speckling. The posterior margins of segm. 3-7 bright red. A clear ventrolateral row of dark spots on segm. 3-8 (much clearer than in *B. quadrifida*). The spots on segm. 3 and 8 larger and darker than on the segments in between. Length of tergite 1 mediodorsally about 1/3 that of tergite 2. Tergite 1 partly hidden under metanotum.

Genitalia (figs. 26-27): Pygofer as in *B. quadrifida*. Clasper in lateral view, very slender, almost straight to the apex. A rounded crest runs along its dorsal margin. The clasper broadens less abruptly to its base than in *B. quadrifida*, giving rise to a less prominent dorsal heel. Ventrally the clasper broadens gradually to its base. By a slight torsi in the clasper, the clasper hollow is bent to a more lateral position.

Measurements: Body length: 18.7 and 19.6 mm; tegmen length: 21.0 and 22.1 mm; pronotum length: 2.5 and 2.7 mm; mesonotum length: 3.9 mm both; head width: 4.0 and 4.3 mm; width of pronotum collar: 5.2 and 6.0 mm.

Distribution: Roon island, Geelvink Bay.

Etymology: See under *B. laureli*.

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