

THE NYMPHAL STAGES OF SOME AUCHENORRHYNCHA ASSOCIATED WITH RICE
IN SOUTH EAST ASIA

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ABSTRACT

The nymphal stages of planthoppers and leafhoppers commonly associated with rice in Asia are described and illustrated. Keys are given to separate the five nymphal instars, to separate sexes, and to distinguish common species at the fifth instar. The following species are dealt with: Nisia nervosa (Motsch.) (Meenoplidae); Nilaparvata lugens (Stal) (Delphacidae); Sogatella furcifera (Horvath) (Delphacidae); Sogatodes pusanus (Distant) (Delphacidae); Laodelphax striatellus (Fallén) (Delphacidae); Cofana spectra (Distant) (Cicadellidae); Cofana unimaculata (Signoret) (Cicadellidae); Thaia Ghauri sp. (Cicadellidae); Macrosteles striifrons (Anufriev) (Cicadellidae); Cicadulina bipunctella (Matsumura) (Cicadellidae); Recilia dorsalis (Motsch.) (Cicadellidae); Nephotettix cincticeps (Uhler) (Cicadellidae); Nephotettix nigropictus (Stal); Nephotettix malayanus Ishihara & Kawase; Nephotettix virescens (Distant).

INTRODUCTION

In spite of the great importance of a variety of leafhopper and planthopper species as pests of rice in South East Asia, there are few published accounts of the nymphal stages as a means to their early identification. The present work will enable the identification of nymphal stages of the more common species. This study has been made while preparing a larger work (Claridge & Wilson, in prep.) which will deal with the identification of the more common species associated with rice in South East Asia.

The paper is divided into three sections: 1) the separation of nymphal instars, 2) the development of external genitalia in the nymphs, and 3) descriptions of the more common species and a key (based on 5th instars) to separate them. Details of the general morphology of Auchenorrhyncha nymphs have been omitted for reasons of space, but can be found in Vilbaste (1968 for Delphacidae, 1982 for Cicadelloidea).

STUDY AREA, MATERIALS AND METHODS

The majority of species figured here have resulted from field collections in Australia, Indonesia, Malaysia, the Philippines and Thailand. Some of these have been maintained in culture in Cardiff, U.K., while others have been drawn from field-collected specimens preserved in alcohol.

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It is intended that the work be relevant to as wide an area of Asia as possible. To this end species such as Laodelphax striatellus (Fallén) and Nephotettix cincticeps (Uhler) are included, although they are not widely distributed in tropical Asia, but appear confined to more northerly countries such as Japan, Taiwan and China.

Drawings were made using a camera lucida attachment to a Wild microscope. The size range between the largest and smallest nymphs figured has necessitated drawings at different magnifications. Scale lines are indicated on each drawing. Only fifth (final) instar nymphs have been figured, since in this stage the maximum development of characters used for their separation is achieved.

Nomenclature follows that of Claridge & Wilson (1982).

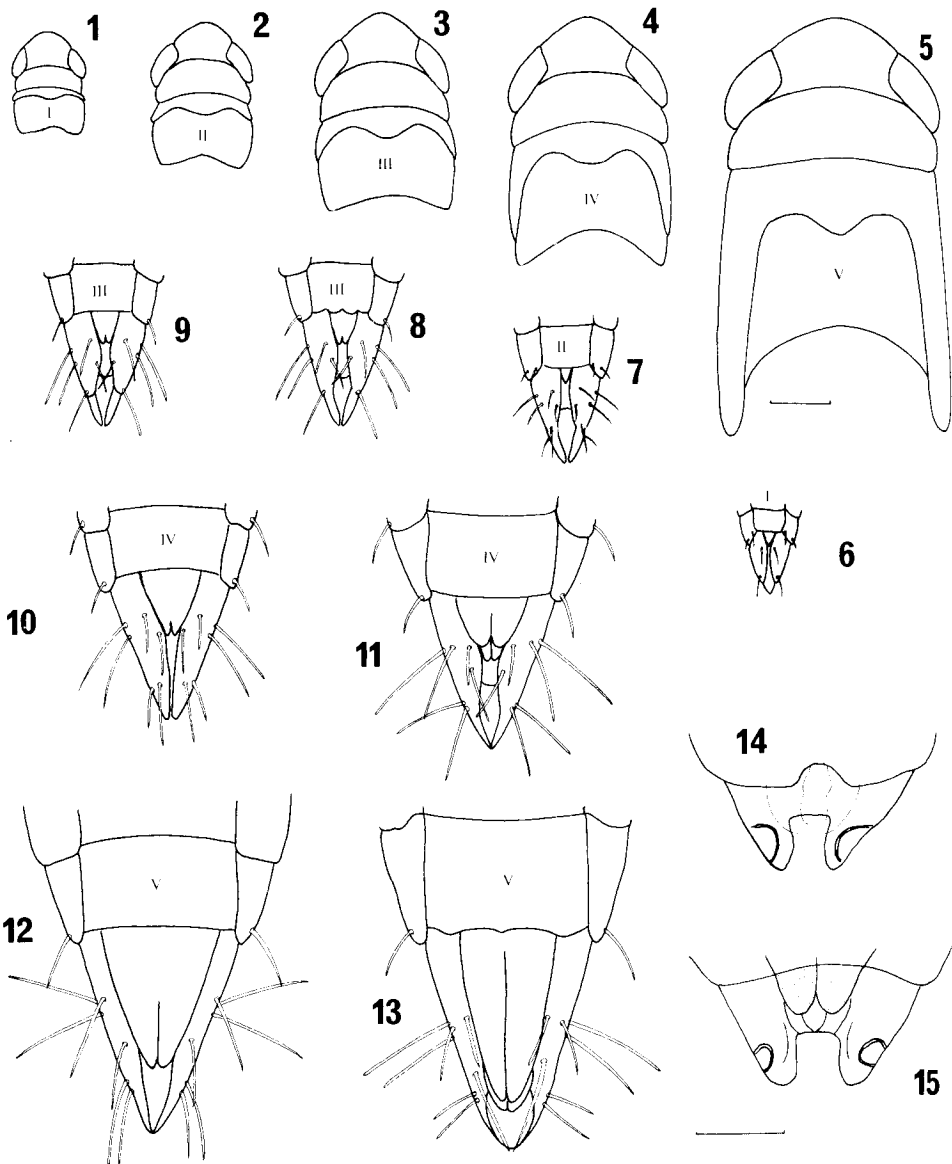
RECOGNITION OF NYMPHAL INSTARS

While the thorax offers few diagnostic features for species determination, the nymphal instars may be readily separated by the relative development of the wing pads. The nymphal stages of a rice feeding Cicadellid Nephotettix cincticeps (Uhler) were differentiated using this character by Mochida (1970). Keys to separate instars have been given by Kathirithamby (1974, 1981), Vilbaste (1982) and Walter (1975). In using these works it is apparent that it can be more difficult to separate nymphal instars by using a key than by illustrations alone. However, it has been thought necessary to provide one here and the following key is based partly on features of the above. Where nymphs have been preserved in alcohol, swelling may occur and the relative lengths of wing pads in relation to abdominal segments may prove to be inaccurate. Where possible these characters have been avoided.

Only drawings of a Cicadellid, Nephotettix virescens (Distant) are given (Figures 1-5) but the relative development of the meso- and metathoracic wing pads applies equally to all Auchenorrhyncha nymphs.

KEY TO SEPARATE NYMPHAL INSTARS

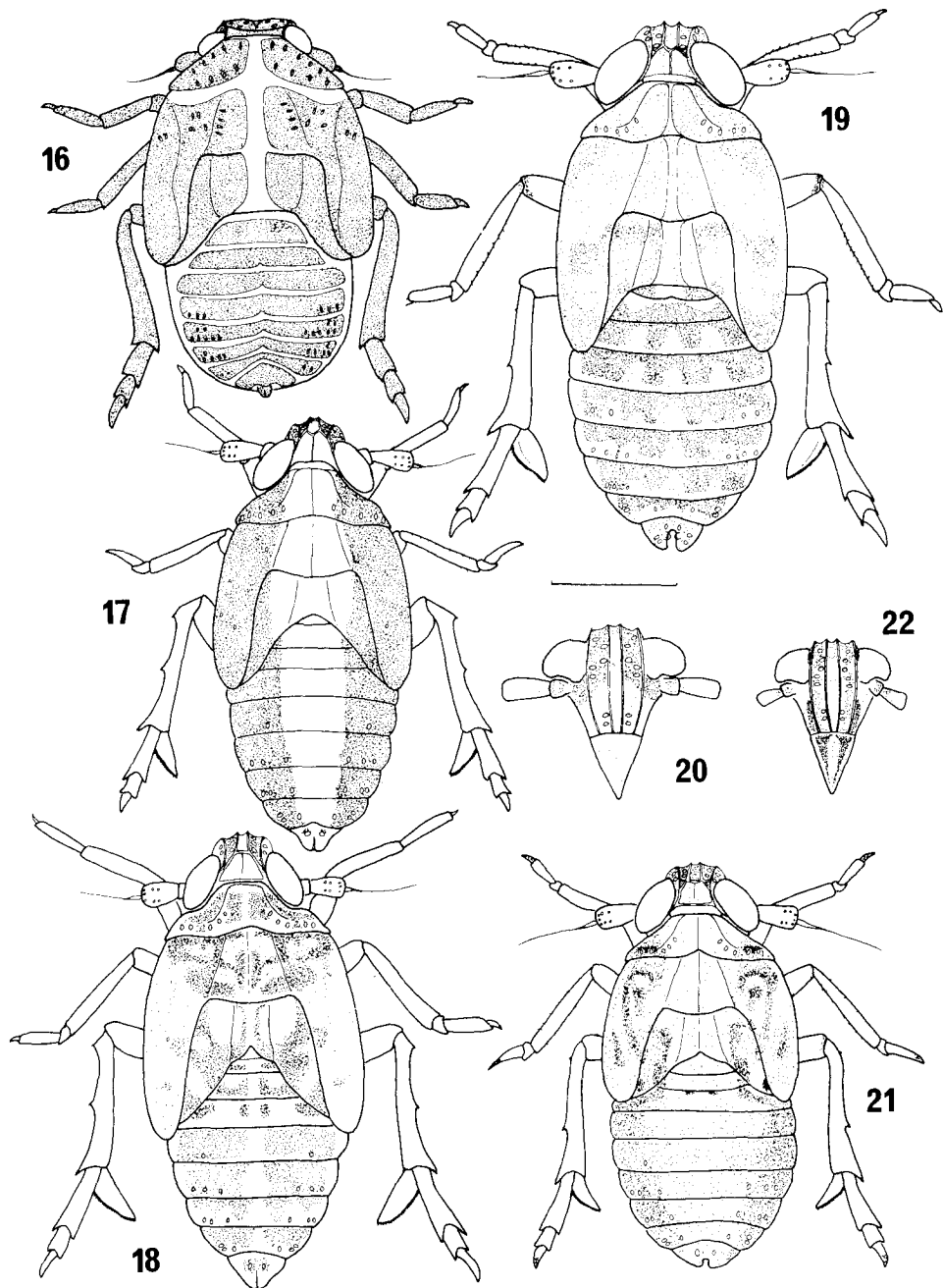
- 1 Mesonotal wing pads showing little development. Length of mesonotum (a on Figures 1,2) less than length of pronotum (length b) 2
- Mesonotal wing pads well developed. Length of mesonotum (a on Figs. 3,4,5) equal or greater than length of metanotum (length b) 3
- 2 Posterior margin of mesonotum straight or (Figure 1) with lateral margins shorter than median lobe Instar I
- Posterior margin of mesonotum showing lateral development of wing pads, which are approximately same length as median lobe (Figure 2) Instar II



Figs. 1-5: *Nephrotettix virescens*, head and thorax; I-V instar. scale line = 0.25 mm.

Figs. 6-13: *Nephrotettix virescens*, ventral view of tip of abdomen. 6, instar I; 7, instar II; 8, instar III ♂; 9, instar III ♀; 10, instar IV ♂; 11, instar IV ♀; 12, instar V ♂; 13, instar V ♀. scale line = 0.25 mm.

Figs. 14-15: *Nilaparvata lugens*, ventral view of tip of abdomen. 14, instar V ♂; 15, instar V ♀. scale line = 0.25 mm.



Figs. 16-22: dorsal view of V instar nymphs. scale line 0.5 mm.
 16, *Nisia nervosa*; 17, *Sogatodes pusanus*; 18, *Sogatella furcifera*; 19, *Nilaparvata lugens*; 20, *N. lugens* face; 21, *Laodelphax striatellus*; 22, *L. striatellus*, face.

KEY TO SEPARATE SEXES OF CICADELLIDAE (THIRD TO FIFTH INSTARS)

- 1 Single triangular plate-like structure (subgenital plate) on sternum IX, with short slit from the apex towards the base (Figures 8,10,12) male
- Paired outgrowths on sternum VIII and sternum IX in instar III (Figure 9). In instars IV and V outgrowths from sternum VIII extend over those from sternum IX (Figures 11,13), apical slit longer, and in instar V extends almost to base of outgrowths (Figure 13) female

KEY TO FIFTH INSTAR NYMPHS AND DESCRIPTIONS

Lengthy descriptions of individual species have not been given in this section, but only those features which will serve for their identification. Only the most common species are included and inevitably some individuals will be found on rice which cannot easily be identified. Future progress will rely on breeding experiments to associate nymphs and adults of those species not yet included.

In the key morphological features such as chaetotaxy have been used in preference to colour characters, since it is considered that these may be less variable than some colour patterns over a wide geographical distribution. However, some species are certainly less variable for colour than others, and where colour patterns or markings have been found to be reliable they have been included where convenient.

The nymphs of the families comprising the Fulgoromorpha are characterised by the possession of sensory pits. These pits consist of round or elliptical depressions in the cuticle, in one edge of which is inserted a hair-like structure which lies horizontally across the depression. The pattern of sensory pits on the head, thorax and abdomen of the four species of Delphacidae included here has been investigated. Vilbaste (1968) produced a preliminary key to the nymphs of Northern European Delphacidae in which the arrangement and number of sensory pits provided the most reliable characters for their identification. While some small differences were found, especially in the positions of the sensory pits on the face (see Figures 20,22) these were not the easiest of characters to use for these species and have not been used in the key.

While the key has been prepared for use in the identification of fifth instar nymphs, some of the characters may apply equally to earlier instars.

KEY TO NYMPHS (FIFTH INSTARS) OF COMMON RICE FEEDING AUCHENORRHYNCHA

- 1 Postclypeus distinct from frons (Figure 20,22). Pedicel (second segment) of antenna enlarged or bulbous, often with wart-like sensillae. Body with sensory pits Fulgoromorpha (2)
- Postclypeus not distinct from frons. Pedicel (second segment) of antenna not or scarcely thicker than scape (first segment), no wart-like sensillae. Body without sensory pits Cicadomorpha (6)

- 2 Movable spur at distal end of head tibia (Figures 17,18, 19,21) *Delphacidae* (3)
- Spur absent. Head, thoracic plates and abdominal tergites light to dark grey in colour (Figure 16). Generally rounded appearance *Meenoplidae*:
..... *Nisia nervosa* (Motschulsky)
- 3 Prominent brown lateral stripes on dorsal surface of body (Figure 17), ground colour yellow
..... *Sogatodes pusanus* (Distant)
- Otherwise marked (Figures 18,19,21) (4)
- 4 Head narrow; vertex plate about as long as wide (Figure 18). Dorsal surface of thorax and abdomen marked with various amounts of grey and white markings on a white or creamy white background *Sogatella furcifera* (Horvath)
- Head broad; vertex plate wider than long (Figures 19,21). Dorsal surface more generally pigmented with brown and yellow background colour (5)
- 5 Larger species (head width 0.52 - 0.68mm), post-clypeus pale yellow/brown even in specimens heavily marked with brown on dorsal surface (Figure 19). Dominant species in tropical Asia *Nilaparvata lugens* (Stal)
- Smaller species (head width 0.50 - 0.54mm). Post-clypeus marked with dark brown (Figure 22). Appears restricted in distribution to northern parts of Asia, especially important in Japan, Taiwan, Korea, S. China
..... *Laodelphax striatellus* (Fallén)
- 6 Dorsal surface of body without spines (setae) except for short spines present on last segment (Figure 23). Ocelli prominent on crown of vertex between eyes (Figures 23,24) (7)
- Dorsal surface of body with prominent spines on abdominal segments (Figures 25-34), although may be restricted to last segments (e.g. Figure 26), may also be present on thorax and head (Figure 25). Ocelli not as above (8)
- 7 Mostly light yellow/brown, with darker brown stripes on tergites, and on wing pads (Figure 23). Vertex with anterior margin rounded. Ocelli distinct (Figure 23) ..
..... *Cofana spectra* (Distant)
- Mostly pale green, tinged with brown along margins of wing pads. Vertex with anterior margin angularly produced (Figure 24). Ocelli indistinct (Figure 24) ...
..... *Cofana unimaculata* (Signoret)
- 8 Head and thorax (including wing pads) covered with prominent spines (Figure 25) *Thaia* sp.
(*T. ghauri* Dworakowska drawn)
- Head and thorax without such spines (Figures 26-34) (9)

- 9 Dorsal surface of abdominal segments with rows of prominent spines (Figures 29-34) (11)
- Dorsal surface of abdominal segments with prominent spines confined to last two or three segments (Figures 26-28) (10)
- 10 Prominent black spots on last segment (Figures 27,28), otherwise pale yellow (Figure 27) or with dark markings (Figure 28). Head unmarked
 Cicadulina bipunctella (Mats.)
- Vertex with two black spots (Figure 26)
 Macrosteles striifrons Anufriev
- 11 Distinct black or dark markings present on dorsal surface of body (12)
- Markings on dorsal surface more suffuse (Figure 29), (relatively pale species) Recilia dorsalis (Motsch.)
- 12 Last abdominal segment without dark markings on dorsal surface (Figure 31). Head with two distinct black spots on anterior margin of vertex (Figure 31). Face otherwise unmarked Nephotettix malayanus Ishihara & Kawase
- Last abdominal segment with dark markings (Figures 30, 32-34). Head unmarked (Figure 34) or with markings which extend onto face (Figures 32,33) (13)
- 13 Last two abdominal segments with dark stripes, one median on last segment, the other more or less well developed on posterior margin of segment forming a cross (Figures 32,33), other markings on dorsal surface more or less well-developed ... Nephotettix nigropictus (Stal)
- Markings on last two abdominal segments not as above, usually a form of dark spot on last segment (Figures 30,34) (14)
- 14 Dark spot on last segment small (Figure 34), remainder of body relatively unmarked, pale green/yellow in colour Nephotettix virescens (Distant)
- Dark spot on last segment very well developed (Figure 30), varying amounts of dark markings on rest of body
 Nephotettix cincticeps (Uhler)

DESCRIPTIONS

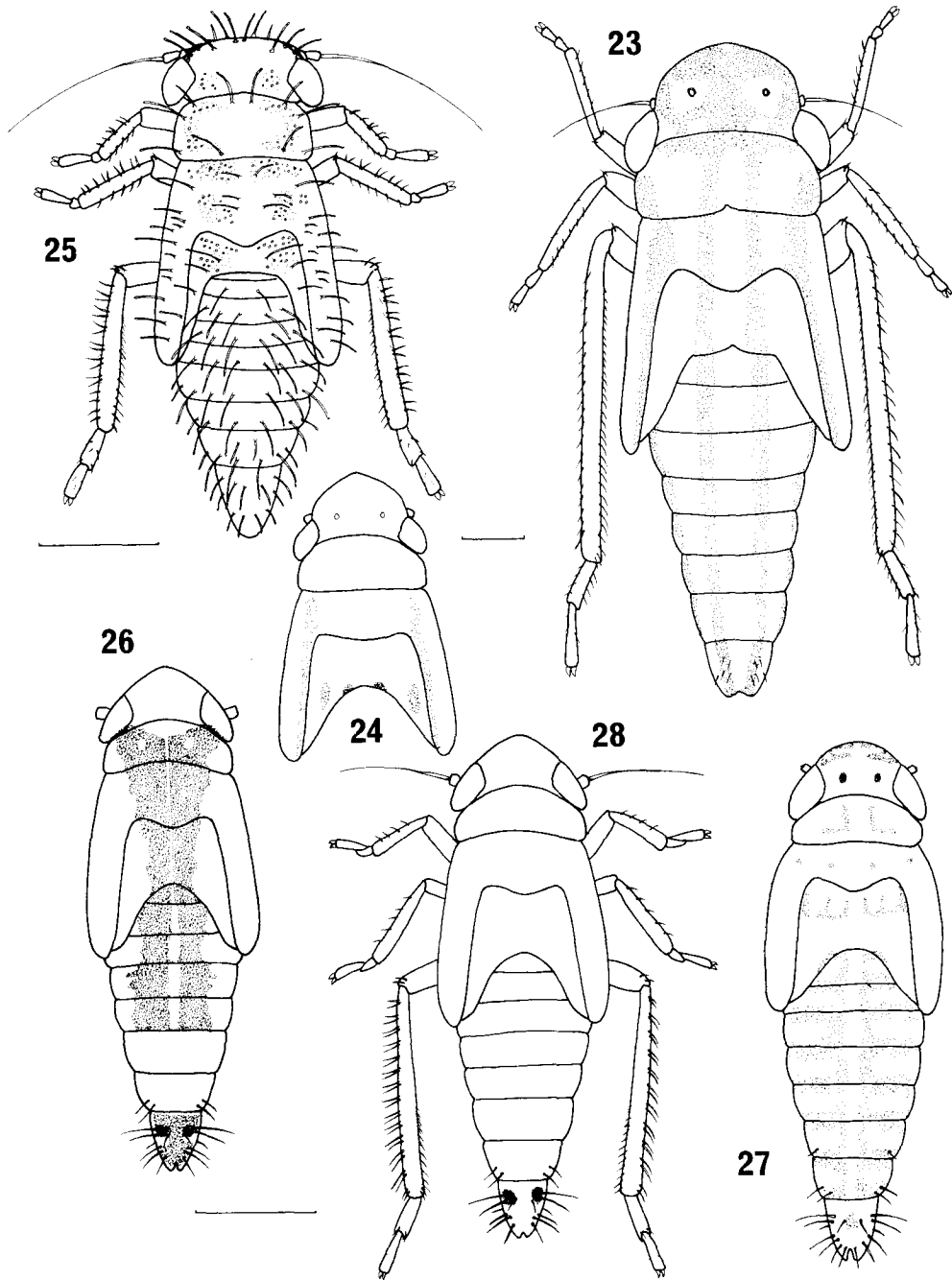
Fulgoromorpha

Family Meenoplidae

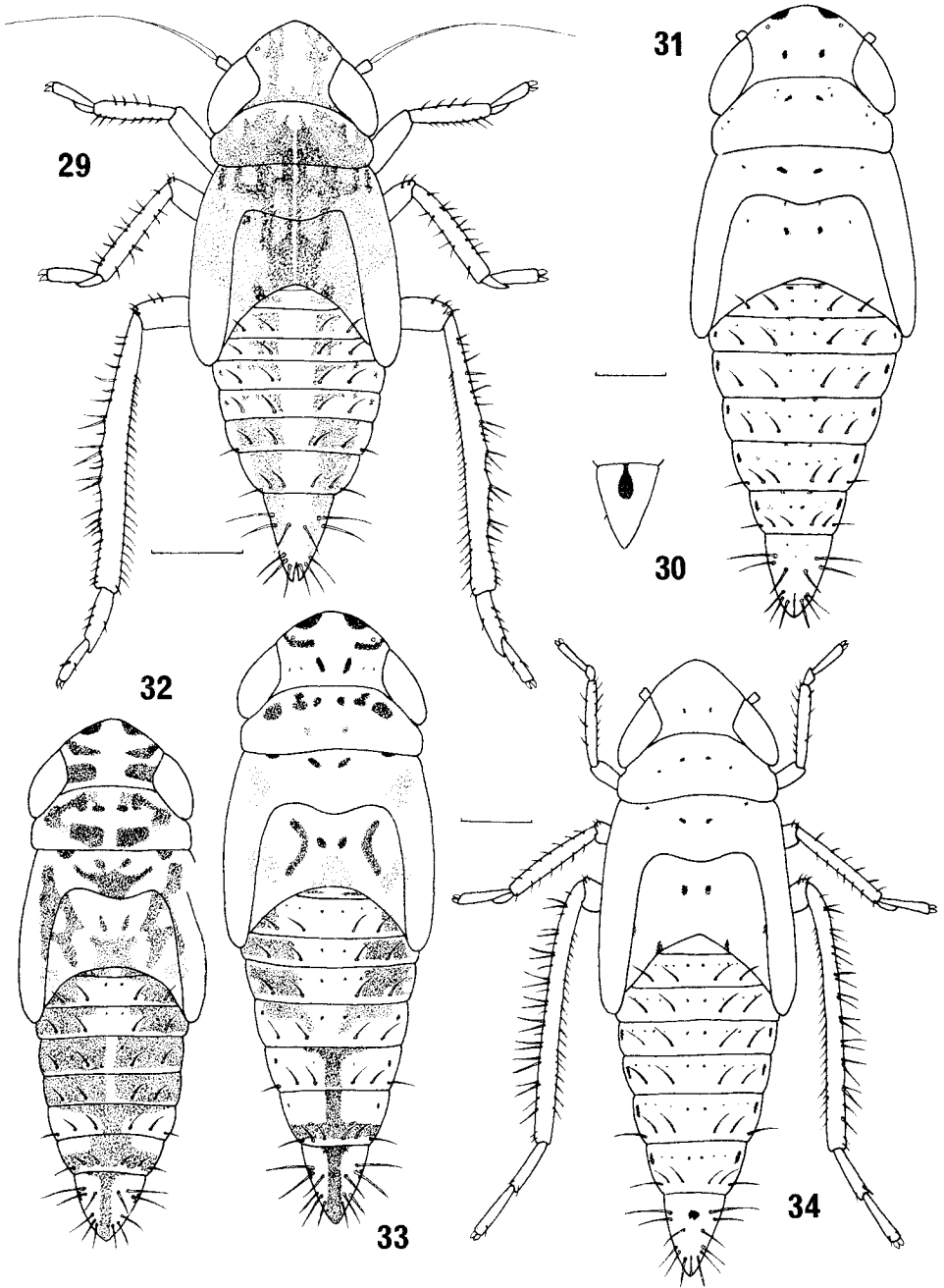
Nisia nervosa (Motschulsky) (= atrovenosa Lethierry) (Figure 16)

The only common Fulgoromorph species found in rice fields and which does belong to the Delphacidae. May be easily recognised by the absence of a tibial spur and the grey coloration of dorsal surface (Figure 16).

Material examined from: Philippines, Indonesia (Bali, Sulawesi).



Figs. 23-28: dorsal view of V instar nymphs. scale line = 0.5 mm.
 23, *Cofana spectra*; 24, *Cofana unimaculata*; 25, *Thaia gaurii*;
 26, *Macrosteles striifrons*; 27-28, *Cicadulina bipunctella*.



Figs. 29-34: dorsal view of V instar nymphs. scale line = 0.5 mm.
 29, *Recilia dorsalis*; 30-34, *Nephrotettix* species;
 30, *N. cincticeps*, final abdominal segment; 31, *N. malayanus*;
 32-33, *N. nigropictus*; 34, *N. virescens*.

Family Delphacidae "Planthoppers"

Sogatodes pusanus (Distant) "White-backed planthopper" (Figure 17)

Often commonly found on rice. Nymph may be recognised by the lateral dark stripes on the dorsal surface of the body.

Material examined from: Philippines.

Sogatella furcifera (Horvath) "White-backed planthopper" (Figure 18)

Common and important rice pest in Asia. Nymph illustrated by Nasu (1967, 1969). May be distinguished from N. lugens by its pale white background colour and by the narrow head (Figure).

Material examined from: Philippines, Indonesia, Australia.

Nilaparvata lugens (Stål) "Brown Planthopper" (Figures 19,20)

Most important Delphacid species attacking rice in Asia. Nymph illustrated by Nasu (1967, 1969) and by Kathirithamby (1981). It may be distinguished from other species by its pale yellow brown coloration with darker markings on the dorsal surface. It is considerably larger than the similar Laodelphax striatellus but confusion should not usually arise, since Laodelphax is rare in tropical areas, where N. lugens is dominant.

Material examined from: Philippines, Indonesia, Malaysia, Australia, Thailand, China, India.

Laodelphax striatellus (Fallén) "Smaller brown planthopper" (Figures 21,22)

May be distinguished from N. lugens by its generally smaller size. The specimens studied originated from Italy, but Nasu (1967, 1969) figures specimens from Japan which agree in general appearance with the Italian specimens but do appear to be darker in coloration.

Material examined from: Italy.

Cicadomorpha

Subfamily Cicadellinae

Cofana spectra (Distant) (Figure 23)

A large species, common on rice but also on grass species away from rice.

Material examined from: Philippines, Indonesia (Java).

Cofana unimaculata (Signoret) (= Kolla mimica Distant) (Figure 24)

Slightly smaller than C. spectra and less common. Nymph figured by Ishihara (1971) under the name Yasumatsuus mimicus.

Material examined from: Philippines, Indonesia (Java).

Subfamily Typhlocybinae

Thaia sp.: Thaia ghourii Dworakowska (Figure 25)

Nymph with distinctive long spines to dorsal surface. Thaia ghourii appears to be the common species on rice in Indonesia.

Material examined from: Indonesia (Java, Bali).

Subfamily Deltocephalinae

Macrosteles striifrons Anufriev (Figure 26)

Originally described from the Soviet Maritime Territory. Not widespread in tropical areas, but found commonly in the Philippines and rarely in Java. Other Macrosteles species may be found in more northerly areas such as Japan and China.

Material examined from: Philippines.

Cicadulina bipunctella (Matsumura) (Figures 27,28)

Two distinct colour forms (Figures 27, 28) are found in this species, as also reported by Ammar (1978), for specimens from Egypt. In the population examined here (from Bali, Indonesia) the two forms were present in both sexes and in approximately equal proportions.

Material examined from: Indonesia (Bali).

Recilia dorsalis (Motschulsky) "Zig-zag Leafhopper" (Figure 29)

Similar in general form to Nephotettix species but with dark markings on dorsal surface being generally more diffuse than those found in Nephotettix. Markings darker on thorax than abdomen.

Material examined from: Philippines.

Nephotettix Matsumura species "Green Leafhoppers"

Some members of this genus are very important pests of rice in Asia, and are vectors of rice virus diseases. The most common species in tropical Asia are N. virescens and N. nigropictus.

Nephotettix cincticeps (Uhler) (Figure 30)

An important pest species in Japan. Not examined for this study but included (Figure 30 of last abdominal segment) from the illustrations of Nasu (1967, 1969). Appears to differ from other species by the prominent black markings on the dorsal surface of the last abdominal segment (Figure 30).

Nephotettix malayanus Ishihara & Kawase (Figure 31)

Not common species on rice, and may be associated with Leersia sp. Nymph has distinct black spots on head (Figure 31) and lacks prominent markings on last abdominal segment (Figure 31).

Material examined from: Indonesia (Java), Australia.

Nephotettix nigropictus (Stal) (Figures 32,33)

Often darkly pigmented, particularly in the male (Figure 32), the female often paler than shown here (Figure 33). Even in pale specimens the distinctive markings of the last abdominal segments (as described in key) (Figures 32,33) are clear.

Material examined from: Philippines, Malaysia, Indonesia, Australia.

Nephotettix virescens (Distant) (Figure 34)

Often found together with N. nigropictus in rice fields, and may be distinguished by its paler coloration and absence of extensive areas of dark pigmentation. The small/dark spot on the dorsal surface of the last abdominal segment serves to separate the two species, as used by Ling (1968). The small size of the spot serves to separate the species from N. cincticeps.

Material examined from: Indonesia, Philippines, Malaysia.

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