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## The Oriental species of *Helopeltis* (Heteroptera: Miridae): a review of economic literature and guide to identification

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### Abstract

The taxonomy of the Oriental species of *Helopeltis* is revised and a review of the economic literature is given. An identification key is provided for the 14 recognized species, one of which, *H. sulawesi*, is described as new. A diagnosis and brief description is given for each species, as well as illustrations of useful taxonomic characters, information on distributions and host records, and a discussion of any known or suspected misidentifications. Lectotype designations are made for 13 nominal species and the following new synonymies are established: *H. bradyi* Waterhouse = *H. ceylonensis* De Silva, **syn. n.** and *H. romundei* Waterhouse, **syn. n.**; *H. cinchonae* Mann = *H. brevicornis* Poppius, **syn. n.**; *H. clavifer* (Walker) = *H. australiae* Kirkaldy, **syn. n.** and *H. niger* Walker, **syn. n.**; *H. cuneata* Distant = *H. elegans* Poppius, **syn. n.**; *H. fasciaticollis* Poppius = *H. pallidus* Poppius, **syn. n.** and *H. pallidiceps* Poppius, **syn. n.**; *H. theivora* Waterhouse = *H. oryx* Distant, **syn. n.** The somewhat obscure synonymy of *H. theobromae* Miller under *H. theivora* is confirmed. Two subgenera are recognized and diagnosed: *Afropeltis* **subgen. n.** (type species *Eucerocoris westwoodi* White), including all African species of the genus, and *Helopeltis sensu stricto*, containing the Oriental and Australasian species.

### Introduction

Plant bugs of the genus *Helopeltis* are serious pests of various cultivated plants in the Old World tropics. The damaging effects of these insects on tea plants in India was documented over a century ago in reports by Peal (1873) and Wood-Mason (1884). It was in these early accounts that the common names 'tea-bug' and 'tea-mosquito' were established, as well as various names referring to the damage that results from feeding, including 'tea-blight', 'mosquito-blight' and 'spot-blight'. Since the late 1800s over 100 species of plants have been reported as hosts for *Helopeltis* spp., including a number of major cash crops such as black pepper (*Piper nigrum*), cashew (*Anacardium occidentale*), cinchona (*Cinchona* spp.), cocoa (*Theobroma cocoa*), and tea (*Camellia sinensis*).

The genus has a palaeotropical distribution extending from West Africa to New Guinea and northern Aus-

tralia. Of the 40 recognized species, 26 are restricted to Africa, four are broadly distributed in the Oriental Region, four are endemic to the Philippine Islands, two are distributed throughout the Malay Peninsula, Sumatra and Java, and one species is endemic to each of the following areas: 1. South India and Sri Lanka. 2. Pulo Laut Island (south-east coast of Borneo). 3. Sulawesi. 4. New Guinea and northern Australia. The identity and distribution of *H. podagricus* A. Costa are unknown.

The African species of the genus were revised by Schmitz (1968), who conducted detailed morphological studies of the male and female reproductive systems and investigated numerous structures of the external morphology. Three additional species from West Africa were described by Schmitz in 1988. The Asian and Pacific members of the genus have never been the subject of a comprehensive taxonomic study, and no key exists that will allow for the identification of the species in this region. Many Oriental species are morphologically similar, and several of the broadly distributed taxa (e.g., *H. theivora* Waterhouse, *H. fasciaticollis* Poppius) are highly variable in overall size, coloration, and some

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structures of the external morphology such as the scutellar process. The apparent inability of early workers to recognize the extreme variation in some species has resulted in the description of many synonyms. Further, the widespread occurrence of misidentifications, particularly in the economic literature, means that a degree of caution must be used when considering the published accounts of some species. This is especially true for accounts of *H. antonii* Signoret in south India and Sri Lanka, since some of these almost certainly pertain to the externally similar species *H. bradyi* Waterhouse. References to *H. antonii* in Indonesia are incorrect, because this species is shown in the present study to be restricted to the Indian subcontinent. Additional information regarding misidentifications is provided in the species discussions that follow.

The primary objective of this study is to re-evaluate species limits in Oriental *Helopeltis*, based on all available morphological, biological and distributional information, and to provide a key that will facilitate species recognition in this economically important group of plant bugs. The paper also provides a review of the literature pertaining to the biologies, host plants, pest status and control of Asian species. Much of this literature deals with two major pest species, *H. antonii* and *H. theivora* (= *H. theobromae* Miller), but valuable information also has been published for *H. bradyi*, *H. cinchonae* Mann, and *H. clavifer* (Walker). The only comprehensive review of literature is by Devasahayam & Nair (1986) for *H. antonii*, and pertains mostly to the occurrence of this species on cashew in India (see also earlier review by Pillai *et al.*, 1976). Two other papers that provide information on a broad range of subjects are by Lever (1949) for *H. bradyi* and *H. cinchonae*, and Miller (1941) for *H. theivora*.

## Literature Review

### Biology

Like many groups of tropical Miridae, *Helopeltis* spp. exhibit a more or less continuous cycle of generations through the year. Das (1984) reported that in the tea-growing regions of north-east India, *H. theivora* reaches peak abundance in the period from June to September, with population levels gradually declining in November as cooler weather conditions prevail. Few adults are found on the tea plants during the winter months, but numbers start increasing again in March as nymphs from overwintering eggs begin attaining maturity (Das, 1984; Mann, 1902). On cocoa in Malaysia, population levels of *H. theivora* peak in October and are lowest in April/May (Tan, 1974a). In peninsular India, the build-up of populations of *H. antonii* on cashew in October/November is synchronized with the emergence of new foliage following the cessation of the monsoon rains. Peak abundance is reached in January/February when cashew trees are in full bloom, the insects remaining active on the plants until the onset of the monsoon rains in June (Devasahayam, 1985; Rajapakse & Jeevaratnam, 1983; Sundararaju, 1984). There is also evidence indicating that *Helopeltis* populations fluctuate in response to more localized and less regular climatic events, tending not to do well under conditions of heavy rain, high winds, or low

relative humidity (Betrem, 1950; Lever, 1949; Miller, 1941; Pillai *et al.*, 1976).

The eggs of *Helopeltis* spp. are white, ovo-elongate (slightly narrower apically) and laterally compressed apically, 1.0-1.2 mm long (Ambika & Abraham, 1979; Miller, 1941; Tan, 1974a). Two unequal respiratory horns (filaments) arise from the anterior end of the egg, these usually 0.4-0.5 mm long. The eggs are embedded in plant tissue singly or in small groups, usually with the operculum and respiratory horns exposed. The majority of species appear to have preferred oviposition sites depending on the host plant. On cocoa, *H. theivora* prefers the pods, but will occasionally oviposit on young shoots (Miller, 1941; Tan, 1974a), while on tea this species prefers new shoots and rarely the petioles and midribs of leaves (Das, 1984; Mann, 1902). *Helopeltis antonii* lays its eggs primarily on the young shoots, inflorescence stalks and developing nuts of cashew, but will sometimes accept the petioles and ventral midribs of leaves (Ambika & Abraham, 1979). Lever (1949) reported that both *H. bradyi* and *H. cinchonae* select young tea shoots for oviposition. Incubation periods vary depending on locality and season, but are generally in the range of 6-11 days. Much longer periods were noted for winter populations of *H. theivora* in north-east India (20-27 days) (Das, 1984) and for *H. bradyi* (13-16 days) and *H. cinchonae* (17-22 days) on winter tea in the Cameron Highlands, West Malaysia (Lever, 1949).

*Helopeltis* spp. have five larval instars (nymphs) that vary in size, colour and the development of certain body parts (e.g. antennae, wings). Descriptions and illustrations of the nymphal instars are provided by Ambika & Abraham (1979) for *H. antonii* and Miller (1941) for *H. theivora*. The rate of larval development is affected by climatic factors and/or rearing conditions such as temperature and relative humidity (Betrem, 1953), as well as the quality of the food source (Awang *et al.*, 1988). Most reported nymphal lifespans (first instar through fifth instar) are in the range of 9-19 days (Ambika & Abraham, 1979; Devasahayan, 1985; Miller, 1941; Smith, 1973; Tan, 1974a), but much longer periods have been reported for October-December populations of *H. bradyi* (27-43 days) and *H. cinchonae* (30-54 days) reared on tea in the Cameron Highlands (Lever, 1949), December/January populations of *H. theivora* (25-39 days) on tea in north-east India (Das, 1984), and for *H. antonii* (17-28 days) raised on cashew in Bangalore, India (Babu *et al.*, 1983).

Adult longevity and fecundity also vary depending on rearing conditions. Tan (1974a) recorded a mean adult longevity of 30 days for *H. theivora* raised on cocoa pods in West Malaysia. The same species was reported by Awang *et al.* (1988) to have a mean longevity of 20 days when reared on cocoa pods, but only six days when raised on the shoots. Longevity records for *H. antonii* reared on terminal shoots of cashew seedlings are in the range of 4-14 days (Ambika & Abraham, 1979; Pillai *et al.*, 1976).

Devasahayan (1985) showed that the fecundity of *H. antonii* reared on cashew plants in Vittal, India, was seasonally variable (13-82 eggs per female), with the highest mean value in the period from January to March (46.1 eggs per female). Other reported fecundity values for this species on cashew are 10-41 eggs (Pillai *et al.*, 1976)

and 28-35 eggs (Ambika & Abraham, 1979). Tan (1974a) gave fecundity values of 50-63 eggs per female for *H. theivora* raised on cocoa pods in West Malaysia, and Smith (1973) reports 30-50 eggs per female for *H. clavifer* on the same food source in New Guinea. Awang *et al.* (1988) noted that *H. theivora* did not produce viable eggs when reared on shoots of the cocoa plant, but had a mean fecundity of 44 eggs per female when raised on the pods.

### Pest status

*Helopeltis* spp. have been recorded from a vast number of plants in the Oriental and Australasian regions (see section on host plants in species accounts). From an economic perspective the primary plants attacked are cashew, cinchona, cocoa and tea. Other economically important plants damaged by *Helopeltis* spp. include allspice (*Pimenta dioica*) and black pepper (Devasahayam *et al.*, 1986), apple (*Malus* sp.) and grapes (*Vitis* sp.) (Puttarudriah & Appana, 1955), and guava (*Psidium guajava*) (Chong, 1987; Gopalan & Perumal, 1973) (see also list of host plants in Miller, 1941). Estimates of crop loss attributed to damage by *Helopeltis* are variable and depend on factors such as agricultural practices, control methods, locality, climate and the plant and insect species involved (see estimates for cashew, cocoa and tea below).

Typical feeding damage by *Helopeltis* spp. appears as a discoloured, necrotic area or lesion around the point of entry of the labial stylets into the plant tissue. The lesion can be elongate or spherical and becomes darker with age as the tissue around the stylet puncture dies, presumably in response to the enzymatic action of the insect's salivary secretions. Miles (1987) reported finding a pectinase in the salivary glands of *H. clavifer*, and noted that the insect feeds by evacuating the contents of individual plant cells, leaving the cell walls intact and uncollapsed.

On tea plants, feeding occurs primarily on the leaves of new flushes and to a lesser degree on the stems. Prior to the use of modern chemical pesticides, crop losses on tea plantations in India sometimes reached 100% (Muraloedharan, 1987). Das (1984) reported that a single late-instar nymph of *H. theivora* could make as many as 80 feeding lesions in a 24-hour period. Affected leaves often curl and become deformed, sometimes dying from the tip or edges inward. Die-back of young shoots is common under conditions of heavy infestation. Lever (1949) noted that feeding damage caused by *H. bradyi* and *H. cinchonae* on tea in the Cameron Highlands (Malaysia) was most severe during periods of dull, calm, misty weather, the insects being much less active under conditions of heavy rain, wind and/or bright sunshine. Smith *et al.* (1985) reported that in New Guinea the feeding activity of *H. clavifer* on tea is highest in the early morning and late afternoon, and that the adults prefer shaded, more humid positions near the center of the plant. Similar observations were made by Das (1984) regarding the activity of *H. theivora* on tea plants in India.

*Helopeltis antonii* is perhaps the most serious pest of commercially grown cashews in India, with crop losses sometimes reaching 30-40% (Devasahayam & Nair, 1986). The nymphs and adults feed on the leaves and

stems of new shoots, the inflorescence panicles, and on the developing nuts. In severe infestations the young shoots and panicles dry up, giving the infested trees a scorched appearance. Successive attacks on new growth can result in stunting or death of the tree. Damage to immature nuts causes them to shrivel, while older nuts develop a blistered or scabby appearance. Infestations during the early stages of fruit set often result in immature fruit drop. In field trials, Sathiamma (1977) found that panicles (48.5%) and fruits (32%) sustained higher levels of attack than young shoots (14%). Nymphs caged on young shoots made an average of 114 feeding lesions per day (range 78-235), while females made an average of 97 (16-238) and males 25 (11-59).

Cocoa is attacked by *Helopeltis* spp. wherever it is grown in the Old World tropics. In Sri Lanka and south India, cocoa is inhabited by *H. bradyi*, while throughout tropical Asia and the islands of the western Pacific, *H. theivora* is the primary species. *Helopeltis bradyi* also has been reported damaging cocoa in Sarawak (Ron, 1985, as *H. clavifer*) and Java (Betrem, 1950, as *H. antonii*), and specimens in the present study were examined from peninsular Malaysia, Sumatra, and other Indonesian islands. In New Guinea, *H. clavifer* was first reported damaging cocoa in the early 1950s (Dun, 1954) and has since become a serious problem particularly in the Central and Northern Provinces where it sometimes causes losses in pod production approaching 80% (DASF, 1971; Smith, 1984; Szent-Ivany, 1961).

Feeding on cocoa occurs primarily on the pods in all stages of development and on young shoots. Pod feeding is preferred by both nymphs and adults, with adult longevity and fecundity being much greater in pod reared individuals (Awang *et al.*, 1988). Feeding damage on pods appears as dark, circular lesions usually hardening as scars on the husk. Heavy infestations can result in pod malformation and premature drop. Tan (1974b) reported that pod wilt is mostly restricted to fruits that are damaged when they are less than 5 cm long, and that larger damaged pods had reduced dry bean weight. Feeding damage on pods provides an avenue for secondary invasion of micro-organisms, and also serves to attract other pests such as the cocoa pod borer, *Conogethes punctiferalis* (Guenée) (Lepidoptera: Pyralidae) (Chong, 1987; Fernando & Manickavasagar, 1956). Shoot-feeding occurs primarily on the midribs of leaves and on the stems, with severe infestations often resulting in shoot die-back and the production of subsequent flushes. Tan (1974b) found that if restricted to feeding on shoots, both the nymphs and adult males of *H. theivora* preferred the green shoots of older flushes, while adult females preferred the reddish shoots of new flushes. In these feeding trials, the mean number of lesions per day ranged from one to 17. Fernando & Manickavasagar (1956) reported a maximum of 60 feeding lesions per day for adults of *H. bradyi*. As has been found with other crops, feeding damage on cocoa is generally concentrated on shaded parts of the plant.

### Control

Prior to the development and extensive use of organic insecticides, little could be done to control outbreaks of *Helopeltis* spp. on tropical crops. Flaming of

cocoa pods using flares and kerosene lamps and hand-picking were recommended as control practices in Java, but these labour-intensive techniques had little or no effect (Betrem, 1950; Miller, 1941). Preparations such as kerosene emulsion, pyrethrum lime, lime sulphur, nicotine sulphate sprays and dust, and derris powders also were used but usually with poor to moderate results (Betrem, 1950; Fernando & Manickavasagar, 1956; Miller, 1941). Cultural practices including pruning, weeding and shading schemes also were employed early on to assist in the control of *Helopeltis* spp. (Das, 1984; Fernando & Manickavasagar, 1956).

Of the modern chemical insecticides, DDT was the first to be widely used to combat infestations of *Helopeltis* spp. Lever (1949) recommended three dustings with DDT at 10-day intervals to control *H. bradyi* on tea in the Cameron Highlands. In an evaluation of 11 insecticides, Damadaran & Nair (1969) reported that two sprayings of DDT 15 days apart provided the best control of *H. antonii* on cashew. These workers also found that systemic insecticides were much less effective than all of the contact chemicals tested. As the use of DDT fell off in the 1970s, gamma-HCH or lindane rapidly became established as the standard chemical treatment for *Helopeltis* spp. This chemical has been used extensively in West Africa since 1956 to control cocoa mirids, but problems with resistance were noted as early as 1961 (Tan, 1974b). Lindane is still widely used to control *Helopeltis* spp. on cocoa in Malaysia (Chong, 1987) and New Guinea (Smith, 1984), and remains the standard treatment for *H. antonii* on cashew in India (Pillai, 1987). A decrease in the effectiveness of lindane against *H. theivora* on tea in the Cachar region of India was reported by Muraleedharan (1987), and similar signs of resistance have been noted for the same species on cocoa in Malaysia (Chong, 1987). In recent years, workers have tested many different chemicals and formulations in an attempt to find alternative treatments to gamma-HCH. Perhaps the most successful of these has been endosulfan, which is now widely used to control *H. antonii* on cashew (Devasahayam & Nair, 1986) and *H. theivora* on tea (Das, 1984; Smith *et al.*, 1985). Other tested chemicals with efficacies similar to that of endosulfan include carbaryl, monocrotophos, phosalone, phosphamidon and quinalophos (Nair & Abraham, 1982, 1983, 1984). Tuck (1987) found that while other chemicals such as dioxacarb, isoprocarb, propoxur and synthetic pyrethroids were effective against *H. theivora* on cocoa in Malaysia, their overall performance in terms of cost and effectiveness could not match that of the gamma-HCH formulations.

The method and timing of insecticide applications have been shown to be important factors in the control of *Helopeltis* spp. infestations on tropical crops. In the majority of cases two or three applications of insecticide are recommended at 10-15 day intervals to control outbreaks. On cashew, it is recommended that insecticide treatments coincide with the emergence of new shoots, panicle emergence and again at fruit set (Babu *et al.*, 1983; Pillai, 1987). Early morning and late afternoon applications have been shown to be most effective, as these are the times when *Helopeltis* spp. are most active. Some insecticides such as lindane, carbaryl and phosalone are very effective when applied as dusts or powders particularly in dry weather conditions (Nair & Abraham,

1983; Smith, 1984) and a few such as the synthetic pyrethroids are best applied through fogging (Tuck, 1987). However, the majority of chemical treatments appear to have their greatest efficacies when applied as low to high volume sprays (Devasahayam & Nair, 1986; Tuck, 1987). Systemic insecticides are much less effective against *Helopeltis* spp. than contact chemicals (Abraham & Nair, 1981; Damadaran & Nair, 1969).

A great number of natural enemies of *Helopeltis* spp. have been reported in the literature. A list of the known parasitoids, predators and pathogens of African and Asian *Helopeltis* spp. is compiled in an article by CIBC (1983) (see also Devasahayam & Nair, 1986; Lim *et al.*, 1989; Sundararaju, 1984). In most instances, it appears that natural enemies, while playing an important role in control, can not maintain populations of *Helopeltis* spp. below economic thresholds. Integrated control programmes with reduced pesticide use and the monitoring of natural enemies have been suggested as reasonable alternatives to blanket spraying (CIBC, 1983). This would allow population of natural enemies to increase and provide more suitable environments for investigations of improved biological control.

Biological control programmes against *Helopeltis* spp. have not been attempted, but the high levels of parasitism provided by some egg and nymphal parasitoids certainly warrant further investigation. Egg parasitoids of the genus *Telenomus* (Scelionidae) and the mymarid *Erythmelus helopeltidis* Gahan are particularly promising, as are the nymphal parasitoids of the genus *Leiothron* (Braconidae) (CIBC, 1983). In Malaysia, *E. helopeltidis* has been reported to parasitize up to 36% of the fertile eggs of *H. cinchonae* on tea (Lever, 1949) and 11-47% of the eggs of *H. theivora* on cocoa (Ibrahim, 1989). Parasitism levels of 6-66% have been recorded for *Leiothron sahlbergellae* (Wilkinson) on *Sahlbergella singularis* Haglund (Heteroptera: Miridae) in West Africa (CIBC, 1983).

Predators also appear to play an important role in the natural control of *Helopeltis* spp. The reduviid, *Endochus inornatus* Stål was reported taking as many as 20 individuals of *H. antonii* per day on cashew plantations in India (Devasahayam & Nair, 1986; Sundararaju, 1984). Other potentially important reduviids are identified by CIBC (1983) and Devasahayam & Nair (1986), but since these insects are not specific to *Helopeltis* or even the Miridae, their potential value as biological control agents is questionable. The role of ants in deterring *Helopeltis* spp. on cocoa by way of their close association with mealybugs has been investigated by various workers, but opinions are mixed regarding the influence these insects have on *Helopeltis* populations (Betrem, 1950; Chong, 1987; CIBC, 1983; Fernando & Manickavasagar, 1956; Miller, 1941).

Clearly, much work remains to be done on the influence of natural enemies on *Helopeltis* populations, and the potential for biological control by parasitoids and predators as well as fungal and bacterial pathogens.

#### Methods and terminology

Many species of Oriental *Helopeltis* are very similar in coloration and general structure, and it is often necessary to examine structures of the male and female genitalia to obtain accurate identifications. The form of the female

genital chamber and its associated structures and the shape of the lobal sclerite of the male vesica are particularly useful taxonomic characters and have been illustrated here for each species. The male parameres show little variation between most Oriental species of the genus and are figured here only for *H. antonii* to illustrate their general shape.

The structures of the male and female genitalia were dissected and examined in glycerine following maceration in warm 10% potassium hydroxide solution and subsequent washes with dilute acetic acid and water. Female preparations were stained with chlorazol black to facilitate inspection of the membranous regions of the genital chamber. Illustrations were prepared from temporary slide mounts in glycerine jelly, using a Wild M-20 compound microscope with camera lucida. All genitalic preparations were stored in glycerine in plastic microvials affixed to the pinned specimens.

The description of the female genitalia provided in this study applies only to the Oriental species of the genus. The terminology follows that of Schmitz (1968), which is based on the earlier studies of Slater (1950) and Davis (1955). Since neither Slater nor Davis examined representatives of the tribe Monaloniini, it has been necessary to apply several new terms in the present study to distinguish various structures of the genital chamber for which homologous structures could not be recognized (e.g., transverse sclerites, medial ridge - see subgeneric description). Schmitz (1968) also applied several new terms in his treatment of the female genitalia of African *Helopeltis* spp., some of which are used here (e.g. anterior and posterior lobes of the genital chamber). Any synonymous terms or names referring to possible homologous structures from earlier works are given in square brackets within the text of the description of the female genitalia.

The terminology of the male genitalia follows Kelton (1959) as modified by Schwartz (1987) regarding the sclerotized appendages of the vesica.

In combination with structural features of the genitalia, a number of colour pattern characters were found to be useful for distinguishing species. In particular, the patterns of infuscation on the head, pronotum and abdomen are useful for separating several closely related species. Other distinguishing features of the external morphology include the relative length of antennal segment I and the length of the setae on antennal segments II and III. The structure of the scutellar process was found to be highly variable and of little value for distinguishing the species-level taxa recognized in the present study (see also discussion under *H. theivora* species account).

In the following taxonomic account, the species are arranged alphabetically. A diagnosis and brief description are provided for each species as well as illustrations of useful taxonomic characters and a list of all known host plant associations. The type(s) of most nominal species were examined and lectotype designations made when appropriate. Type material could not be located for *H. antonii*, *H. cinchonae*, *H. podagricus* or the junior synonym *H. febriculosa*. Full collection data including date and collector are recorded only for the new species, *H. sulawesi*, and the type(s) of previously described species. The number and sex of specimens collected at

specific localities are recorded for several little known species. For all other species, the material examined is reported by country only followed by a list of specimen depositories. A record of institutional abbreviations used in reporting specimen depositories is provided in the acknowledgements.

All measurements were made with an ocular micrometer and are reported in millimeters. Scanning electron micrographs were prepared on a Hitachi S-2500 microscope with Ilford HP-5 film.

#### Taxonomy

*Helopeltis* belongs to the tribe Monaloniini, which is distinguished from other groups of Bryocorinae by the elongate, cylindrical body form (figs 35, 62), the structure of the pretarsus (figs 8, 9), the reduced numbers of meso- and metafemoral trichobothria, with strongly tuberculate bothria and indistinct trichomae, the metathoracic scent efferent system lacking developed ostiole and evaporative area on metaepisternum (figs 6, 7), and the eggs with respiratory horns (Schuh, 1976). *Helopeltis* is readily distinguished from other members of the tribe by the large, spinelike process on the scutellum (fig. 60) and by characteristics of the male and female genitalia, particularly the structure of the genital chamber of the female.

The relationship of *Helopeltis* to other genera of Monaloniini is not well understood. My preliminary investigation of members of this tribe suggests that *Helopeltis* belongs to a group of genera united by the following derived features: 1. First antennal segment very long with apex gradually to abruptly inflated. 2. Large antennal fossae with moderately to strongly produced inner and dorsal margins. 3. Scutellum with slightly raised, smooth apical disc (absent in Oriental species of *Helopeltis*). 4. Femora distinctly swollen apically and sometimes medially. The genera possessing these attributes are *Arthriticus* Bergroth, *Helopeltis*, *Ragwelellus* Odhiambo and *Rayeria* Odhiambo. The first three genera are further distinguished by the indistinct pronotal calli and the nearly hairless dorsal surface of the body. *Eucercoris* Westwood may also belong to this group, but the unique type of the genus was not examined in conjunction with the present study. My brief study of the female genitalia of the Monaloniini did not provide any conclusive evidence bearing on the relationships of the genera in this group (see subgeneric discussion). The male genitalic structures of the genera related to *Helopeltis* were not studied in the present work.

The African and Oriental species of *Helopeltis* fall into two distinct groups based on characters of the genitalia and external morphology. Schmitz (1968) described the new subgenus *Afropeltis* to accommodate the African species of the genus, leaving the Oriental species in the nominate subgenus. Unfortunately, Schmitz did not designate a type species for *Afropeltis*, so the name is unavailable under Article 13, Section b of the International Code of Zoological Nomenclature. Since I am in agreement with the recognition of two subgenera within *Helopeltis*, I hereby designate *Eucercoris westwoodi* White as the type species of the subgenus *Afropeltis* as applied in the sense of Schmitz (1968). The major features distinguishing the two subgenera are given below (taken in part from Schmitz, 1968).

**Subgenus *Helopeltis* Signoret, 1858.** Type species. *Helopeltis antonii* Signoret by monotypy.

**Diagnostic features.** Head with flattened or weakly concave frons not visible anteriorly of antennal fossae in lateral view; tylus strongly produced with curved (convex) anterior margin; jugum flattened. Antennal segment I abruptly inflated distally. Pronotum with weak transverse furrow, at least medially; necklike region anteriorly of furrow flattened or weakly convex, not noticeably elevated above furrow. Scutellum broadly U-shaped, strongly inflated, without smooth, weakly raised medial stripe and apical disc; base of scutellar process occupying most of dorsal surface of scutellum. Hind wing with undivided cubital suture and with postcubital ending at margin of wing. Femora moderately to strongly inflated apically, usually also with swollen region(s) medially. Pretarsal claw with preapical tooth arising from inner-ventral surface. Male genitalia: left paramere with weakly to moderately developed sensory lobe and elongate, gradually curved shaft with excavated ventral surface (fig. 12); vesica unilobed with single, clublike lobal sclerite (see Schmitz (1968) for other distinguishing characters of phallus). Female genitalia: genital chamber encircled by pair of narrow, smooth sclerotized rings, which are either entirely separate, fused posteriorly, or fused posteriorly and anteriorly; anterior lobe of chamber without separately developed seminal depository, posterior lobe terminating in elongate tubular sleeve (figs 20, 49); posterior wall of chamber with two strongly elevated, spinose lobes (fig. 18) (see Schmitz (1968) for other distinguishing features of female genitalia).

**Subgenus *Afropeltis* subg. n.** Type species *Euceroicis westwoodi* White, here designated.

**Diagnostic features.** Head with weakly convex frons narrowly visible anteriorly of antennal fossae in lateral view; tylus weakly produced with straight (vertical) anterior margin; jugum slightly inflated and rounded. Antennal segment I gradually widened distally. Pronotum with deep transverse furrow; necklike anterior region moderately convex and noticeably elevated above furrow. Scutellum V-shaped with slightly raised, smooth median stripe and apical disc; lateral areas of scutellum shallowly punctate; base of scutellar process occupying at most anterior third of scutellum. Hind wing with bifurcate cubital suture; postcubital not reaching wing margin. Femora gradually and less strongly inflated apically, not or only slightly swollen medially. Pretarsal claw without tooth on inner-ventral surface. Male genitalia: left paramere with more strongly developed, often tuberculate sensory lobe and short, flattened shaft (see fig. 37 in Schmitz, 1968); vesica bilobed or trilobed with two lobal sclerites, or two large fields of tuberculate spines in place of sclerites (see fig. 32 in Schmitz, 1968). Female genitalia: genital chamber laterally with closed sclerotized rings, which usually possess a series of teeth or blunt tubercles at least on outer surface of inner half of ring (see fig. 54 in Schmitz, 1968); anterior lobe of chamber with separate, well-developed seminal depository entering lobe on its anteroventral surface (see Schmitz, 1988), posterior lobe without elongate, tubular apex; posterior wall of genital chamber without spinose lobes.

The following taxonomic account treats only those

species belonging to the subgenus *Helopeltis*, all of which are distributed in the Oriental and Australasian regions. Some characters given in the description of *Helopeltis sensu stricto* may apply to the genus as a whole and are included here because a full description of the genus is not provided.

#### Subgenus *Helopeltis* Signoret

*Helopeltis* Signoret, 1858: 502 (gen. n.); Atkinson, 1890a: 51 (cat.); Reuter, 1910: 153 (cat.); Carvalho, 1952: 59 (cat.); 1955: 38 (key); 1957: 133 (cat.); Schmitz, 1968: 213-220 (morph. & compar. with subg. *Afropeltis*). *Aspicelus* Costa, 1864: 146-147 (gen. n.). Synonymized by Walker (1873: 165).

**Description of male.** Moderate to large species, 5.3-8.3 mm; pale brownish orange to dark brown general coloration; paler species usually with fuscous markings on head, pronotum, legs and antennae; dorsal surface shiny, without or with only limited pale setae.

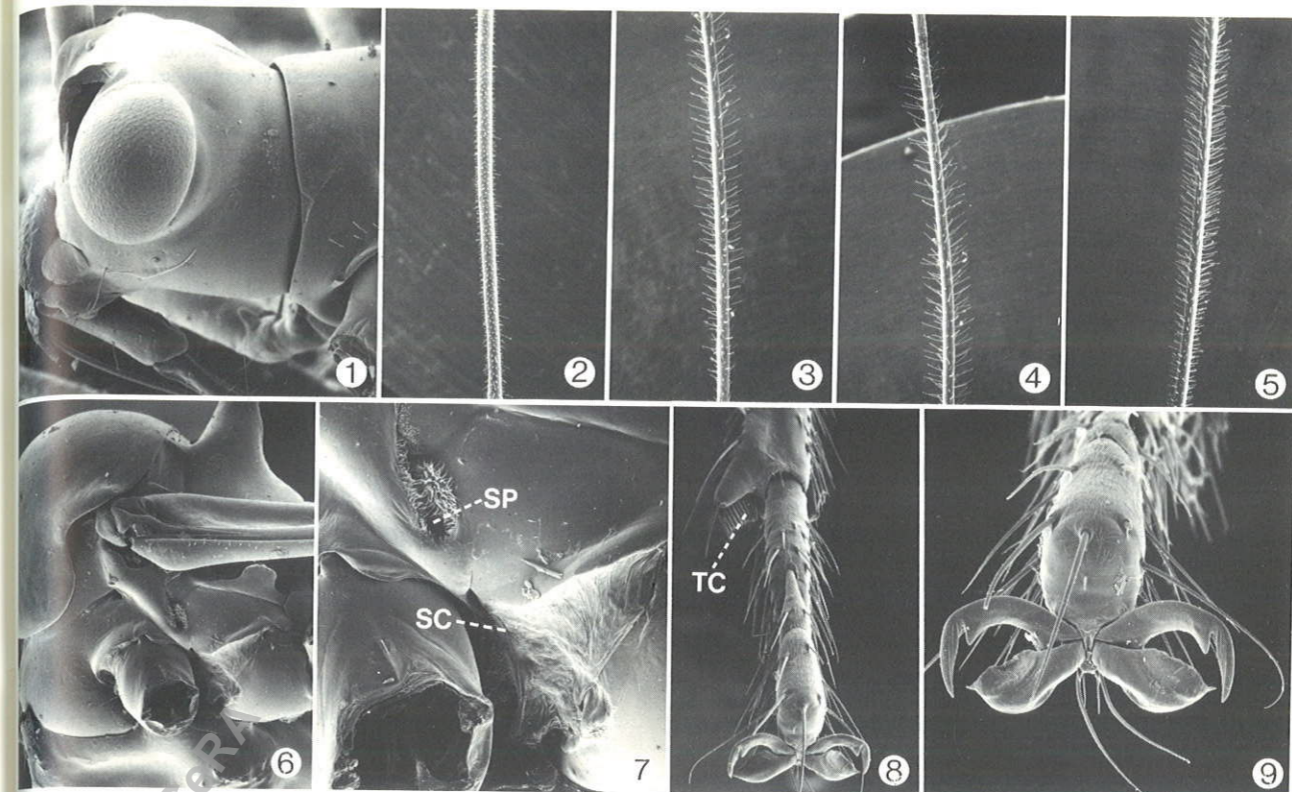
Head short, about twice as broad as long in dorsal view (figs 21, 52); vertex moderately to strongly convex, with distinct longitudinal sulcus; frons flattened or weakly concave, not extending beyond anterior margins of antennal fossae (fig. 1); tylus noticeably produced, setose, anteromedial region sometimes collapsed; antennal fossae large, with strongly produced inner and dorsal margins; eyes subspherical, not or only slightly elevated above vertex, occupying about half of head height in lateral view; jugum and lorum short, flattened; buccula prominent, short; buccal cavity subspherical; genae and gula broadly developed, length of gula approximately twice that of buccal cavity.

Antennae cylindrical, longer than length of body; segment I inflated distally, length usually much greater than posterior width of pronotum, with scattered, short, pale setae; segments II and III similar in length, much longer than segment IV; segments II-IV more densely covered with pale setae, those on II and III sometimes much longer than diameter of segment (figs 2-5).

Labium reaching to apex of mesosternum or slightly beyond; segments I-III similar in length, segment IV slightly longer.

Pronotum strongly narrowed anteriorly at level of calli, but lacking well defined furrow between necklike anterior lobe (collar) and posterior lobe of disc; calli indistinct; collar flattened or weakly convex dorsally; posterior lobe rising sharply from anterior constriction, posterolateral angles broadly rounded, posterior margin broadly convex overall, middle third straight or very weakly concave; scutellum strongly produced dorsally into elongate, spinelike process with expanded, setose apex (fig. 60); apex of scutellum broadly and evenly rounded; thoracic pleura dorsoventrally compressed (figs 6, 7); mesepimeric spiracle (SP) large, elongate, fringed with setae; metathorax lacking distinct scent efferent system - scent canal (SC) weakly developed, positioned along posterior margin of mesocoxal cavity and terminating in notched depression on metaepisternum ventrad of mesepimeric spiracle; metaepisternum otherwise unmodified, without developed ostiole, peritremal disc or evaporative area.

Hemelytra elongate, translucent, with broad gap



Figs 1-9. Scanning electron micrographs of *Helopeltis* spp. Fig. 1, dorsolateral view of head of *H. theivora*. Figs 2-5, antennal segment II: 2, *H. clavifer*, distal two-thirds of segment; 3, *H. fasciaticollis*, basal two-thirds; 4, *H. fasciaticollis*, distal two-thirds; 5, *H. theivora*, distal two-thirds. Figs 6-9, *H. theivora*: 6, lateral view of thorax; 7, thoracic pleura (SC, scent canal; SP, mesepimeric spiracle); 8, fore tarsus and apex of tibia (TC, tibial comb); 9, pretarsus.

between apex of scutellum and inner margin of resting clavus; clavus narrow, rarely slightly roughened; lateral margins of corium broadly and weakly concave; cuneal incisure very shallow, fracture weak; cuneus at level of fracture 5-6 times as long as wide; membrane with single large areolar cell (figs 35, 62).

Legs elongate, femora noticeably inflated distally and with scattered short setae; tibiae with longer spinelike setae intermixed distally with tiny dark spinules; fore tibiae with well developed apical comb (TC) (fig. 8); tarsi dilated distally, segment III with long guard setae; pretarsus as in fig. 9, with toothed claw, strongly developed pseudopulvillus and setiform parempodia.

**Genitalia.** Genital capsule: anterior margin diagonally produced (fig. 10); strongly upturned distad of paramere sockets, usually with notched posterodorsal margin; aperture divided by broad sclerite (fig. 11) - lower (genital) aperture smaller than upper (anal) aperture. Left paramere: sensory lobe weakly to moderately developed; shaft evenly curved, tapering to blunt or angulate apex; basal attachment sclerite long and tapered (fig. 12). Right paramere: small, with blunt apex and short basal sclerite (fig. 13). Aedeagus: vesica comprised of elongate, reversible membranous sac (ES) with long, coiled ductus seminis (DS) and large lobal sclerite (LS) medially (fig.

14); sac usually with distinct field of spinelike tubercles proximal and distad of sclerite; lobal sclerite broadly attached to membranous sac along inner basal margin, apex usually with distinct field of spines; entire vesica surrounded by membranous sheath (MSH) originating from lateral margins of phallosome (PH) and distal margins of the phallobase (PB) (Schmitz (1968) refers to this as the membranous part of the phallosome) - sheath narrowly opened distally at level of apex of phallosome.

**Female.** Length 5.9-9.3 mm; similar to male in structure and vestiture, except body sometimes slightly larger and with shorter setae on antennal segment II; general coloration sometimes paler than for male, particularly on head and pronotum, or at least darkened areas less extensive.

**Genitalia.** Genital chamber mostly membranous with distinct anterior and posterior lobes, but lacking separately developed seminal depository (figs 20, 49); anterior lobe (AL) usually incorporating several weakly developed transverse sclerites (TS), or sometimes lobe less well developed and without sclerites; dorsal surface of anterior lobe with weakly to strongly elevated, membranous ridge (MR) medially, usually incorporating sclerite (MSL) of variable size and uniformity; duct of spermathecal gland (DSG - see fig. 49) entering genital chamber

dorsally on medial ridge; posterior lobe (PL) terminating in narrow, tubular sleeve (TSL - see figs 18, 49) (Schmitz (1968: 218) misinterpreted the tubular sleeve as the DSG); lateral oviducts (LO) entering genital chamber dorsally, separated medially by depressed region bearing variously developed medial ridge and sclerite as described above; enlarged distal region of oviduct (referred to as the dorsal sac by Schmitz, 1968) with weakly sclerotized plate internally bearing series of parallel ribs (PR); genital chamber ventrad of entry level of oviducts encircled by two sclerotized bands or rings (SR) which are either entirely separate (figs 19, 36, 59), narrowly to broadly fused posteriorly (figs 20, 23-26, 49), or broadly fused anteriorly and posteriorly (figs 39, 53); posterior wall of genital chamber consisting of two strongly elevated spinose lobes (SL) separated medially by depressed membranous region, dorsal surface of spinose lobes lightly to moderately sclerotized (fig. 18) (The spinose lobes of the posterior wall appear to be homologous to the inter-ramal sclerites of other Miridae as defined by Davis (1955). Slater (1950) referred to these sclerotized plates as 'A' structures in the Mirinae, Deraeocorinae and Phylinae, and 'J' structures in the Orthotylinae. The paired dorsal processes arising from the 'J' structures of orthotylinae were termed 'K' structures by Slater (1950) and biramous processes by Davis (1955). Schmitz (1968: 218) considered the spinose lobes of the posterior wall of Oriental *Helopeltis* to be homologous to the 'K' structures of the Orthotylinae; dorsal surface of base of ovipositor with variously shaped, bilobed process (BP) positioned ventrad of lobes of posterior wall of genital chamber (figs 18, 49).

**Distribution.** Sri Lanka, south and north-east India, south-east Asia, and the tropical Pacific from Taiwan, south to Sumatra, and east to New Guinea and north-east Australia.

**Discussion.** My examination of the female genitalia of representative members of the Monaloniini (see introduction to taxonomy section) raised some question about the monophyly of the genus *Helopeltis*. The subgenera of *Helopeltis* are united by the spinelike process on the scutellum, and although the structure of the scutellum is distinctly different for the two groups, the spine must be considered as synapomorphic. *Afropeltis* and *Helopeltis* also share the condition of having an entirely membranous ventral aspect of the female genital chamber. The related genera *Arthriticus*, *Ragwelellus*, and *Rayeria* have variously developed sclerotized regions associated with the ventral wall of the genital chamber, which may be homologous with the ventral labiate plate of other Miridae as described by Davis (1955). The sclerotized ventral wall may be plesiomorphic within the Monaloniini, a point which can only be verified through a more comprehensive study of the included genera.

A number of major features of the female genital chamber suggest the possibility that *Helopeltis* and *Ragwelellus* are not monophyletic genera. For example, the subgenera *Ragwelellus* (*Narinellus*) and *Helopeltis sensu stricto* were the only groups examined that have a noticeably developed medial ridge and sclerite on the dorsal surface of the genital chamber between the entry points

of the lateral oviducts. These two subgenera also have unbroken, ribbonlike sclerotized rings that fully encircle the genital chamber. All other groups of Monaloniini examined have the dorsomedial region of the genital chamber undeveloped, and sclerotized rings that are composed of either, broken or sutured sclerites forming two smaller closed rings restricted to the dorsolateral regions of the chamber (subgenera *Afropeltis* and *Ragwelellus*), or indistinct, broken sclerites forming two much larger rings that encircle the chamber in a more dorsal position (*Rayeria*, *Arthriticus*). The above characters suggest a sister-group relationship between *Helopeltis sensu stricto* and *Ragwelellus* (*Narinellus*) and are incongruent with the two characters described in paragraph one that support the monophyly of the genus *Helopeltis*. No characters of the female genitalia or the external morphology were found that support a sister-group relationship for the two subgenera of *Ragwelellus*. The absence of a separate seminal depository in *Helopeltis sensu stricto* and *Ragwelellus sensu stricto* further confuses the determination of relationships in this complex of genera. Clearly, a broader study of taxa and characters, including those of the male genitalia, is required to resolve the question of monophyly in *Ragwelellus* and *Helopeltis*, and to establish the relationships that these genera have with other groups of Monaloniini.

The subgenus *Helopeltis sensu stricto* can be divided into two distinct species-groups on the structure of the female genital chamber. One group comprising *H. antonii*, *H. clavifer*, *H. collaris*, *H. fasciaticollis* and *H. theivora* is distinguished by the poorly developed anterior lobe, which lacks transverse sclerites, the small medial sclerite, and the unfused sclerotized rings (figs 19, 36, 59). The other group containing the remaining species except *H. cinchonae* is recognized by the more pronounced anterior lobe of the chamber, usually with transverse sclerite(s), well developed medial sclerite and partially fused sclerotized rings (see description of female genitalia). *Helopeltis cinchonae*, which does not fit either group, has a very simple genital chamber without transverse and medial sclerites, and lacks sclerotized ribs in the broadened distal region of the lateral oviducts (fig. 31).

#### Key to species of the subgenus *Helopeltis*

1. Length of antennal segment I equal to or only slightly greater than width of head across eyes (fig. 35); vesica of male genitalia without lobal sclerite; genital chamber of female as in fig. 31; Burma, Thailand, Taiwan, Vietnam and West Malaysia.....*cinchonae* Mann
- Length of antennal segment I much greater than width of head across eyes (fig. 62); male vesica with prominent lobal sclerite (fig. 14).....2
2. Abdominal sterna I-III marked with a distinct fuscous patch laterally, sometimes extending onto sterna IV and V (fig. 16).....3
- Abdominal sterna I-III uniformly pale laterally (fig. 44).....5
3. General coloration brownish orange; head mostly pale with narrow region bordering antennal fossa and extending along inner-dorsal margin of eye

- fuscous (fig. 57); lobal sclerite and genital chamber as in figs 56 and 55, respectively; Sumatra and West Malaysia.....*sumatranus* Roepke
- General coloration brown to dark reddish brown, pronotum sometimes paler brownish red; head mostly fuscous with apex of tylus, spot ventrad of eye, and distolateral spot bordering pronotal collar pale (fig. 17).....4
4. Base of hind femur with broad pale band, distal region usually fuscous; length of antennal segment I much greater than posterior width of pronotum (ratio: males, 1.50:1-1.85:1; females, 1.45:1-1.60:1); lobal sclerite with limited scattered tubercles at apex only (figs 28-30); sclerotized rings of genital chamber fused posteriorly; south India, Java, Sri Lanka, Sumatra, Timor and West Malaysia.....*bradyi* Waterhouse
- Basal third and apex of hind femur mostly fuscous, middle section pale with fuscous spots or mottling; length of antennal segment I slightly greater than posterior width of pronotum (ratio: males, 1.20:1-1.45:1; females, 1.05:1-1.30:1); lobal sclerite with dense distribution of tubercles distally, usually extending proximally along outer margin to near median level of sclerite (fig. 15); sclerotized rings of genital chamber not fused posteriorly; south India and Sri Lanka.....*antonii* Signoret
5. Extreme base of antennal segment I fuscous, at least within confines of fossa, region immediately distad of basal constriction sometimes noticeably paler.....6
- Extreme base of antennal segment I pale.....12
6. Males.....7
- Females.....9
7. Scutellum uniformly yellowish brown to fuscous; lobal sclerite as in fig. 48.....*obscuratus* Poppius
- Scutellum fuscous laterally, narrowly to broadly pale medially.....8
8. Apices of jugum and lorum darkened (fig. 51); hind femora uniformly fuscous; lobal sclerite relatively narrow basally (fig. 50).....*pellucida* Stål
- Apices of jugum and lorum pale; hind femora with broad pale band basally; lobal sclerite broader basally (fig. 22).....*bakeri* Poppius
9. Tylus uniformly darkened (fig. 46); genital chamber as in fig. 45; Pulo Laut, Indonesia.....*insularis* Kirkaldy
- Tylus uniformly pale, or at least broadly pale distally (fig. 51); Philippine Islands.....10
10. Head ventrad of eyes uniformly brownish yellow or brownish orange, rarely with buccula and gula tinged with fuscous, but jugum and lorum always pale; head sometimes more extensively pale, leaving only margins of antennal fossae and dorsomedial spot behind eyes fuscous.....11
- Head mostly fuscous, with only apex of tylus and lateral stripe ventrad of eye pale (fig. 51); jugum, lorum, buccula and gula always fuscous; genital chamber as in fig. 49.....*pellucida* Stål
11. Pronotal disc uniformly brownish yellow or brownish orange, without fuscous markings; ratio of length of antennal segment I to posterior width of

- pronotum 1.55:1-1.75:1; genital chamber with weakly developed medial ridge (fig. 20).....*bakeri* Poppius
- Pronotal disc brown to fuscous, rarely paler yellowish brown, but then with fuscous suffusion on posterior margin of collar and anterior half of calli; ratio of length of antennal segment I to posterior width of pronotum 1.80:1-1.90:1; genital chamber with strongly developed medial ridge (fig. 47).....*obscuratus* Poppius
12. Head mostly fuscous, especially dorsally and ventrally, usually with pale marks or broad pale stripe laterally (figs 38, 58), or sometimes more extensively pale in teneral specimens, but then posterior margin of pronotum broadly infuscated; sclerotized rings of genital chamber unfused (figs 36, 59).....13
- Head uniformly pale, or infuscated only on dorso-distal surface behind eyes (fig. 52) and rarely on apex of tylus; pronotal disc uniformly pale or sometimes with large, quadrate, fuscous patch, but never broadly darkened along entire posterior margin; sclerotized rings of genital chamber fused anteriorly and posteriorly (figs 39, 53).....16
13. Pronotal collar uniformly darkened, or at least with anterior margin infuscated, rarely entirely pale, but then pronotal disc also uniformly pale.....14
- Pronotal collar bicoloured, with anterior third to one-half pale and distal portion fuscous, sometimes uniformly pale, but then pronotal disc with at least posterior margin broadly darkened.....15
14. Abdominal tergum IV and most of tergum III fuscous (fig. 32); setae on antennal segment II of male shorter than diameter of segment (fig. 2); medial ridge of genital chamber reaching posteriorly to near position of sclerotized rings (fig. 33); lobal sclerite as in fig. 34; New Guinea and Australia.....*clavifer* (Walker)
- Abdominal terga III and IV uniformly pale (fig. 43); setae on antennal segment II of male longer than diameter of segment (figs 3, 4); medial ridge of genital chamber reaching slightly beyond midpoint of lateral oviducts (fig. 41); lobal sclerite as in fig. 42; north-east India, Philippine Islands, Sabah, Taiwan and West Malaysia.....*fasciaticollis* Poppius
15. Head fuscous with apex of tylus and basolateral spot bordering pronotal collar pale (fig. 38); lobal sclerite and genital chamber as in figs 37 and 36, respectively; Philippine Islands.....*collaris* Stål
- Head with broad pale stripe laterally, or sometimes more extensively pale ventrad of eyes, remainder of head fuscous (fig. 58); lobal sclerite and genital chamber as in figs 61 and 59, respectively; Sri Lanka, India, south-east Asia, Malaysia, Sumatra and Java.....*theivora* Waterhouse
16. Head and pronotum uniformly pale brownish yellow; legs unicolorous, hind pair noticeably darker than others; lobal sclerite and genital chamber as in figs 40 and 39, respectively; body length 5.9-6.4 mm; Java and West Malaysia.....*cuneata* Distant
- Basodorsal region of head, anterior margin of

pronotal collar, and large medial patch on pronotal disc fuscous (fig. 52), remainder of head and pronotum brownish orange; legs pale, with fuscous spots distally on femora and on basal half of tibiae - distal fourth of femora and base of tibiae entirely darkened; lobal sclerite and genital chamber as in figs 54 and 53, respectively; body length 8.3-9.3 mm; Sulawesi.....*sulawesi* sp. n.

*Helopeltis (Helopeltis) antonii* Signoret  
(figs 10-19)

*Helopeltis antonii* Signoret, 1858: 502 (sp. n.); Carvalho, 1957: 133 (cat.).

**Diagnosis.** Recognized by the colour pattern of the head (fig. 17); antennal segment I only slightly longer than posterior width of pronotum (see couplet 4 in key); abdominal sterna I-III with fuscous patch laterally (fig. 16); sclerotized rings of female genital chamber not fused (fig. 19); and lobal sclerite of male vesica as in fig. 15.

**Description of male.** Length 5.9-6.9 mm; dark brown or reddish brown general coloration, with most of thorax paler red or brownish red; head mostly fuscous with apex of tylus and spots ventrad and posteriad of eyes pale (fig. 17); antennae uniformly fuscous except base of segment I narrowly pale; pronotum red or brownish red, usually much paler than head and hemelytra; scutellum brown to dark brown, sometimes darker medially and distally, base of scutellar process usually dirty white or pale brownish yellow; hemelytra uniformly brown, or with embolium, veins and cuneus slightly darker; abdominal sterna I-III with fuscous patch laterally; legs brownish yellow, moderately to extensively mottled with fuscous, basal third and apex of hind femora usually entirely fuscous; genitalia as in figs 10-15.

**Female.** Length 7.2-8.0 mm; similar to male in colour and general structure; genitalia as in figs 18 and 19.

**Distribution.** Andaman Islands, south India, Sri Lanka.

**Host association.** *Helopeltis antonii* is a serious pest of cocoa, cashew, and tea in India and Sri Lanka. Other reported host plants include: allspice, annatto (*Bixa orellana*), apple, black pepper, camphire (*Lawsonia alba*), cinchona, grapevine, guava, horseradish tree (*Moringa oleifera*), jambos or rose apple (*Eugenia jambos*), mango (*Mangifera indica*), neem (*Azadirachta indica*), and red gum (*Eucalyptus* sp.) (see Devasahayam & Nair, 1986). The host records given by Miller (1941) for *H. antonii* were taken primarily from a paper on *Helopeltis* in Java (Roepke, 1916b) and almost certainly pertain to the externally similar species, *H. bradyi*. The records given by Babu *et al.* (1983) for mango and avocado (*Persea americana*) in the Philippine Islands, and for tea, cinchona, kapok (*Ceiba pentandra*), black pepper, tamarind (*Tamarindus indica*), and camphor (*Cinnamomum camphora*) in Java also pertain to other species.

**Type.** The original description of *H. antonii* by Signoret (1858) does not provide a type designation or indicate the number of specimens examined. The majority of Signoret's types are deposited in four major collections: Museo ed Istituto di Zoologia dell'Università, Napoli; Museo Zoologico de 'La Specola,' Università Degli Studi, Firenze; Museum National d'Histoire Naturelle, Paris; Naturhistorisches Museum, Wien. An enquiry was sent to each of these institutions, but the type of

*H. antonii* was not located. A response was not received from the Zoological Museum in Naples.

My identification of this species is based on a comparison of specimens collected in Sri Lanka and south India against the original description and dorsal habitus illustration of *H. antonii* given by Signoret (1858). The short first antennal segment depicted in the illustration (Plate II, fig. 2) and the description of leg coloration, particularly the hind femora without a pale annulus basally, clearly distinguishes Signoret's *H. antonii* from the externally similar species *H. bradyi*, which also occurs in Sri Lanka and south India.

**Discussion.** *Helopeltis antonii* shows less morphological variation than *H. bradyi* and *H. theivora*, the only other species known from southern India and Sri Lanka. The pronotum of both males and females is red or brownish red, and the femora are usually broadly pale medially with fuscous markings. The hind femora do not have a pale band basally as in *H. bradyi*, and the first antennal segment is much shorter than that of *H. bradyi* or *H. theivora*.

Much has been written in the economic literature concerning the biology, host plants, pest status and control of *H. antonii* (see introduction). This species is very similar to *H. bradyi*, and as established here, the two species have similar distributions in the Indian subcontinent. Previously, *H. bradyi* was not known to occur in the Indian Region, except as established by De Silva (1957) under the name *H. ceylonensis* in Sri Lanka. It is therefore highly likely that at least some of the published information on *H. antonii* actually pertains to *H. bradyi*.

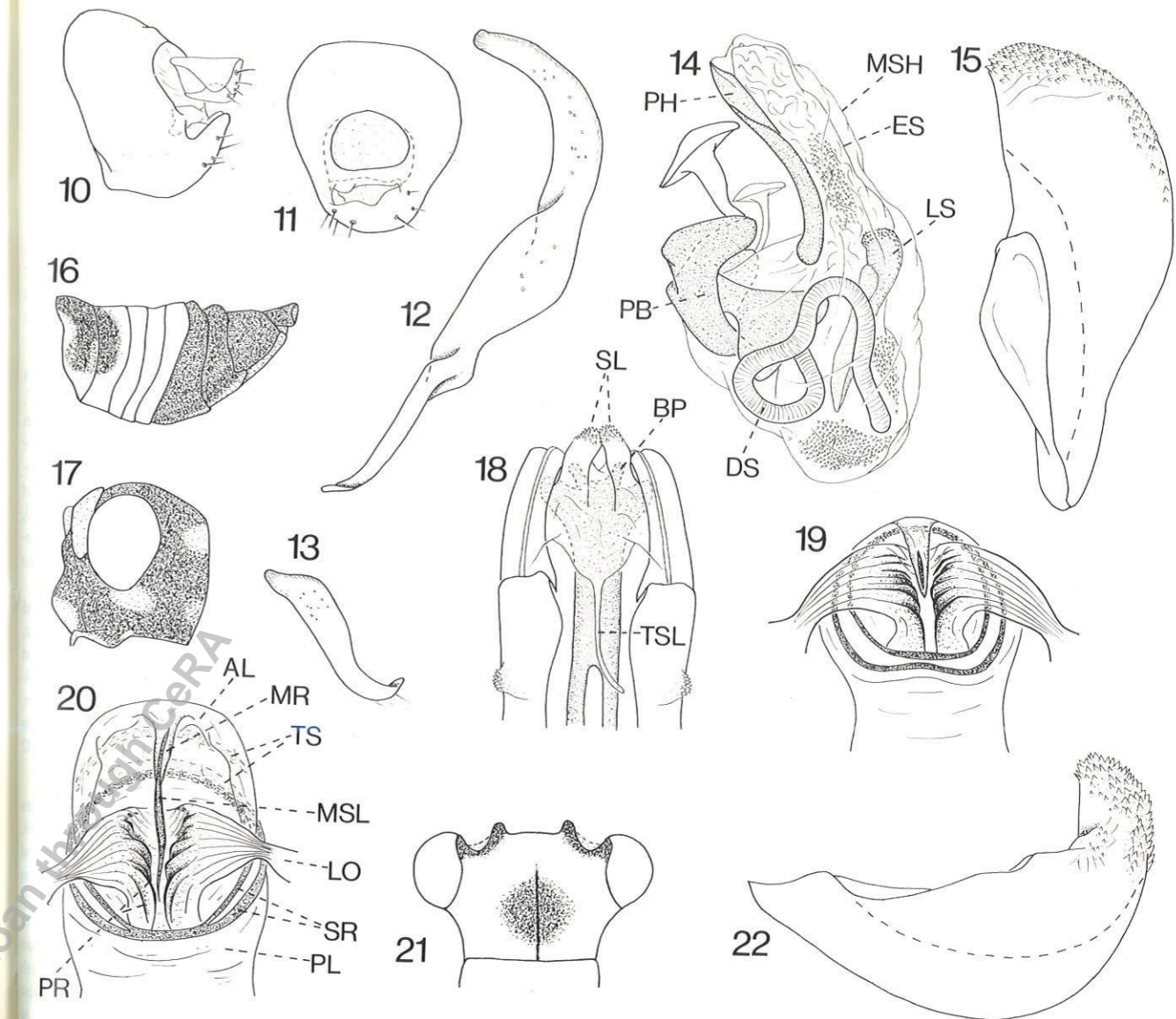
**Material examined.** Sixty-three specimens from Sri Lanka and the states of Kerala and Mysore in India, and one male from the Andaman Islands (NHML).

*Helopeltis (Helopeltis) bakeri* Poppius  
(figs 20-22)

*Helopeltis bakeri* Poppius, 1915b: 75-76 (sp. n.); Carvalho, 1957: 134 (cat.).

**Diagnosis.** The males of this sexually dimorphic species are recognized by the following combination of characters: extreme base of antennal segment I fuscous; scutellum darkened laterally, with narrow to broad pale stripe medially; head fuscous, with broad pale band ventrad of eye reaching from tylus to posterior margin of head; hind femora with pale band basally; and lobal sclerite of vesica as in fig. 22. Females of *H. bakeri* are noticeably paler than males, with the head pale yellowish orange, except extreme base of antennal segment I, margins of antennal fossae, and spot on vertex fuscous (fig. 21). Females are further distinguished from the closely related species, *H. obscuratus*, by the paler pronotal disc, shorter first antennal segment, and structure of the genital chamber (fig. 20).

**Description of male.** Length 5.9-7.1 mm; dark brown general coloration; head mostly fuscous, with broad pale band ventrad of eye reaching from tylus to posterior margin of head; antennae brown or dark yellowish brown, extreme base of segment I darker fuscous; pronotum uniformly dark fuscous; scutellum brown to fuscous laterally, narrowly to broadly pale medially; scutellar process pale basally, usually becoming brown to fuscous distally; hemelytra with base of clavus and corium, embolium, veins and cuneus brown to fuscous, remainder of clavus and corium mostly translucent gray; legs mostly yellowish



Figs 10-22. Figs 10-19, *H. antonii*: 10, male genital capsule, lateral view; 11, male genital capsule, posterodorsal view; 12, left paramere, dorsal view; 13, right paramere, lateral view; 14, aedeagus (DS, ductus seminis; ES, eversible sac of vesica; LS, lobal sclerite of vesica; MSH, membranous sheath; PB, phallobase; PH, phalotheca); 15, lobal sclerite of vesica; 16, female abdomen, lateral view; 17, female head, lateral view; 18, base of ovipositor showing posterior wall of female genital chamber (BP, bilobed process; SL, spinose lobes; TSL, tubular sleeve of posterior lobe of chamber); 19, genital chamber of female, dorsal view. Figs 20-22, *H. bakeri*: 20, genital chamber of female (AL, anterior lobe; LO, lateral oviduct; MSL, medial sclerite; MR, medial ridge; PL, posterior lobe; PR, parallel ribs of oviduct; SR, sclerotized rings; TS, transverse sclerite); 21, female head, dorsal view; 22, lobal sclerite of vesica.

brown, with limited brown to fuscous markings; hind and sometimes middle femora mostly fuscous, with only broad band at base pale; lobal sclerite of genitalia as in fig. 22.

**Female.** Length 6.1-8.0 mm; colour of head as described in diagnosis; antennae brown to fuscous, segment I usually noticeably paler distad of fuscous base; pronotum and scutellum uniformly brownish orange, with scutellar process sometimes darker brown distally; colour of hemelytra as described for male; fore and middle legs yellowish brown with limited darker brown markings; hind femora uniformly brown to fuscous, without

pale band basally; hind tibiae brown or yellowish brown; rarely hind legs mostly yellowish brown as in fore and middle pairs; genital chamber as in fig. 20.

**Distribution.** Philippine Islands.

**Host association.** This species has been collected on cocoa pods at Mt Makiling, Luzon and Sulop, Mindanao. It is also recorded from cotton at Victorias, Negros.

**Type.** This species was described from three specimens collected at Los Baños, Laguna Province, Luzon, Philippine Islands. A

female specimen with the following label data is here designated the lectotype: Label 1, 'Los Banos, P.I., Baker'; 2, '399'; 3, '*Helopeltis bakeri* n. sp.' [handwritten]; 4, 'Mus. Zool. H.fors. Spec. typ. No 10118, *Helopeltis bakeri* Popp.'; 5 (here added), 'LECTOTYPE, *Helopeltis bakeri* Poppius, det. G. Stonedahl, 1991'. The other two specimens, one male and one female mounted on the same card point, bear only the locality label reading, 'Los Banos, P.I., Baker' and a newly added paralectotypes label. All three specimens are deposited in the University Zoological Museum, Helsinki. A female specimen with the same locality label is deposited in the collection of the USNM, but appears not to be part of the original syntype series, since Poppius (1915b) refers only to the three specimens deposited in the Helsinki Museum.

**Discussion.** As noted in the diagnosis, *H. bakeri* is a sexually dimorphic species, the males being much darker and smaller than the females. It is distinguished from other species distributed in the Philippine Islands by the characters given in the key and species diagnosis.

**Material examined.** PHILIPPINE ISLANDS: 2♂, 4♀ (USNM — no specific locality data). Luzon: Laguna: 3♂, 1♀, Mt Makiling (USNM); 1♂, 4♀, Los Baños (BISH, USNM); 1♂, 2♀, Los Baños (UZMH — lectotype and paralectotypes). Quezon: 1♀, Mt Banahao (RNHL); 1♀, Tayabas (USNM). Rizal: 1♂, Wa-wa Dam, Mt Montalbán (BISH). Mindanao: Davao del Sur: 4♂, 4♀, 2 nymphs, Sulop and Dinaig (NHML). Negros: Negros Occidental: 2♀, Victorias (USNM). Negros Oriental: 3♂, 1♀, Camp Lookout, Dumaguete (AMNH). Panay: Antique: 1♀, Culasi (USNM).

*Helopeltis (Helopeltis) bradyi* Waterhouse  
(figs 23-30)

*Helopeltis bradyi* Waterhouse, 1886: 458 (sp. n.); Betrem, 1953: 177 (as subspecies of *H. antonii*); Carvalho, 1957: 134 (cat.).

*Helopeltis romundeii* Waterhouse, 1888: 207 (sp. n.); Carvalho, 1957: 136 (cat.). **Syn. n.**

*Helopeltis ceylonensis* De Silva, 1957: 459-461 (sp. n.). **Syn. n.**

**Diagnosis.** Similar to *H. antonii*, but distinguished by the longer first antennal segment and colour of the hind femora (see couplet 4 in key); lobal sclerite of male vesica with fewer spines restricted to apex of sclerite (figs 27-30); and sclerotized rings of female genital chamber fused posteriorly (figs 23-26).

**Description of male.** Length 5.5-6.9 mm; general coloration as in *H. antonii* except pronotum sometimes uniformly dark brown and hind femora fuscous, with broad basal band pale; lobal sclerite of vesica as in figs 27-30.

**Female.** Larger than male, length 6.6-8.6 mm, and similar general coloration, except pronotum nearly always reddish orange or brownish red; genital chamber as in figs 23-26.

**Distribution.** South India, Indonesia, Malaysia, Singapore, Sri Lanka.

**Host association.** This species is a pest of cocoa, cashew, cinchona and tea. Specimens also have been collected on *Capsicum* sp. and *Citrus* sp. in Java, *Palaquium gutta* in West Malaysia (Lever, 1949), coffee (*Coffea arabica*) in Sri Lanka, and *Eucalyptus saligna* in Sumatra. Miller (1941) names *Cephaelis angustifolia*, *Dioscorea* sp. and *Oxalis* sp. as other possible host plants of *H. bradyi*. This is also likely to be the undetermined species, or possibly one of several species, reported to be damaging *Acacia mangium* in Sarawak (Hamid, 1987).

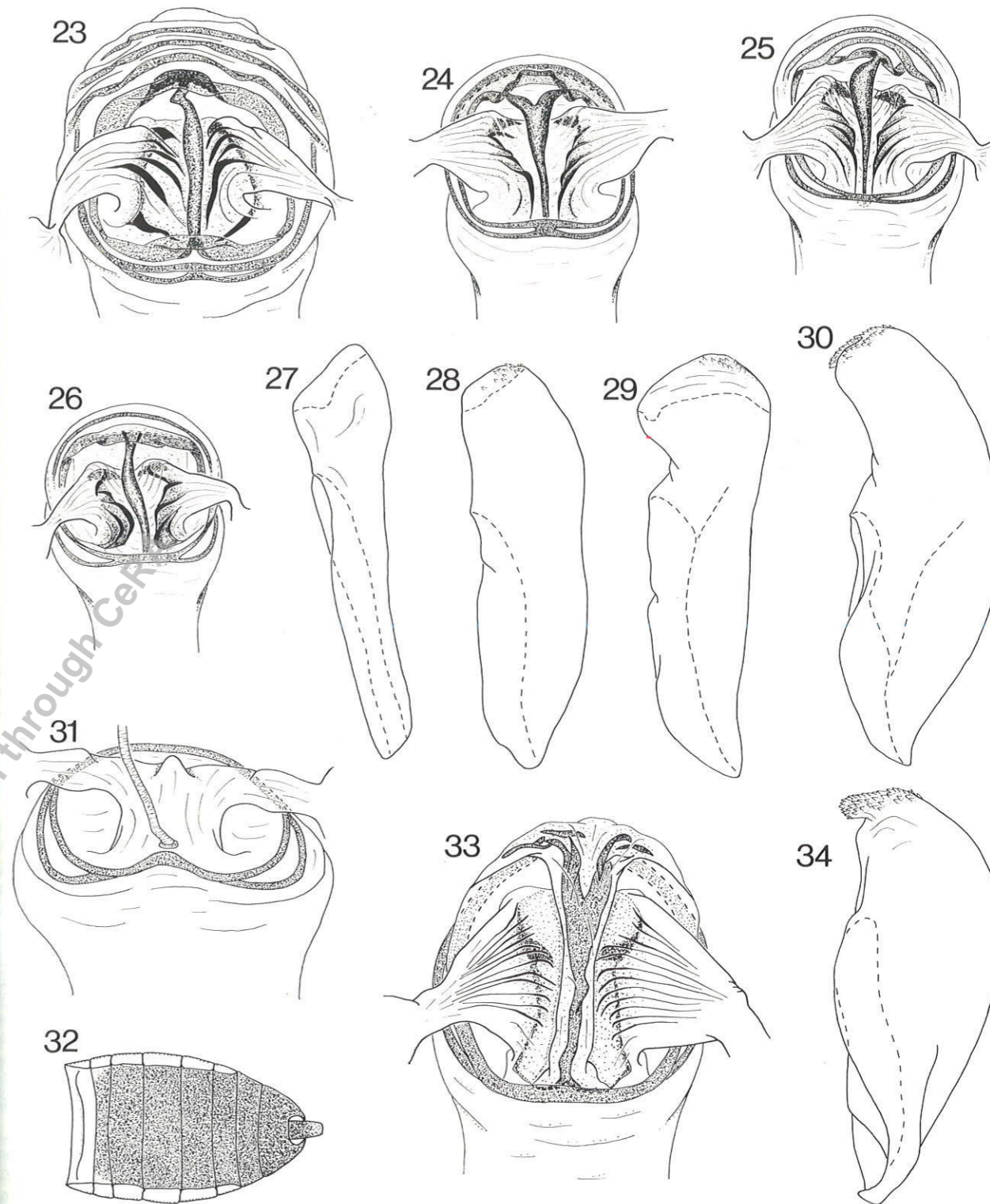
**Type.** *Helopeltis bradyi* was described from a series of specimens donated to the NHML in 1885 by H.B. Brady (Entomology Acc. No. 85-104). In the original description, Waterhouse (1886) did not designate a type or specify the number of specimens examined. The NHML Entomology register reports that six specimens were donated by Brady, but in fact the NHML collection contains nine adults (4♂, 5♀) and four nymphs labelled with accession no. 85-104. One of the male specimens with the following label data is here designated lectotype: Label 1, 'Type' [red-bordered disc]; 2, '*Helopeltis bradyi* ♂ (Type), Waterh.' [handwritten]; 3, 'Java 85-104'; 4 (here added), 'LECTOTYPE, *Helopeltis bradyi* Waterhouse, det. G. Stonedahl, 1991'. The remaining 12 specimens of the original syntype series, including the five nymphs, are identified by my yellow paralectotype labels.

**Types of synonyms.** *Helopeltis romundeii* also was described from a series of specimens donated to the NHML by H. B. Brady (1887, Entomol. Acc. No. 87-37). Eleven specimens with this accession number are deposited in the NHML collection. A male specimen with the following label data is here designated lectotype: Label 1, 'Type' [red-bordered disc]; 2, '*Helopeltis romundeii* ♂ (Type), Waterh.' [handwritten]; 3, 'Java 87-37'; 4 (here added), 'LECTOTYPE, *Helopeltis romundeii* Waterhouse, det. G. Stonedahl, 1991'. My yellow paralectotype labels have been added to the remaining 10 specimens of the original syntype series.

*Helopeltis ceylonensis* was described from an unspecified number of specimens collected at Teldeniya, Sri Lanka, 10.V.1956, M. D. De Silva. The original description states that the holotype and paratypes are deposited in the entomology collection of the Department of Agriculture, Peradeniya, Ceylon, with other paratypes deposited in the NHML. My recognition of this nominal species is based on the examination of the 32 paratypes deposited in the NHML collection.

**Discussion.** *Helopeltis bradyi* is perhaps the most variable species of the subgenus. Externally, it most closely resembles *H. antonii*, sharing with this species the distinctive dark patch on the lateral surface of abdominal sterna I-III. It is easily distinguished from *H. antonii* by the longer first antennal segment and structure of the male and female genitalia (see diagnosis and couplet 4 in key). Males of *H. bradyi* are usually smaller and darker than females, the general coloration ranging from dark reddish brown to deep fuscous. Rarely, males have the pronotal disc paler brownish red. Females usually have a reddish orange to brownish red pronotal disc, but in some Indonesian populations, the disc is occasionally dark reddish brown or fuscous. Differences in colour do not appear to be correlated with season or host association, as individuals from a single collection often differ widely in this regard. It is important to note that freshly moulted (teneral) adults are usually much paler in colour than older, hardened specimens.

Unlike other Asian species of *Helopeltis*, the structures of the male and female genitalia of *H. bradyi* show considerable variation. Variation in the lobal sclerite of the vesica tends to cluster around four basic types. Two of these sclerite types (figs 28, 29) are found only in specimens from Indonesian populations. A third type (fig. 30) is apparently restricted to populations occurring in Sri Lanka and south India. The final sclerite type, which is quite distinct in that it lacks the field of spines distally (fig. 27), was seen in two specimens collected in Sabah. The variation in structure of the lobal sclerite appears to be strongly correlated with geography, suggesting that perhaps four distinct taxa are involved. However, a very different picture emerges from an examination of the female genital chamber.



Figs 23-34. Figs 23-26, *H. bradyi*, variation in genital chamber of female: 23, Sabah; 24, Java; 25, South India; 26, Java. Figs 27-30, *H. bradyi*, variation in lobal sclerite of vesica: 27, Sabah; 28, 29, Java; 30, Sri Lanka. Fig. 31, female genital chamber of *H. cinchonae*. Figs 32-34, *H. clavifer*: 32, female abdomen, dorsal view; 33, female genital chamber; 34, lobal sclerite of vesica.

As with the lobal sclerite, the variation in the structure of the genital chamber tends to cluster around four distinct types (figs 23-26). The occurrence of intermediates, while more common than intermediate lobal sclerites, does not confuse the recognition of four distinct chamber types in the material examined. However, unlike the lobal sclerite, the structure of the genital chamber is only weakly correlated with geography, and females from a single population will often have more than one type of genital chamber. For example, of the four females dissected from the type series of the nominal species *H. bradyi*, two had the chamber type depicted in fig. 26, one individual had the chamber type shown in fig. 25 and one displayed yet another type of genital chamber (fig. 24). A similar situation was revealed by the dissection of four female paratypes of the nominal species *H. ceylonensis*, two specimens had the chamber type illustrated in fig. 25 and two possessed the chamber type shown in fig. 26. The only chamber type that remained constant within a geographically distinct group of populations was that depicted in figure 23, which was observed only in specimens collected in Sabah. Given that the males from Sabah also possess a unique lobal sclerite, there is a case for treating these specimens as a distinct species. However, considerably more material from Sabah and surrounding areas would need to be examined before a final decision is made regarding the status of this possible new 'species.'

The decision to synonymize *H. ceylonensis* and *H. romundeii* with *H. bradyi* in the present study is based primarily on the inability to recognize a morphologically distinct female for each of the three nominal species. Further, the variation in the genitalic structures of males and females could not be correlated with observed differences in colour and external morphology, which tend to be continuously variable. Questions regarding the status of *H. bradyi* and *H. romundeii* as distinct species were voiced by several previous workers including Miller (1941) and Betrem (1953).

**Material examined.** Numerous specimens from south India (AMNH, NHML), Java (NHML, RNHL, USNM, WAG), West Malaysia (NHML), Sabah (NHML, USNM), Singapore (USNM), Sri Lanka (NHML, USNM), Sumatra (NHML), and Timor (BISH).

***Helopeltis (Helopeltis) cinchonae* Mann**  
(figs 31, 35)

*Helopeltis cinchonae* Mann, 1907: 326-330 (sp. n.); Carvalho, 1957: 134 (cat.).

*Helopeltis brevicornis* Poppius, 1915a: 52-53 (sp. n.); Carvalho, 1957: 134 (cat.). **Syn. n.**

**Diagnosis.** This species is easily distinguished from other members of the subgenus by the short first antennal segment (see description), structure of the female genital chamber (fig. 31), and vesica of male genitalia without a lobal sclerite.

**Description of male.** Length 5.3-6.6 mm; dark brown general coloration; head uniformly fuscous except narrowly pale bordering inner-dorsal margin of eye, and with pale spot posteriad of eye bordering pronotal collar; antennae brown to dark reddish brown, segment I sometimes paler yellowish brown at least in part; length of antennal segment I equal to or only slightly greater than width of head across eyes; pronotum brownish yellow to dark brown, sometimes distinctly bicoloured with posterior half of collar and most of calli darker than posterior lobe; scutellum fuscous, distal half of scutellar process usually paler brownish yellow; hemelytra brown or dark brown, some-

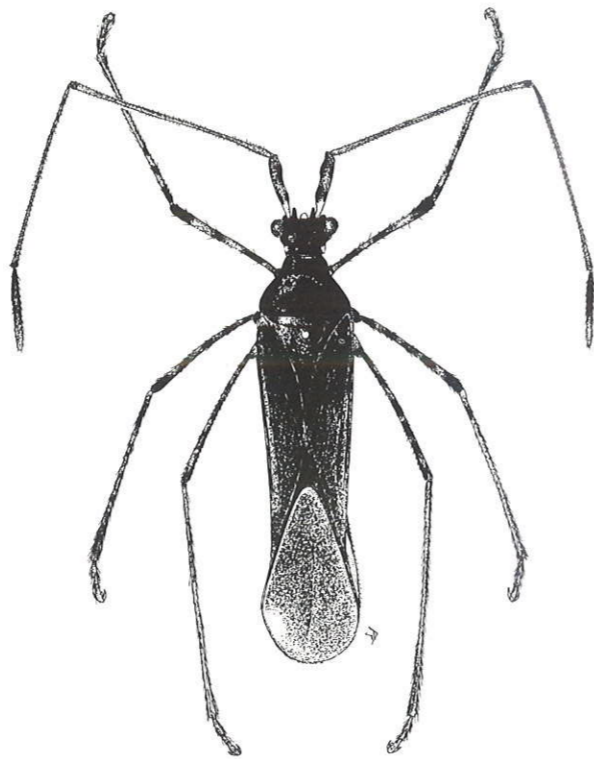


Fig. 35. Dorsal habitus of *H. cinchonae*, female.

times slightly paler basally, cuneus distinctly tinged with red; legs brown or brownish yellow with fuscous markings, apical fourth of femora mostly fuscous, hind femora sometimes more extensively darkened; tibiae darkened basally sometimes to midpoint, distal region brownish yellow.

**Female.** Length 6.6-8.9 mm; similar to male in colour and general structure, except usually somewhat larger; genital chamber as in fig. 31.

**Distribution.** Assam, Bhutan, south-east Asia, Java, Taiwan.

**Host association.** This species is a recognized pest of cinchona and tea in north-east India and south-east Asia (Lever, 1949; Mann, 1902). According to Lever (1949), it has been collected on over 60 plants including vines, herbs, shrubs, trees, a palm and one fern. He lists the following economic host plants: *Capsicum frutescens*, *Coffea arabica*, *Cyphomandra betacea*, *Dioscorea* spp., *Ipomoea batatas*, *Passiflora edulis*, *Solanum* spp. Other host plants reported by Lever (1949) are *Begonia semperflorens*, *Bidens pilosa*, *Caryota* sp., *Diplazium tomentosum*, *Erechtites* sp., *Melastoma malabathricum* and *Mikania scandens*. Miller (1941) added the following records from Malaysia: *Azalea scabra*, *Cephaelis angustifolia*, *Cymbidium* spp., *Gymnura omphaloides*, *Oenothera* sp. and *Oxalis* sp.

**Type.** The type of *H. cinchonae* was not examined in conjunction with the present study. In the original description, Mann (1902) states only that the species is 'found on cinchona at Munsong, British Bhutan, and also at Mungpoo, Darjeeling, at an elevation of 2700 to 4000 feet'. If a type specimen exists for *H. cinchonae*, it would most likely be deposited in the collection of the Institute for Agricultural Research, New Delhi or at the Agricultural Research Institute in Pusa.

**Type of synonym.** *Helopeltis brevicornis* was described from an unspecified number of specimens collected at nine different localities in Taiwan. Seven specimens matching the locality data given in the original description are deposited in the UZMH. A male with the following label data is here designated the lectotype: Label 1, 'Anping, Formosa, H. Sauter'; 2, '7. VIII.'; 3, '*Helopeltis brevicornis* n. sp.' [handwritten]; 4, 'Mus. Zool. H:fors, Spec. typ. No. 10145, *Helopeltis brevicornis* Popp.'; 5 (here added), 'LECTOTYPE, *Helopeltis brevicornis* Poppius, det. G. Stonedahl, 1991'. Paralectotype labels have been added to the other six specimens deposited in the UZMH. These specimens have locality data as follows: 1♀, Fuhosho; 1♂, Kankau (Koshun), IV, 1912; 1♂, Taihorin, 1911; 1♂, 2♀, Taihorinsho, 1909 - all Formosa, H. Sauter. According to the original description (Poppius 1915a), other paralectotypes are deposited in the collections of the Hungarian Natural History Museum, Budapest and the Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin, Eberswalde. Gaedike (1971) recorded 22 syntypes of *H. brevicornis* in the Eberswalde collection.

**Discussion.** The identity of *H. cinchonae* is clear from the original description and illustrations (Mann, 1902). Specimens examined from throughout south-east Asia are not discernibly different from the lectotype of *H. brevicornis* collected in Taiwan, and thus the latter species is here proposed as a new junior synonym of *H. cinchonae*. It would appear that Poppius (1915a) was unaware of Mann's description of *H. cinchonae* when he described *H. brevicornis*.

**Material examined.** One-hundred and three specimens from Burma (NHML, SMNH), Java (RNHL, WAG), West Malaysia (NHML, RNHL), Taiwan (BISH, RNHL, UZMH), Thailand (UZMK), and Vietnam (NHML).

***Helopeltis (Helopeltis) clavifer* (Walker)**  
(figs 2, 32-34)

*Dulichius clavifer* Walker, 1871: 170 (sp. n.).

*Helopeltis braconiformis* Walker, 1873: 165-166 (sp. n.); Waterhouse, 1886: 459 (syn.).

*Helopeltis niger* Walker, 1873: 165 (sp. n.); Carvalho, 1957: 135 (cat.). **Syn. n.**

*Helopeltis australiae* Kirkaldy, 1908: 786 (sp. n.); Carvalho, 1957: 134 (cat.). **Syn. n.**

*Helopeltis clavifer*: Distant, 1904a: 108 (list); Carvalho, 1957: 135 (cat.).

**Diagnosis.** *Helopeltis clavifer* belongs to a group of four species recognized by the uniformly pale basal sterna of the abdomen, narrowly pale base of antennal segment I, mostly fuscous head, and unfused sclerotized rings of the female genital chamber. Within this group, which includes *H. collaris*, *H. fasciaticollis* and *H. theivora*, *H. clavifer* is distinguished by the colour of the pronotum and abdominal terga (see couplets 13 and 14 in key), short setae on antennal segment II of the male (fig. 2), and by the structure of the female genital chamber (fig. 33).

**Description of male.** Length 6.4-7.6 mm; dark brown or reddish brown general coloration, thorax including scutellum sometimes much paler, yellowish orange to red; head mostly fuscous anteriorly and dorsally, sometimes with frons paler brown; head ventrad of eyes narrowly to broadly pale, in paler specimens sometimes with only buccula and gula narrowly darkened, in darker specimens sometimes with only apex of tylus and spot ventrad of eye pale; antennae brown to fuscous, base of segment I narrowly pale; pronotum red or brownish red

to dark fuscous, paler specimens sometimes with anterior margin of collar narrowly fuscous, and with faint fuscous spot on either side of scutellum near apex, sometimes also with posterior half of collar, calli and apex of scutellum paler brownish yellow; scutellar process brown or dark brown; hemelytra with bases of clavus and corium opaque white, and embolium, veins and cuneus dark brown, remainder of clavus and corium translucent gray or brown; coloration of legs variable, in darker specimens mostly brown to fuscous usually with bases of femora pale, in paler specimens mostly brownish yellow, with darker markings; lobal sclerite of vesica as in fig. 34.

**Female.** Length 6.8-8.3 mm; similar to male in colour and general structure; genital chamber as in fig. 33.

**Distribution.** New Guinea and northern Queensland, Australia.

**Host association.** *Helopeltis clavifer* is a pest of cocoa and tea in New Guinea, and also has been reported damaging cashew and sweet potato (*Ipomoea batatas* and *I. hederifolia*). Other host plants reported by Smith (1978) for New Guinea are as follows: *Acalypha caturus*, *Annona* spp., *Bixa orellana*, *Camellia sinensis*, *Cassia fistula*, *Centrosema pubescens*, *Eucalyptus deglupta*, *Flemingia strobilifera*, *Gliricidia sepium*, *Ixora* sp., *Leucaena leucocephala*, *Mangifera indica*, *Mimosa invisa*, *Passiflora edulis*, *Persea americana*, *Polyscias* sp., *Psidium guajava* and *Pueraria phaseoloides*.

**Type.** *Helopeltis clavifer* was originally described in the genus *Dulichius* Stål by Walker (1871). The original description indicates that three specimens from New Guinea were examined by Walker. Two of the original syntypes are deposited in the NHML collection. A male with the following label data is here designated lectotype: Label 1, 'Type' [green-bordered disc]; 2, '*Dulichius clavifer*, var. B (Type) Walker' [handwritten]; 3, '59.58 Dory, New Guinea'; 4, '2. *Dulichius ? clavifer*'; 5 (here added), 'LECTOTYPE, *Dulichius clavifer* Walker, det. G. Stonedahl, 1991'. A headless female with the same label data as above, except lacking labels 1 and 4, is identified by a newly added paralectotype label.

**Types of synonyms.** The original description by Walker (1873), indicates that *H. braconiformis* was described from a single specimen collected in New Guinea, and presented to the NHML by H.H. Saunders. The female holotype has the following label data: Label 1, 'Type' [green-bordered disc]; 2, '*Helopeltis braconiformis* (Type) Walker' [handwritten]; 3, 'Dor.'; 4, 'Dorey [? handwritten] Wallace'; 5, 'Saunders 65.13.'; 6, '4. *Helopeltis braconiformis*'; 7 (here added), 'HOLOTYPE, *Helopeltis braconiformis* Walker, det. G. Stonedahl, 1991'.

*Helopeltis niger* was described from a single specimen collected in Wagiou, New Guinea, and presented to the NHML by H.H. Saunders. The male holotype has the following label data: Label 1, 'Type' [green-bordered disc]; 2, '*Helopeltis niger* (Type) Walker' [handwritten]; 3, 'Saunders 65.13.'; 4, 'Wag.'; 5, '3. *Helopeltis niger*'; 6 (here added), 'HOLOTYPE, *Helopeltis niger* Walker, det. G. Stonedahl, 1991'.

The original description of *H. australiae* by Kirkaldy (1908) does not specify the number of specimens examined. However, statements in the description such as 'fourth absent' (in reference to antennal segment IV) and scutellar process 'partly broken at the base and lying on its side,' suggest that only a single specimen was involved. Kirkaldy provided the following data for the habitat of this species in eastern Australia: 'Q.: Kuranda (Aug.; Perkins)'. A badly damaged male specimen in the BISH collection agrees with the original description (including the broken scutellar process), and is here recognized as the

holotype of this nominal species. The label data for this specimen is as follows: Label 1, 'Cairns, Q., K. [handwritten in red], Austr., 8. 1904'; 2 (red), 'Type of *austrinus* Kirk.' [species name misspelled]; 3 (here added), 'HOLOTYPE, *Helopeltis australiae* Kirkaldy, det. G. Stonedahl, 1991'. As is often the case with Kirkaldy's type specimens, the label data do not fully correspond to those given in the original description. In this specific case, the red 'K' on the locality label is almost certainly an abbreviation for Kuranda, which is just north of Cairns in Queensland. A collector is not given on the locality label, but the '8.' is undoubtedly a reference to the month of August.

**Discussion.** The thorax of this species is quite variable in colour, ranging in both males and females from reddish or yellowish orange to dark fuscous. Walker (1871), aware of the variation in colour, classified the pale and dark individuals as two distinct varieties. However, this did not prevent him from describing the same species two additional times in 1873, *H. niger* (dark thorax) and *H. braconiformis* (red thorax). The male genital structures of the holotype of *H. niger* are indistinguishable from those of other males of *H. clavifer*. Further, my examination of the holotype and other specimens of *H. australiae* showed that this nominal species is well within the range of colour and structural variation displayed by typical *H. clavifer*. Based on these findings, *H. australiae* and *H. niger* are here proposed as new junior synonyms of *H. clavifer*.

The reference by Ron (1985) to *H. clavifer* in Sarawak is incorrect and probably pertains to the externally similar species *H. bradyi*.

**Material examined.** Seventy-nine specimens from West Irian (USNM), Papua New Guinea (BISH, NHML, RNHL, WAG), and northern Queensland, Australia (NHML, SMNH).

*Helopeltis (Helopeltis) collaris* Stål  
(figs 36-38)

*Helopeltis collaris* Stål, 1870: 667 (sp. n.); Carvalho, 1957: 135 (cat.).

**Diagnosis.** This species is related to *H. clavifer*, *H. fasciaticollis*, and *H. theivora* (see *H. clavifer* diagnosis), but is distinguished from these species by the following combination of characters: bicoloured pronotal collar; head ventrad of eye fuscous, without pale spot or more extensive pale stripe (fig. 38); and structure of the male and female genitalia (figs 37 and 36, respectively).

**Description of male.** Length 6.6 mm; brown general coloration; head fuscous with only apex of tylus and obscure spot on posterolateral margin pale (fig. 38); antennal segment I brown, base narrowly pale, segments II-IV fuscous; setae at apex of antennal segment II nearly as long as diameter of segment, setae near base of segment noticeably shorter; pronotum with anterior three-fourths of collar brownish yellow, calli and disc pale brown to fuscous; scutellum including process fuscous; hemelytra opaque white basally, with embolium, veins and cuneus brown; remainder of clavus and corium translucent brownish gray; legs dark yellowish brown with dark brown markings, more extensively darkened at apices of femora and bases of tibiae; lobal sclerite of vesica as in fig. 37.

**Female.** Length 7.3-7.7 mm; similar to male in colour and general structure, except pronotal disc sometimes broadly brownish yellow posteriad of calli, leaving only posteromedial region of disc fuscous; genital chamber as in fig. 36.

**Distribution.** Philippine Islands.

**Host association.** A single specimen was collected from *Piper nigrum* on Basilan.

**Type.** A female specimen identified only by a red label reading 'Typus' and a second handwritten label reading '*Helopeltis collaris* Stål' is deposited in the Swedish Museum of Natural History. This specimen agrees with the description of *H. collaris* given by Stål (1870) and is here designated a LECTOTYPE, as there is no clear indication that Stål based his description on a single specimen.

**Discussion.** Only five examples of this species were seen from the southern Philippine Islands. All specimens were similarly coloured (see male description) except the lectotype, which had the pronotal disc broadly pale behind the calli. Other features of the lectotype, including the genitalic structures, were indistinguishable from those of the other females examined.

*Helopeltis collaris* is distinguished from the majority of species occurring in the Philippines Islands (i.e., *H. bakeri*, *H. obscuratus*, *H. pellucida*) by the narrowly pale base of the first antennal segment and the structure of the female genital chamber. From *H. fasciaticollis*, which also has the first antennal segment pale basally, it is distinguished by the colour of the head and pronotal collar (see description).

**Material examined.** PHILIPPINE ISLANDS: 1♀ (SMNH, lectotype). Basilan: 1♂ (NHML). Luzon: Nueva Vizcaya: 1♂, Imugan (USNM). Mindanao: Bukidnon: 1♀, Tangcolan (USNM). Surigao del Norte: 1♀, Surigao (USNM).

*Helopeltis (Helopeltis) cuneata* Distant  
(figs 39, 40)

*Helopeltis cuneata* Distant, 1903: 270 (sp. n.); Carvalho, 1957: 135 (cat.).

*Helopeltis elegans* Poppius, 1914: 147-148 (sp. n.); Carvalho, 1957: 135 (cat.). **Syn. n.**

**Diagnosis.** Recognized by the pale brownish yellow coloration, with antennal segments III and IV, process and apex of scutellum, apical angle of corium, and last two segments of abdomen brown to fuscous, and by the structure of the male and the female genitalia (figs 40 and 39, respectively). The general coloration of this species is similar to that of *H. sulawesi* and *H. sumatranus*, but *H. cuneata* is considerably smaller than either of these species.

**Description of male.** Coloration as noted in diagnosis; darkened apical region of corium weakly convex dorsally; legs pale brownish yellow, femora with scattered, faint, fuscous spots; lobal sclerite of vesica as in fig. 40.

**Female.** Length 5.9-6.4 mm; similar to male in colour and general structure; genital chamber as in fig. 39.

**Distribution.** Java, West Malaysia.

**Host association.** Miller (1941) reports this species as occurring on 'Araceae,' but gives no reference for the record. No host associations were given for the three specimens examined in the present study.

**Type.** The original description of *H. cuneata* does not specify the number of specimens examined. A single female matching the locality data given by Distant (1903) is deposited in the collection of the NHML. This specimen has the following label data and is here designated the lectotype: Label 1, 'Type' [red-

bordered disc]; 2, '*cuneata* Dist.' [handwritten]; 3, 'Bulsit Besar. Siam: Malay States No. 93'; 4, 'Annandale & Robinson. Siamese Malay States. 1903-127.'; 5 (here added), 'LECTOTYPE, *Helopeltis cuneata* Distant, det. G. Stonedahl, 1991'.

**Type of synonym.** According to the original description (Poppius, 1914), *H. elegans* was described from one male and one female collected at Nusa Kambangan, Java. Poppius records 'Museum Helsingfors and Museum Leyden' as the depositories of these specimens. I have examined two females that match the type data given by Poppius. Because both of these specimens bear his handwritten identification labels, it is almost certain that they are the ones referred to in the original description. The fact that no male specimen was located suggests that the sex of one of the original specimens was misinterpreted by Poppius. The better of the two specimens, deposited in the UZMH, is here designated the lectotype: Label 1, '38 54'; 2, 'E. Jacobson. Noesa Kambangan, Java Mrt. 1911'; 3, '*Helopeltis elegans* n. sp. [handwritten] B. Poppius det.'; 4, 'Mus. Zool. H.fors, Spec. typ. No 9804, *Hyalopeltis elegans* Popp.' [genus misspelled on label]; 5 (here added), 'LECTOTYPE, *Helopeltis elegans* Poppius, det. G. Stonedahl, 1991'. The other specimen, deposited in the RNHL, has the same label data, but with label 1 reading '38 53' and without label 4. A paralectotype label has been added to this specimen.

**Discussion.** My examination of the types of *H. cuneata* and *H. elegans* revealed that these two nominal species are conspecific, and thus *H. elegans* is here proposed as a new junior synonym of *H. cuneata*.

**Material examined.** In addition to the types, four other specimens of this species were examined. A badly damaged male, identified only by a handwritten label reading '*Helopeltis cuneatus* Dist.' is deposited in the RNHL. A single female collected in Java by S. Leefmans also was examined. This specimen has NHML Entomol. Acc. No. 1916-33 printed on the locality label. The NHML Accessions Register confirms that the specimen was collected in Java by Leefmans, but gives no additional information regarding locality or host plant. The two remaining specimens, both females, were collected in Bogor, Java, 16.IV.1950 (RNHL).

*Helopeltis (Helopeltis) fasciaticollis* Poppius  
(figs 3, 4, 41-44)

*Helopeltis fasciaticollis* Poppius, 1915a: 53 (sp. n.); Carvalho, 1957: 135 (cat.).

*Helopeltis pallidus* Poppius, 1915a: 54 (sp. n.); Carvalho, 1957: 136 (cat.). **Syn. n.**

*Helopeltis pallidiceps* Poppius, 1915b: 76-77 (sp. n.); Carvalho, 1957: 136 (cat.). **Syn. n.**

**Diagnosis.** Related to *H. clavifer*, *H. collaris* and *H. theivora* by the structure of the female genital chamber and colour of the head, first antennal segment, and abdominal sterna (see *H. clavifer* diagnosis). *H. fasciaticollis* is distinguished from these species by the very long setae on antennal segment II of the male and by the structure of the male and female genitalia (figs 42 and 41, respectively). This species is further distinguished from *H. collaris* and *H. theivora* by the colour of the pronotal collar (see couplet 13 in key), and from *H. clavifer* by the uniformly pale abdominal terga III and IV (fig. 43).

**Description of male.** Length 6.2-7.0 mm; dark brown general coloration, pronotal disc sometimes paler brownish orange to nearly red; head mostly fuscous, apex of tylus, spot ventrad of

eye, and lateral spot bordering collar pale, sometimes with larger pale region anteroventrad of eye; antennae brown or dark brown, base of segment I narrowly pale brownish yellow; pronotum brown or dark brown, disc sometimes brownish orange to nearly red; scutellum brownish orange to fuscous, process brown to fuscous, or rarely with base pale yellow; hemelytra with bases of clavus and corium opaque white, and embolium, veins, inner-distal margin of corium, and cuneus dark brown, remainder of clavus and corium translucent gray or brown gray, sometimes more deeply tinged with fuscous; colour of legs variable, pale brownish yellow with limited fuscous markings to mostly brown or dark brown with only bases of femora pale; lobal sclerite of vesica as in fig. 42.

**Female.** Length 6.6-7.8 mm; similar to male in colour and general structure, but pronotal disc always brownish orange to nearly red, and legs usually extensively darkened; genital chamber as in fig. 41.

**Distribution.** North-east India, Malaysia, Philippine Islands, Sumatra, Taiwan.

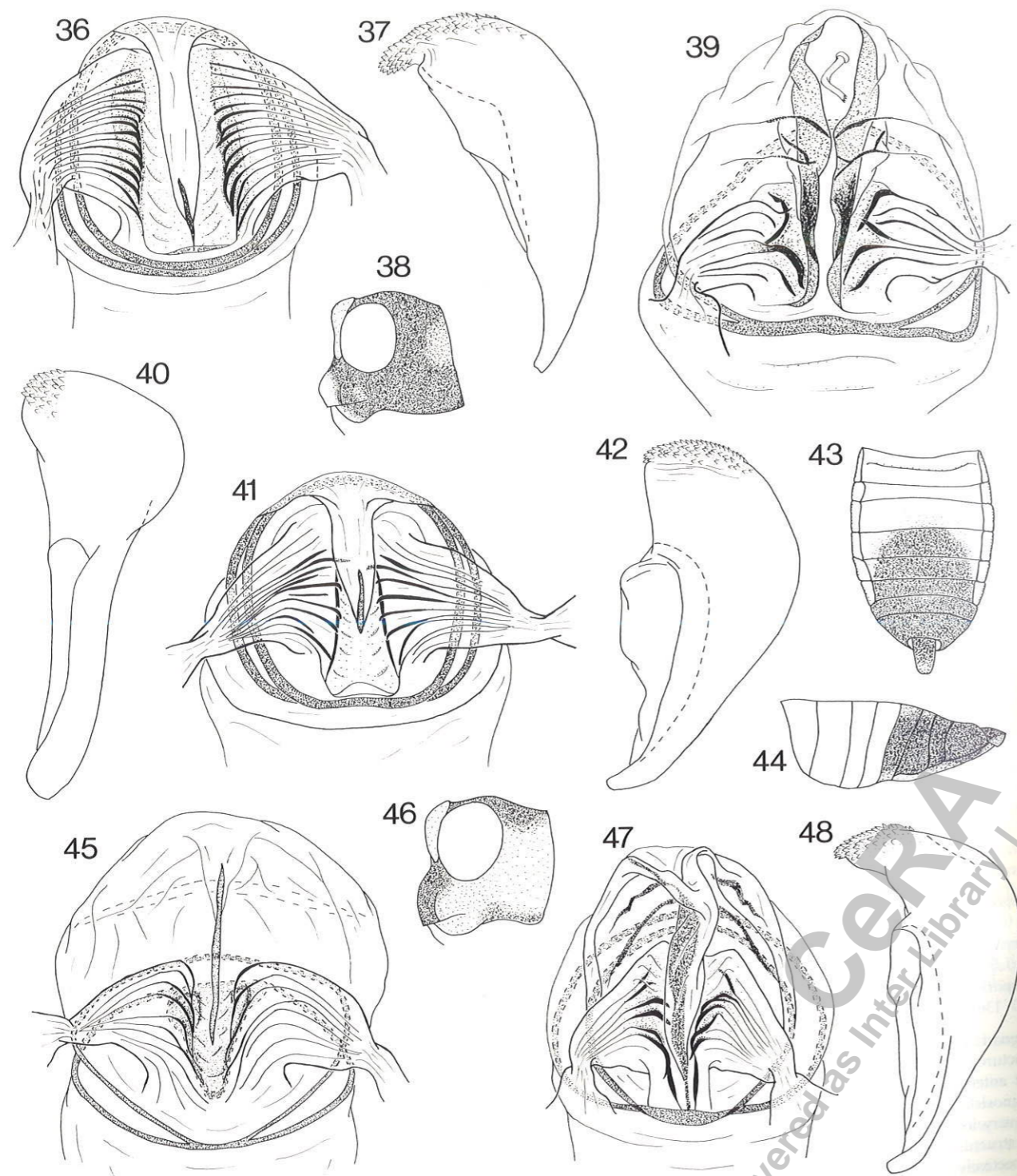
**Host association.** This species has been collected on cashew, cocoa, and passion fruit (*Passiflora edulis*) in Sabah.

**Type.** According to the original description (Poppius, 1915a), *Helopeltis fasciaticollis* was described from a series of specimens collected at several localities in Taiwan and deposited in the collections of the Hungarian Natural History Museum, Budapest, the Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin, Eberswalde and the University Zoological Museum, Helsinki. I have examined four specimens from the original syntype series that are deposited in the UZMH. A male with the following label data is here designated LECTOTYPE: Label 1, 'Kankau (Formosa) H. Sauter, 1912'; 2, '7. IV.'; 3, '*Helopeltis fasciaticollis* n. sp.' [handwritten]; 4, 'Mus. Zool. H.fors, Spec. typ. No 10151, *Helopeltis fasciaticollis* Popp.'; 5 (here added), 'LECTOTYPE, *Helopeltis fasciaticollis* Poppius, det. G. Stonedahl, 1991'. Paralectotype labels have been added to the other UZMH specimens: 1♂, 1♀, Kankau (Koshun); 1♀, Fuhosho. Three additional paralectotypes are reported to be deposited in the Eberswalde collection (Gaedike, 1971) and others are likely to be found in the Budapest collection.

**Types of synonyms.** *Helopeltis pallidus* was described from three females collected at Kankau, Taiwan. A specimen deposited in the collection of the UZMH with the following label data is here designated lectotype: Label 1, 'Kankau (Koshun) Formosa, H. Sauter 1912'; 2, '22. IV.'; 3, '*Helopeltis pallidus* n. sp.' [handwritten]; 4, 'Mus. Zool. H.fors, Spec. typ. No 10154, *Helopeltis pallidus* Popp.'; 5 (here added), 'LECTOTYPE, *Helopeltis pallidus* Poppius, det. G. Stonedahl, 1991'. The other two specimens from the original syntype series are reported to be deposited in the Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin, Eberswalde (Gaedike, 1971).

*Helopeltis pallidiceps* was described from a single male collected on Mt Makiling in the Philippine Islands. The label data for this specimen is as follows: Label 1, 'Mt. Makiling, Luzon, Baker'; 2, '*Helopeltis pallidiceps* n. sp.' [handwritten]; 3, 'Mus. Zool. H.fors, Spec. typ. No. 10155, *Helopeltis pallidiceps* Popp.'; 5 (here added), 'HOLOTYPE, *Helopeltis pallidiceps* Poppius, det. G. Stonedahl, 1991'. The holotype is deposited in the collection of the UZMH.

**Discussion.** The synonymy of the nominal species *H. pallidus* and *H. pallidiceps* is based on a comparison of the above listed type material. The lectotype of *H. pallidus* is clearly a general



Figs 36-48. Figs 36-38, *H. collaris*: 36, female genital chamber; 37, lobal sclerite of vesica; 38, female head, lateral view. Figs 39, 40, *H. cuneata*: 39, female genital chamber; 40, lobal sclerite of vesica. Figs 41-44, *H. fasciaticollis*: 41, female genital chamber; 42, lobal sclerite of vesica; 43, female abdomen, dorsal view; 44, female abdomen, lateral view. Figs 45, 46, *H. insularis*: 45, female genital chamber; 46, female head, lateral view. Figs 47, 48, *H. obscuratus*: 47, female genital chamber; 48, lobal sclerite of vesica.

specimen of what is otherwise a typical female of *H. fasciaticollis*. The male holotype of *H. pallidiceps*, while smaller and paler than the lectotype of *H. fasciaticollis*, is indistinguishable from the latter specimen structurally, including the genitalia. The males of this species are quite variable with regard to size and colour, but it is clear from the specimens examined here that the types of *H. pallidiceps* and *H. fasciaticollis* are more or less at the opposite ends of the range of variation in colour and size.

**Material examined.** Fifty-five specimens from Darjeeling, India (NHML), West Malaysia (NHML, RNHL), Philippine Islands (AMNH, BISH, UZMK), Sabah (NHML, USNM), Sumatra (RNHL) and Taiwan (UZMH, lectotype and paralectotypes).

***Helopeltis (Helopeltis) insularis* Kirkaldy**  
(figs 45, 46)

*Helopeltis insularis* Kirkaldy, 1902: 265 (sp. n.); Carvalho, 1957: 135 (cat.).

**Diagnosis.** Recognized by the following combination of characters: base of antennal segment I uniformly fuscous; tylus entirely darkened, not pale apically (fig. 46), and abdominal sterna I-V pale laterally. The female genital chamber is very similar to that of *H. bakeri*, but differs in the one examined specimen by the broader, more rounded anterior lobe (fig. 45).

**Description of female type.** Length 8.0 mm; dark brown general coloration; head fuscous dorsally and anteriorly, paler yellowish brown ventrad and posteriad of eyes and on bases of lorum and jugum; antennae segment I brown, with fuscous mottling producing overall dark brown coloration; antennal segments II-IV missing; pronotum with collar and calli yellowish brown and disc dark brown; mesoscutum and anterior margin of scutellum yellowish brown, remainder of scutellum including process fuscous; hemelytra brown, slightly translucent; clavus, embolium, paracuneus, and anterolateral margin of cuneus darker brown; legs yellowish brown with limited brown to fuscous markings; apical fourth of femora and bases of tibiae mostly fuscous; genital chamber as in fig. 45.

**Male.** Unknown.

**Distribution.** Known only from the type locality, Pulo Laut, Indonesia.

**Host association.** Unknown.

**Type.** The original description of *H. insularis* is based on an unspecified number of specimens (male and female) collected on Pulo Laut in Indonesia. I have examined a single female from the original syntype series, and here designate this specimen the lectotype of the species, label data: Label 1, 'Pulo Laut, J. Gribodo' [handwritten]; 2, '*Helopeltis insularis*' [handwritten]; 3, 'Type ♀ Kirk.' [handwritten]; 4, 'Coll. Kirkaldy, ex. coll. Montandon'; 5, '*Helopeltis insularis* Kirk.' [handwritten]; 6 (here added), 'LECTOTYPE, *Helopeltis insularis* Kirkaldy, det. G. Stonedahl, 1991.' The lectotype is deposited in the collection of the UZMH. No other syntypes of *H. insularis* were discovered despite inquiries at several other institutions known to contain Kirkaldy material.

**Discussion.** It is impossible to establish with certainty the type locality of *H. insularis* as there are a number of islands in Indonesia named Laut (Pulo is clearly a modification of the Malaysian word Pulau which means island). The largest of these and perhaps the most accessible at the turn of the century is located off the south-east coast of Borneo in the Makassar Strait.

Another less likely possibility would be the much smaller island of Laut situated south of Pontianak in the Kalimantan Barat region of Borneo.

***Helopeltis (Helopeltis) obscuratus* Poppius**  
(figs 47, 48)

*Helopeltis obscuratus* Poppius, 1915b: 76 (sp. n.); Carvalho, 1957: 135 (cat.).

**Diagnosis.** Recognized by the following combination of characters: base of antennal segment I uniformly fuscous; scutellum uniformly darkened, not pale medially; head ventrad of eyes, including all of tylus, broadly pale; and female genital chamber as in fig. 47. Females are further distinguished from the closely related species, *H. bakeri*, by the darker pronotal disc and longer first antennal segment (see couplet 11 in key).

**Description of male.** Length 6.6-6.9 mm; brown to dark brown general coloration; head fuscous dorsally, mostly pale brownish yellow ventrad of eyes with only buccula, gula and sometimes apex of lorum darker brown; antennae brown or dark reddish brown, extreme base of segment I fuscous, sometimes with paler yellowish brown region distad of basal constriction; pronotum and scutellum including scutellar process uniformly brown to fuscous; hemelytra translucent gray or brownish gray; embolium, inner distal margin of corium, and cuneus fuscous; legs with femora dark yellowish brown to fuscous, basal fourth usually noticeably paler; tibiae brown or yellowish brown, sometimes darker fuscous basally; lobal sclerite of vesica as in fig. 48.

**Female.** Length 7.6-8.5 mm; coloration as described for male, except head sometimes more extensively pale, with only margins of antennal fossae and dorsal region posteriad of eyes fuscous; genital chamber as in fig. 47.

**Distribution.** Philippine Islands.

**Host association.** Unknown.

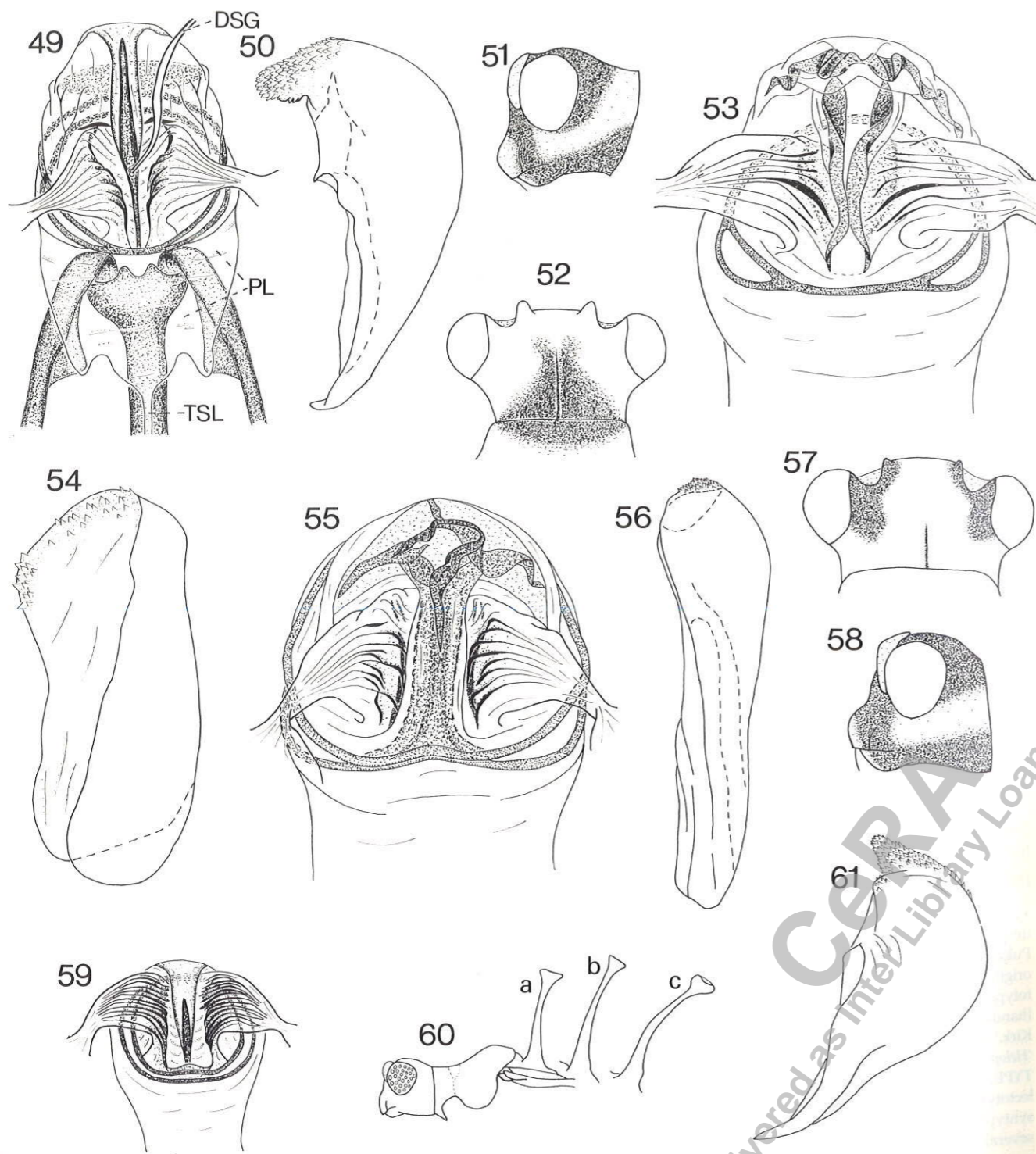
**Type.** According to the original description (Poppius, 1915b), *Helopeltis obscuratus* was described from a single female collected at Los Baños in the Philippine Islands and deposited in the collection of the UZMH. The exact label data for this specimen is as follows: Label 1, 'Los Baños, P.I., Baker'; 2, '400'; 3, '*Helopeltis obscuratus* n. sp.' [handwritten]; 4, 'Mus. Zool. H.fors, Spec. typ. No. 10119, *Helopeltis obscuratus* Pop.'; 5 (here added), 'HOLOTYPE, *Helopeltis obscuratus* Poppius, det. G. Stonedahl, 1991.' The head of the holotype is missing, but the species is easily recognizable by features of the thorax, legs and genitalia. Three additional specimens with the same locality label (one also with second label reading '400') are deposited in the USNM, but were apparently not seen by Poppius when he described this species.

**Material examined.** PHILIPPINE ISLANDS: Basilan: 1♀ (USNM). Luzon: 1♂, 4♀ (including holotype), Los Baños (BISH, USNM, UZMH); 1♂, Mt Maliling (USNM).

***Helopeltis (Helopeltis) pellucida* Stål**  
(figs 49-51)

*Helopeltis pellucida* Stål, 1870: 667 (sp. n.); Carvalho, 1957: 136 (cat.).

**Diagnosis.** This species is related to *H. bakeri*, *H. insularis* and *H. obscuratus* on the basis of the uniformly darkened base of



**Figs 49-61.** Figs 49-51, *H. pellucida*: 49, female genital chamber (DSG, duct of spermathecal gland; PL, posterior lobe; TSL, tubular sleeve of posterior lobe); 50, lobal sclerite of vesica; 51, female head, lateral view. Figs 52-54, *H. sulawesi*: 52, female head, dorsal view; 53, female genital chamber; 54, lobal sclerite of vesica. Figs 55-57, *H. sumatranus*: 55, female genital chamber; 56, lobal sclerite of vesica; 57, female head, dorsal view. Figs 58-61, *H. theivora*: 58, female head, lateral view; 59, female genital chamber; 60, variation in male scutellar process (a, Vietnam; b, South India; c, Java); 61, lobal sclerite of vesica.

antennal segment I and structure of the genital chamber of the female. *H. pellucida* is distinguished from these species by the mostly fuscous head, with pale lateral stripe not extending anteriorly of eyes (fig. 51); scutellum with broad, pale stripe medially (also present in males of *H. bakeri*); uniformly fuscous hind femora, without pale band basally; and by the structure of the male and female genitalia (figs 50 and 49, respectively). Females are further distinguished from *H. insularis* by the pale apex of the tylus (fig. 51), and from *H. bakeri* by the fuscous pronotum.

**Description of male.** Length 7.0 mm; dark brown general coloration; head mostly fuscous, with broad pale band reaching from anteroventral margin of eye to and across posterodorsal margin of head; tylus pale yellow, at least apically; antennae dark brown, extreme base of segment I darker fuscous followed by region of yellowish brown fading into dark brown; pronotum uniformly dark fuscous; scutellum fuscous laterally, broadly pale medially; scutellar process brown; hemelytra with bases of clavus and corium, embolium, inner-distal margin of corium, and cuneus fuscous, remainder of clavus and corium translucent gray; legs with femora dark brown and tibiae slightly paler brown; lobal sclerite of vesica as in fig. 50.

**Female.** Length 7.8-8.3 mm; similar to male in colour and general structure; genital chamber as in fig. 49.

**Distribution.** Philippine Islands.

**Host association.** Unknown.

**Type.** A single female with the following label data is deposited in the SMNH: Label 1 (red), 'Typus'; 2, '*Helopeltis pellucida* Stål' [handwritten]; 3 (here added), 'LECTOTYPE, *Helopeltis pellucida* Stål, det. G. Stonedahl, 1991.' I have designated this specimen a lectotype rather than considering it a holotype because there is no evidence provided in the original description to indicate that only a single specimen was examined by Stål (1870).

**Material examined.** PHILIPPINE ISLANDS: 1♀ (SMNH, lectotype). MINDANAO: Basilan: 1♀ (USNM). Lanao del Norte: 1♂, Kolambugan (USNM).

***Helopeltis (Helopeltis) sulawesi* sp. n.**  
(figs 52-54)

**Diagnosis.** Recognized by the pale brownish orange general coloration with limited fuscous markings on the head, pronotal disc, hemelytra and legs (see description), the broad lobal sclerite of the male vesica (fig. 54), and by the structure of the female genital chamber (fig. 53). This species is similar in colour to *H. cuneata* and *H. sumatranus*, but is easily distinguished by the large fuscous patch medially on the pronotal disc and the dark spot on the posterodorsal margin of the head (fig. 52). It is further distinguished from *H. cuneata* by the much larger body size.

**Description of male.** Length 8.3 mm; pale brownish orange general coloration; head pale brownish yellow with large fuscous spot posterodorsally; antennae segment I yellowish brown with fuscous spots on dorsal surface, expanded apical region reddish brown; antennal segments II-IV reddish brown; pronotum brownish orange, anterior margin of collar and large medial patch on disc fuscous; mesoscutum and scutellum brownish orange, scutellar process slightly darker brown; hemelytra brownish orange, apices of corium and cuneus tinged with fuscous; legs yellowish brown with limited fuscous spots; apical

fourth of femora and bases of tibiae entirely darkened; lobal sclerite of vesica as in fig. 54.

**Female.** Length 8.7-9.3 mm; similar to male in colour and general structure; genital chamber as in fig. 53.

**Distribution.** Sulawesi.

**Host association.** The holotype and male paratype of this species were collected on cocoa.

**Holotype** ♂. INDONESIA: Sulawesi: Manado [= Manado], III 1949, on cocoa, Jowangkoi (RNHL).

**Paratypes.** INDONESIA: Sulawesi: 1♀, Bantimurung, 100-400 m, 6.X.1965, R. Straatman (BISH); 1♀, Malino, August 1937, C.T. & B.B. Brues (AMNH); 1♂, Mapanget, 13-V-1941, on cocoa, Tammes (RNHL).

***Helopeltis (Helopeltis) sumatranus* Roepke**  
(figs 55-57)

*Helopeltis sumatranus* Roepke, 1916a: 180-182 (sp. n.); Carvalho, 1957: 136 (cat.).

**Diagnosis.** Recognized by the brownish orange general coloration; pale head, with only margins of antennal fossae and narrow region bordering inner-dorsal margin of eye fuscous (fig. 57); abdominal sterna I-III marked with a fuscous patch laterally; and by the structure of the male and female genitalia (figs 56 and 55, respectively).

**Description of male.** Length 6.2-7.5 mm; yellowish orange to pale brownish orange general coloration; head pale, with margins of antennal fossae and vertex bordering inner margin of eye fuscous; antennae segment I brown, usually paler brownish yellow basally, segments II-IV dark brown; pronotum brownish orange, sometimes tinged with brown dorsally, or rarely uniformly fuscous; scutellum yellowish orange or brownish orange, sometimes infuscated laterally, or rarely extensively darkened and leaving only apex pale; hemelytra pale brownish orange, translucent, sometimes with embolium and apex of corium lightly tinged with fuscous, cuneus dark brown; fore and middle legs uniformly brownish orange; hind femora brownish orange basally, sometimes with limited fuscous markings, distal fourth to half fuscous; hind tibiae yellowish brown with base narrowly darkened, or sometimes hind tibiae mostly dark brown; lobal sclerite of vesica as in fig. 56.

**Female.** Length 8.0-8.9 mm; similar to male in colour and general structure, except pronotum never extensively darkened; genital chamber as in fig. 55.

**Distribution.** Sumatra and West Malaysia.

**Host association.** This species occurs primarily on Gambir (*Uncaria gambir*). A single example also was collected on cocoa.

**Type.** *Helopeltis sumatranus* was described from a series of 11 males and 17 females collected in Asahan, Sumatra. I have examined three females from the original syntype series. Two of these are deposited in the collection of the NHML and one in WAG. The latter specimen is here designated the LECTOTYPE of the species, label data: Label 1 'Asahan, Sumatra, 1912, W. Roepke'; 2 (red), 'Holotypus, Roepke'; 3 (here added), 'LECTOTYPE, *Helopeltis sumatranus* Roepke, det. G. Stonedahl, 1991.' Paralectotype labels have been added to the two specimens in the NHML collection. A female specimen bearing a red, handwritten syntype label and deposited in the RNHL is not consid-

ered to be part of the original syntype series because it lacks Roepke's locality label for Asahan, Sumatra, 1912.

**Material examined.** Forty-nine specimens from Sumatra (NHML, RNHL, USNM, WAG) and one specimen from Johore Paloh, West Malaysia (NHML).

***Helopeltis (Helopeltis) theivora* Waterhouse**  
(figs 1, 5-9, 58-65)

*Helopeltis theivora* Waterhouse, 1886: 458 (sp. n.); 1894: 31-32 (descr.); Mann, 1907: 275-337 (variation); Carvalho, 1957: 137 (cat.).

*Helopeltis febriculosa* Bergroth, 1889: 271-272 (sp. n.); Atkinson, 1890b: 177-178 (descr.); Distant, 1904b: 440 (syn.); Mann, 1907: 331 (syn. note); Carvalho, 1957: 137 (cat.).

*Helopeltis oryx* Distant, 1904b: 441 (sp. n.); Carvalho, 1957: 136 (cat.). **Syn. n.**

*Helopeltis theobromae* Miller, 1939: 343-344 (sp. n.); Betrem, 1953: 177 (syn. as subsp. of *H. theivora*); Carvalho, 1957: 137 (cat.).

**Diagnosis.** Distinguished from other species of the subgenus by the following combination of characters: base of antennal segment I narrowly pale; distal third of antennal segment II and much of segment III of male with long, erect setae (fig. 5); head usually with broad, pale stripe laterally (fig. 58); pronotum usually with anterior half of collar and at least anterolateral margins of disc pale (figs 64, 65), or sometimes more broadly pale, leaving only posterior margin of disc infuscated (fig. 63); abdominal sterna I-V uniformly pale laterally; and male and female genitalia as in figs 61 and 59, respectively.

**Description of male.** Length 5.7-6.6 mm; brown or dark brown general coloration; head mostly fuscous, apex of tylus and broad stripe ventrad of eye pale (stripe usually reaching from base of tylus to posterodorsal margin of head), paler specimens sometimes with head more extensively pale ventrad of eyes, rarely with only gula narrowly darkened; antennae brown to fuscous, segment I usually paler yellowish brown, especially ventrally, and marked with fuscous patches dorsally, extreme base of segment I dirty white or pale yellow; antennal segments II-IV brown to fuscous, setae on distal third of segment II and much of segment III mostly longer than diameter of segment, those on basal two-thirds of segment II noticeably shorter; colour of pronotum variable, in paler specimens mostly brownish yellow with posterior margins of collar and disc broadly fuscous (fig. 63), in darker specimens mostly fuscous with pale lateral spot on disc usually extending onto propleuron (figs 64, 65); scutellum yellowish brown anteriorly, at least on anterolateral corners, fuscous distally; scutellar process usually dark brown; hemelytra with bases of clavus and corium narrowly opaque white, and embolium, inner-posterior margin of corium, and cuneus dark brown, remainder of clavus and corium translucent gray or brownish gray, clavus sometimes more extensively tinged with fuscous; leg colour variable, in darker specimens femora mostly brown to fuscous, usually with pale band basally, in paler specimens mostly brownish yellow, with brown to fuscous markings; tibiae of all specimens brownish yellow with fuscous markings, sometimes extensively darkened basally; lobal sclerite of vesica as in fig. 61.

**Female.** Length 6.4-7.6 mm; similar to male in colour and general structure; genital chamber as in fig. 59.

**Distribution.** Sri Lanka, south and north-east India, south-east Asia, Malaysia, Indonesia.

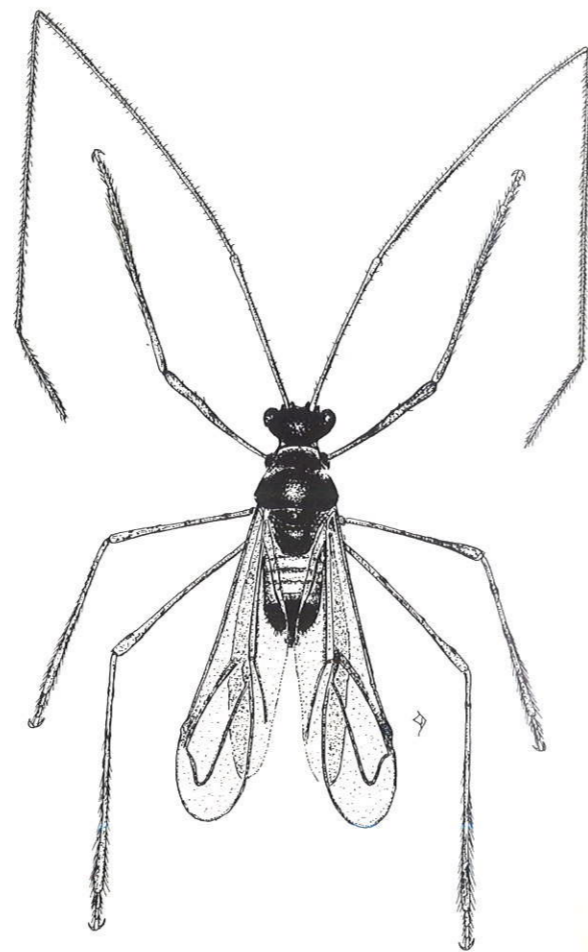


Fig. 62. Dorsal habitus of *H. theivora*, female.

**Host association.** *Helopeltis theivora* is a major pest of cocoa and tea in India and Asia. It also has been reported damaging other economically important plants such as black pepper, camphor, cashew, and cinchona. Additional host plants of this species are given by Miller (1941) and Das (1984).

**Type.** Several early economic accounts of this species (e.g., Wood-Mason, 1884) credit a Mr F. Moore of the East India's Company Museum with the recognition and naming of *H. theivora* as a distinct species. A description was never published by Moore, so the treatment of Waterhouse (1886) is officially recognized as the original description of the species. In his introduction, Waterhouse states, 'Mr. Moore has kindly lent me a specimen of a third species, the Assamese tea-bug, to which he gave the name *H. theivora*.' Although this establishes that Waterhouse's description is based on a single specimen collected in Assam, it does little to identify the specimen. A female in the collection of the NHML has been labelled the holotype of this species, label data: Label 1, 'Type' [red-bordered disc]; 2, 'Mr. M. Pike, Serispore Tea Factory, Hylakandy, Cachar' [handwritten], 3, 'Tea blight insect, *Helopeltis theivora* (Moore) Waterh., Type, Cachar, Nov. 1873' [handwritten, with the word 'Type' underlined]. This specimen is mounted on a large rectangular card along with

two early instar nymphs. No mention is made of the nymphs in Waterhouse's description.

The style of the script on the locality label of the type is different from that on the identification label. Further, the underlined word 'type' on the identification label is in yet another script, different from that of the rest of the label. The latter script is the same as that seen on other Waterhouse types (e.g., *H. bradyi*, *H. romundei*), which suggests that either Waterhouse or an assistant under his direction is responsible for labelling the above specimen the type. This evidence strongly suggests that the above specimen is the one described by Waterhouse in 1886. The following label has been added to the specimen to signify its type status: 'HOLOTYPE, *Helopeltis theivora* Waterhouse, det. G. Stonedahl, 1991.'

**Types of synonyms.** The original description of *H. febriculosa* indicates that the species was described from a single female collected in Sikkim, India on *Cinchona*. No identified type of this species is deposited in the UZMH collection, which is the primary depository of Bergroth type material. However, there is the possibility that the specimen in question is concealed somewhere in the general collections of the UZMH, as Bergroth types are frequently poorly labelled. In any case, the recognition of the species, now considered to be a synonym of *H. theivora*, is clear from the original description.

*Helopeltis oryx* was described from a single female collected in Kandy, Sri Lanka. The holotype is deposited in the collection of the NHML and has the following label data: Label 1, 'Type H.T.' [red-bordered disc]; 2, 'oryx Dist.' [handwritten]; 3, 'Kandy, Ceylon, 7.02'; 4, 'Distant Coll. 1911-383'; 5 (here added), 'HOLOTYPE, *Helopeltis oryx* Distant, det. G. Stonedahl, 1991.'

*Helopeltis theobromae* was described from an unspecified number of males and females collected on cocoa in Serdang, West Malaysia, Aug.-Dec. 1938, N.C.E. Miller. The male holotype and eight paratypes are deposited in the collection of the NHML. One of the labelled paratypes has a Jan. 1939 collection date, which is outside the date span given in the original description.

**Discussion.** The size and general coloration of *H. theivora* is highly variable and has been shown by Mann (1907) to be strongly correlated with season. Mann noted that individuals become progressively darker with age, the change in colour being most noticeable the first few days after the last moult. He also found that males from summer/autumn (July-October)

populations are on the average much darker than those from winter/spring broods (November-June), but that the converse was true of females. The range of pronotal coloration observed in the present study is illustrated in figs 63-65.

Mann (1907) also studied individual and seasonal variation in the size of various external structures of *H. theivora*. He found that some structures such as the antennal segments and scutellar process varied by as much as 25% above or below the monthly mean. Individuals from winter populations tended to be smaller on the average than those from summer populations. Relative lengths of body parts were found to be much more stable and could be used effectively to distinguish *H. theivora* from other species.

The male and female genitalia of *H. theivora* show little variation, both within and between populations. The genital chamber of the female is characterized by the numerous well developed ribs in the expanded distal region of the lateral oviducts and by the distinct medial sclerite (fig. 59). The related species *H. antonii* (fig. 19) and *H. fasciaticollis* (fig. 41) possess smaller medial sclerites and have fewer, less developed ribs in the lateral oviducts. The genital chamber of *H. collaris* (fig. 36) is nearly identical to that of *H. theivora*, but the two species are easily distinguished on the basis of characters of the external morphology. The lobal sclerite of the male vesica is distinguished by the relatively narrow base and by the well produced, acute apex (fig. 61).

Several early workers questioned the status of *H. febriculosa* as a distinct species (Atkinson, 1890b: 177; Waterhouse, 1889: 273), but it was not formally synonymized with *H. theivora* until the work of Distant (1904: 440). Strong support for this synonymy was provided in Mann's (1907: 331) detailed study of morphological variation in *H. theivora*.

The synonymy of *H. theobromae* by Betrem (1953: 177, as subspecies of *H. theivora*) was not included in Carvalho's Catalogue of Miridae (1957), and as a result, has not been recognized in most of the modern economic and taxonomic literature. My study of the type and other specimens identified as *H. theobromae*, mostly from cocoa, confirm that this nominal species is a synonym of *H. theivora*. Further, I can find no morphological basis for its recognition as a distinct subspecies.

My examination of the unique female type of *H. oryx* revealed that this nominal species is conspecific with *H. theivora*. Although the holotype is considerably darker than the average female of *H. theivora*, the pattern of dark markings is compara-



Figs 63-65. Variation in colour pattern of head and pronotum of *H. theivora*: 63, Vietnam; 64, South India; 65, Assam.

ble, particularly those on the head and thorax. Also, the genital chamber of *H. oryx* is indistinguishable from that of *H. theivora*. Distant (1904b) referred to the unique structure of the scutellar process in the original description of *H. oryx*, but other than being strongly deflexed, the process appears normal. As first noted by Mann (1907) and confirmed here, the scutellar process of *H. theivora* is highly variable in size and the degree of deflection (fig. 60). Based on the above information, *H. oryx* is proposed as a new junior synonym of *H. theivora*.

**Material examined.** Numerous specimens from Burma (SMNH), Hai-nan Tao Island, China (NHML), south and north-east India (AMNH, NHML, USNM), Java (RNHL, WAG), West Malaysia (BISH, NHML, RNHL), Singapore (USNM), Sri Lanka (NHML), Sumatra (AMNH, NHML, RNHL, USNM), Thailand (NHML), Vietnam (NHML).

### *Helopeltis (Helopeltis) podagricus* (Costa)

*Aspicelus podagricus* Costa, 1864: 147-148 (sp. n., fig. 6).  
*Helopeltis podagricus*: Walker, 1873: 165 (cat.); Carvalho, 1957: 136 (cat.).  
*Helopeltis podagricus*: Atkinson, 1890b: 179 (descr.).

**Discussion.** *Helopeltis podagricus* was described by A. Costa in 1864, with no mention of the number of specimens examined or the habitat of the species. A colour illustration was included with the original description, but it is rather schematic and the colour, which may have faded since the date of publication, is unlike that of any known species of the genus. Atkinson (1890b) translated the original description into English. As noted by Schmitz (1968: 221), it is clear from the original description that Costa's species belongs to the subgenus *Helopeltis sensu stricto*, but the identity of this nominal species can not be determined with certainty. The type of *H. podagricus* should be deposited in the Museo ed Istituto di Zoologia dell'Universita, Napoli along with other surviving types of A. Costa. Unfortunately, the staff at this institution have neglected to respond to several inquiries regarding this matter. A similar conclusion was reached by Schmitz (1968), who it would appear also received no assistance from the Naples Museum. Since there is no evidence to suggest that the type of *H. podagricus* is not in the Naples Museum or that it has been destroyed, the problem concerning the identity and status of this nominal species must be considered as unresolved at the present time.

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