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Grass-dependent Thysanoptera of the family Thripidae from Australia

LAURENCE A. MOUND
CSIRO Ecosystem Sciences, PO Box 1700, Canberra, ACT 2601. E-mail: laurence.mound@csiro.au

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Abstract

The diversity of Thysanoptera associated with grasses worldwide is discussed. Associations between thrips and members of the Poaceae have evolved independently in three thrips families. In Australia, almost 70 species of Thripidae are recorded as specific to Poaceae. Most of these thrips breed only on leaves, with 10 species in four genera breeding in grass florets, and a very few species feeding on both leaf and flower tissues. An identification key is provided to 28 genera of Thripidae found in Australia and known to be fully dependent on Poaceae, including four new genera of Thripinae with 16 new species. The new taxa are: *Aliceathrips* **gen.n**., *A. mnestes* **sp.n**., *A. engaius* **sp.n**., *A. palmeri* **sp.n**., *A. sorghi* **sp.n**. *Bregmatothrips australis* **sp.n**. *Kranzithrips mareebai* **gen. & sp.n**. *Masamithrips* **gen.n**., *M. masamii* **sp.n.,** *M. geikiei* **sp.n**., *M. melinus* **sp.n**., *M. tanyoeikus* **sp.n.,** *M. williei* **sp.n.,** *M. wyndhami* **sp.n**. *Monothrips cuspis* **sp.n**. *Parexothrips palumai* **sp.n**. *Stenchaetothrips bambusicola* **sp.n**. *Striathrips sulcatus* **gen. & sp.n**. One nomenclatural change is *Aliceathrips australiensis* (Girault) **comb.n.** transferred from *Bolacothrips*. The following five species are newly recorded from Australia: *Bolacothrips striatopennatus* (Schmutz), *Bregmatothrips binervis* (Kobus) [with *Bregmatothrips saccharicolus* (Bianchi) as a **new synonym**], *Exothrips sacchari* (Moulton), *Stenchaetothrips indicus* (Ramakrishna & Margabandhu) [with *Stenchaetothrips brasiliensis*(Hood) as a **new synonym**], *Takethrips megas* Nonaka & Jangvitaya.

Key words: Poaceae, Thripinae, new genera, new species

Introduction

The relationship between the species richness of a plant family and the number of phytophagous insects that exploit members of that family as hosts is far from linear. At plant family level, the host associations of the insect Order Thysanoptera exhibit little obvious pattern. For example, among the 5,500 species of Thysanoptera, scarcely 30 species, all but one of which are Thripidae, are associated with the Orchidacae, a family of 18,500 species (Mabberley, 1997). In contrast, the 18,000 species of Fabaceae support two extensive radiations - flower-living Thripidae in the *Megalurothrips* genus-group (Xie *et al.*, 2010), and foliage-feeding Phlaeothripidae particularly on *Acacia* (Crespi *et al.*, 2004). The largest plant family, the Asteraceae with 23,000 species, supports many unrelated flower-thrips species, including two substantial radiations - the *Frankliniella minuta* group (Thripidae) in South America (Mound & Marullo, 1996), and *Haplothrips* (Phlaeothripidae) in the Holarctic (Minaei & Mound, 2008). In contrast, the Poaceae includes only 9,000 species, half the number recognised in the Orchidaceae, but at least 300 species of thrips are fully dependent on grasses and bamboos, and these represent more than 10% of all phytophagous Thysanoptera.

Among Thysanoptera, the grass-living habit has evolved independently in three different families, and grasses provide four distinct habitats that have been exploited by thrips. Some thrips species breed only in grass florets, where larvae and adults feed mainly on developing ovules. A second habitat, and one that is exploited by a far larger diversity of thrips species, is provided by the tissues of young leaves. These two habitats are usually quite distinct, with only a few species feeding on both floret and on leaf tissues. However, not all thrips species for which grasses and bamboos provide the sole breeding habitat are phytophages. Associated with the bases of grasses is a series of fast-running predatory thrips species, presumably feeding primarily on mites. The fourth habitat associated with grasses is provided by fungi that live in grass tussocks, and this is exploited by a suite of specialist fungus-feeding thrips. It is this adaptation to a range of micro-habitats that makes the association between thrips and Poaceae so interesting. Moreover, in addition to the thrips that are fully dependent on grasses, a few polyphagous species sometimes breed on these plants, such as *Thrips tabaci*. However, most polyphagous thrips are probably unable to maintain viable populations on grasses, as has been demonstrated by Sharma *et al.* (2011) for the Western Flower Thrips, *Frankliniella occidentalis.*

If host-plant relationships are considered within an evolutionary context, then it is necessary to distinguish between those plants that provide an essential breeding site for an insect species, and plants from which adults only have been collected. Thus it is critical to distinguish those thrips species that are adapted to and dependent on grasses for breeding, from thrips for which grasses provide merely an occasional feeding resource or even just a place to shelter – however important this might be to the life of an individual. Long lists of species collected from grasses with no evidence of any real dependency, such as the 46 Thripidae listed by Ananthakrishnan & Sen (1980), actually confound recognition of patterns of host plant exploitation. The study presented here is concerned solely with taxa of the family Thripidae found in Australia that are considered to be fully dependent on Poaceae; the many other species that can be found associated more casually with grasses are not considered. Some of the taxa discussed here are introduced, from Europe, Africa and South America. Others have natural ranges across Asia into tropical Australia, although many are endemic to the Australian continent.

The first purpose of this paper is to emphasise the importance of grasses to the Thysanoptera diversity of Australia, and to provide an introduction and means of identifying the 28 genera of Thripidae involved. The second purpose is to describe four new genera and 16 new species in preparation for a web-based identification and information system to the Terebrantia of Australia (Mound, Paris *et al.*, 2011). Extended descriptions of taxa, also keys to species, are given here only where these are not available in the published literature. Full nomenclatural details of all Thysanoptera taxa are web-available (Mound, 2011), and a full checklist of Australian Thysanoptera is similarly provided (ABRS, 2011). Holotypes of the new species described here are deposited in the Australian National Insect Collection, Canberra.

The diversity of grass thrips

Of the three families of Thysanoptera that include grass thrips, the Aeolothripidae includes the fewest species specific in their biology to Poaceae. Aeolothripids associated with grasses are fast-running, wasp-like predators, living at the base of grasses and presumably feeding on mites. Within the Aeolothripidae this behaviour and habitus has evolved independently several times, including species of *Stomatothrips* in the Americas (Mound & Marullo, 1996), *Gelothrips* and *Desmothrips* in Australia (Pereyra & Mound, 2010), and several distantly related *Aeolothrips* species in Europe and North America (zur Strassen, 2003; Hoddle *et al.*, 2008). A far wider range of grass-living thrips species are members of the family Phlaeothripidae. The large genus *Haplothrips* occurs on all continents, and includes species that breed in the inflorescences of grasses (Minaei & Mound, 2008). *Podothrips* is a group of coccid predators living on grasses and bamboos (Mound & Minaei, 2007), and *Bamboosiella* is another genus of grass thrips with species that are probably predatory (Okajima, 2006). No leaf-feeding Phlaeothripidae are known to breed on grasses, but spore-feeding thrips of the sub-family Idolothripinae occur commonly at the base of grass tussocks, including genera such as *Bolothrips, Carientothrips* and *Nesothrips* (Mound, 1974). Moreover, fungus-feeding Phlaeothripinae that are usually associated with leaf litter can also be found at the base of grass tussocks, and some species, such as those of the Australian genus *Apostlethrips*, are possibly specific to this habitat (Mound & Minaei, 2006).

The largest diversity of Thysanoptera species that are dependent on grasses occurs in the family Thripidae. However, of the four Thripidae subfamilies, no Sericothripinae are known to be dependent on grasses (Mound &

Tree, 2009); among Dendrothripinae only the two species of *Edissa* breed on grasses (Mound, 1999); whereas among Panchaetothripinae several species breed only on these plants, particularly some in the genus *Caliothrips* (Mound, Paris *et al.*, 2011). It is amongst the Thripinae that extensive radiations onto Poaceae have occurred. Species of *Aptinothrips* and *Limothrips*, although Holarctic in origin are now widespread in temperate regions around the world. *Chirothrips* is a large genus with most species Holarctic in origin, but with smaller numbers endemic to Africa and South America, and *Arorathrips* is a related genus of Neotropical species. Only a few endemic grass-living Thripidae have been recorded from South America, including species of the genus *Plesiothrips*, a few species of *Frankliniella*, and possibly *Prionotothrips* (Mound & Marullo, 1996). The Afro-tropical fauna remains very poorly known, but in Asia there are several endemic species on Poaceae. These include the widely distributed *Priesneriola oneillae*, all members of the genera *Bolacothrips*, *Bregmatothrips* and *Stenchaetothrips*, as well as a series of genera on bamboo species in Thailand and Malaysia (Mound & Ng, 2009), including *Takethrips megas* that is here recorded from Australia.

Grass-living Thripidae in Australia

Over much of southern temperate Australia pastures are dominated by imported grasses. In such areas the dominant grass-living Thripidae are species of *Aptinothrips*, *Chirothrips* and *Limothrips*, all introduced from Europe, also more rarely *Apterothrips* that presumably came from the west coast of North America (Hoddle *et al.*, 2008). In contrast, Australian native Poaceae in southern Australia support one species of *Caprithrips*, and three species of *Odontothripiella*, all endemic to Australia. *Karphothrips* breeds only on the leaves of the native sword-grass *Gahnia* (Cyperaceae), and *Moundothrips* lives either on Poaceae or Restionaceae. *Physemothrips* is found only much further south, on grasses in the Antarctic Islands.

In the warmer parts of Australia, widespread introduced grasses such as Buffel Grass, *Cenchrus ciliaris*, usually bear New World species of the genera *Arorathrips* and *Plesiothrips*. These thrips species now occur throughout the tropics and subtropics, and they are commonly found together with species such as *Anaphothrips sudanensis*, *A. obscurus*, and *A. swezeyi*. The introduced tropical grasses also support species of *Caliothrips*, *Edissa*, *Phibalothrips* and *Stenchaetothrips*, all of which presumably originated in the Old World tropics. Certainly, there is considerable overlap between the thrips fauna of northern Australia and that of Indonesia and Southeast Asia (Mound & Tree, 2011). But it is on the native grasses of northern Australia that the greatest diversity of endemic grass thrips is found, with species of *Aliceathrips*, *Kranzithrips*, *Masamithrips*, *Monothrips*, *Ozanaphothrips* and *Striathrips* known only from Australia. In contrast, the genera *Bolacothrips*, *Bregmatothrips*, *Exothrips*, *Monothrips*, *Organothrips*, *Parexothrips*, *Stenchaetothrips* and *Takethrips* all occur in other tropical countries, despite including some species that are presumed to be endemic to Australia. This thrips fauna of northern Australia is particularly complex, and the patterns of structural variation between populations are not yet fully understood, particularly in *Aliceathrips* and *Masamithrips*.

Feeding sites and host associations of grass-dependent Thripidae

Most of the grass-living Thripidae species considered here breed only on the leaves of their hosts. Some of these, such as *Anaphothrips obscurus*, cause feeding damage in the form of linear markings on leaves. Feeding and breeding in such species seems to be associated largely with newly emerged, young leaves. Of the thrips that occur in the florets of Poaceae, *Arorathrips* and *Chirothrips* species are specific to this habitat, with each larva developing in its own individual floret. Also breeding specifically within grass florets are three species of *Odontothripiella*. Furthermore, *Plesiothrips perplexus* presumably lays its eggs within florets, judging from the weak, non-serrate ovipositor of females. The biology of *Takethrips* species remains unknown, other than being associated with bamboos, but the ovipositor of *T. megas* is very weak and lacks serrations, similar to that of *Plesiothrips* species. Such an ovipositor could not be used to insert an egg into plant tissues, and *T. megas* presumably deposits its eggs within the florets of its bamboo host. *Limothrips* species are unusual amongst the grass-dependent thrips, in that although they feed and breed on young leaves, adults and larvae will also move to the florets where they feed on and cause damage to the developing embryo.

The precise host associations of grass thrips are determined infrequently, most host records being limited to the statement "grasses". Despite this, in the experience of the present author during extensive field work across Australia, grass thrips that are endemic to Australia are found associated almost exclusively with endemic grass species. Thus the species of *Odontothripiella* that breed in grass florets are associated with *Danthonia*, *Stipa*, and *Themeda*. Species of the indigenous genera *Aliceathrips*, *Masamithrips*, *Karphothrips* and *Monothrips*, also *Caprithrips moundi* and *Brematothrips australis*, all of which breed on leaves, are associated with native grasses including the genera *Chrysopogon*, *Poa*, and *Stipa*, and the sword grass, *Gahnia* (Cyperaceae). In contrast, introduced thrips species are associated with non-native grasses: *Arorathrips mexicanus* is common in the florets of Buffel Grass, *Cenchrus ciliaris*; *Chirothrips manicatus* breeds in the florets of *Dactylis* and *Phalaris*; *Bolacothrips striatopennatus* appears to be associated with the soft, broad leaves of *Paspalum*; *Aptinothrips rufus* is particularly catholic in its tastes with adults being found on many non-native grass species.

The sharp separation in host associations between native and introduced thrips species has a major effect on thrips diversity in the extensive areas of exotic grass species across Australia. Buffel Grass is now widespread across the north of Australia, and native grass thrips are effectively excluded from the resultant grassland community. Similarly, in the south of the continent, the vast areas of introduced grasses, such as *Dactylis*, *Lolium*, and *Phalaris*, do not provide a habitat for Australian endemic thrips. Unfortunately, there are no serious studies on these ecological relationships.

Supra-generic relationships among grass-living Thripinae

The supra-generic classification of Thysanoptera is by no means satisfactory. Many groups have been proposed, but few have any sound phylogenetic basis. Within the Thripidae four subfamilies are currently recognised, Panchaetothripinae, Dendrothripinae, Sericothripinae and Thripinae, although even the recognition of these remains contentious (Bhatti, 2006). Within the Thripinae various groups have been named, but none of them is satisfactorily defined. *Chirothrips* and *Limothrips* have been placed together in a group called the Chirothripini, but this is not defined by any synapomorphies. Similarly, the Aptinothripina was proposed to include a range of Thripinae that lack elongate pronotal setae, although this character state is clearly homoplasious. Among the Thripinae discussed in this paper, the members of several endemic genera share certain character states that possibly indicate some level of phylogenetic relationship. For example, the presence of one or more pairs of setae on the prosternal basantra is an unusual character state that is shared by one or more species of *Caprithrips*, *Exothrips*, *Karphothrips*, *Kranzithrips*, *Masamithrip*, *Monothrips*, and *Organothrips*, but not by any species of *Aliceathrips*. The absence of a discal seta on the fore wing clavus is another unusual character state shared by species in the genera *Aliceathrips*, *Masamithrips*, *Karphothrips* and *Monothrips*, but not by the species in *Kranzithrips*. The presence of paired campaniform sensilla close to the tergal posterior margin is shared by species of *Aliceathrips*, *Bregmatothrips*, *Karphothrips*, *Kranzithrips* and *Monothrips*. However, this latter character state also occurs in some other Poaceae-dependent thrips, including *Aptinothrips* and *Apterothrips*, and is possibly related to the shared host association rather than an indication of relationships.

Key to Thripidae genera with species dependent on Poaceae in Australia

1. Female with sternite VII posteromarginal setal pairs S1 & S2 arising closer to each other than to setal pair S3 (Fig. 40) 2
-. Sternite VII pairs of posteromarginal setae arising equidistant from each other (Figs 10, 36) 3
2. Prosternum with no setae; prosternal ferna complete medially; ocellar setae pair III arising within triangle (Fig. 38). *Exothrips*
-. Prosternum with 2 or more setae, prosternal ferna divided medially (Fig. 44); ocellar setae pair III arising outside triangle (Fig. 39) . . . . . *Parexothrips*
3. Pronotum with no long setae at posterior angles 4
-. Pronotum with at least one pair of prominent posteroangular setae 15
4. Wings absent, or reduced to lobes no longer than width of thorax 5
-. Wings fully developed. 10
5. Prosternum with one or more pairs of setae (Fig. 45). . . . . *Caprithrips*
-. Prosternum without any setae 6
6. Abdominal sternites with transverse row of discal setae (cf Fig. 10) 7
-. Abdominal sternites with no discal setae (cf Fig. 36). 8
7. Antennae 6-segmented; tarsi 1-segmented . . . . . *Aptinothrips*

-. Antennae 8-segmented; tarsi 2-segmented . . . . . *Ozanaphothrips* [part]
8. Abdominal sternites III–VI posterior margins with craspedum deeply lobed between marginal setae . . . . . *Apterothrips*
-. Abdominal sternites III–VI with no craspedum 9
9. Body dark brown, strongly reticulate; antennae 7-segmented . . . . . *Moundothrips*
-. Body variable, yellow to brown, never strongly reticulate; antennae 8- or 9-segmented, segment VI sometimes with incomplete suture . . . . . *Anaphothrips* [in part]
10. Antennae 7-segmented; fore wings without prominent setae 11
-. Antennae 8- or 9-segmented; fore wings with setae on veins including costa 12
11. Body colour pale yellow, including antennal segments I – V; metathoracic endofurca elongate lyre-shaped . . . . . *Edissa*
-. Head and thorax dark brown, strongly reticulate, abdomen golden; metathoracic endofurca transverse . . . . . *Phibalothrips*
12. Body dark brown; head and pronotum reticulate with markings inside the reticles; hind coxae internally with prominent coiled apodeme; metathoracic endofurca elongate lyre-shaped. . . . . *Caliothrips*
-. Body colour various, yellow or brown or bicoloured; reticulation, when present, without internal markings; hind coxae internally without a coiled apodeme; metathoracic endofurca transverse 13
13. Abdominal sternites with transverse row of discal setae . . . . . *Ozanaphothrips* [part]
-. Abdominal sternites with no discal setae 14
14. Ocellar setae I absent; antennal segments III & IV with sensorium simple; metanotum with complex sculpture lines (Fig. 90); ovipositor weak, not serrate (Fig. 91); metapre-episternum broadly band-like . . . . . *Takethrips*
-. Ocellar setae I present; antennal segment IV with sensorium forked, III with sensorium sometimes simple; metanotum with reticulate sculpture; ovipositor serrate; metapre-episternum slender and tapering laterally. . . . . *Anaphothrips* [in part]
15. Tergites V–VII with paired ctenidia laterally (Figs 30, 82) 16
-. Tergites V–VII without paired lateral ctenidia 17
16. Antennal segments III–IV with sensoria simple . . . . . *Bolacothrips*
-. Antennal segments III–IV with sensoria forked . . . . . *Stenchaetothrips*
17. Female abdominal tergite X with pair of stout thorn-like setae . . . . . *Limothrips*
-. Female abdominal tergite X without such setae 18
18. Sensorium on antennal segment III simple, on IV usually simple but rarely forked 19
-. Sensorium forked on antennal segments III and IV 28
19. Prosternal basantra with 1 or more pairs of setae (Fig. 58). 20
-. Prosternum without any setae 24
20. Fore tibia inner apex with broadly flattened or bifurcate seta; head strongly prolonged in front of eyes; ocellar setae pair I absent . . . . . *Organothrips*
-. Fore tibia inner apex without modified seta; head scarcely prolonged in front of eyes; ocellar setae pair I present 21
21. Abdominal tergites with no craspedum including segment VIII (Fig. 46); sternites with no discal setae . . . . . *Karphothrips*
-. Tergites II–VIII with broad craspedum on posterior margin (Figs 47, 62); sternites with or without row of discal setae 22
22. Abdominal sternites II–VI posterior margin with craspedum of five broad lobes (Fig. 49); ocellar setae I absent; fore wing clavus with discal seta present; sternites with no discal setae . . . . . *Kranzithrips* **gen.n.**
-. Abdominal sternites II–VI posterior margin either with dentate craspedum or with no craspedum; ocellar setae I present; fore wing clavus with no discal seta; sternites with transverse row of discal setae 23
23. Abdominal sternites with dentate craspedum (Figs 76, 78); maxillary palps 3-segmented . . . . . *Monothrips*
-. Abdominal sternites with no craspedum (Fig. 60); maxillary palps 2-segmented . . . . . *Masamithrips* **gen.n.**
24. Fore wing clavus with no discal seta (Fig. 13); sternites with transverse row of discal setae (Figs 10, 17) 25
-. Fore wing clavus with discal seta (Fig. 35); sternites without discal setae (Fig. 36) 26
25. Body and legs yellow; pronotum with 2 pairs of posteroangular setae (Figs 1, 5); mesothoracic furca usually without spinula; metanotum without campaniform sensilla (Fig. 1) . . . . . *Aliceathrips* **gen.n.**
-. Body brown or bicoloured; pronotum with one pair of small posteroangular setae; mesothoracic furca with short spinula; metanotal campaniform sensilla present or absent . . . . . *Ozanaphothrips* [part]
26. Pronotum weakly trapezoidal, head not unusually small (Fig. 31); antennal segment II symmetrical; tergal campaniform sensilla close to posterior margin (Fig. 33); metapre-episternum transversely band-like; female macropterous dark brown; male sometimes bicoloured, macropterous or micropterous . . . . . *Bregmatothrips*
-. Pronotum strongly trapezoidal, much larger than head (Fig. 23); antennal segment II often strongly asymmetric and prolonged laterally; tergal campaniform sensilla distant from posterior margin; metapre-episternum scarcely prolonged laterally; female macropterous, brown, sometimes bicoloured when teneral; male apterous 27
27. Mesothoracic furca T-shaped with broad lateral flanges, invaginations close together near mid-line (Fig. 25) . . . . *Chirothrips*
-. Mesothoracic furca weak, without broad lateral flanges, invaginations widely separated (Fig. 24) . . . . . *Arorathrips*
28. Fore tibial apex with 2 claws, rarely with one; sensorium on antennal segment VI with greatly enlarged, broadly oval base . . . . . *Odontothripiella*
-. Fore tibia without an apical claw; sensorium on antennal segment VI with circular base 29
29. Fully apterous, head with no ocelli; tergite IX with 2 pairs of stout setae [Macquarie Island] . . . . . *Physemothrips*
-. Macropterous, rarely micropterous; setae on tergite IX slender 30
30. Abdominal tergites II–VII with no craspedum; tergites with little sculpture; female with ovipositor valves weakly sclerotised and not serrate . . . . . *Plesiothrips*
-. Abdominal tergites II–VII with lobed craspedum and many transverse striae (Fig. 96); female with ovipositor valves strongly sclerotised and serrate . . . . . *Striathrips* **gen.n.**

***Aliceathrips* gen.n.**
(Figs 1–22)

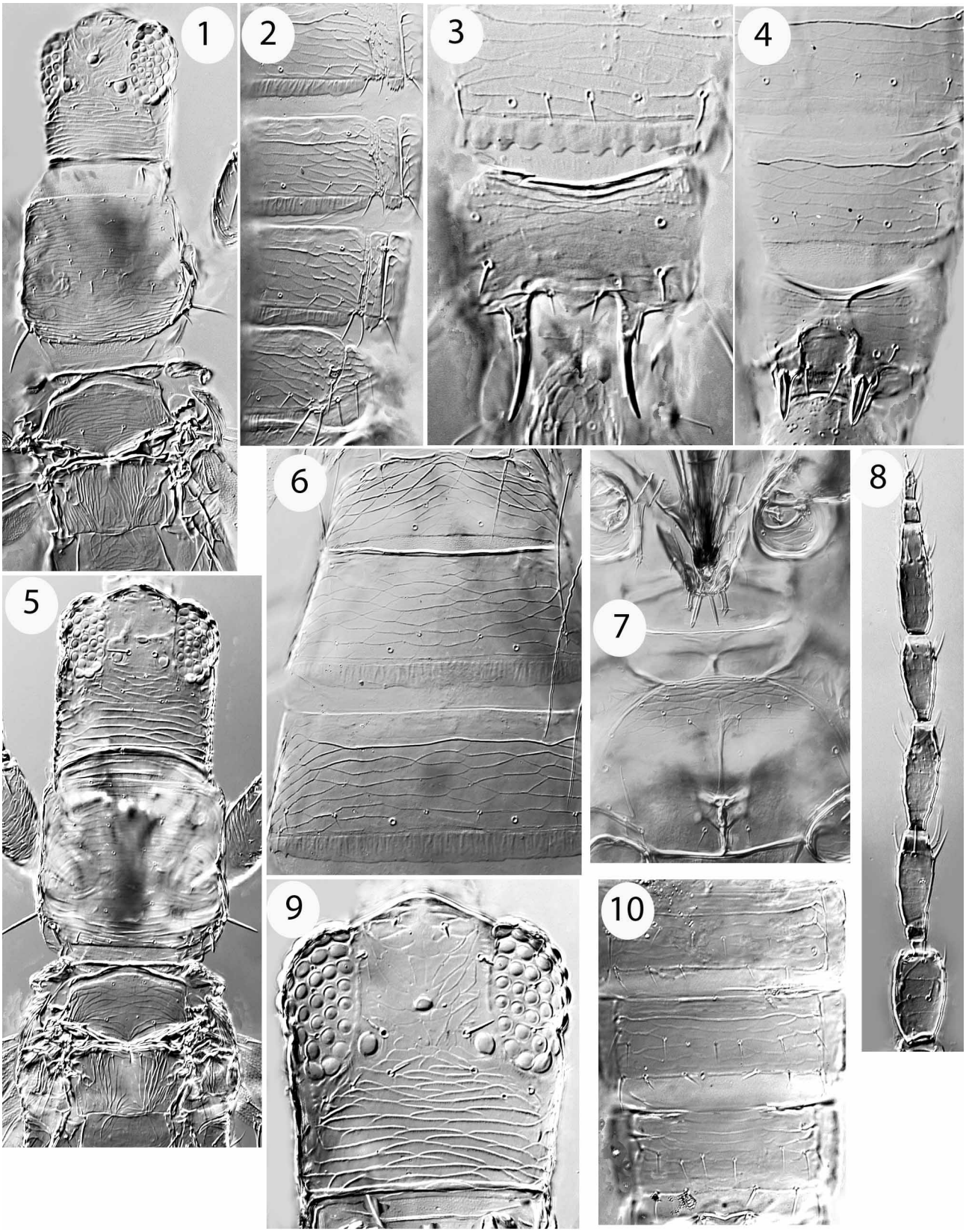
Diagnosis. Macropterous Thripinae. Antennae 7- or 8-segmented, segment I with no dorso-apical setae, sensoria on III–IV simple, (forked on IV in *engaius*); segments II–III with few or no microtrichia. Head projecting conically in front of eyes, cheeks almost parallel; compound eyes with 5 pigmented facets; ocellar setae pair I present, pair III arising between anterior margins of posterior ocelli; maxillary palps 2-segmented (3-segmented in *engaius*), mouth cone large. Pronotum scarcely wider at posterior than anterior, surface with faint transverse reticulation, discal setae small; with 2 pairs of posteroangular setae, 4 pairs of posteromarginal setae. Prosternal basantra with no setae; ferna continuous medially; spinasternum transverse, meso and meta furca without spinula (mesofurcal spinula present in *engaius*), mesothoracic sterno-pleural sutures complete; metapre-episternum transverse. Mesonotal anterior campaniform sensilla present, median pair of setae distant from posterior margin. Metanotal sculpture irregularly linear/reticulate on posterior half; median setae near anterior margin, closer to lateral pair than to each other; no campaniform sensilla. Tarsi 2-segmented. Fore wing slender, first vein with 3 widely spaced setae on distal half; second vein with few widely spaced setae; clavus with 4 or 5 veinal setae but no discal seta; posterior fringe wavy. Tergites weakly sculptured medially; II–VIII with craspedum present, campaniform sensilla near posterior margin, pleurotergites slender (Fig. 2); IX with 2 pairs of campaniform sensilla, median dorsal setae slender to stout; X with median split complete or incomplete. Sternites with transverse row of discal setae, posterior margin with no craspedum; sternite II with 2 pairs of marginal setae, III–VII with 3 pairs, all arising at margin on VII. Male (where known) with or without transverse pore plate on antecostal area of some median sternites; tergite IX posterior margin with pair of stout processes.

Type-species *Aliceathrips mnestes* sp.n.

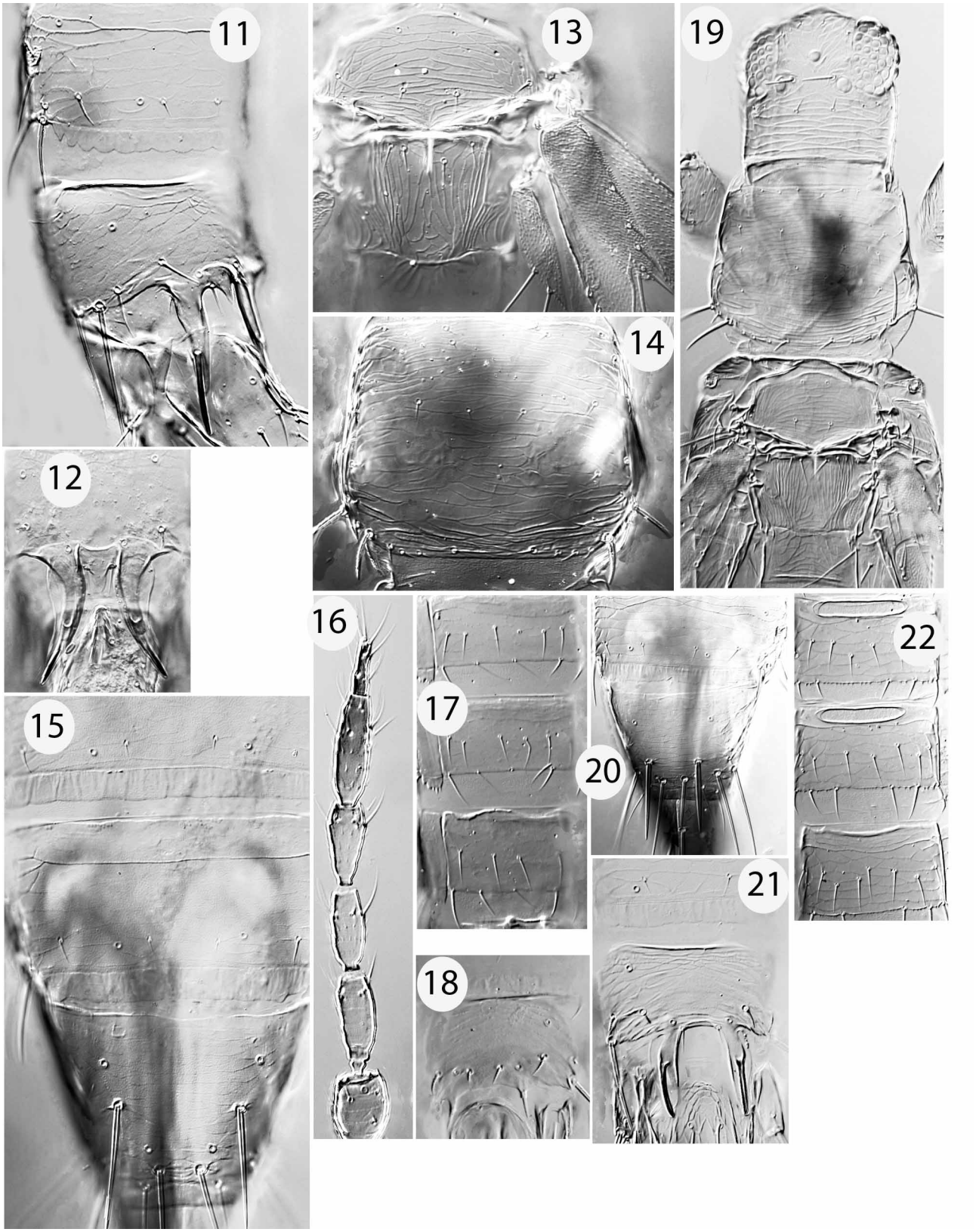
Comments. Species in this genus share many character states with the species in both *Masamithrips* and *Monothrips*. From both of these they differ in head shape, with the head larger and the cheeks less narrowed behind the eyes, and in lacking setae on the prosternal basantra. Moreover, in contrast to the species of *Masamithrips*, the males bear a pair of processes on the posterior margin of the ninth tergite, although pore plates on the antecostal area of the sternites are present or absent in different species. The genus also shares many character states with those of *Ozanaphothrips*, but the species in that genus lack prominent posteroangular setae on the pronotum. *Aliceathrips* has been found widely across northern Australia, with only a few specimens known from as far south as northern New South Wales. The genus is named in recognition of the many contributions by Alice Wells to our knowledge of Australian thrips.

Key to *Aliceathrips* species

1. Antennae 7-segmented; male with no pore plates on sternites, tergite IX posterior margin with closely placed pair of long curved processes (Figs 11, 12) . . . . . *mnestes* **sp.n.**
-. Antennae 8-segmented; male with transverse pore plate on antecostal area of one or more sternites (Fig. 22), tergite IX processes different 2
2. Antennal segment IV with forked sensorium; maxillary palps 3-segmented (Fig. 7); mesothoracic furca with spinula; male sternite III with pore plate; male tergite IX posterior margin with pair of stout black conical processes (Fig. 4) . *engaius* **sp.n.**
-. Antennal segment IV with sensorium simple; maxillary palps 2-segmented; mesothoracic furca with no spinula; male sternites III–V or VII each with pore plate; male tergite IX posterior margin different 3
3. Abdominal tergite X and posterior third of IX dark brown; female with tergite IX median dorsal setae stout, arising close to posterior setal pairs (Fig. 20) [male tergite IX posterior margin with paired processes (Fig. 21)]. . . . . *palmeri* **sp.n.**
-. Abdominal tergites IX and X different in colour; female with tergite IX median dorsal setae slender and arising well forward 4
4. Abdominal segments IX and X pale, X sometimes with split incomplete; male tergite IX posterior margin with elongate paired processes (Fig. 3) . . . . . *australiensis*
-. Abdominal segments IX–X uniformly light brown, with complete split; male tergite IX posterior margin with small setiform processes (Fig. 18). . . . . *sorghi* **sp.n.**



FIGURES 1–10. *Aliceathrips* spp. *A. australiensis* 1–3: **(1)** head & thorax; **(2)** tergites V–VIII; **(3)** male tergites VIII–IX. *A. engaius* 4–8: **(4)** male tergites VII–IX; **(5)** head & thorax; **(6)** tergites I–III; **(7)** thoraxic sterna; **(8)** antenna. *A. mnestes* 9–10: **(9)** head; **(10)** sternites V–VII.



FIGURES 11–22. *Aliceathrips* spp. *A. mnestes* 11–16: **(11–12)** male tergites VIII–IX; **(13)** meso & metanota; **(14)** pronotum; **(15)** tergites VII–IX; **(16)** antenna. *A. sorghi* 17–18: **(17)** sternites V–VII; **(18)** male tergites VIII–IX. *A. palmeri* 19–22: **(19)** head & thorax; **(20)** tergites VIII–X; **(21)** male tergites VIII–IX; **(22)** male sternites V–VII.

***Aliceathrips australiensis* (Girault) comb.n.**
(Figs 1–3)

Limothrips australiensis Girault, 1928: 3
Pezothrips aureus Girault, 1929: 2
Limothrips formosus Girault, 1929: 2

This species, together with the indicated synonyms, was placed by Mound & Houston (1987) in the genus *Bolacothrips*, but this is clearly incorrect as the tergites lack any ctenidia, and ocellar setae pair I are present. The species was described from a single female collected at Wynnum in northern Brisbane, and that specimen was described as having all the antennal segments missing beyond segment II. On tergite IX, the median marginal setae are shorter than the lateral pair, and the median dorsal setae are slightly stouter with their apices just extending to the posterior margin of the tergite. The single female from which *formosus* was described was collected at Taringa, Brisbane, and cannot at present be distinguished from the *australiensis* holotype. The synonymic species, *P. aureus*, was described from a single female collected on Mt Coot-tha, Brisbane, but this specimen lacks wings and all of the major setae, and the head is crushed and distorted. *A. australiensis* is possibly a complex of species, in which females differ very little in structure from each other. The processes on the posterior margin of tergite IX of males vary slightly in structure between samples, and females from near Broome, Western Australia, are variable in the length and stoutness of the tergite IX mid-dorsal setae. Specimens that can confidently be considered *A. australiensis* have been studied only from eastern Australia, including northern New South Wales, the Brisbane area of Queensland, and central Northern Territory near Alice Springs.

***Aliceathrips engaius* sp.n.**
(Figs 4–8)

Female macroptera. Body and legs yellow, ovipositor and mouth parts dark; fore wing slightly darker on basal half than on distal half; antennal segment I pale, II light brown, III–V yellow with apex light brown, VI–VIII brown. With the character states in the generic diagnosis; antennae 8-segmented (Fig. 8), III with sensorium simple, IV with sensorium forked (inner branch sometimes slender and difficult to see). Ocellar setae III 1.5 times as long as an ocellus (Fig. 5). Pronotal posteroangular setae inner pair much shorter than outer pair; metanotum with weak irregular sculpture (Fig. 5); mesosternal anterior margin with about 12 setae; tergites with transverse reticulation, tergite IX median dorsal setae slender and not extending to posterior margin, posterior pair I equal in length to pair II; X with median split incomplete; sternite II with 0–3 discal setae, III–VII with 4–10 discal setae in an irregular transverse row.

Measurements (holotype female in microns). Body length 1550. Head length 150; width across eyes 145; ocellar setae III 23. Pronotum, length 150; maximum width 160; pa inner setae 20; pa outer setae 45. Fore wing length 720. Metanotal median setae 15. Tergite IX median-dorsal setae 45; marginal setae S1 115; S2 115. Tergite X setae S1 65. Antennal segments III–VIII length 50, 42, 35, 48, 10, 12.

Male macroptera. Smaller and paler than female; tergite IX with pair of stout dark processes (Fig. 4); sternite III with transverse pore plate on antecostal area.

Material studied. Holotype female, **Northern Territory**, Macdonnell Ranges, Standley Chasm, from *Triodia hubbardi* leaves, 24.iii.2010 (Chris Palmer).

Paratypes: 7 females taken with holotype; same locality, date and collector, 2 females from *Digitaria brownii* leaves, 11 females, 5 males from *Neurachne tenuifolia* leaves; same locality, 31.x.1999, 1 female, 1 male from *Neurachne tenuifolia* leaves. Macdonnell Range, Ellery Creek, 2 females beaten from *Alectryon oleifolius*, 1.xi.1999.

Comments. This is the largest species in the genus, with a particularly slender body. It differs from the other species in having the maxillary palps elongate and 3-segmented, the sensoria on the fourth antennal segment forked, and the median dorsal setae on tergite IX of females short and slender. The male has a pore plate only on sternite III, and the paired conical processes on tergite IX are different from those of the males of other species.

***Aliceathrips mnestes* sp.n.**
(Figs 9–16)

Female macroptera. Body and legs yellow, fore femora external margins shaded brown, abdominal segments IX–X brownish yellow but particularly shaded near posterior margins; antennal segment I white, II brown, III pale with extreme apex shaded, IV–V pale with apical quarter light brown, VI–VIII brown; fore wings and all major setae pale. With the character states in the generic diagnosis; antennae 7-segmented (Fig. 16), III–IV with sensorium simple. Ocellar setae III 1.0–1.5 as long as an ocellus (Fig. 9); metanotum weakly reticulate medially, median setae varying in distance from anterior margin (Fig. 13); mesosternal anterior margin with about 6 setae; tergite IX median dorsal setae slightly stouter than posterior setae and extending just beyond tergal posterior margin (Fig. 15), posterior setal pair I shorter than pair II; X with median split incomplete; sternite II with 1–3 discal setae, III–VII with 5–9 discal setae (Fig. 10).

Measurements (holotype female in microns). Body length 1280. Head length 135; width across eyes 135; ocellar setae III 20. Pronotum, length 110; maximum width 135; pa inner setae 25; pa outer setae 30. Fore wing length 550. Metanotal median setae 12. Tergite IX median dorsal setae 45; marginal setae S1 75; S2 125. Tergite X setae S1 115. Antennal segments III–VII length 40, 35, 35, 45, 20.

Male macroptera. Smaller and paler than female; tergite IX with pair of elongate curved processes (Figs 11, 12); sternites with no pore plates.

Material studied. Holotype female, **Northern Territory**, 70km south of Darwin, Litchfield Park, from grasses, 31.xii.1995 (LAM2941).

Paratypes: 11 females, 2 males taken with holotype; same locality, 14 females from grass by pool, 26.xii.1996. **Queensland**, Badu Island, 1 female, 1 male, 18.xi.2009.

Comments. The females of this species are closely similar to those of *A. australiensis*, but the antennae are 7-segmented and the males have a unique pair of processes on the posterior margin of tergite IX.

***Aliceathrips palmeri* sp.n.**
(Figs 19–22)

Female macroptera. Body and legs yellow, abdominal segment X and posterior third of IX dark brown; antennal segment I white, II–IV pale with II and apex of III and IV variably weakly shaded, V pale with apex light brown, VI–VIII brown; fore wings and major setae pale, but median dorsal setal pair on IX brown. With the character states in the generic diagnosis; antennae 8-segmented, III–IV with sensorium simple. Ocellar setae III 2.0 as long as an ocellus (Fig. 19). Pronotal posteroangular setae longer than antennal segment III; prosternal ferna weakly continuous medially; metanotum with weak longitudinal sculpture (Fig. 19); mesosternal anterior margin with about 12 setae; tergite IX median dorsal setae stout, arising on posterior third of tergite close to posterior setae (Fig. 20), posterior pair I shorter than pair II; X with median split complete; sternite II with 0–3 discal setae, III–VII with 4–10 discal setae sometimes arranged irregularly.

Measurements (holotype female in microns). Body length 1400. Head length 125; width across eyes 125; ocellar setae III 30. Pronotum, length 130; maximum width 160; pa inner setae 45; pa outer setae 45. Fore wing length 650. Metanotal median setae 20. Tergite IX median dorsal setae 60; marginal setae S1 100; S2 125. Tergite X setae S1 115. Antennal segments III–VIII length 40, 35, 35, 47, 8, 10.

Male macroptera. Smaller and paler than female; tergite IX with pair of long curved processes (Fig. 21); sternites III–VII with transverse pore plate on antecostal area (Fig. 22).

Material studied. Holotype female, **Northern Territory**, Alice Springs, from *Panicum decompositarum* lvs., 27.xi.2008 (Chris Palmer).

Paratypes: 13 females, 5 males taken with holotype; **Queensland**, Moura, 1 female from *Cenchrus ciliaris*, 20.i.1966; Dalby, Broadwater Lake, 1 female, 27.ii.2003; 45km south of Tambo, 3 females, 20.v.1999; 15km south of Charters Towers, 1 female, 1 male, 2.vii.1995; Emerald, 1 female, 29.x.2001. **Western Australia**, Kununnura, ii–iv. 2005.

Comments. The females of this species have the median dorsal setae on tergite IX stout, arising in a posterior position and extending well beyond the posterior margin of the tergite. The male has processes on the ninth tergite

that are similar to those of *A. mnestes*, but the sternites bear pore plates. Two females have also been seen from Kununurra in the north of Western Australia that probably represent this species.

Aliceathrips sorghi sp.n.

(Figs 17–18)

Female macroptera. Body and legs yellow, abdominal segments IX–X uniformly shaded light brown, fore femora weakly shaded on external margin; antennal segment I white, II light brown, III–IV pale with apex variably weakly shaded, V mainly light brown, VI–VIII brown; fore wings and major setae pale including median dorsal setae on IX. With the character states in the generic diagnosis; antennae 8-segmented, III–IV with sensorium simple, III relatively short. Ocellar setae III at least 2.0 as long as an ocellus. Pronotal posteroangular setae almost 2.0 times as long as antennal segment III; prosternal ferna weakly continuous medially; metanotum with weak longitudinal sculpture; mesosternal anterior margin with about 8 setae; tergite IX median dorsal setae not stout, extending just beyond posterior margin, posterior pair I slightly shorter than pair II; X with median split complete; sternite II with 0–3 discal setae, III–VII with 5–9 discal setae, on VII relatively long (Fig. 17). .

Measurements (holotype female in microns). Body length 1230. Head length 110; width across eyes 110; ocellar setae III 30. Pronotum, length 115; pa inner setae 55; pa outer setae 60. Fore wing length 530. Metanotal median setae 25. Tergite IX median dorsal setae 45; marginal setae S1 100; S2 110. Tergite X setae S1 85. Antennal segments III–VIII length 30, 25, 30, 45, 8, 10.

Male macroptera. Smaller and paler than female; tergite IX with pair of short straight, setiform processes (Fig. 18); sternites III–V with transverse pore plate on antecostal area.

Material studied. Holotype female, **Western Australia**, Kununurra, from *Sorghum* young plants, 26.ii.2005 (LAM4616).

Paratypes: 17 females, 6 males taken with holotype.

Comments. The females of this species have unusually short antennae, and the males have a pair of short, setiform processes on the posterior margin of the ninth tergite.

Anaphothrips Uzel

An identification key to the 43 species of this genus known from Australia is given by Mound & Masumoto (2009). Most of these species are specific to a wide range of dicotyledenous plants in at least 20 families, with scarcely 10 *Anaphothrips* species dependent on grasses. In contrast, the North American species of the genus are apparently restricted to Poaceae (Nakahara, 1995). In the more northern parts of Australia, *A. obscurus*, *A. sudanensis* and *A. swezeyi* are introduced from other subtropical areas; by feeding on young leaves, these thrips can induce linear markings on the leaves of introduced grasses and cereal crops. In southern Australia, six endemic grass-living *Anaphothrips* species have been found. These occur mostly in the eastern parts of the continent, including the mountains of the South East, and always in association with the leaves of native grass species.

Apterothrips Bagnall

Of the two species recognised in this genus, only *A. apteris* is known from Australia. This species probably originated on the western coast of North America, but is now widespread round the coastal regions of South America to the Falkland Islands and across the southern ocean to Australia and New Zealand. This dispersal was probably effected by the whaling industry. Although commonly taken from the leaves of grasses, *A. apteris* is associated with *Erigeron* in coastal California, and has been found damaging lucerne in Western Australia, and garlic in Tasmania. The second species in the genus, *A. secticornis*, presumably originated in the northern part of the Holarctic. The two species can be distinguished because the sternal craspeda of *A. apteris* have five lobes, whereas the sternal craspeda of *A. secticornis* have seven lobes (Mound & Marullo, 1996).

Aptinothrips Haliday

This European genus of four wingless species includes one, *A. rufus*, that is possibly the most abundant thrips worldwide. Found on grass leaves throughout the temperate world, including at high elevations in some tropical countries, *A. rufus* is common in southern Australia on introduced pasture grasses. It is easily recognised by the 6-segmented antennae with an enlarged sixth segment. In New Zealand montane grasses, *A. stylifer* with 8-segmented antennae, is common, and this species may possibly be found in suitable habitats in Tasmania. Palmer (1975) provided an illustrated account of the species of *Aptinothrips*.

Arorathrips Bhatti
(Figs 23–24)

This New World genus currently includes eight species, but several other species described in *Chirothrips* should be transferred here (Mound & Marullo, 1996). These species are distinguished by the reduction of the metasternal furca, such that the furcal pits are widely separated not close together medially (Fig. 24). One of these species, *A. mexicanus*, is now widespread on grasses throughout the tropics and subtropics, and Mound & Palmer (1972) provided an illustrated account, under the generic name *Chirothrips*, of the two *Arorathrips* species known from Australia (*A. mexicanus* and *A. spiniceps*). Larvae of species in these genera apparently always develop each within a single grass floret, and the few larvae that have been examined have such small legs that they seem to be effectively immobile.

Bolacothrips Uzel

Judging from the presence and position of the ctenidia on the abdominal tergites (Fig. 30), this genus of 12 species is closely related to genus *Thrips*. As with *Stenchaetothrips*, the genus represents a group of Old World species each of which is specific to Poaceae. *Bolacothrips* species have 7-segmented antennae, but are unusual in having simple sensoria on segments III−IV, whereas these are always forked in species of *Thrips* and *Stenchaetothrips*. One Australian species listed previously under this genus (Mound, 1996) lacks abdominal ctenidia, and is here transferred to the new genus above as *Aliceathrips australiensis*. There is no satisfactory overview of the 12 species of *Bolacothrips*, and some are not satisfactorily distinguished from each other. Bhatti (1983) provided a checklist of 10 species together with extensive notes on two of these; zur Strassen (1993) described one new species from Cape Verde Islands together with useful comparative notes, and Masumoto & Okajima (2002) described one new species with a key to three species from Japan. One of the 12 species has the body brown (*africanus*), four have the abdomen yellow with the terminal segments brown (*evittatus*, *eximius*, *graminis*, *pulcher*), and the remainder are almost uniformly yellow. All species in this genus apparently breed on grass leaves, and all of them are particularly similar to each other in details of body sculpture and chaetotaxy.

Key to *Bolacothrips* species from Australia

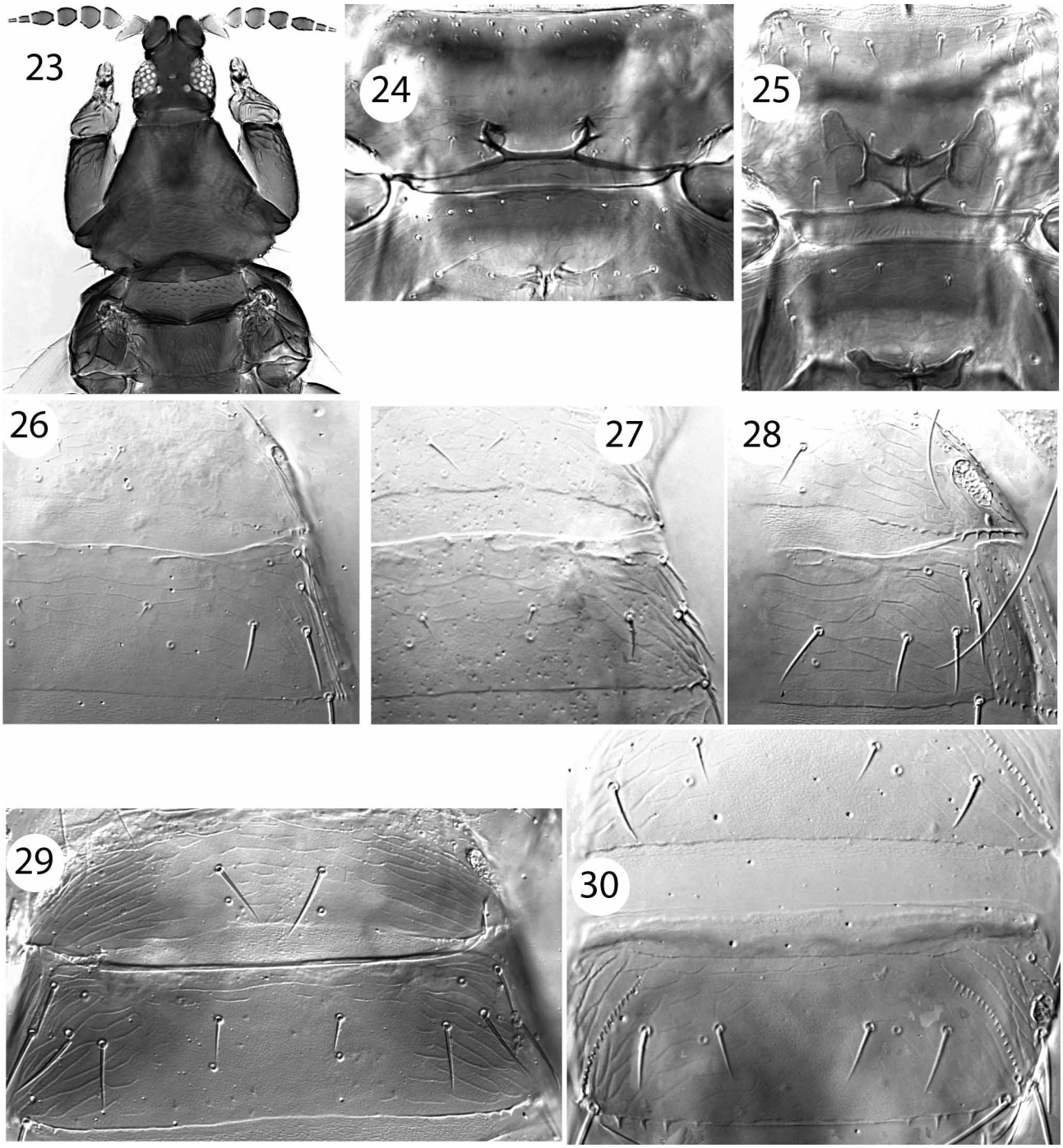
1. Abdomen with terminal segments (VIII) IX–X dark brown ..... *pulcher*
-. Abdomen almost uniformly yellow ..... *striatopennatus*

Bolacothrips pulcher (Girault)

Plesiothrips pulcher Girault, 1929: 3

This species has been taken widely in eastern Australia, from Cape Tribulation in northern Queensland to Batemans Bay just south of Sydney and also at Canberra. It has been found around Darwin in Northern Territory, as well as on Lord Howe Island and New Caledonia. Abdominal tergites IX–X are uniformly dark brown, but VIII is

variable from brown to yellowish-brown, the anterior margin of the head is sometimes shaded brown, and the fore wings are pale with a weak transverse darker mark. Judging from the description, *B. graminis* from Egypt is similar, but the other two species with bicoloured abdomen are considered to have almost uniformly pale fore wings, and *evittatus* has three pairs of posteromarginal setae on sternite II instead of the normal two pairs. In structure and chaetotaxy, *pulcher* is similar to the Australian specimens of *striatopennatus*, with one of the four lateral setae on tergite II very slightly displaced medially.



FIGURES 23–30. Grass living Thripinae. *Arorathrips mexicanus* 23–24: **(23)** head & thorax; **(24)** meso & metasterna. **(25)** *Chirothrips manicatus*, meso & metasterna. *Bolacothrips striatopennatus* 26–30: **(26–28)** tergites I–II, females from Mt Coottha, Brisbane; **(29)** tergites I–II, female from Thailand; **(30)** tergites VII–VIII, female from Thailand.

Bolacothrips striatopennatus (Schmutz)

(Figs 26–30)

Thrips striatopennata Schmutz, 1913: 1002

This species was described from Sri Lanka, and is known from India and Indonesia to Japan, Taiwan and Guam; the specimens available from Australia are listed below. The chaetotaxy of abdominal tergites I–II is considered important in distinguishing species in this genus (Bhatti, 1983; Masumoto & Okajima, 2002). In *striatopennatus* the median setae on tergite I are stated to be more than 26 microns in length, and on tergite II the lateral margin setal row is considered to comprise three setae, with a fourth seta placed mesad of this row (Fig. 29). Moreover, antennal segment II of *striatopennatus* lacks microtrichia, abdominal tergites II–IV are commonly slightly shaded anterolaterally, and both sexes can be micropterous. In contrast, *B. yasuakii* from Japan, has at least one clear row of microtrichia on antennal segment II, the median setae on tergite I are 9–14 microns long, the four lateral setae on tergite II are arranged in a straight row, the abdomen has no dark shadings, and both sexes are macropterous.

The available specimens from Australia appear to be intermediate between these two species. Antennal segment II of some specimens bears a few very weak microtrichia, but these are considerably weaker than those on the type specimens of *yasuakii*. The median setae on tergite I vary in length 15–20 microns (Figs 26–27), although one micropterous female has them 25 microns long (Fig. 28). Moreover, the length of these setae is sometimes bilaterally asymmetrical. The setal row laterally on tergite II in the Australian specimens usually has one seta placed slightly mesad of the row (Figs 26–28), but again this is not always bilaterally symmetrical. None of the specimens has any shading laterally on the tergites. The initial assumption was that the Australian populations represent a new species, but consideration of the variation amongst the available specimens led to the conclusion that, at present, they are better regarded as extreme variants of a widespread Asian species.

Material studied. Queensland; Brisbane, Mt Coot-tha, 8 females, 2 males (all macropterae), 20.v.2004; same locality, 1 female microptera, 20.x.1985; same locality, 1 female, 1 male from *Themeda australis*, 22.iii.1968; Brisbane Forest Park, 1 female macroptera, 21.viii.2004, 1 female microptera, 16.i.2006; Cairns, 1 male microptera, 7.xi.2008. **New South Wales**, 30km west of Batemans Bay, 2 females, 3 males (all micropterae), 13.i.1999, 1 female macroptera, 9.xi.2002; Ettalong, 2 females from grasses, 28.vi.1968; Windsor, 1 female from grass, 19.vi.1968. **Victoria**, Mt Napier, 1 female microptera, 25.iii.2005.

Bregmatothrips Hood

With one new synonym recognised below, together with one newly described species, this genus now includes a total of nine species, all of which apparently breed on grass leaves. Four described species are currently considered synonyms of the type species, *B. venustus*. These are all from the southern Nearctic, and *venustus* is one of only two species in the genus that has a single dorso-apical seta on the first antennal segment. In contrast the other seven members of the genus all have two setae in this position. These seven are all from the Old World: one is from southern Europe, with others described from Iran, Egypt, Cape Verde Islands, and South Africa, also two from Asia of which one is known from tropical Australia. Bhatti (1984) distinguished two groups among the members of this genus, but the new species described below includes character states from both of these groups. No key to identify the members of this genus is available, therefore a key to world species is provided here as an Appendix (page 40).

Key to species of *Bregmatothrips* from Australia

1. Antennae 8-segmented, segment IV with sensorium forked; both sexes macropterous, body brown, legs largely brown, antennal segments III–V yellow . . . . . *binervis*
-. Antennae 7-segmented (rarely 8), segment IV with sensorium simple; female macropterous, body brown, tibiae and antennal segments III–V yellow; male micropterous, legs, antennal segments I–V and most of body yellow with abdominal segments VI–X dark brown . . . . . *australis* **sp.n.**

Bregmatothrips binervis (Kobus)

Thrips binervis Kobus, 1893: 158
Diarthrothrips saccharicolus Bianchi, 1945: 275. **syn.n.**

Described originally from Java, and recorded widely across India with two further synonyms from that country (Bhatti, 1984), specimens of this species have been studied from various sites in northern Australia between Brisbane, Badu Island (Torres Strait), Darwin and Kununurra. The new synonym is from New Caledonia, and specimens from that territory, including a paratype female, have been compared with specimens from India and Australia. In contrast to species of the *B. venustus* group recognised by Bhatti (1984), the maxillary palps are 2-segmented, there are five setae on antennal segment IV, sternite VII of females has the median pair of setae arising in front of the posterior margin, and the paired processes on the posterior margin of tergite IX in males are stout as in the new species described below.

Bregmatothrips australis sp.n.
(Figs 31–37)

Female macroptera. Body brown, femora light brown, tibiae and tarsi yellow; antennal segments III–V clear yellow, I and VI–VII brown, II yellow in apical half; fore wing pale; major setae on body light brown. Head longer than wide (Fig. 31); ocellar setae I not close together, III arise outside the triangle just posterolateral to fore ocellus; compound eyes slightly prolonged ventrally, with 5 pigmented facets; postocular setae pair I absent, II arise far to posterior, III small, IV as long as II; vertex with many transverse lines; mouth cone large and extending between fore coxae (Fig. 32), maxillary palps 2-segmented. Antennae 7-segmented but VII sometimes with partial suture; segment I with 2 dorso-apical setae; sensorium on III–IV simple; IV with 4 setae plus one subsidiary sensorium dorsolaterally; segments with very few microtrichia. Pronotum weakly trapezoidal (Fig. 31), notopleural sutures extending along lateral margins; 2 pairs of posteroangular setae, 3 pairs of posteromarginals; dorsal surface almost without sculpture lines. Mesonotum with transverse sculpture, anterior campaniform sensilla not present, one pair of setae anterior to second pair near posterior margin, lateral setal pair minute. Metanotal median area reticulate (Fig. 31), median setae close to anterior margin; campaniform sensilla absent. Prosternal ferna complete medially (Fig. 32); mesothoracic sterno-pleural sutures complete; meta-pre-episternum broadly band-like; meso and meta furcae without spinula. Tarsi 2-segmented. Fore wing first vein with about 7 setae in basal half, 2 setae near apex; second vein with about 6 setae; clavus with 3 or 4 veinal and one discal setae. Tergite I reticulate, II–VIII with no sculpture medially except near anterior margin; I–VIII with campaniform sensilla close to posterior margin (Fig. 33), II–VIII with pale, translucent craspedum of small lobes (Fig. 34); pleurotergites slender (Fig. 37); tergite IX with 2 pairs of campaniform sensilla; X longitudinally reticulate, dorsal split complete. Sternites without craspeda (Figs 36, 37), discal area with variable number of small microtrichia, particularly laterally, II with 3 pairs of marginal setae, VII with setae S1 arising in front of margin.

Measurements (holotype female in microns). Body length 1750. Head, dorsal length 135; ventral length to mouth cone tip 310; width across eyes 130; ocellar setae III 30. Pronotum, length 175; maximum width 175; pa inner setae 50; pa outer setae 40. Fore wing length 700. Metanotal median setae 35. Tergite IX setae S1 150; S2 175. Tergite X setae S1 160. Antennal segments III–VII length 37, 32, 30, 60, 28.

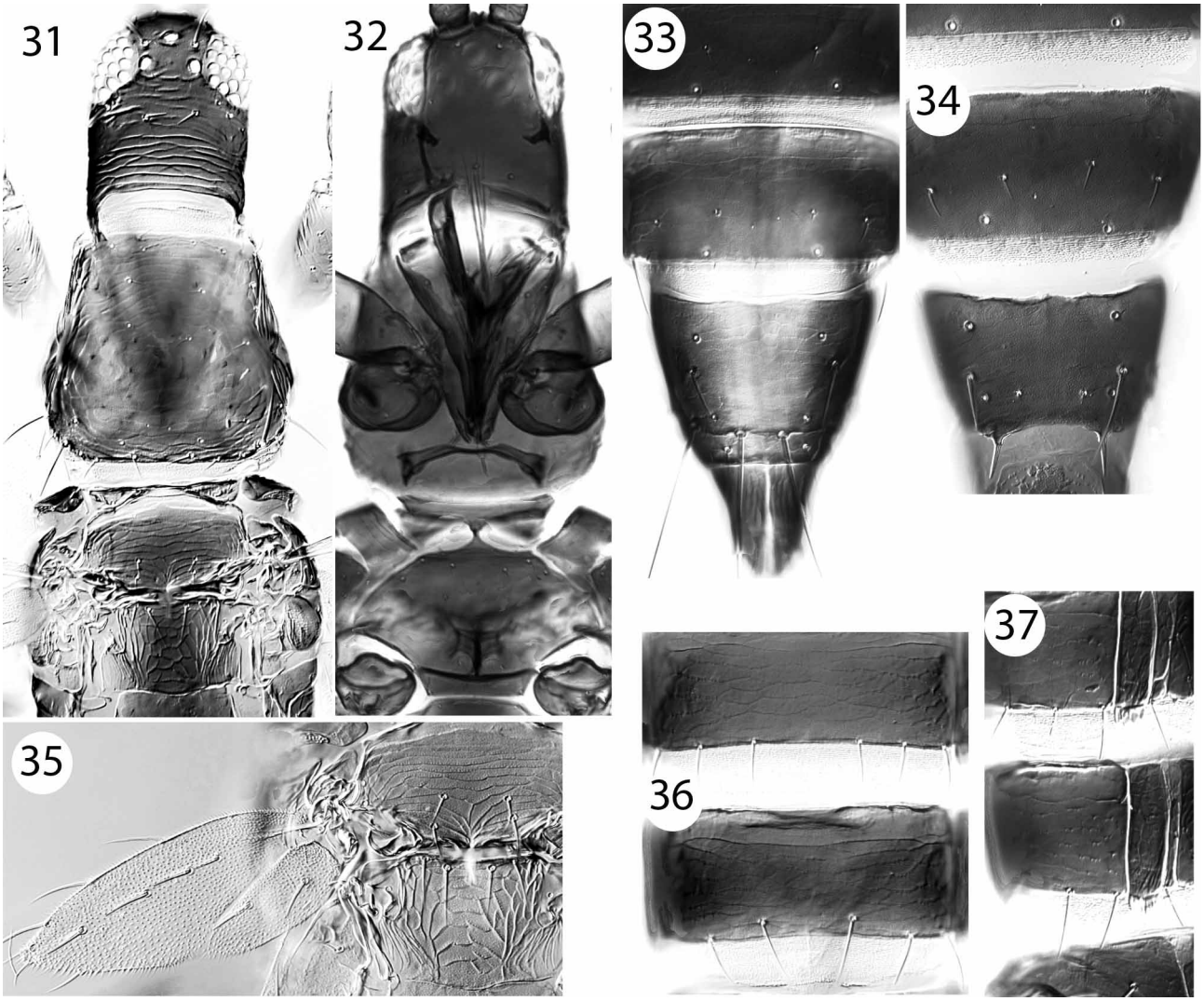
Male microptera. Bicoloured, body mainly yellow with abdominal segments VI–X dark brown; legs and antennal segments I–V yellow. Similar in structure to female; ocelli small; tergal craspeda scarcely half as wide as in female; tergite IX posterior margin with pair of stout setiform processes (Fig. 34); sternites with no pore plates, discal area with many small microtrichia.

Measurements (paratype male in microns). Body length 1450. Fore wing length 150.

Material studied. Holotype female, **New South Wales**, Bullio, 25km west of Mittagong, from *Cymbopogon refractus* leaves, 2.iv.2010 (LAM5351).

Paratypes: 8 females, 6 males taken with holotype; 6 females, 3 males same locality and date from native Poaceae; **Queensland**, Mt Tamborine, 3.iii.1966, 1 female in water trap; Ravenshoe, 3.vii.1995, 1 female from grass.

Comments. Although it shares many character states with *binervis*, this new species is intermediate between the two groups recognised by Bhatti (1984) in that the main sensorium on antennal segment IV is simple, not forked, and this segment bears only four (not five) setae in addition to a second, small, sensorium. Only two other species in this genus have 7-segmented antennae, *furcatus* and *willcocksi* from Africa, and both of these have a forked sensorium on the fourth antennal segment.



FIGURES 31–37. *Bregmatothrips australis*. **(31)** head & pronotum; **(32)** ventral view of head & prothorax; **(33)** tergites VII–X; **(34)** male tergites VII–IX; **(35)** meso & metanota with wing lobe; **(36–37)** sternites VI–VII.

Caliothrips Daniel

This is one of only three genera of the subfamily Panchaetothripinae that involves species dependent on Poaceae. Currently this genus includes 22 species, and these are distributed widely around the tropics. All of them apparently breed only on leaves, with five species known to be specific to Poaceae but the others often associated with Fabaceae or more broadly polyphagous (Mound, Zhang & Bei, 2011). An identification and information system is web-available (Mound, Paris *et al.*, 2011) to the species taken in Australia (*C. graminicola* and *C. striatopterus*).

Caprithrips Faure
(Fig. 45)

Six species are recognised in this genus of small, wingless thrips, all of them leaf-feeding on grasses. The natural

distributions of these species remain unclear, but two were described from India, one from Europe, one from Southeastern USA, and one from Australia, and a key to these is provided by Bhatti (1980). Of these six species, *C. moundi* lacks sternal craspeda and appears to be an Australian endemic, living on native *Poa* species in the Southeast of the continent. Two other species are known from Australia, both of which have sternal craspeda. *C. orientalis* has been found both near Darwin and in northern Queensland, and is otherwise known from India, Fiji and New Caledonia (Bournier & Mound, 2000), as well as Cape Verde Islands (zur Strassen, 1993). Single females of *C. insularis* have been seen from Queensland, near Brisbane and also near Cairns, as well as from four of the Torres Strait Islands. However, the species is common in Florida and Georgia on the leaves of *Paspalum notatum*, a cultivated grass native to Argentina (Sharma *et al.*, 2011), and is also recorded from Trinidad, Surinam, and New Caledonia. Members of this genus share with those of five other genera in Australia the presence of one or more pairs of setae on the prosternal basisternum (Fig. 45) – *Masamithrips*, *Karphothrips*, *Kranzithrips*, *Monothrips* and *Parexothrips*. *C. moundi* usually has the prosternal ferna curving forwards and meeting in the mid-line, but some individuals have these plates forming simple transverse ovals.

Chirothrips Haliday

(Fig. 25)

As in *Arorathrips*, the species of this genus develop within individual florets of grasses, with one larva to each floret (Minaei & Mound, 2010). An illustrated account of the four species known from Australia is provided by Mound & Palmer (1972). *C. manicatus* is a widespread Palaearctic species that is common in southern Australia. In contrast, *C. ah* and *C. atricorpus* are African species that are widespread in northern Australia. *C. frontalis* has been found rarely in northern Australia, and is probably from South America.

Edissa Faure

Species of the subfamily Dendrothripinae breed only on leaves, and their hosts are almost exclusively dicotyledonous plants. The species of *Edissa* appear to be the only members of this subfamily in which species breed on the leaves of Poaceae. Two species have been described, *E. flava* from South Africa and Sudan, and *E. steinerae* from north-eastern Australia including the Torres Straits Islands. Un-named specimens have also been studied from Thailand and southern Japan (Mound, 1999). No males of *Edissa* are known, and the small differences between the available samples might be interpreted as representing variation within a single widespread species.

Exothrips Priesner

Nineteen species are listed in this genus, of which 12 are from India, five from Africa, one from the Philippines, and one from Europe. No revision or identification system to these has been published, apart from Bhatti (1975) who provided a key to 10 species from India together with an extensive diagnosis of the genus. *Rhamphothrips* and *Parexothrips* are considered to be related (Bhatti, 1978), because the females in all three genera share a remarkable condition of having the median two pairs of setae on sternite VII arising close to each other. Mound & Tree (2011) suggested that *Exothrips* possibly represents a grass-feeding lineage of species derived from *Rhamphothrips*, in which the head is larger relative to the pronotum, the pronotum is not elongate, and the prosternal ferna do not curve forward medially.

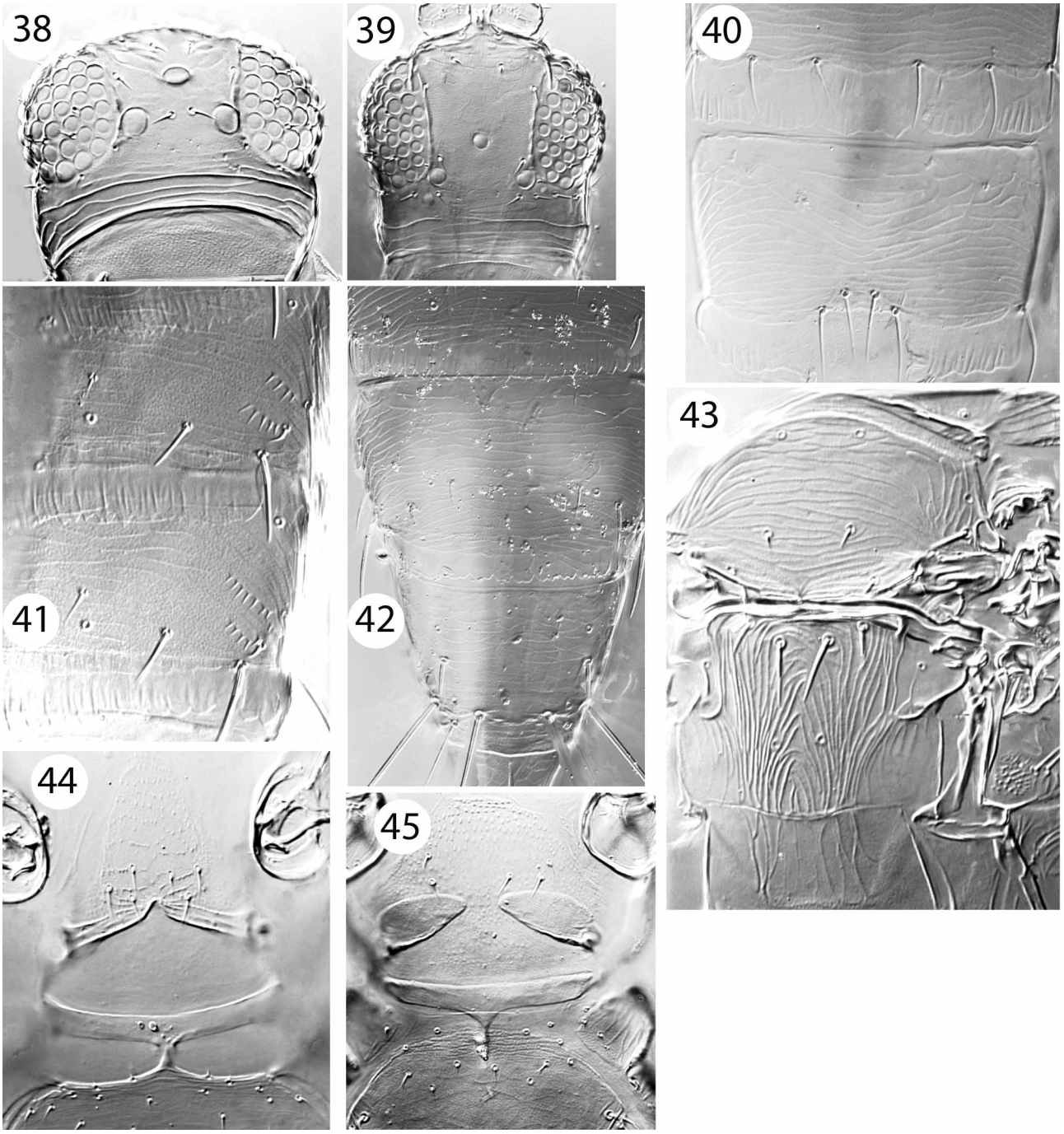
Exothrips sacchari (Moulton)

(Fig. 38)

Anaphothrips sacchari Moulton, 1936: 265

This species, known previously only from a single female taken at Victorias, Philippines, is identified here from Australia based on the redescriptions of the holotype by Bhatti (1975) and Reyes (1994). Antennal segment VI of

the holotype was described as brown with the base paler. In a series of six females from *Sorghum* flowers at Kununurra, Western Australia, three have antennal segment VI dark brown with V medium brown, and three have VI pale in the basal half, and V largely pale; two males collected with these females have the antennae almost uniformly pale. In a series of 11 females taken from grass flowers at Litchfield, near Darwin in Northern Territory, antennal segment VI is consistently paler at the base than medially, with V very pale brown, and three males taken with these females have pale antennae. The colour of the antennal segments in *sacchari* is here considered to be variable.



FIGURES 38–45. Grass living Thripinae. **(38)** *Exothrips sacchari*, head. *Parexothrips palumae* 39–44: **(39)** head; **(40)** female sternites VI–VII; **(41)** tergites VI–VII; **(42)** tergites VII-IX; **(43)** meso & metanota; **(44)** prosternum. **(45)** *Caprithrips insularis*, prosternum.

The males taken in Australia in association with *sacchari* females lack a tooth on the fore tibia. This condition is shared with the Indian species *sakimurai*, although that species has the metanotal median pair of setae arising close to the lateral pair. Also similar is *hemavarna*, a species that is widespread across India, but the males of that species have a stout tooth on the fore tibia, and a transverse row of microtrichia on sternites VII–VIII. The two males from *Sorghum* at Kununurra have no sternal microtrichia, but the three males taken at Litchfield have a transverse row of microtrichia on sternites VII–VIII that varies from weakly to strongly developed, and two males taken in Brisbane Forest Park with four females are similar to these. On the head, the setae of postocular pair I are minute and wide apart, a condition shared with *hemavarna* (see Bhatti, 1975), but ocellar setae pair III vary in position from just in front of, to just behind the tangent between the anterior margins of the posterior ocelli (Fig. 38); moreover, the position of these two setae is often asymmetric. A few males from near Darwin, and also from Brisbane, have the craspedum on tergites VI–VII more or less dentate laterally, but the craspedum is smooth laterally in the males from Kununurra and also in some males from other northern localities. At present it seems best to consider all of these Australian specimens as conspecific under the name *sacchari*.

Karphothrips Mound & Walker

(Fig. 46)

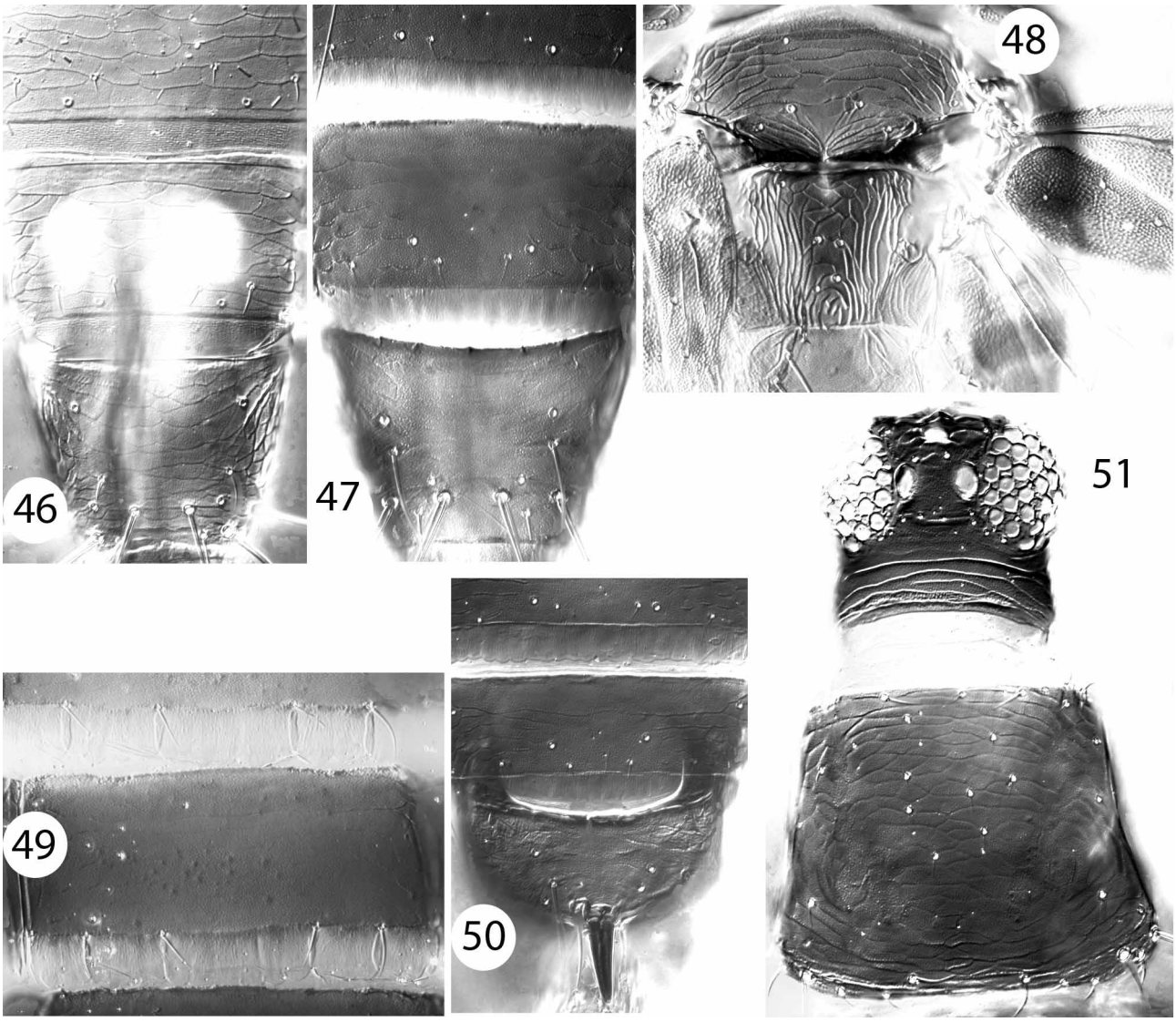
Only one species is known in this genus. Described originally from a single female found in New Zealand, both sexes and larvae of *K. dugdalei* have been taken from the leaves of the common sword grass, *Gahnia*, at various sites across southern Australia, between Tasmania and Albany in Western Australia (Mound, 2002). This is a slender, yellow species, with a long head superficially similar to *Aptinothrips* species, but with slender wings that lack a discal seta on the clavus, and prosternal basantra that bear one or two pairs of setae. The tergal campaniform sensilla are close to the posterior margin, as in *Bregmatothrips*, but no craspeda are developed (Fig. 46), antennal segment I lacks dorso-apical setae, tergite IX of females has very short median dorsal setae, and the males have a single round pore plate medially on the third sternite.

Kranzithrips gen.n.

Diagnosis. Macropterous, fore wing setae small, widely spaced, many cilia straight but some wavy; clavus with discal seta (Fig. 48). Antennae 8-segmented, III–IV with sensorium long and simple; segment I with no dorso-apical setae. Head almost as long as wide (Fig. 51), ocellar setae I absent but with longitudinal ridge anterior to first ocellus; compound eyes with no pigmented facets; maxillary palps 2-segmented. Pronotum weakly trapezoidal, 2 pairs of posteroangular setae. Metanotum irregularly reticulate medially, median setae small, distant from anterior margin (Fig. 48); campaniform sensilla present. Prosternal basantra with one pair of setae, ferna continuous medially; mesothoracic sternopleural sutures complete; meso and metafurcae without spinula; meta pre-episternum broad and band-like with one seta. Abdominal tergite I with no craspedum, II–VIII with pale, broad and weakly lobed craspedum (Fig. 47), campaniform sensilla close to posterior margin except on VIII; IX with 2 pairs of campaniform sensilla, median dorsal setae slender; X with split almost complete. Sternite II with 2 pairs of marginal setae, III–VI with 3 pairs and craspedum of 5 broad and overlapping lobes (Fig. 49), VII with no craspedum medially. Male similar to female, sternites III–VII with broad pore plate; tergite IX with pair of stout, thorn-like setae forming a single median process (Fig. 50).

Type species *Kranzithrips mareebai* sp.n.

Comments. The new species for which this genus is erected is similar in general appearance to the species of *Yoshinothrips*, but has tergal and sternal craspeda. The tergal craspeda and position of the campaniform sensilla suggest a relationship to *Bregmatothrips*, but unlike the species of that genus it lacks dorso-apical setae on the first antennal segment, the head and pronotum are different in shape, and the male has sternal pore plates and a different chaetotaxy on tergite IX (Figs 34, 50). The lack of ocellar setae pair I on the head, and the male with large sternal pore plates and large setae on the ninth tergite suggest this genus is not closely related to the Australian genera, *Aliceathrips*, *Masamithrips* and *Monothrips*.



FIGURES 46–51. Grass living Thripinae. **(46)** *Karphothrips dugdalei*, tergites VII–IX. *Kranzithrips mareebai* 47–51: **(47)** tergites VII–IX; **(48)** meso & metanota; **(49)** sternites V–VI; **(50)** male tergites VII–IX; **(51)** head & pronotum.

***Kranzithrips mareebai* sp.n.**
(Figs 47–51)

Female macroptera. Body brown, legs paler with tibiae and tarsi almost yellow; antennal segments III–IV and basal half of V yellow, VI–VIII light brown; fore wing shaded medially and at base including clavus, but pale subbasally and on apical quarter. With the characters indicated above; ocellar setae pair III shorter than length of an ocellus, arising within the triangle; postocular setae minute, three setae in simple row close to margin of eye (Fig. 51); tergite I reticulate, II–IV with decreasing amount of sculpture medially, V–VIII with no sculpture between median campaniform sensilla; sternal marginal setae small, median pair on VII arising just in front of margin.

Measurements (holotype female in microns). Body length 1420. Head length 80; width across eyes 110; ocellar setae III 8. Pronotum, length 140; maximum width 180; pa inner setae 30; pa outer setae 40. Fore wing length 600. Metanotal median setae 12. Tergite IX, median dorsal setae 40; setae S1 70; S2 95. Tergite X setae S1 75. Antennal segments III–VIII length 38, 32, 43, 45, 12, 15.

Male macroptera. Similar to female except sternites with broad pore plate; tergite IX median setae very stout, apparently fused together (Fig. 50).

Measurements (paratype male in microns). Body length 1150. Tergite IX median setae 50.

Material studied. Holotype female, **Queensland**, between Mareeba and Kuranda, in grass tussock, 26.viii.2004 (B.Kranz 928b).

Paratypes, 2 females, 1 male collected with holotype.

Limothrips Haliday

This is a European genus that includes eight species, although two of these are of doubtful validity. A key to the six species that can be recognised is provided by zur Strassen (2003), and three of these are recorded from southern Australia. The biology of these thrips is unusual amongst grass-living Thripidae, in that *Limothrips* species apparently feed both on the leaves and in the florets of grasses. Lewis (1959) indicated that *L. cerealium* oviposits in leaf sheaths, and feeds on very young leaves, and Rao *et al.* (2010) stated that adults and larvae of this species move to the florets and feed on the developing embryo. However, there is no evidence that these thrips feed on grass pollen. Damage by *L. cerealium* to the developing seeds of wheat and barley can make these unsuitable for brewing beer. Known as thunderflies in northern Europe, the large numbers of adults that appear in summer storms (Kirk, 2004) can cause problems by entering and triggering smoke detectors in buildings (Lewis, 1997). Two other *Limothrips* species occur in southern Australia, but these are less common than *cerealium*. They are readily distinguished, because in *L. angulicornis* the second antennal segment has the apical external margin prolonged into tooth, whereas in *L. denticornis* it is the third segment that is thus prolonged. Although all three of these species feed and breed on the leaves and in the florets of grasses and cereals, in Australia they have been found only on introduced species of Poaceae.

Masamithrips gen.n.

(Figs 52–70)

Diagnosis. Macropterous Thripinae. Antennae 8-segmented, segment I with no dorso-apical setae, sensoria on III–IV simple. Head broadest across eyes, cheeks straight, converging to base; compound eyes with 5 pigmented facets; ocellar setae pair I widely separated, pair III arising between posterior ocelli (Figs 53, 63), postocular setae minute; maxillary palps 2-segmented. Pronotum weakly trapezoidal, surface with faint transverse reticulation, discal setae small; with 2 pairs of posteroangular setae. Prosternal basantra with 1–7 pairs of setae (Fig. 58); fernal plates weakly connected medially; spinasternum transverse, meso and meta furca without spinula, mesothoracic sterno-pleural sutures complete. Mesonotal anterior campaniform sensilla present, median pair of setae distant from posterior margin. Metanotal sculpture linear on posterior half; median setae just behind anterior margin, closer to lateral pair than to each other; no campaniform sensilla. Fore wing slender, first vein with 3 widely spaced setae on distal half; second vein with few widely spaced setae; clavus with 4 or 5 veinal setae but no discal seta (Fig. 54); posterior fringe wavy. Tergites weakly sculptured medially, laterally usually with microtrichia on some sculpture lines; II–VIII with craspedum present, campaniform sensilla near posterior margin; IX with 2 pairs of campaniform sensilla; X with complete median split. Sternites with transverse row of discal setae, posterior margin with no craspedum; sternite II with 2 or 3 pairs of marginal setae, III–VII with 3 pairs, all arising at margin on VII. Male (where known) with oval pore plate on antecostal area of some median sternites (Fig. 61); tergite IX with no stout setae.

Type-species *Masamithrips masamii* sp.n.

Comments. The genus represents a northern Australian endemic radiation on Poaceae, and appears to involve a considerable number of similar-looking species. Species in this genus share most character states with the species of *Monothrips*, but differ in the number of maxillary palp segments and the absence of sternal craspeda. The genus is probably also related to *Aliceathrips*, but species in that genus differ from those of *Masamithrips* in the form of the head and in the lack of setae on the prosternal basantra. *Caprithrips* species also share many character states with *Masamithrips* species, particularly the head shape, but have no long pronotal setae, and are always wingless. The genus is named in recognition of the significant contributions by Masami Masumoto to our knowledge of Thripinae.

Key to *Masamithrips* species

1. Female with tergite IX median dorsal setae shorter than median posterior pair, scarcely extending to posterior margin of tergite (Fig. 59); female sternite VI usually with small pore plate on antecostal area (Fig. 60); antennal segment IV weakly shaded brown [abdominal segment X brown, IX almost clear yellow] . . . . . *masamii* **sp.n.**
-. Female with tergite IX median dorsal setae long and stout, as long as or longer than median posterior pair, extending well beyond posterior margin of tergite (Fig. 55); female sternite VI with no pore plate; antennal segment IV either clear yellow or uniformly brown 2
2. Abdominal tergite VIII marginal setae S2 stout and more than 3 times as long as S1, almost as long as posteroangular seta (Fig. 66); tergite X longer than tergite IX [abdominal segment X and posterior half of IX dark brown] . . . . . *tanyoeikus* **sp.n.**
-. Abdominal tergite VIII marginal setae S2 scarcely larger than S1, at most 1.5 times as long and scarcely 0.5 as long as posteroangular setae (Figs 68, 70); tergite X rarely as long as IX 3
3. Antennal segment VI yellow in basal 0.3–0.5, V almost clear yellow . . . . . *melinus* **sp.n.**
-. Antennal segment VI brown or scarcely paler at base, V at least shaded brown 4
4. Antennal segments IV–V as dark brown as VI . . . . . *williei* **sp.n.**
-. Antennal segment IV as yellow as III 5
5. Antennal segment III 2.0 times as long as wide (Fig. 52); abdominal segment X and posterior half of IX dark brown; tergite VIII setae S2 subequal in length to setae S1 (Fig. 55) . . . . . *geikiei* **sp.n.**
-. Antennal segment III 2.2 times as long as wide (Fig. 69); abdominal segments IX–X almost yellow; tergite VIII setae S2 almost 2.0 times as long as setae S1 (Fig. 70) . . . . . *wyndhami* **sp.n.**

Masamithrips geikiei sp.n.

(Figs 52–55)

Female macroptera. Body and legs mainly yellow; fore femora external margin weakly shaded; abdominal segment X and posterior half of IX dark brown; antennal segments I–IV yellow, V light brown, VI–VIII brown; fore wing including clavus weakly shaded in basal half with apex pale. Similar to *M. masamii* and *M. melinus* in body structure and chaetotaxy, pronotal posteroangular setae shorter (Fig. 53); tergite IX shorter than X, with median dorsal setae extending well beyond posterior margin of tergite, stouter than posterior median setae and slightly shorter (Fig. 55). Sternite II with about 0–3 discal setae and 2 pairs of marginal setae; III–VII with irregular row of about 3–10 discal setae.

Measurements (holotype female in microns). Body length 1260. Head length 100; width across eyes 110; ocellar setae III 7. Pronotum, length 120; maximum width 130; pa inner setae 15; pa outer setae 30. Fore wing length 520. Metanotal median setae 10. Tergite IX length 80; median dorsal setae 60; setae S1 70; S2 85. Tergite X length 90; setae S1 70. Antennal segments III–VIII length 30, 23, 23, 30, 7, 10.

Material studied. Holotype female, **Western Australia**, Geikie Gorge, near Fitzroy Crossing, from hard leaves of *Triodia* sp., 27.ii.2005 (LAM 4624).

Paratypes: 5 females taken with holotype.

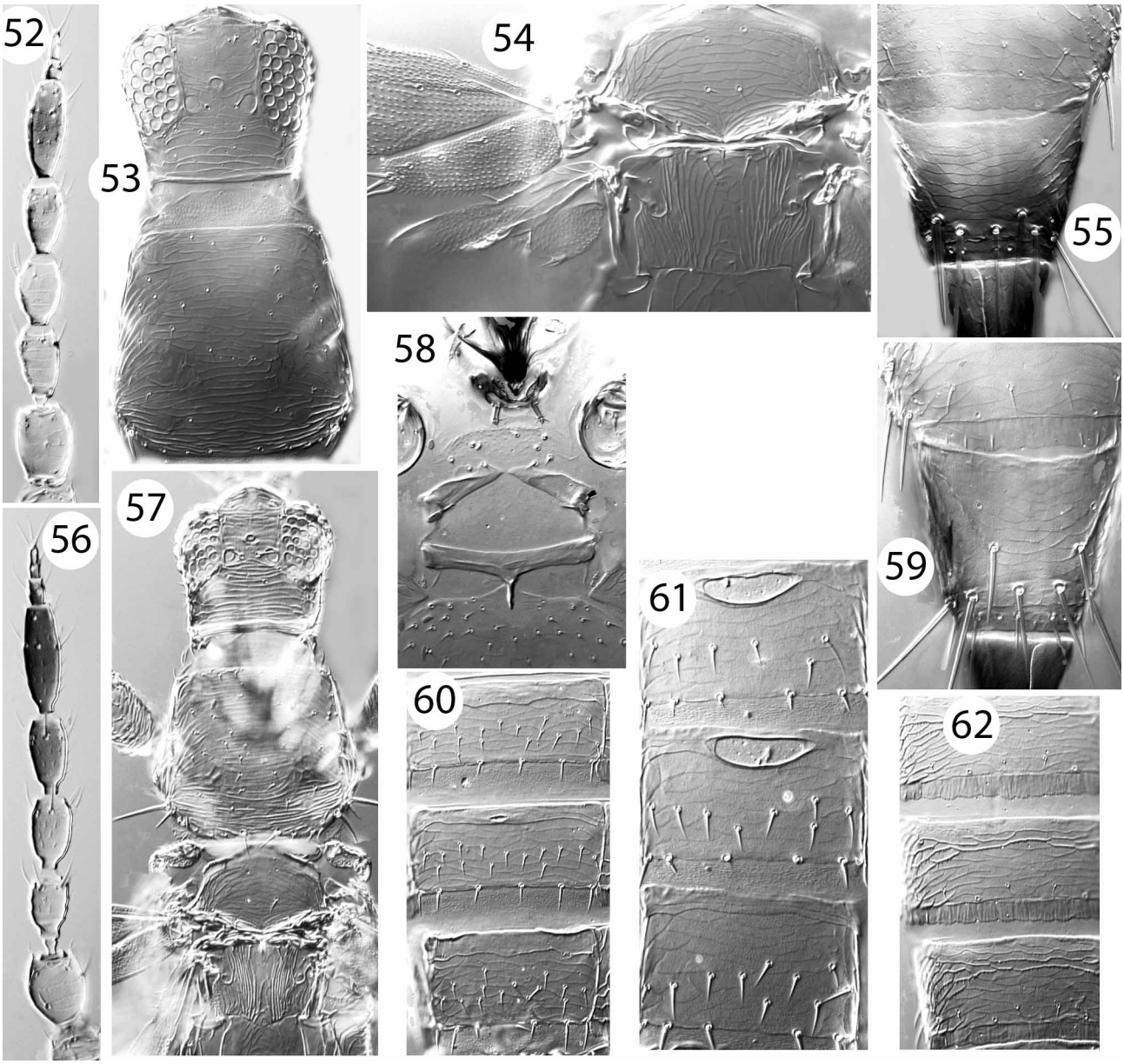
Comments. Four males were taken with the females listed above, but at present it is not possible to distinguish the males of this species from those of *M. masamii* with which they were also collected. This species is closely related to *M. melinus* and *M. williei*, but is distinguished by the colour of the antennae and tergite IX, as well as the shorter pronotal setae. In the holotype, one of the metanotal median setae is displaced and arises far behind the anterior margin.

Masamithrips masamii sp.n.

(Figs 56–62)

Female macroptera. Body mainly yellow, abdominal segment X dark brown also posterior margin of IX usually brown, antennal segments I–III yellow, IV weakly shaded, V–VIII light brown; fore wing including clavus very weakly shaded in basal half with apex pale. Head anterior margin projecting conically in front of eyes (Fig. 57); ocellar setae pair I far apart; III arising between mid-points of posterior ocelli. Pronotum posterior margin with 4 pairs of setae, posteroangular setal pairs sub-equal in length. Prosternal basantra granulate, with about 4 pairs of setae; fernal plates scarcely connected medially (Fig. 58). Metanotum medially with irregular sculpture. Fore wing first vein with 6–8 setae on basal half, 3 widely spaced setae on distal half; second vein with about 5 widely spaced

setae. Tergal sculpture weak but complete medially; II–VIII with broad craspedum, campaniform sensilla close to posterior margin (Fig. 62); tergites V–VIII with few microtrichia laterally; setal pair S2 on VIII no longer than S1; tergite IX longer than X, with median dorsal setae scarcely extending to posterior margin of tergite, no longer than posterior median setae (Fig. 59). Sternite II with about 6 discal setae and 3 pairs of marginal setae; III–VII with irregular row of about 10–15 discal setae; sternite VI with small oval pore plate on antecostal area (Fig. 60).



FIGURES 52–62. *Masamithrips* spp. *M. geikiei* 52–55: **(52)** antenna; **(53)** head & pronotum; **(54)** meso & metanota; **(55)** tergites VIII–X. *M. masamii* 56–62: **(56)** antenna; **(57)** head & thorax; **(58)** prosternum; **(59)** tergites VIII–X; **(60)** sternites V–VII; **(61)** male sternites V–VII; **(62)** tergites IV–VI.

Measurements (holotype female in microns). Body length 1280. Head length 100; width across eyes 110; ocellar setae III 15. Pronotum, length 120; maximum width 135; pa inner setae 35; pa outer setae 40. Fore wing length 570. Metanotal median setae 20. Tergite IX length 90; median dorsal setae 40; setae S1 55; S2 80. Tergite X length 75; setae S1 75. Antennal segments III–VIII length 30, 25, 28, 40, 8, 12.

Male macroptera. Similar to but smaller than female, apex of abdomen yellow; tergite IX dorsal setae small and slender; sternite II with 2 discal and 3 pairs of marginal setae, V–VI with broad pore plate on antecostal area (Fig. 61).

Material studied. Holotype female, **Western Australia**, Kununurra, Kununurra Gorge, from sticky *Triodia* leaves, 23.ii.2005 (LAM 4577).

Paratypes: **Western Australia**: 4 females, 4 males taken with holotype (plus larvae); same locality and host, 4 females, 22.ix.2009; Kununurra, Ivanhoe, 1 female from dead twig, 24.ii.2005; Geikie Gorge, Fitzroy Crossing, 12 females, 11 males from soft *Triodia* leaves, 27.ii.2005.

Comments. Females of this species are unique within the genus in having a pore plate near the anterior margin of the sixth sternite. Most other members of the genus have only two pairs of marginal setae on the second abdominal sternite, and the median dorsal setae on tergite IX long and often stout.

Masamithrips melinus sp.n.

(Figs 63–64)

Female macroptera. Body, legs and antennae mainly yellow, abdominal segment X and lateral margins of IX shaded light brown, antennal segments III–V yellow, VI yellow in basal 0.4–0.5. Closely similar to *M. masamii* in body structure and chaetotaxy; tergite IX as long as X, with median dorsal setae extending well beyond posterior margin of tergite, longer and stouter than posterior median setae. Sternite II with about 6 discal setae and 2 pairs of marginal setae; III–VII with irregular row of about 10–15 discal setae.

Measurements (holotype female in microns). Body length 1140. Head length 90; width across eyes 100; ocellar setae III 15. Pronotum, length 120; maximum width 135; pa inner setae 40; pa outer setae 30. Fore wing length 520. Metanotal median setae 25. Tergite IX length 70; median dorsal setae 65; setae S1 70; S2 100. Tergite X length 70; setae S1 75. Antennal segments III–VIII length 25, 25, 28, 38, 7, 10.

Male macroptera. Similar to but smaller than female, apex of abdomen yellow; tergite IX dorsal setae small and slender; sternite II with 3 pairs of marginal setae, IV–VI with broad pore plate on antecostal area.

Material studied. Holotype female, **Western Australia**, Kununurra, Kununurra Gorge, from native Poaceae, 23.ii.2005 (LAM 4574).

Paratypes: **Western Australia**: 14 females, 1 male collected with holotype.

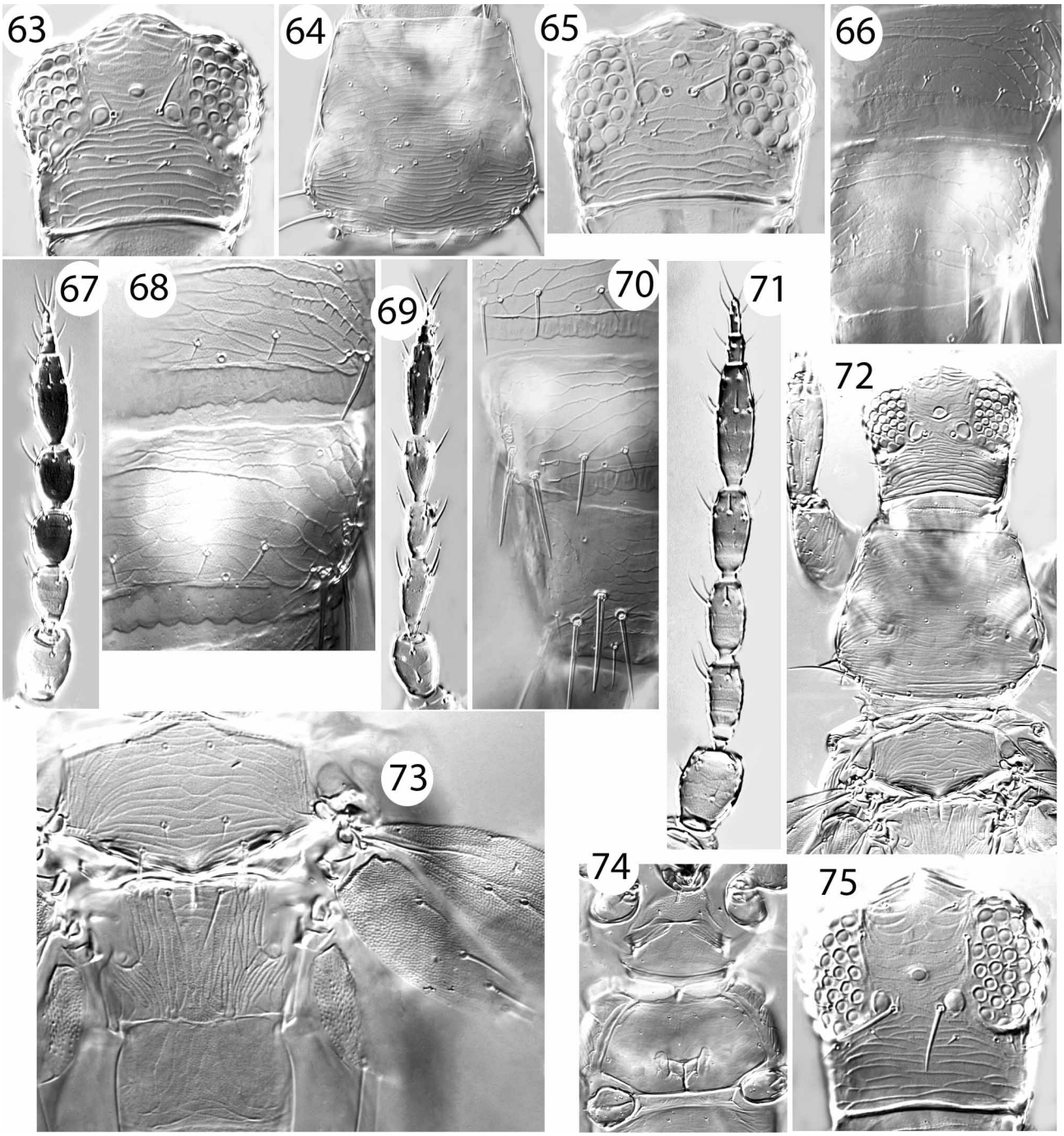
Non-paratypic specimens: **New South Wales**, Bullio, 25km west of Mittagong, 3 females from *Cymbopogon refractus* leaves, 2.iv.2010; Broken Hill, 2 females from *Cymbopogon ambiguus* leaves, 15.i.2001. **Northern Territory**, Alice Springs, 100km west, Serpentine Gorge, 1 female from *Cymbopogon ambiguus* leaves, 1.x.1999. **Queensland**, Aramac, 36km NE, 10 females from *Cymbopogon* sp., 10.iv.2005.

Comments. This species is closely similar in structure to *M. masamii*, apart from the differences noted above. These two were collected at the same site, but not from the same grass species. The specimens listed from New South Wales and Northern Territory cannot be distinguished from the type series from the north of Western Australia. In contrast, the females listed from Queensland have the fifth antennal segment distinctly shaded, and the sternites have few discal setae, but are otherwise similar in structure.

Masamithrips tanyoeikus sp.n.

(Figs 65–66)

Female macroptera. Body bicoloured, mainly yellow, with base of fore femora shaded, abdominal segment X and distal half of IX dark brown, antennal segments V–VIII light brown; fore wing including clavus weakly shaded in basal half with apex pale. Head with anterior margin slightly conical, cheeks short and straight; ocellar setae pair III arising between mid-points of posterior ocelli (Fig. 65); maxillary palps 2-segmented. Pronotum posterior margin with 3–4 pairs of setae, outer posteroangular setae slightly shorter than inner pair. Prosternal basantra granulate, with 2–4 pairs of setae; fernal plates with very slender median connection. Metanotum with irregular longitudinal reticulation medially. Fore wing first vein with 7 setae on basal half, 3 widely spaced setae on distal half; second vein with 2 to 4 widely spaced setae. Tergal sculpture weak but complete medially; II–VIII with broad craspedum; tergites V–VIII with few microtrichia on 3 or 4 lines of sculpture; setal pair S2 on VIII three times as long as S1 (Fig. 66); IX with median dorsal setae long and stout; tergite X longer than IX and curving slightly ventrally. Sternite II with 2 discal and 2 pairs of marginal setae, III–VI with irregular row of about 9 discal setae, VII with about 12 medially.



FIGURES 52–62. *Masamithrips* and *Monothrips* spp. *Mas. melinus* 63–64: **(63)** head; **(64)** pronotum. *Mas. tanyoeikus* 65–66: **(65)** head; **(66)** tergites VII–VIII. *Mas. williei* 67–68: **(67)** antenna; **(68)** tergites VII–VIII. *Mas. wyndhami* **(69)** antenna; **(70)** tergites VII–VIII. *Mono. cuspis* 71–74: **(71)** antenna; **(72)** head & thorax; **(73)** meso & metanota; **(74)** prosternum. **(75)** *Mono. flavus*, head.

Measurements (holotype female in microns). Body length 1070. Head length 75; width across eyes 100; ocellar setae III 17. Pronotum, length 110; maximum width 125; pa inner setae 55; pa outer setae 53. Fore wing length 520. Metanotal median setae 13. Tergite IX length 75; median dorsal setae 60; setae S1 57; S2 70. Tergite X length 105; setae S1 65. Antennal segments III–VIII length 27, 20, 22, 35, 8, 12.

Material studied. Holotype female, **Northern Territory**, from grasses, 130km East of Three Ways, 18.v.1999 (LAM 3720).

Paratype, 1 female collected with holotype.

Comments. The elongate tenth abdominal tergite, also the chaetotaxy of tergite VIII (Fig. 66), are unique in this species.

***Masamithrips williei* sp.n.**
(Figs 67–68)

Female macroptera. Body and legs mainly yellow, abdominal segment X dark brown, lateral margins of IX shaded light brown; antennal segments I–III yellow, IV–VIII dark brown (Fig. 67); fore wing weakly shaded on basal half. Closely similar to *M. melinus* in body structure and chaetotaxy; prosternal basantra with 2 pairs of setae; tergite IX with median dorsal setae extending well beyond posterior margin of tergite, subequal to posterior median setae in length and thickness; tergite X longer than IX. Sternite II with 2 pairs of marginal setae, 4 females with no discal setae on II, but 1 female with 3 discal setae; sternites III–VII with irregular row of 5–7 discal setae.

Measurements (holotype female in microns). Body length 1120. Head length 95; width across eyes 110; ocellar setae III 6. Pronotum, length 110; maximum width 130; pa inner setae 35; pa outer setae 35. Fore wing length 510. Metanotal median setae 25. Tergite IX length 80; median dorsal setae 65; setae S1 70; S2 100. Tergite X length 95; setae S1 80. Antennal segments III–VIII length 25, 20, 20, 35, 6, 10.

Material studied. Holotype female, **Western Australia**, Broome, Willie Creek, from grass on salt marsh, 2.iii.2005 (LAM 4662).

Paratypes: 2 females taken with holotype; **Queensland**, Boigu Island, 2 females from grass, 16.xi.2009.

Comments. The tenth abdominal tergite is dark and elongate in this species, although less so than in *M. tanyoeikus* described above, and ocellar setae pair III is small. In contrast to the other species of *Masamithrips*, this species has the fourth and fifth antennal segments uniformly dark brown (Fig. 67), and the second abdominal sternite usually lacks discal setae.

***Masamithrips wyndhami* sp.n.**
(Figs 69–70)

Female macroptera. Body and legs mainly yellow, abdominal segment X brownish yellow; antennal segments I–IV yellow, V weakly shaded near apex (Fig. 69), VI–VIII brown; fore wing pale. Similar to *M. melinus* in body structure and chaetotaxy; head relatively long, cheeks almost as long as lateral margin of eyes; prosternal basantra with 16 setae; tergite VIII setal pair S1 about 0.5 as long as S2 (Fig. 70); tergite IX with median dorsal setae extending well beyond posterior margin of tergite, stouter than posterior median setae but subequal in length (Fig. 70); tergite X shorter than IX. Sternite II with 7 discal setae and 3 pairs of marginal setae; III–VII with irregular double row of 8–10 discal setae.

Measurements (holotype female in microns). Body length 1350. Head length 105; width across eyes 115; ocellar setae III 15. Pronotum, length 125; maximum width 130; pa inner setae 35; pa outer setae 55. Fore wing length 570. Metanotal median setae 20. Tergite IX length 90; median dorsal setae 55; setae S1 50; S2 75. Tergite X length 75; setae S1 50. Antennal segments III–VIII length 35, 25, 30, 45, 7, 10.

Material studied. Holotype female, **Western Australia**, Wyndham 30km south, from *Triodia* sp., 26.ii.2005 (LAM 4619).

Comments. This is a particularly elongate species, with relatively slender antennae, an unusually large number of setae on the prosternal basantra, and three pairs of marginal setae on the second sternite. The S2 setae on the eighth tergite are relatively long (Fig. 70), although not as long as in *M. tanyoeikus*.

***Monothrips* Moulton**

This genus was based on a single female collected at Rabaul, New Britain. However, the same species, *M. flavus*, has been found widely across Northern Australia, and a second closely related species is described here from the north of Western Australia. Because of the presence of a few microtrichia laterally on the tergal sculpture lines (Fig. 79), Moulton (1940) suggested a relationship to the Sericothripinae, a suggestion that finds no support from any other character states. This genus shares most character states with *Masamithrips*, but has the maxillary palps with three segments, and the abdominal sternites with a dentate craspedum on the posterior margins. No male is known in this genus.

Key to *Monothrips* species

1. Craspedum on abdominal tergites II–VI very finely toothed medially, strongly toothed laterally (Fig. 79); craspeda on sternites with long teeth laterally but rounded lobes medially (Fig. 78) . . . . . *flavus*
-. Craspedum on abdominal tergites II–VI toothed across full width, but most strongly toothed laterally (Fig. 77); craspeda on sternites with long pointed teeth medially as well as laterally (Fig. 76) . . . . . *cuspis* **sp.n.**

Monothrips cuspis sp.n.

(Figs 71–74, 76–77)

Female macroptera. Body, legs and antennae yellow, antennal segment VI light brown, also VII–VIII, abdominal segment X and distal half of IX brown; major setae pale; fore wing weakly shaded in basal third, then darker medially with apex pale; compound eyes with 5 pigmented facets. Right antenna of holotype with segments VII–VIII fused; head with anterior margin slightly conical; ocellar setae pair I wide apart, pair III arising between hind margins of posterior ocelli (Fig. 72); maxillary palps 3-segmented. Pronotum posterior margin with 4 pairs of setae, outer posteroangular setae shorter than inner pair. Prosternal basantra granulate, with one pair of setae; fernal plates large with slender median connection (Fig. 74). Metanotal sculpture transverse at anterior, linear on posterior half (Fig. 73). Fore wing first vein with 3 + 2 setae on basal half, 3 widely spaced setae on distal half; second vein with 5 to 7 widely spaced setae; clavus with 4–5 marginal but no discal setae (Fig. 73). Hind tibia with row of stout setae on inner margin. Tergal sculpture weak, particularly medially; I with microtrichia on sculpture lines; II with 4 lateral marginal setae; II–VIII with campaniform sensilla close to posterior margin (Fig. 77); craspedum narrow medially on I, broad on II–VIII, with long prominent teeth on VII–VIII; tergites VI–VIII with prominent microtrichia on 3 or 4 lines of sculpture; IX with 2 pairs of campaniform sensilla, median dorsal setae small and slender. Sternites II–VII with transverse row of 5–9 discal setae medially, craspedum of long teeth on II–VI complete medially, incomplete on VII (Fig. 76).

Measurements (holotype female in microns). Body length 1400. Head length 105; width across eyes 125. Pronotum, length 135; maximum width 160; pa inner setae 60; pa outer setae 35. Fore wing length 550. Metanotal median setae 25. Tergite IX, median dorsal setae 20; setae S1 120; S2 175. Tergite X setae S1 165. Antennal segments III–VIII length 37, 32, 35, 50, 10, 13.

Material studied. Holotype female, **Western Australia**, Kununurra, Frank Wise Institute, from grasses, 24.ii.2005 (LAM 4586).

Comments. The single female from which this species is described has the tergal and sternal craspeda more strongly toothed than in *M. flavus*. The right antenna of this specimen is probably aberrant with the terminal segments fused, and ocellar setae III are presumably lost rather than minute (Fig. 72).

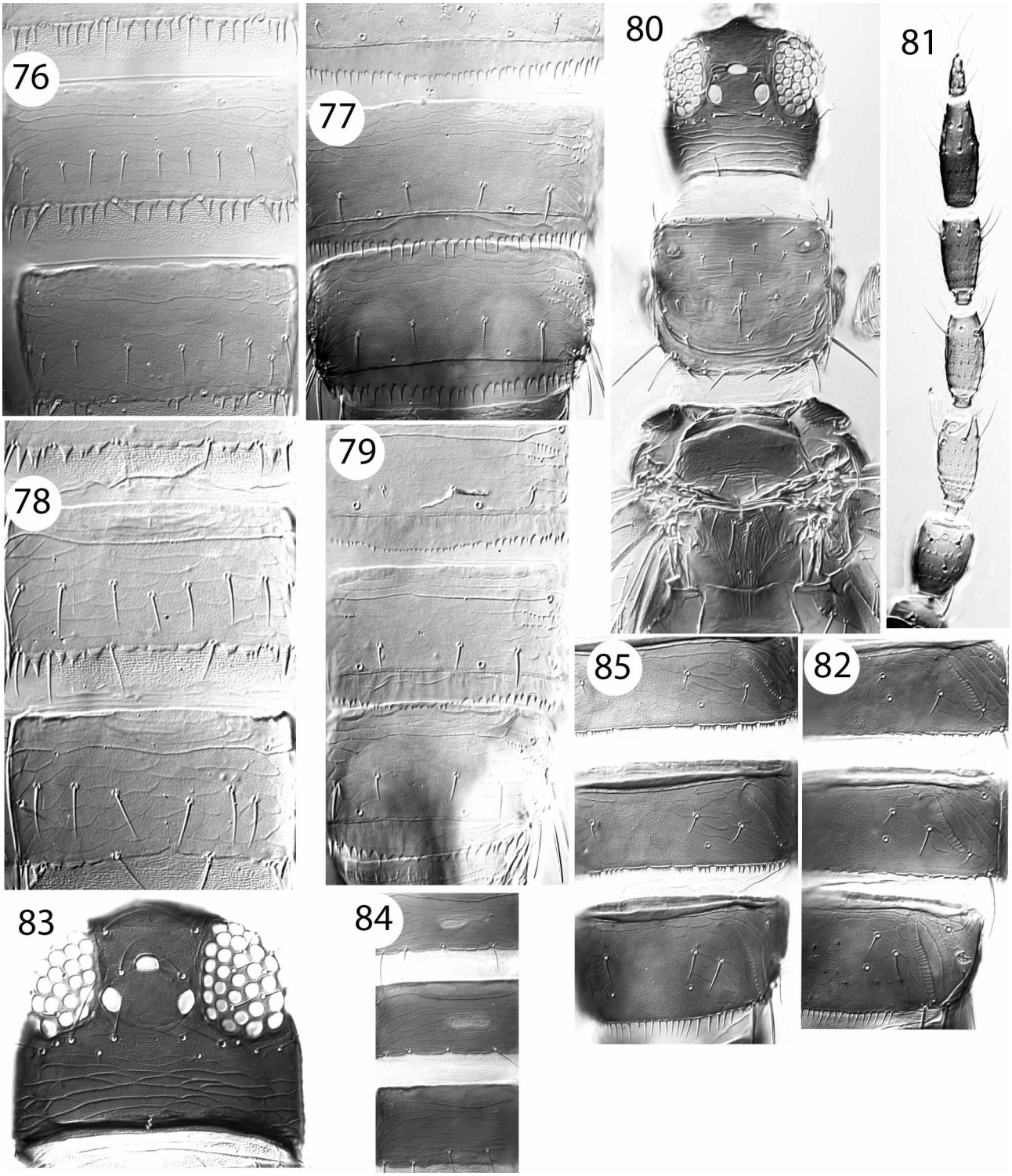
Monothrips flavus Moulton

(Figs 75, 78–79)

Monothrips flavus Moulton, 1940: 246

This species was described from one female, collected from *Saccharum* at Rabaul, New Britain, and a second female was subsequently recorded from Australia, just south of Darwin (Mound, 2002). It is very similar in structure and colour to *M. cuspis* described above, apart from the form of the tergal and sternal craspeda (Figs 78, 79). The fore ocellus is usually much smaller than the other two ocelli, and ocellar setae III are about as long as the side of the triangle (Fig. 75).

Material studied. Western Australia; Broome, Willie Creek, 3 females from *Chrysopogon pallidus*; Cable Beach, 5 females from *Stipa* sp. **Northern Territory**, Humpty Doo, 1 female from grass, 15.v.1999. **Queensland**, Badu Island, 2 females from *Chrysopogon phallax* lvs, 18.xi.2009; Tully, 1 female from grasses, 25.vii.1968.



FIGURES 76–85. Grass living Thripinae. *Monothrips cuspis* 76–77: **(76)** sternites V–VII; **(77)** tergites VI–VIII. *Monothrips flavus* 78–79: **(78)** sternites V–VII; **(79)** tergites VI–VIII. **(80)** *Stenchaetothrips bambusicola*, head & thorax. *Stenchaetothrips biformis* 81–83: **(81)** antenna; **(82)** tergites VI–VIII; **(83)** head. *Sten. bambusicola* 84-85: **(84)** female sternites V-VII; **(85)** tergites VI–VIII.

Moundothrips Wilson

The only species in this Panchaetothripinae genus, *M. apterygus*, is an Australian endemic, and is known only from wingless individuals. The plant species on which it actually breeds remains uncertain. Claimed originally to have

been collected from the leaves of grasses, subsequent observations suggested that the host might be a species of Restionaceae, but this has yet to be confirmed. Information and illustrations for this genus are web-available (Mound, Paris *et al.*, 2011).

Odontothripiella Bagnall

With few exceptions, the species of this genus breed in the flowers of Fabaceae, and many show high levels of host specificity within that family. In contrast, three species (*O. compta*, *reedi* and *unidentata*) breed only in the florets of particular native Poaceae. Despite this host plant difference, these three species share so many structural character states with the typical members of the genus that breed on Fabaceae that there is no reason to consider them as generically distinct. An identification key to the 18 described members of *Odontothripiella* was provided by Pitkin (1972).

Organothrips Hood

Three species are recognised in this genus. *O. wrighti* is known only from a few specimens from grasses in northern Australia, but *O. bianchii* was described from Hawaii, and *O. indicus* is known from India and Australia (Mound, 2000). The latter two species have been found living below the surface of water in the mucous layer of plants including *Typha*, *Colocasia* and *Eichornia*. These thrips share with several other grass-living thrips in Australia the character state of the prosternum bearing a pair of setae. However, the form of the head strongly prolonged in front of the eyes, and the curious seta at the inner apex of the fore tibiae, are distinctive.

Ozanaphothrips Mound & Masumoto

This genus is known only from Australia. There are six described species, of which most are dark brown but with one brightly bicoloured, and five of them are known only from the northern parts of the continent. The sixth, *O. fenarius*, was described from many specimens taken in the southern half of Western Australia, but in December 2010 was found breeding on the leaves of an unidentified native grass in forest on the east coast, near Narooma south of Sydney. Like *Anaphothrips* species, these thrips all lack long setae on the pronotum, but in contrast to the members of that genus they have sternal discal setae. Two species have craspeda on the sternites, but these structures are not present in the other four species. The host plants are various native Poaceae, although one species is known only from a species of Cyperaceae.

Parexothrips Priesner

This genus was redefined by Bhatti (1975), who distinguished it from *Exothrips*, and described a second species. The two genera share most character states, but in *Parexothrips* species ocellar setae pair III arise outside the ocellar triangle, the prosternal basantra bears two or more pairs of setae, and the prosternal ferna is incomplete medially.

Parexothrips palumai sp.n.
(Figs 39–44)

Female macroptera. Body and legs yellow, tergite X apex dark brown; antennal segments VI–VIII brown, V shaded light brown in distal half; fore wings very weakly shaded in basal half. Antennae 8-segmented, segment I with no dorso-apical setae, sensoria on III–IV forked; II with no microtrichia, III–VI with microtrichia on dorsal and ventral surfaces. Head broadest across eyes (Fig. 39), cheeks short and narrowed behind eyes; compound eyes

with 5 weakly pigmented facets; ocellar setae pair I not close together, pair III arising anterior to posterior ocelli; 3 pairs of small postocular setae; maxillary palps 3-segmented. Pronotum weakly trapezoidal, surface with faint transverse reticulation, discal setae small; with 8 pairs of posteromarginal setae of which pair VIII is longer but lies parallel to the pronotal margin. Prosternal basantra with 2–3 pairs of setae; fernal plates not connected medially (Fig. 44); spinasternum transverse, meso and meta furca without spinula, mesothoracic sterno-pleural sutures complete. Mesonotal anterior campaniform sensilla present (Fig. 43), median pair of setae minute and distant from posterior margin. Metanotal sculpture lines form an arch at posterior margin; median setae just behind anterior margin, all four setae about equidistant from each other; campaniform sensilla present (Fig. 43). Fore wing slender, first vein with 6 setae near base, 3 widely spaced setae on distal half; second vein with 4 widely spaced setae; clavus with 5 veinal setae and 1 discal seta; posterior fringe wavy. Tergites weakly sculptured medially, VI–VIII laterally with microtrichia on two sculpture lines and setal pair IV minute (Fig. 41); II–VIII with broad craspedum, campaniform sensilla near posterior margin, median setae minute and far apart, posteroangular setae arising mesad of posterior angle; IX with 2 pairs of campaniform sensilla, median dorsal setae slender (Fig. 42); X with complete median split. Sternites with no discal setae; II–VI posterior margin with craspedum forming large lobes between marginal setae; sternite II with 2 pairs of marginal setae, III–VII with 3 pairs, median 2 pairs on VII arise close together (Fig. 40).

Measurements (holotype female in microns). Body length 1230. Head, dorsal length 75; ventral length to mouth cone tip 200; width across eyes 115; ocellar setae III 10. Pronotum, length 150; maximum width 150; pa setae 15. Fore wing length 600. Metanotal median setae 20. Tergite VI setae S1 length 5, distance between them 60. Tergite IX setae S1 100; S2 115. Tergite X setae S1 85. Antennal segments III–VIII length 37, 33, 35, 40, 10, 12.

Material studied. Holotype female, **Queensland**, Mt Spec, 80km NW of Townsville, from grass tufts, 20.vii.1968 (LAM 756).

Paratypes: **Queensland**, 2 females taken with holotype; Darnley Island, 9 females from *Cymbopogon citriodorum* lvs, 17.ix.2009; same site and date, 3 females from grasses.

Comments. Only two species are described in this genus, *tenellus* from Egypt and India, and *capitis* from India. The arcuate sculpture on the posterior half of the metanotum of this new species is similar to that of *capitis* as illustrated by Bhatti (1975), and that species is also similar in having the fore wing clavus with a discal seta. However, the head shape is more like that of *tenellus*, although that species lacks ocellar setae pair I and has a reticulate metanotum.

Phibalothrips Hood

This Panchaetothripinae genus comprises one species from southern Europe, one from Malaysia, and two species that have overlapping distributions between Africa and Southeast Asia. These two are *P. peringueyi* that is recorded widely across the Oriental region from South Africa to Japan, and *P. longiceps* that is found in Australia as well as New Caledonia, New Guinea and Fiji. These two are distinguished from each other on slight differences in the colour of the base of the fore wings. *P. longiceps* is widely distributed across Australia north of Sydney, breeding on the leaves of grasses, but usually only on introduced species.

Physemothrips Stannard

The first species described in this genus has been taken in large numbers on Macquarie Island, breeding on the leaves of several different species of grasses. A second species was described subsequently from islands south of New Zealand, but there remains a possibility that this is no more than a local variant (Mound & Walker, 1982). These thrips are wingless, with the head conical in front of the eyes and bearing no ocelli. Females bear two pairs of setae on tergite IX that are unusually stout but do not extend beyond the apex of segment X. Males have a transverse pore plate close to the antecostal ridge on sternites III–VI, and two pairs of thorn-like setae medially on tergite IX.

Plesiothrips Hood

A total of 19 species are currently listed in this genus. Of these, five are from Southeastern USA, and the others are all Neotropical with the exception of *P. sakagamii* described on three females from Taiwan. However, there is little in the description of that species to distinguish it from *P. perplexus*, a species that is widespread among tropical countries and is variable in colour and chaetotaxy. This species has been taken across northern Australia from various introduced grasses and also *Zea mays*. There are no published studies on the breeding habits of this thrips, but the ovipositor is too weak and non-serrate to be effective in inserting eggs into plant tissues, suggesting the possibility that the eggs of this thrips are placed within the glumes of florets.

Stenchaetothrips Bagnall

Currently, 32 species are listed in this genus, all from the Oriental region apart from one described from Sudan and another from Brazil. These thrips all breed on the young leaves of grasses, and their feeding can cause visible damage. Three species are here recorded from Australia, all from the northern half of the continent. One of these is the oriental Rice Thrips, a second is another Asian species that is here interpreted as also having been introduced to the Neotropics, and the third is a new species described below. Bhatti (1982) provided a key to 15 species from India, and Wang (2000) provided a key to a further five species from Taiwan. However, there is possibly further synonymy to be recognised within the genus; for example, the holotype and one paratype female of *S. spinalis* from Philippines have been studied, and contrary to the original description the metanotum does not have campaniform sensilla; this species therefore cannot at present be distinguished from *S. tenebricus* from southern India as defined by Bhatti (1982).

Key to *Stenchaetothrips* species from Australia

1. Body and legs almost entirely yellow, tergite X variably shaded; fore wings pale; abdominal tergite VIII posterior margin with no microtrichial comb (Fig. 88); postocular setae pair II more than half as long as pairs I and III (Fig. 86). . . . . *indicus*
-. Body extensively brown, fore wings deeply shaded; tergite VIII with complete comb of equally long microtrichia (Figs 82, 85); postocular setae pair II much shorter than I or III (Figs 80, 83) 2
2. Metanotal campaniform sensilla present (Fig. 80); tergite VII posterior margin with small posteriorly directed triangular teeth (Fig. 85); fore wing slightly paler near base; antennal segment V largely yellow; male with pronotum and pterothorax yellow or at least paler than head and abdomen . . . . . *bambusicola* **sp.n.**
-. Metanotal campaniform sensilla absent; tergite VII posterior margin with laterally directed teeth present only toward lateral margins (Fig. 82); fore wing uniformly shaded, base not paler; antennal segment V brown (Fig. 81); male either uniformly brown, or head and pronotum paler than abdomen . . . . . *biformis*

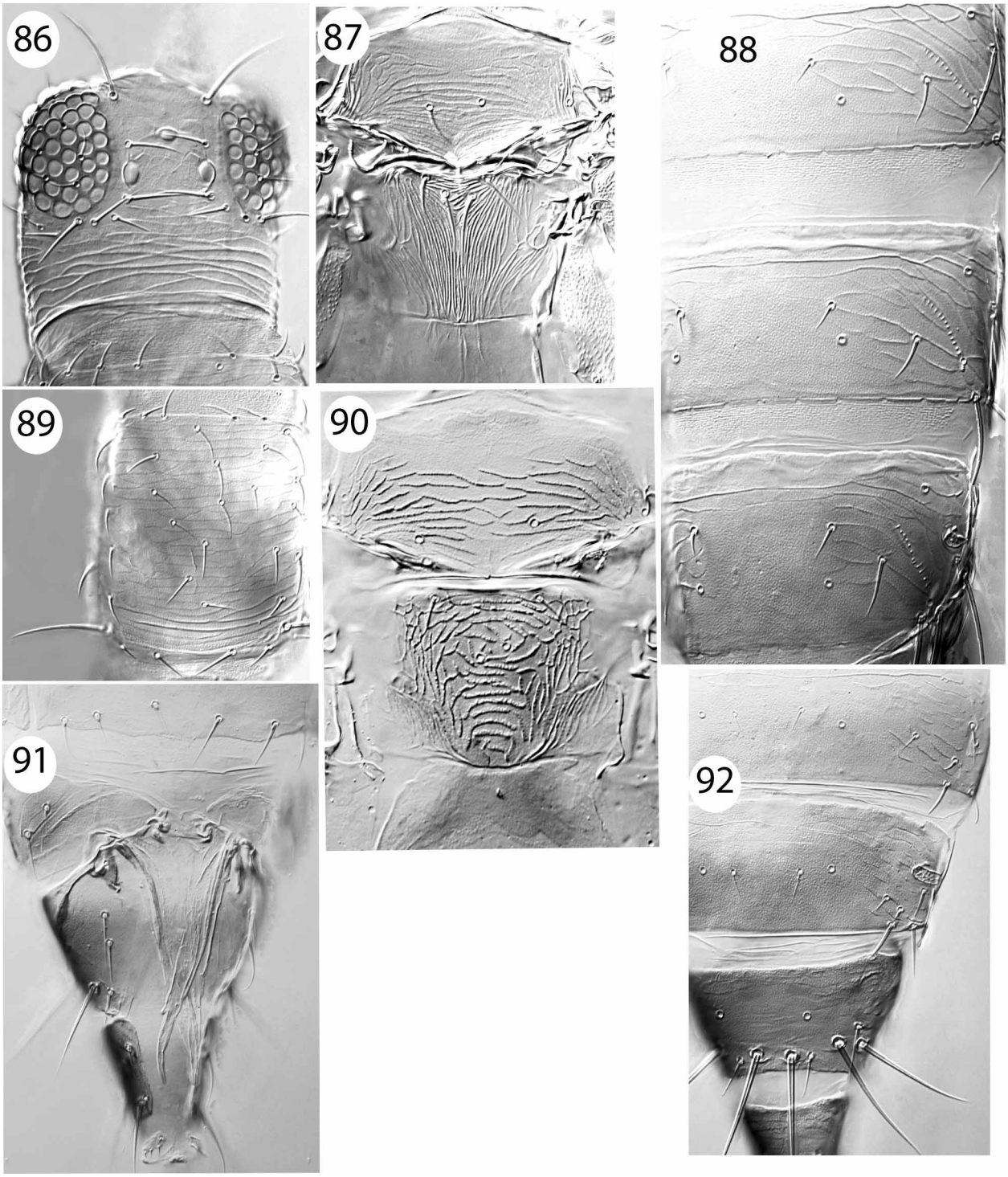
Stenchaetothrips bambusicola sp.n.

(Figs 80, 84–85)

Female macroptera. Body brown, legs yellow with femora shaded with brown, major setae dark brown; antennal segment I brown, II yellowish in apical half, III almost entirely yellow, IV–V shaded at apex, VI brown in apical half, VII brown; eyes with no pigmented facets; fore wing light brown but slightly paler sub-basally just distal to clavus. Head as long as wide, cheeks rounded (Fig. 80); ocellar setae III weak, arising just outside anterior sides of triangle; postocular setae I and III sub-equal, II and IV minute. Antennal segment III slender, sensoria on III–IV not elongate. Pronotum with faint transverse lines of sculpture, 2 pairs of long posteroangular setae, 3 pairs of posteromarginal setae. Mesonotal campaniform sensilla present, median setal pair arising well in front of posterior margin. Metanotum closely striate, median setal pair not at anterior margin, campaniform sensilla present (Fig. 80). Fore wing first vein with 3 distal setae; second vein with about 10 setae. Prosternal ferna complete medially; meso and meta furca without spinula. Tergites I–IV with a few small craspedal teeth near posterolateral angles, these are progressively more extensive toward mid-line on V–VII (Fig. 85); VIII with complete marginal comb; paired ctenidia present on VI–VIII; IX with 2 pairs of campaniform sensilla, median dorsal setae stout but not reaching posterior

margin. Sternites and pleurotergites with no discal setae; sternite II with 2 pairs of posteromarginal setae, III–VII with 3 pairs, median pair on VII arising in front of margin; sternites V–VI with transverse pore plate medially (Fig. 84).

Measurements (holotype female in microns). Body length 1450. Head length 135; width across eyes 135. Pronotum, length 130; maximum width 160; pa inner setae 45; pa outer setae 55. Fore wing length 630. Metanotal median setae 30. Tergite IX setae S1 75; S2 100. Tergite X setae S1 90. Antennal segments III–VII length 50, 45, 35, 45, 15.



FIGURES 86–92. *Stenchaetothrips* and *Takethrips* spp. *Sten. indicus* 86–89: **(86)** head; **(87)** meso & metanota; **(88)** tergites VI–VIII; **(89)** pronotum. *Takethrips megas* 90-92: **(90)** meso & metanota; **(91)** ovipositor; **(92)** tergites VII-X.

Male macroptera. Similar to female, but thorax almost yellow; tergal craspedal teeth similar to female, but no comb on VIII; tergite IX with 4 median setae almost in straight line; sternites III–VII with transverse pore plate, posterior margins with no teeth.

Material studied. Holotype female, **Northern Territory**, Jabiru, Kakadu, from *Bambusa arnhemica* lvs, 23.xii.1996 (LAM3084).

Paratypes: 2 females, 7 males collected with the holotype.

Comments. The structure of this new species is closely similar to that described for *S. divisae* Bhatti (1982), based on a single female from Sibpore, West Bengal. However, the presence of sternal pore plates in the female of this new species is unusual, and the illustration of *S. divisae* indicates that the craspedal teeth on tergite VI are more distinct from each other than in *bambusicola*. Possibly also related is *S. bambusae* (Shumsher) although that was described as having a much paler body. The type material of neither *divisae* nor *bambusae* is available, but Bhatti (1982) interpreted *S. bambusae* based on several specimens from bamboo in India and illustrated the head as having postocular setal pair III longer than pair I. Specimens labelled as *bambusae* by Ananthakrishnan in the Natural History Museum, London, collected from bamboo in Orissa, have only two or three tergal marginal teeth these being close to the lateral margin of the tergite and translucent. The *Stenchaetothrips* species associated with bamboo across Southeast Asia into northern Australia thus need further study. In the Philippines, a further species is described from bamboo, *S. spinalis*, but that has a slender spinula on the mesofurca, postocular setae IV are longer than antennal segment II, the tergites lack marginal teeth laterally, and the sternites of females have no pore plates.

Stenchaetothrips biformis **(Bagnall)**

(Figs 81–83)

Bagnallia biformis Bagnall, 1913: 237
Thrips oryzae Williams, 1916: 353

Described originally from England on *Phragmites*, the synonym listed above was described from India on rice, *Oryza sativa*, and a further six synonyms are generally accepted as referring to the same species, the Oriental Rice Thrips (Bhatti, 1982; Mound, 2011). This thrips is considered to be widespread across the Old World, from Australia to Europe, and also introduced to South America. In contrast, Vierbergen (2004) suggested that the "rice form", from Asia and South America, is different from the form that lives on *Phragmites* in Europe, and discriminated these two as follows:

"rice form" - postocular setae I absent; antennal segments IV and V length/width ratios less than 1.9 and 1.8; pronotum with 8 discal setae; sternites IV–VI of female with pore plates;

"*Phragmites* form" - postocular setae I usually present; antennal segments IV and V length/width ratios more than 2.4 and 2.0; pronotum with about 18 discal setae; sternites of female without pore plates.

The illustration accompanying the original description of *oryzae* indicates the presence of postocular setae I, contrary to Vierbergen's "rice form". Bhatti (1982) reported that "syntypes" of this species he studied had this pair of setae either present or absent, and the slide in the BMNH collection labelled "TYPE" has this pair of setae present. Moreover, six of the paratypes have one or both of these setae present, although both setae are absent in four other paratypes. None of these females has any sternal pore plates visible, although all of them are imperfectly cleared. Williams (1916: 355) stated "*Type* in the British Museum" therefore the specimen labelled as "TYPE" should be considered the holotype according to the Code of Zoological Nomenclature. Of the type series of *Bagnallia biformis*, only one female and one male remain suitable for study (the other specimens are in a mountant that has turned black). The female, labelled Lectotype, has the left but not the right seta of postocular setae pair I, whereas the male has both of these setae. There is thus little support from the type specimens of the two nominal species for Vierbergen's (2004) conclusion.

In Australia, this thrips has not been recorded from rice, but it is widespread in eastern Queensland on grasses in damp places, and a total of 22 slide-mounted individuals have been examined. Of these, seven lacked either one or both of postocular setal pair I, whereas 15 had both setae well developed. None of these specimens had more than eight pronotal discal setae, and none of the females had any sternal pore plates. Vierbergen (2004) stated that he had studied 18 specimens of the "rice form", but all of these were from Surinam. Since this species is introduced to South America, it is likely that the introduced population will have gone through a genetic bottle neck, and thus

exhibit a limited range of variation in comparison to that found in Asian populations. Bhatti (1982) summarised the variation exhibited by the rice thrips, within and between populations derived from various Asian localities as well as Europe. His interpretation of this as representing a single widespread species that breeds on various Poaceae in damp habitats, including rice, is here considered the most appropriate decision.

Stenchaetothrips indicus (Ramakrishna & Margabandhu)

(Figs 86–89)

Fulmekiola indica Ramakrishna & Margabandhu, 1931: 1034
Anaphidothrips brasiliensis Hood, 1954: 212. **Syn.n.**

Female macroptera. Body and legs clear yellow, abdominal segment X sometimes weakly shaded; antennal segments I–IV yellow, V weakly shaded near apex, VI–VII brown but VI usually paler at base; eyes with no pigmented facets; fore wing uniformly pale. Head with setae long (Fig. 86). Pronotum with 10– 20 setae in median area (Fig. 89). Metanotal sculpture typical of genus, without campaniform sensilla (Fig. 87). Tergites IV–VIII with little or no sculpture medially, posterior margins with no craspedum or teeth (Fig. 88); IX without anterior campaniform sensilla, median dorsal setae slender.

Male macroptera. Similar to female; sternites III–V with transverse pore plate, VI–VIII with median pair of setae arising in front of margin; tergite IX median four pairs of setae arising in transverse row.

Material studied. Queensland, Townsville, 1 female, 20.vii.1968; Boigu Island, 1 female from *Saccharum*, 16.xi.2009. **New South Wales**, 25km west of Mittagong, Bullio, 28 females, 6 males from *Cymbopogon refractus* leaves, 2.iv.2010; **Australian Capital Territory**, Oakey Hill, 1 female, 1 male from *Stipa* sp., 3.iv.2010. The following are essentially similar in structure but with a rather larger number of pronotal discal setae: **Northern Territory,** Darwin, one female, 20.xii.1996; **Thailand**, Chiang Mai, 4 females from *Cymbopogon*, 28.i.2005. Studied from BMNH, London: **Thailand**, Suphanburi, 2 females from *Saccharum*, vi.1973. **Pakistan**, Rawalpindi, 1 female from *Saccharum*, 19.ix.1980. **Jamaica**, Monynuck, 2 females from *Saccharum*, 26.i.1965. **Trinidad**, near Arima, 3 females from grasses, xi.1970.

Comments. Although type material is not available, Bhatti (1982) indicated that *S. sacchari* (Kruger) from Java is possibly a senior synonym of *indicus*, a species that is widespread in India. Hood described *brasiliensis* from three females taken on *Andropogon* near Brasilia, and these have been compared with two females from *Saccharum* in Jamaica (Mound & Marullo, 1996). Moreover, as noted below, three females have now been studied from Trinidad, and these eight are the only specimens known from the Neotropics. Presumably, in common with *S. biformis* and *S. minutus*, this species has been introduced to that area from tropical Asia, possibly on sugar cane planting material. *S. indicus* is unique among the described species in the genus in lacking a comb of slender microtrichia on the posterior margin of tergite VIII in females. In this species, the posterior margin of tergite VIII bears a weak craspedum of small flat translucent lobes, but these vary in size and are not visible in all the available specimens, all of which are here interpreted as conspecific. The number of discal setae on the pronotum varies among the specimens studied, and females from Trinidad and Jamaica have an anterior pair of campaniform sensilla on tergite IX although these are not present in any of the other specimens listed above.

Striathrips gen.n.

Diagnosis. Macropterous Thripinae, Body surface with many closely spaced transverse striae (Figs 94-97); antennae 8-segmented, segment I with one dorso-apical seta, III–IV with long forked sensoria. Head with ocellar setae I absent; compound eyes with no pigmented facets. Pronotum with 2 pairs of posteroangular setae; pronotum, metanotum, tergites and sternites with numerous transverse striae. Prosternal basantra without setae, ferna complete; meso and metafurca without spinula. Fore wing with setal rows widely spaced, clavus with discal seta. Tergites II–VIII with craspedum of small lobes; IX with 2 pairs of campaniform sensilla, median dorsal setae short; X with no longitudinal split; sternites with weak, narrow craspedum, VII with all setae arising at margin.

Type species *Striathrips sulcatus* sp.n.

Comments. Relationships of the new species described below are far from clear. The lobed tergal craspeda and presence of one dorso-apical seta on the first antennal segment suggest a relationship to *Bregmatothrips*, but the tergal campaniform sensilla are placed far forward from the posterior margin of each tergite, and ocellar setae pair I are not present. The dense transverse striae on the tergites and sternites are unusual, but are reminiscent of *Amalothrips flacidus* from India, as illustrated by Bhatti (1975).

Striathrips sulcatus sp.n.

(Figs 93–97)

Female macroptera. Body, legs, and antennal segments I–III yellow, IV with light brown shading, V–VIII dark brown; fore wing weakly shaded at base, pale at apex, and with two dark and two light transverse areas, clavus dark. Antennal segments III–IV with apical neck and bearing long, slender, forked sensoria (Fig. 93); III with no microtrichia, IV with a few microtrichia ventrally; external sensorium on V–VI slightly flattened, VIII longer than VII. Head with ocellar setae III long, arising on margins of triangle (Fig. 94); postocular setae small, arising close to margins of eyes. Pronotal inner posteroangular setae longer than external pair, 4 pairs of posteromarginal setae (Fig. 94). Mesonotum transversely striate, anterior campaniform sensilla present; two pairs of setae near posterior margin. Metanotum transversely striate, median pair of setae behind anterior margin, campaniform sensilla present; metascutellum longitudinally striate except near posterior margin (Fig. 95). Abdominal tergite I striate (Fig. 96), campaniform sensilla near posterior margin, craspedum absent medially but weakly developed laterally; II–VIII with campaniform sensilla equidistant from anterior and posterior margins (Figs 96–97); IX with weak transverse sculpture, median dorsal setae well-developed but short. Sternites transversely striate, II with 2 pairs of marginal setae, III–VII with 3 pairs, all arising at margin; craspedum weak, irregular and narrow.

Measurements (holotype female in microns). Body length 1560. Head length 110; width across eyes 130; ocellar setae III 45. Pronotum, length 160; maximum width 185; pa inner setae 70; pa outer setae 40. Fore wing length 730. Metanotal median setae 35. Tergite IX, median dorsal setae 30; setae S1 100; S2 130. Tergite X setae S1 130. Antennal segments III–VIII length 50, 50, 37, 55, 12, 15.

Material studied. Holotype female macroptera, **Queensland**, Mt Malloy, 22km SE of Mossman, 23.vii.1968 (LAM 770).

Takethrips Nonaka & Jangvitaya

This genus comprises two species collected from unidentified bamboos and grasses in Thailand. *T. bambusae* has a stout and serrated ovipositor that does not extend to the apex of the abdomen, whereas in *T. megas* the ovipositor is very weakly sclerotised with no marginal serrations (Fig. 91). Another genus from Thailand and Japan, *Yoshinothrips*, is similar to *Takethrips*, but the three known species all have two pairs of long pronotal posteroangular setae, and the ovipositor is stout and boldly serrated (Mound & Ng, 2009).

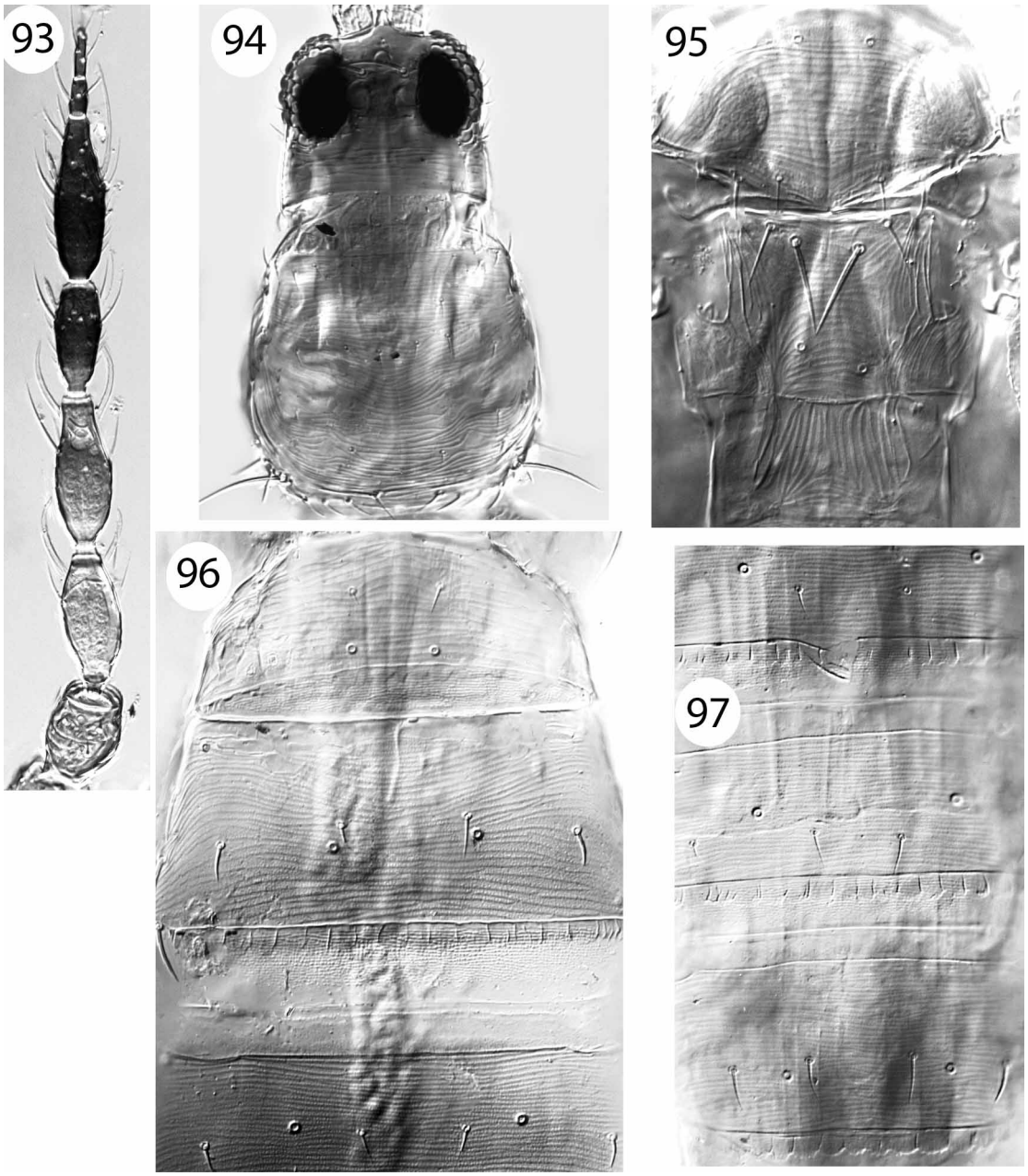
Takethrips megas Nonaka & Jangvitaya

(Figs 90–92)

Takethrips megas Nonaka & Jangvitaya, 1993: 744

Described from Thailand, where it was collected on bamboo at Bangkok and Phuket Island, this species is recorded here from Australia on a single female that was collected on Yam Island, Torres Strait Islands. The identification is based on the original description, and a series of photomicrographs kindly prepared by Dr Masami Masumoto. The specimen from Yam Island differs from the Thailand specimens in having the median pair of setae on the mesonotum arising in front of the posterior margin, not at the margin, and in having the median dorsal setae on tergite IX arising lateral to the campaniform sensilla, not anterior to these sensilla. However, the metanotal sculpture (Fig. 90) seems to be distinctive.

Female macroptera. Body light brown with median abdominal segments paler; antennal II–IV yellow; fore wings pale with second quarter shaded. Head elongate, cheeks incut behind eyes; ocellar setae pair I absent about 6 eye facets weakly pigmented; mouth cone large, extending between fore coxae, maxillary palps 3-segmented. Antennae 8-segmented, I with paired dorso-apical setae, sensoria on III–IV simple. Pronotum without sculpture, apart from posterior sub-marginal line; notopleural sutures apparently extending along lateral margins of pronotum; 4 pairs of posteromarginal setae, none elongate. Prosternal ferna weakly joined medially; meso and metafurcae without spinula. Metanotum with complex sculpture (Fig. 90). Fore wing first vein with 3 + 2 + 2 setae; second vein with 8 setae; clavus with 4 veinal and one discal setae; posterior cilia strongly wavy. Abdominal tergites without sculpture medially, no ctenidia laterally; VIII with no marginal comb (Fig. 92), IX with one pair of campaniform sensilla, X with no dorsal split. Sternites II–VII each with 3 pairs of marginal setae, often arising submarginally, no discal setae; ovipositor very weak (Fig. 91).



FIGURES 93–97. *Striathrips sulcatus.* **(93)** antenna; **(94)** head & pronotum; **(95)** meso & metanota; **(96)** tergites I–III; **(97)** tergites VI–VIII.

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References

ABRS (2011) *Order Thysanoptera*, Australian Biological Resources Study: http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/Thysanoptera [accessed 20.ix.2011]

Ananthakrishnan, T.N. & Sen, S. (1980) Taxonomy of Indian Thysanoptera. *Zoological Survey of India (Handbook Series)*, 1, 1–234.

Bagnall, R.S. (1913) Further notes on new and rare British Thysanoptera (Terebrantia) with descriptions of new species. *Journal of economic Biology*, 8, 231–240.

Bhatti, J.S. (1975) A revision of *Exothrips* Priesner and two related genera. *Oriental Insects*, 9, 43–90.

Bhatti, J.S. (1978) A revision of Karny's species of *Anaphothrips* of the Oriental region. *Oriental Insects*, 12, 1–27.

Bhatti, J.S. (1980) Revision of the genus *Caprithrips* with descriptions of two new species from India and Australia. *Australian Journal of Zoology*, 28, 161–171.

Bhatti, J.S. (1982) Revision of the Indian species of *Stenchaetothrips* Bagnall. *Oriental Insects*, 16, 385–417.

Bhatti, J.S. (1983) Revision of *Thrips* species described by Schmutz. *Annalen des Naturhistorischen Museums in Wien*, 84B, 479–507.

Bhatti, J.S. (1984) A remarkable *Bregmatothrips*-like new genus from Africa, with a review of *Bregmatothrips* Hood and *Plutonothrips* Priesner. *Annals of Entomology*, 2, 83–97.

Bhatti, J.S. (2006) The classification of Terebrantia (Insecta) into families. *Oriental Insects*, 40, 339–375.

Bianchi, F.A. (1945) Introduction to the Thysanoptera of New Caledonia. *Proceedings of the Hawaiian entomological Society*, 12, 249–278.

Bournier, J.-P. & Mound, L.A. (2000) Inventaire commenté des Thysanoptères de Nouvelle- Calédonie. *Bulletin de la Societe Entomologique de France*, 105, 231–240.

Crespi, B.J., Morris, D.C. & Mound, L.A. (2004) *Evolution of ecological and behavioural diversity: Australian* Acacia *thrips as model organisms*. Australian Biological Resources Study, Canberra & Australian National Insect Collection, Canberra. 328pp.

Girault, A.A. (1928) Some Insecta and a New All Highness. (Notes compiled in fear and sorrow). Published privately, Brisbane. 4pp.

Girault, A.A. (1929) Description of a case of lunacy in Homo and of new six-legged articulates. Published privately, Brisbane, 4pp.

Hoddle, M.S., Mound, L.A. & Paris, D. (2008) *Thrips of California*. Cd-rom published by CBIT, Brisbane. http://www.lucidcentral.org/keys/v3/thrips_of_california/Thrips_of_California.html

Hood, J.D. (1954) Brasilian Thysanoptera V. *Proceedings of the Biological Society of Washington*, 67, 195–214.

Kirk, W.D.J. (2004). The link between cereal thrips and thunderstorms. *Acta Phytopathologica et Entomologica Hungarica*, 39, 131–136.

Kobus JD (1893). Blaaspooten (Thrips). *Mededeelingen van het Proefstation Oost-Java*, 43, 14–18.

Lewis, T. (1959) The annual cycle of *Limothrips cerealium* Haliday (Thysanoptera) and its distribution in a wheat field. *Entomologia Experimentalis et Applicata*, 2, 187–203.

Lewis, T. (1997) Flight and dispersal, 175–196 in *Thrips as Crop Pests* [ed Lewis, T] CAB International, Wallingford, U.K. 740pp.

Mabberley, D.J. (1997) *The Plant Book*. Cambridge University Press. 858pp.

Masumoto, M. & Okajima, S. (2002) Two *Bolacothrips* species (Thysanoptera, Thripidae) from Japan. *Special Bulletin of the Japanese Society of Coleopterology*, 5, 119–127.

Minaei, K. & Mound, L.A. (2008) The Thysanoptera Haplothripini (Phlaeothripidae) of Iran. *Journal of Natural History*, 42, 2617–2658.

Minaei, K. & Mound, L.A. (2010) Grass-flower thrips of the genus *Chirothrips* (Thysanoptera: Thripidae), with a key to species from Iran. *Zootaxa*, 2411, 33–43. http://www.mapress.com/zootaxa/2010/f/zt02411p043.pdf

Moulton, D. (1936) Thysanoptera of the Philippine Islands. *Philippine Journal of Agriculture*, 7, 263–273.

Moulton, D. (1940) Thysanoptera from New Guinea and New Britain. *Occasional Papers of the Bishop Museum*, 15, 243–270.

Mound, L.A. (1974) Spore-feeding Thrips (Phlaeothripidae) from Leaf Litter and Dead Wood in Australia. *Australian Journal of Zoology.* Supplement, 27, 1–106.
Mound, L.A. (1996) Thysanoptera, pp 249–336, 397–414 (Index), in Wells A, *Zoological Catalogue of Australia*. Volume 26. Psocoptera, Phthiraptera, Thysanoptera. Melbourne. CSIRO Australia.
Mound, L.A. (1999) Saltatorial leaf-feeding Thysanoptera (Thripidae, Dendrothripinae) in Australia and New Caledonia, with newly recorded pests of ferns, figs and mulberries. *Australian Journal of Entomology*, 38, 257–273.
Mound, L.A. (2000) The aquatic thrips *Organothrips indicus* Bhatti (Thysanoptera: Thripidae) in Queensland, and a new species, *O. wrighti*, from tropical Australia. *Australian Journal of Entomology*, 39, 10–14.
Mound, L.A. (2002) Thrips and their host plants: new Australian records (Thysanoptera: Terebrantia). *Australian Entomologist*, 29, 49–60.
Mound, L.A. (2011) Thysanoptera (Thrips) of the World - a checklist. http://www.ento.csiro.au/thysanoptera/worldthrips.html [accessed 26.vii.2011]
Mound, L.A. & Houston, K.R. (1987) An annotated check-list of Thysanoptera from Australia. *Occasional Papers on Systematic Entomology* 4, 1–28.
Mound, L.A. & Marullo, R. (1996) The Thrips of Central and South America: An Introduction. *Memoirs on Entomology, International*, 6, 1–488.
Mound, L.A. & Masumoto, M. (2009) Australian Thripinae of the *Anaphothrips* genus-group (Thysanoptera), with three new genera and thirty-three new species. *Zootaxa*, 2042, 1–76. http://www.mapress.com/zootaxa/2009/f/zt02042p076.pdf
Mound, L.A. & Minaei, K. (2006) New fungus-feeding thrips (Thysanoptera-Phlaeothripinae) from tropical Australia. *Zootaxa* 1150, 1–17. [http://www.mapress.com/zootaxa/2006f/zt01150p017.pdf
Mound, L.A. & Minaei, K. (2007) Australian insects of the *Haplothrips* lineage (Thysanoptera – Phlaeothripinae). *Journal of Natural History*, 41, 2919–2978. http://pdfserve.informaworld.com/869319_751315335_789049544.pdf
Mound, L.A. & Ng, Y.F. (2009) An illustrated key to the genera of Thripinae (Thysanoptera) from South East Asia. *Zootaxa*, 2265, 27–47. http://www.mapress.com/zootaxa/2009/f/zt02265p047.pdf
Mound, L.A. & Palmer, J.M. (1972) Grass-flower infesting thrips of the genus *Chirothrips* Haliday in Australia. *Journal of the Australian Entomological Society*, 11, 332–339.
Mound, L.A., Paris, D., Fisher, N. & Tree, D.J. (2011) World Thysanoptera – an identification and information resource. http://anic.ento.csiro.au/thrips/ [accessed 20.ix.2011]
Mound, L.A. & Tree, D.J. (2009) Identification and host-plant associations of Australian Sericothripinae (Thysanoptera, Thripidae). *Zootaxa*, 1983, 1–22. http://www.mapress.com/zootaxa/2009/f/zt01983p022.pdf
Mound, L.A. & Tree, D.J. (2011) New records and four new species of Australian Thripidae (Thysanoptera) emphasise faunal relationships between northern Australia and Asia. *Zootaxa*, 2764, 35–48.
Mound, L.A. & Walker, A.K. (1982) Terebrantia (Insecta: Thysanoptera). *Fauna of New Zealand*, 1, 1–113.
Mound, L.A., Zhang, H.-R., Bei, Y.-W. (2011) *Caliothrips tongi* sp.n. (Thysanoptera, Thripidae) from China, and a dubious record of North American Bean Thrips. *Zootaxa*, 2736, 57–62.
Nakahara, S. (1995) Review of the Nearctic species of *Anaphothrips* (Thysanoptera: Thripidae). *Insecta Mundi*, 9, 221–248.
Nonaka, T. & Jangvitaya, P. (1993) Bamboo-inhabiting thrips of the family Thripidae (Thysanoptera) from Southeast Asia I. *Japanese Journal of Entomology*, 61, 737–747.
Okajima, S. (2006) *The Suborder Tubulifera (Thysanoptera). The Insects of Japan*, 2, 1–720. The Entomological Society of Japan, Touka Shobo Co. Ltd., Fukuoka.
Palmer, J.M. (1975) The grass-living genus *Aptinothrips* Haliday (Thysanoptera: Thripidae). *Journal of Entomology* (B)**,** 44**,** 175–188.
Pereyra, V. & Mound, L.A. (2010) Phylogenetic relationships within the genus *Desmothrips* (Thysanoptera, Aeolothripidae), an Australian genus of facultative flower-living predators. *Systematic Entomology*, 35, 306–317.
Pitkin, B.R. (1972) A revision of the Australian genus *Odontothripiella* Bagnall, with descriptions of fourteen new species (Thysanoptera: Thripidae). *Journal of the Australian Entomological Society*, 11, 265–289.
Ramakrishna, T.V. & Margabandhu, V. (1931) Notes on Indian Thysanoptera with brief descriptions of new species. *Journal of the Bombay natural History Society*, 34, 1025–1040.
Rao, S, Alderman, S. & Murphy, A. (2010) Floret-infesting thrips in grass seed crops: crop host range and seed loss. *Seed Technology*, 32, 26–36.
Reyes, C. (1994) Thysanoptera (Hexapoda) of the Philippine Islands. *The Raffles Bulletin of Zoology*, 42, 1–507.
Schmutz, K. (1913) Zur Kentniss der Thysanopterenfauna von Ceylon. *Sitzungberichte der Akademie der Wissenschaften in Wien*, 122, 921–1102.
Sharma J, Paini D, Funderburk J & Mound LA. (2011) Host associations of Thysanoptera with *Paspalum distichum* Fluegge and *Paspalum notatum* L. (Poales : Poaceae). *Annals of the Entomological Society of America*, 104, 733–738.
Vierbergen, G. (2004) Eight species of thrips new for the Netherlands and some taxonomical changes in *Stenchaetothrips*, *Thrips* and *Hoplothrips*. *Acta Phytopathologica et Entomologica Hungarica*, 39, 199–209.
Wang, C.-L. (2000) The genus *Stenchaetothrips* Bagnall (Thysanoptera: Thripidae) from Taiwan. *Chinese Journal of Entomology*, 20, 243–253.
Williams, C.B. (1916) *Thrips oryzae* sp.nov., injurious to rice in India. *Bulletin of Entomological Research*, 6, 353–355.
Xie, Y.-H., Zhang, H.-R. & Mound, L.A. (2010) A new species from southwestern China of the holarctic genus *Odontothrips*

(Thysanoptera: Thripidae). *Zootaxa*, 2729, 53–57.
zur Strassen, R. (1993) Chorologische, phänologische une taxonomische Studien an Terebrantia der Kapverden (Insecta: Thysanoptera). *Courier Forschungsinstitut Senckenberg***,** 159**,** 335–380.
zur Strassen, R. (2003) Die terebranten Thysanopteren Europas und des Mittelmeer-Gebietes. *Die Tierwelt Deutschlands*, 74, 1–271.

Appendix: Key to world species of *Bregmatothrips*

1. Antennae 7-segmented 2
-. Antennae 8-segmented 3
2. Antennal segments III–IV with sensorium simple . . . . . *australis* **sp.n**.[in part]
-. Antennal segments III–IV with sensorium forked . . . . . *furcatus* & *willcocksi*[1]
3. Female sternite VII setae arise sub-marginally 4
-. Female sternite VII setae arise at margin 5
4. Antennae with sensoria forked . . . . . *binervis*
-. Antennal sensoria simple . . . . . *australis* **sp.n**.[in part]
5. Antennal segment I with only one dorso-apical seta 6
-. Antennal segment I with 2 dorso-apical setae 7
6. Male micropterous, bicoloured, female macropterous, brown , ... *venustus*
-. Both sexes macropterous, uniformly brown with pale wings . . . . . *piceus*[2]
7. Legs clear yellow; thorax largely yellow, head and at least posterior abdominal segments brown . . . . . *bournieri*
-. At least femora brown; female with thorax brown, male with thoracic segments extensively yellow . . . . . *dimorphus* & *brachycephalus*[3]

[1]The recorded differences between the African species *furcatus* and *willcocksi* probably represent inter-population variation of a single species.

[2]It is possible that *piceus* from Cape Verde Islands is no more than a variety of *venustus* with fully winged males.

[3]The Indian species *brachycephalus* is not clearly distinguished from the European species *dimorphus*. Moreover, females labelled as *dimorphus* (in BMNH, London) from Nigeria, Malawi, Sudan and South Africa have only a single dorso-apical seta on the first antennal segment; these females probably represent *venustus* that is otherwise not recorded from Africa.