



<http://dx.doi.org/10.11646/zootaxa.3964.2.2>

<http://zoobank.org/urn:lsid:zoobank.org:pub:DE38A5A7-32BF-44BD-A450-83EE872AE934>

## Endemics and adventives: Thysanoptera (Insecta) biodiversity of Norfolk, a tiny Pacific Island

LAURENCE A. MOUND & ALICE WELLS

*Australian National Insect Collection CSIRO, PO Box 1700, Canberra, ACT 2601. E-mail: laurence.mound@csiro.au*

### Abstract

The thrips fauna of Norfolk Island is a curious mix of endemics and adventives, with notable absences that include one major trophic group. A brief introduction is provided to the history of human settlement and its ecological impact on this tiny land mass in the western Pacific Ocean. The Thysanoptera fauna comprises about 20% endemic and almost 50% widespread invasive species, and shows limited faunal relationships to the nearest territories, Australia, New Caledonia and New Zealand. This fauna, comprising 66 species, includes among named species 29 Terebrantia and 33 Tubulifera, with four Tubulifera remaining undescribed. At least 12 species are endemics, of which 10 are mycophagous, and up to 10 further species are possibly native to the island. As with the thrips fauna of most Pacific islands, many species are widespread invasives. However, most of the common thrips of eastern Australia have not been found on Norfolk Island, and the complete absence of leaf-feeding Phlaeothripinae is notable. The following new taxa are described: in the Phlaeothripidae, *Buffettithrips rauti* **gen. et sp. n.** and *Priesneria akestra* **sp. n.**; and in the Thripidae, *Scirtothrips araucariae* **sp. n.** and *Thrips merae* **sp. n.**

**Key words:** Norfolk Island, thrips endemism, invasion, faunal relationships, new species

### Introduction

Norfolk Island is a small, isolated, sub-circular, volcanic landmass, less than 10 km in diameter and with an area of approximately 35 km<sup>2</sup> (Fig. 1). It lies about 1450 km east of Brisbane, Australia, and 900 km northeast of Lord Howe Island, and is almost 700 km from both the North Cape of New Zealand to the south and New Caledonia to the north. The climate is sub-tropical, with an annual temperature range from 13°C to 25°C and a mean annual rainfall of a little over 1300 mm. Archaeological evidence suggests that Polynesians were present on the island for a period between 800 and 600 years before the first Europeans visited in 1774. Captain James Cook, with a few of his crew, landed briefly on a northwest rocky beach, but sailed on to New Zealand the same day after noting the numerous tall pine trees and thickets of flax plants (Coyne 2011). The next European visitors arrived late in 1787, on two French vessels commanded by La Pérouse, but they were unable to land, and reported wryly that, such were the sea cliffs and rough seas, the island was fit only for eagles and angels.

In January 1788, within two weeks of the first European colonists of Australia arriving from Britain at Botany Bay, one of the ships of the First Fleet was sent to Norfolk Island with a party of convicts to found a colony. The instructions were to cultivate the flax plants, and presumably to ensure that the French did not attempt to found a settlement. From the subsequent viewpoint of conservation biology, it is important to note that this ship carried with it live material of *Citrus jambhiri* that had been acquired by the First Fleet at Rio de Janeiro on the journey from England (Coyne 2011), and probably also specimens of the Brazilian Red Guava, *Psidium cattleianum*. Subsequently, these two species became highly invasive on the island and, together with several other introduced plants, greatly modified the environment. This modification was facilitated during the penal colony period by extensive deforestation. That colony was finally abandoned in 1855, and the following year the island was occupied by the Pitcairn Islanders who were descendants of the mutineers of the *Bounty*.

During the 1920s extensive areas on the steep slopes of Norfolk Island were further deforested in order to plant bananas, in response to the failure of this crop in eastern Australia at that time. When production in Australia

recovered, the banana plantings on Norfolk Island were abandoned and the areas became overgrown with introduced shrubs, particularly the African Olive. A further major disruption to the vegetation of the island occurred during the 1940s to accommodate extensive military facilities, including a radar station at the top of Mt Bates. These various disruptions to the vegetation over a period of 150 years resulted in the native flora being extensively destroyed.

**The available flora.** More than 500 species of vascular plants are recorded from Norfolk Island (Green 1994). However, only about 140 of these are considered to be native to the island, and of these only 43 are endemics, including eight ferns (Coyne 2011). Representatives of the native flora are now found primarily on a small area of the National Park, most of the island having been cleared for housing and the raising of cattle and food crops (Holloway 1977). The attractive rolling hills are covered with Kikuyu Grass, *Pennisetum clandestinum*, together with thickets of the African Olive, *Olea europaea cuspidata*, and the Brazilian Pepper Tree (Hawaiian Holly), *Schinus terebinthifolius*. In the forests of the National Park, *Citrus jambhiri* no longer forms the dense barriers that were reported 100 years ago, but the stems of *Psidium cattleianum*, constitute an impenetrable thicket through much of the eastern part of these forests. The branches of three of the woody weeds, *Olea*, *Schinus* and *Psidium*, seem rarely to bear epiphytic mosses and lichens; their dead timber is remarkably resistant to fungal decay, and is thus usually devoid of fungus-feeding insects. In contrast, branches of *Citrus jambhiri*, and also of native trees such as *Baloghia*, *Lagunaria* and *Nestegis*, bear many epiphytes, and their dead timber is attacked by fungi supporting populations of various insects.

**Previous studies on Norfolk Island thrips.** Prior to the investigations reported here, only three species of Thysanoptera were recorded from Norfolk Island (Smithers 1998). The earliest recorded thrips, *Hoplandrothrips leai*, was collected by AM Lea in 1915 and described from two specimens (Karny 1925). The second recorded species, *Priesneriana uptoni*, was described from a single female collected in 1968 (Mound 1974). Until now nothing has been known about the biology of either of these thrips. The third species, *Thrips hawaiiensis*, was recorded by Palmer (1992), but that record is here recognised as being based on misidentified specimens of *Thrips novocaledonensis*.

The data presented here are derived from an intensive survey between December 2012 and December 2014 (Table 1). The authors collected on the island on six visits, each of 5 to 10 working days, these representing sampling periods in Winter (1), Spring (2), Summer (2) and Autumn (1). In addition, samples of thrips were taken by Australian Quarantine entomologists during four visits to the island over this period. The resultant 62 named species of Thysanoptera in 44 genera here recorded from Norfolk Island include at least eight named species that are considered to be endemics. There are at least four more un-named species that are presumed to be endemics, but these require further comparison with the mainland fauna before they can be described. The biology and distribution of each recorded species are discussed below; the species are arranged alphabetically by Family, Subfamily and Genus. Most of the genera and species listed below in the three families, Thripidae, Aeolothripidae, and Merothripidae, can be identified using the web-based illustrated system OzThrips (Mound *et al.* 2012), and suitable identification systems for the species of Phlaeothripidae are indicated in the text. Full nomenclatural information about all Thysanoptera taxa is available at ThripsWiki (2015).

**The thrips fauna.** The term **endemic** is applied here to those species that are considered likely to live only on Norfolk Island. The term **native** is used for species that are presumed to include Norfolk Island as one part of their wider natural distribution. The term **adventive** is used for those species that are introduced from other parts of the world. The studies reported here suggest that the thrips fauna of Norfolk Island, like the flora, comprises largely non-native, adventive, species (Table 1). This situation is similar to that of several other Pacific islands including New Caledonia (Bournier & Mound 2000), French Polynesia (Hoddle *et al.* 2008), and Kiribati (Mound & Walker 1987).

The flower-living niche, the plant association that most entomologists associate with thrips, is dominated on Norfolk Island by a single species, *Thrips novocaledonensis*. At various times of the year, this thrips is abundant in the flowers of virtually all species of native and introduced plants. Known otherwise only from New Caledonia and Vanuatu, this thrips is possibly native to Norfolk Island. A second species of genus *Thrips* has been found only in the flowers of the rare and endemic plant, *Myoporum obscurum*. This thrips, described below as *Thrips merae*, is presumably endemic to Norfolk Island, although it shares most structural character states with *Thrips obscuratus*, the common flower thrips of New Zealand.



**FIGURE 1.** Norfolk Island map, indicating collecting sites mentioned in the text. **1**, Airport; **2**, Ball Bay Reserve; **3**, Bird Rock Track; **4**, Bridle Track; **5**, Bullocks Hut Road; **6**, Burnt Pine; **7**, Capt. Cook Point; **8**, Collins Head; **9**, Eucalyptus Plantation; **10**, Headstone Reserve; **11**, Highland Lodge; **12**, 100 Acre Farm; **13**, 100 Acre Reserve; **14**, Mission Road forest; **15**, Mt Bates; **16**, Mt Pitt; **17**, Palm Glen Track; **18**, Prince Philip Drive; **19**, Red Road; **20**, Two Chimneys Road; **21**, Stockyard Road.

The leaf-feeding niche, in contrast, involves one species of Thripidae that is possibly endemic, and two that are probably native. The first, *Scirtothrips araucariae*, is described below, and breeds among the youngest terminal leaves of the endemic Norfolk Island Pine, *Araucaria heterophylla*. However, only females of this *Scirtothrips* species have been found, and this raises the possibility that it may be a natural immigrant associated with one of the *Araucaria* species of eastern Australia or New Caledonia. Of the other two species, *Dendrothrips diaspora* was found breeding on Norfolk Island only on the leaves of the native tree, *Nestegis apetala*, although this thrips is widespread in eastern Australia on various other Oleaceae. Similarly, *Ensiferothrips primus* breeds on Norfolk Island on the leaves of the native shrub, *Streblus pendulinus*, but occurs on various related Moraceae shrubs and trees on Lord Howe Island, New Caledonia and in eastern Australia. Particularly remarkable is the absence on Norfolk Island of any leaf-feeding Phlaeothripidae, despite the large number of species with this habit on both New Caledonia and in eastern Australia. In contrast to the small number of native leaf and flower thrips, an eclectic but by no means extensive range of adventive, worldwide, pest thrips has been found on Norfolk Island on horticultural and vegetable crops.

**TABLE 1.** Norfolk Island Thysanoptera: endemics, adventives and faunal relationships.

THYSANOPTERA TAXA	Norfolk Is. Endemic	Widespread	Australia	New Zealand	New Caledonia
AEOLOTHRIPIDAE					
<i>Aeolothrips fasciatus</i>		+			
MEROTHRIPIDAE					
<i>Merothrips brunneus</i>			+	+	
<i>Merothrips floridensis</i>		+			
PHLAEOTHRIPIDAE—IDOLOTHRIPINAE					
<i>Anaglyptothrips dugdalei</i>			+	+	
<i>Carientothrips flavitibia</i>			+		
<i>Carientothrips snowi</i>	+				
<i>Nesothrips propinquus</i>		+			
<i>Ozothrips janus</i>				+	
<i>Priesneriana uptoni</i>	+				
PHLAEOTHRIPIDAE—PHLAEOTHRIPINAE					
<i>Adraneothrips russatus</i>		+			
<i>Apterygothrips australis</i>			+		
<i>Apterygothrips sparsus</i>			+	+	
<i>Baenothrips moundi</i>			+	+	
<i>Bamboosiella cingulata</i>		+			
<i>Buffettithrips rauti</i>	+				
<i>Deplorothrips</i> —three <b>sp. n.</b>	+				
<i>Giraultithrips nigricoxa</i>			+		
<i>Haplothrips avius</i>			+		
<i>Haplothrips bituberculatus</i>			+		
<i>Haplothrips gowdeyi</i>		+			
<i>Haplothrips leucanthemi</i>		+			
<i>Haplothrips robustus</i>			+		
<i>Holoengythrips maynardae</i>	+				
<i>Hoplandrothrips leai</i>	+				
<i>Hoplothrips corticis</i>		+			
<i>Hoplothrips orientalis</i>		+			
<i>Karnyothrips flavipes</i>		+			
<i>Karnyothrips melaleucus</i>		+			
<i>Lissothrips taverni</i>	+				
<i>Macrophthalmothrips neocaledonensis</i>					+
<i>Plectrothrips australis</i>			+		
<i>Priesneria akestra</i>	+				
<i>Psalidothrips taylori</i>			+		
<i>Sophiothrips martinae</i>	+				
<i>Stephanothrips barretti</i>			+		
<i>Stephanothrips occidentalis</i>		+			
<i>Strepterothrips sp. n.</i>	+				

.....continued on the next page



TABLE 1. (Continued)

THYSANOPTERA TAXA	Norfolk Is. Endemic	Widespread	Australia	New Zealand	New Caledonia
<i>Yarnkothrips kolourus</i>			+	+	
THRIPIDAE—DENDROTHRIPINAE					
<i>Asprothrips seminigricornis</i>		+			
<i>Dendrothrips diaspora</i>			+		
<i>Ensiferothrips primus</i>			+		+
THRIPIDAE—PANCHAEOTHRIPINAE					
<i>Bhattithrips frontalis</i>			+		
<i>Heliiothrips haemorrhoidalis</i>		+			
<i>Hercinothrips bicinctus</i>		+			
<i>Hercinothrips femoralis</i>		+			
<i>Parthenothrips dracaenae</i>		+			
THRIPIDAE—THRIPINAE					
<i>Anaphothrips dubius</i>			+		
<i>Anaphothrips obscurus</i>		+			
<i>Anaphothrips sudanensis</i>		+			
<i>Apterothrips apteris</i>		+			
<i>Aptinothrips rufus</i>		+			
<i>Chaetanaphothrips orchidii</i>		+			
<i>Frankliniella schultzei</i>		+			
<i>Plesiothrips perplexus</i>		+			
<i>Scirtothrips araucariae</i>	+				
<i>Scirtothrips inermis</i>		+			
<i>Tenothrips frici</i>		+			
<i>Thrips australis</i>		+			
<i>Thrips imaginis</i>			+		
<i>Thrips merae</i>	+				
<i>Thrips nigropilosus</i>		+			
<i>Thrips novocaledonensis</i>					+
<i>Thrips simplex</i>		+			
<i>Thrips tabaci</i>		+			

The small number of native thrips species feeding on living plants on Norfolk Island contrasts with the considerable fauna of native Phlaeothripidae feeding on fungi associated with dead plant tissues, at least ten of which are presumed to be endemics. Among the spore-feeding thrips of subfamily Idolothripinae, *Carientothrips snowi* breeds only on the dead fronds of *Rhopalostylis baueri*, the endemic palm tree, and *Priesneriana uptoni* breeds specifically on the dead leaves of Norfolk Island Pine. Among fungus-feeding species of the subfamily Phlaeothripinae, *Buffettithrips rauti*, a new genus and species described below, breeds only on the fallen dead leaves of the endemic plant, *Cordyline oblecta*. Breeding on dead branches, endemic fungus-feeding species include *Sophiothrips martinae*, a species closely resembling one from New Zealand, also *Holoengythrips maynardae* and *Hoplandrothrips leai*, each of which share character states with species in eastern Australia. Four more fungus-feeding species that are probably endemic to Norfolk Island have been collected, but these remain undescribed, pending further studies on the mainland fauna. Three are species of *Deplorothrips*, a genus known from New Zealand and Australia, and one is a species of *Strepterothrips*, a pan-tropical genus that is well represented in Australia. A further endemic species is *Lissothrips taverni* that breeds in association with mosses but

possibly feeds on blue-green algae. However, most of the 62 named species of Thysanoptera listed here from Norfolk Island are clearly adventive from other parts of the world.

There was considerable variation between the numbers of species and numbers of specimens collected during each of the six visits that were made to the island between 2012 and 2014. Presumably some of this variation was due to seasonality. During July (midwinter) most species of thrips were difficult to find. Moreover, *Thrips australis* was found only when at least some of the trees in the *Eucalyptus* plantation were flowering. Lack of rain in the second half of 2014 led to the populations of most species of thrips being very low in November of that year, a notable exception being *Thrips tabaci* that thrives under such warm dry conditions. In part, the observed variation in thrips numbers may be due to the irregularity of the weather on Norfolk Island, with unpredictable periods of drought and rain. However, not all of the observed fluctuation seems likely to have a simple relationship to season. Despite equally intensive collecting efforts, a curiously high proportion of the recorded thrips species were taken only in very low numbers, or on only a single occasion. This included among Thripidae, *Anaphothrips dubius*, *Anaphothrips obscurus*, *Apterothrips apteris*, *Hercinothrips femoralis*, *Parthenothrips dracaenae*, and *Thrips nigropilosus*, and among Phlaeothripidae, *Haplothrips leucantheri* and *Haplothrips robustus*. It is possibly relevant that these are all immigrant, anthropic species, whereas species of thrips that we consider to be native or even endemic to Norfolk Island were found more consistently throughout the sampling period, even when populations were low. The irregular occurrence of so many polyphagous, anthropic species, suggests that there may be frequent transport to the island by one or more means.

Despite the previous comment, the most curious aspect of the Norfolk Island thrips fauna is the apparent absence of so many species that are abundant in eastern Australia. For example, eight species of *Pseudanaphothrips*, nine species of *Desmothrips*, 15 species of *Scirtothrips*, and more than 30 species of genus *Thrips* are known from eastern Australia (Mound *et al.* 2012), but none of the species in the first two of those genera, and only five of the third are known from Norfolk Island. The absence of *Thrips imaginis*, the Australian plague thrips, is particularly difficult to understand, because in October 2014 adults of this species were collected from the flowers of both *Lagunaria patersonia* and *Coprosma baueri* on Phillip Island, a tiny scrap of denuded land 6 km south of Norfolk Island. This species is included in the text below but, despite much collecting effort, *T. imaginis* has not yet been found on Norfolk Island itself. Together with *Pseudanaphothrips achaetus*, it is amongst the most abundant of all insects in the southern half of Australia, where both species are common in the flowers of a very wide range of plants. In eastern Australia north of Sydney, two other flower-living species, *Thrips setipennis* and *Thrips hawaiiensis*, are abundant, and *Megalurothrips usitatus* is widespread further north in Australia, breeding in the flowers of several cultivated Fabaceae as well as in the flowers of *Canavalia* along the coast.

All of these thrips species from eastern Australia might be expected to reach Norfolk Island on winds, as is known for so many species of larger moths (Holloway 1977). Equally surprising are the absences of several widespread pests, including western flower thrips, *Frankliniella occidentalis*; the maize thrips, *Frankliniella williamsi*; and Kelly's citrus thrips, *Pezothrips kellyanus*, that is widespread in Australia and New Zealand. A further problem concerns *Frankliniella schultzei*, the tomato thrips, of which considerable numbers of both sexes were found in the flowers of *Ipomoea cairica* and *Arachis pintoii*, but none were found on any of the vegetable crops examined. The apparent absence of so many pest thrips species is presumably associated with the limited import of living plant material into Norfolk Island. The absence of leaf-feeding Phlaeothripinae, in contrast to the many tens of species of this trophic group in eastern Australia, and also the many species known from New Caledonia, is probably a function of the restricted flora of Norfolk Island.

### **Acknowledgements, abbreviations and depositaries**

The Norfolk Island Quarantine Survey, of which this thrips project was a small part, was devised and skilfully managed by Dr Glynn Maynard of the Australian Department of Agriculture, Fisheries and Forestry or "DAFF" (now the Australian Department of Agriculture). Work on the island was greatly facilitated through the commitment shown by the quarantine officer, Neil Taverner, particularly in helping to develop effective laboratory facilities. We are grateful to many islanders for their enthusiastic support in providing access to their properties, including Mera Martin, Pat Buffett, Matt Bigg, Wayne Boniface, Merv Buffett, Lou Evans, John & Margaret Smith, and Dave South. Australian Quarantine entomologists Ben Boyd and Luke Watson also collected thrips for us, and Brendan Lepschi of the CSIRO herbarium kindly provided some plant identifications.

**Abbreviations.** The following abbreviations are used in the descriptions: po—postocular setae; pronotal setae: am—anteromarginals, aa—anteroangulars, ml—midlaterals, epim—epimerals, pa—posteroangulars; tergite IX: setae S1—pair nearest to midline, setae iS—intermediate seta between S1 and S2.

**Depositaries.** Holotypes of the new species are in the Australian National Insect Collection, CSIRO, Canberra. A reference collection comprising most of the recorded species will be available at Norfolk Island Quarantine Laboratory.

## AEOLOTHRIPIDAE

<http://www.ozthrips.org/terebrantia/aeolothripidae/>

Most species in this family are flower-living, where they are probably facultative predators on other small insects. However, some species are obligate predators, living at ground level or high in the tree canopy. Most species in this family are described from the Northern Hemisphere, although there is an extensive native aeolothripid fauna in Australia. The Australian endemic genus *Desmothrips* includes 18 described species, mainly living in flowers, but none of these have been found on Norfolk Island.

***Aeolothrips fasciatus* (Linnaeus):** This presumably predatory species, with broad, transversely banded wings, is from southern Europe, and has been seen in low numbers from Tasmania and New Zealand (Mound & Walker 1982). Many females, but no males, were collected on 100 Acre Farm from flowering lucerne in association with a large population of *Thrips novocaledonensis*. A few specimens were also taken from lettuce plants at Bullocks Hut Road.

## MEROTHRIPIDAE

<http://www.ozthrips.org/terebrantia/merothripidae/>

Species in this family are minute and rarely collected. They live on dead wood and in leaf litter, feeding on fungus, and most species are described from the Neotropics (Mound & O'Neill 1974).

***Merothrips brunneus* Ward:** Described from New Zealand, this species is also known from eastern Australia. Similar in structure to the worldwide *floridensis*, it is generally darker, with more protuberant eyes each comprising 10–12 facets, and the sensorium on antennal segment III is small and circular. Samples including both sexes have been taken on dead branches with lichens in the National Park on Red Road and Bird Rock Track, and also in the Mission Road forest and 100 Acre Reserve.

***Merothrips floridensis* Watson:** Widespread around the world, apterous females of this species are distinguished from apterae of *brunneus* by their paler colour, more reduced compound eyes usually with only 7–9 facets, and a sensorium on antennal segment III that is clearly transverse not circular. Specimens have been taken from dead branches at several sites on Norfolk Island, including Highland Lodge, Prince Philip Drive, 100 Acre Reserve, and Mt Pitt.

## PHLAEOTHRIPIDAE

<http://www.ozthrips.org/tubulifera/phlaeothripidae/>

This is the largest of the Thysanoptera families. Around the world, a considerable number of species feed on plant leaves where they sometimes induce galls; a smaller number of species live in flowers, a few are predatory on other small insects, but most species are fungus-feeders on dead branches and dead leaves. Many fungus-feeding species have become widely distributed around the world, possibly many years ago by sailing ships in association with

dead wood used as fuel and amongst ballast (Mound 1983), but others possibly have extensive natural distributions.

Two subfamilies are recognised in the Phlaeothripidae. The smaller of these, Idolothripinae, comprises species that feed only on whole fungal spores, judging from their broad maxillary stylets. On Norfolk Island, six such species in five genera have been found (Mound 1974; Mound & Palmer 1983). All the other Phlaeothripidae listed here are species of Phlaeothripinae, and although most are fungus feeders, a few are predators or flower-feeders. As stated in the Introduction, no leaf-feeding Phlaeothripinae have been found on Norfolk Island.

## PHLAEOTHRIPIDAE—IDOLOTHRIPINAE

<http://www.ozthrips.org/tubulifera/phlaeothripidae/idolothripinae/>

***Anaglyptothrips dugdalei* Mound & Palmer** (Fig. 2): Described from New Zealand, and more recently recorded from eastern Australia (Mound & Dang 2013), this wingless yellow thrips has unusually strong reticulate sculpture on the head. It is a spore-feeding species, and a substantial population was found on Norfolk Island in March 2014 breeding at the bases of Kikuyu Grass at 100 Acre Reserve; adults were also found amongst grass and leaf-litter at a property on Stockyard Road.

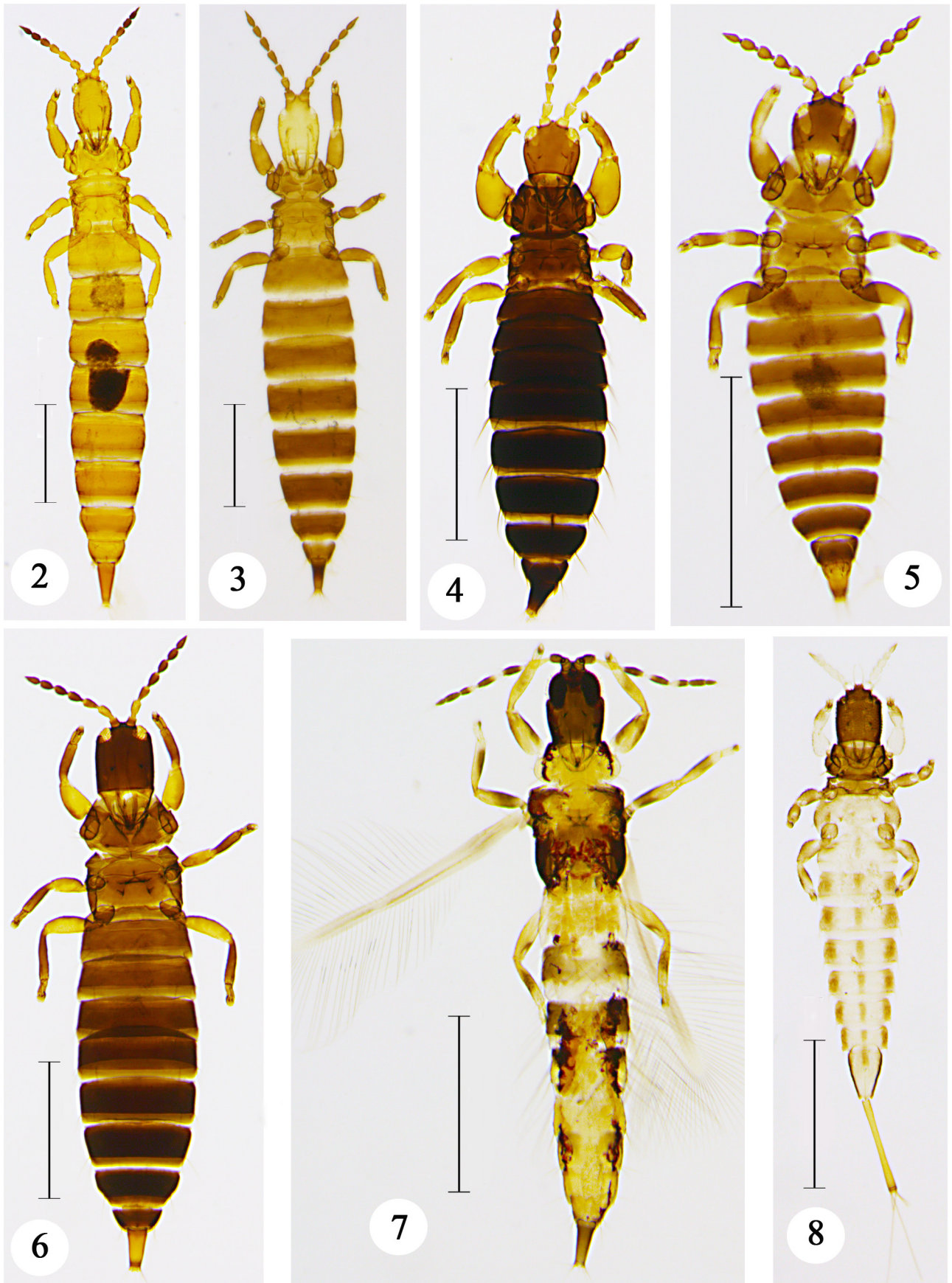
***Carientothrips flavitibia* (Moulton)**: This spore-feeding thrips is common on dead branches in the rainforests of eastern Queensland (Eow *et al.* 2014). A single female was taken from an *Hibiscus* flower in the gardens at the Norfolk Island airport in December 2012.

***Carientothrips snowi* Eow *et al.*** (Fig. 3): Probably a Norfolk Island endemic, this spore-feeding species has been found only on the dead fronds of *Rhopalostylis baueri*, the endemic palm tree. It has been found in considerable numbers at several sites in the National Park, on Palm Grove Track as well as on Red Road. It is a wingless, bicoloured species, with the head yellowish-white but the thorax and abdomen brown, with the median setae on the tergites exceptionally long and pointed.

***Nesothrips propinquus* (Bagnall)** (Fig. 4): Probably originally from New Zealand, this spore-feeding thrips is widespread in territories along the old sailing ship routes to Europe (Mound 1983). It is abundant in eastern Australia, living at the base of grasses but also on dead branches. Small numbers of specimens were taken at many different localities on Norfolk Island from the base of grasses, and from dead leaves and dead branches.

***Ozothrips janus* Mound & Palmer** (Fig. 5): Until now, this small wingless species was known only from the original seven apterae that were collected from *Gahnia* on an island in the Hauraki Gulf, New Zealand (Mound & Walker 1986). It is remarkable for the posterior prolongation of the compound eyes on the ventral surface of the head, and is recorded here from Australia for the first time, based on two males found on Norfolk Island at Two Chimneys Road, and one female at 100 Acre Reserve, in November 2014.

***Priesneriana uptoni* (Mound)** (Fig. 6): Described originally in the genus *Cryptothrips*, this species was known until recently from only a single micropterous female (Mound 1974). Recent field work has demonstrated that the species is common and locally abundant throughout Norfolk Island, living in the leaf-litter of *Araucaria heterophylla*. Only wingless individuals have been found, of both sexes, and although the adult body size is variable, the body colour is distinctive, with the tube bright yellow medially, and the femora much paler than the dark tibiae and tarsi. Large males have swollen fore femora, the fore tibia has a flattened tubercle at the inner apex, the fore tarsus bears a large tooth, and the pronotal and lateral abdominal setae are long and acute. The larvae are bright red, with the pronotal posteroangular setae longer than the pronotum, and the lateral abdominal setae also long and acute. The current placement of *uptoni* in *Priesneriana*, a genus that otherwise includes a single species from India, is tentative; *uptoni* possibly shares a common ancestor with *Heptathrips*, a genus with several species in New Zealand. The dependency of *uptoni* on the Norfolk Island Pine suggests that this thrips is probably endemic to Norfolk Island.



**FIGURES 2–8.** Phlaeothripidae species. (2) *Anaglyptothrips dugdalei*; (3) *Carientothrips snowi*; (4) *Nesothrips propinquus*; (5) *Ozothrips janus*; (6) *Priesneriana uptoni*; (7) *Adraneothrips russatus*; (8) *Baenothrips moundi*.



## PHLAEOTHIRIPIDAE—PHLAEOTHIRIPINAE

<http://www.ozthrips.org/tubulifera/phlaeothripidae/phlaeothripinae/>

***Adraneothrips russatus* (Haga)** (Fig. 7): Described from Japan, and recorded from the southern islands of that country, this fungus-feeding, leaf-litter species has also been seen recently from northern Queensland, Fiji and Yunnan (Dang *et al.* 2013). Females, but no males, are common on Norfolk Island, breeding in leaf litter at many sites across the island, including in the garden at Highland Lodge, at 100 Acre Reserve, in the *Eucalyptus* plantation, and in the National Park forest along Palm Grove Track, Red Road and at Capt. Cook Point. It is a brightly bicoloured thrips, with the pronotum and posterior abdominal segments yellow, but the head, most of the thorax and the tube brown.

***Apterygothrips australis* Pitkin:** This small yellowish-brown species is usually wingless, and is found mainly at the base of grasses. It is widespread across Australia, but only a few specimens have been found on Norfolk Island, taken at Bullocks Hut Road, Capt. Cook Point, and at Burnt Pine. Mound and Walker (1986) recorded this species from New Zealand, and discussed some of the systematic problems associated with *Apterygothrips* and its relationship to *Karnyothrips*. Unfortunately, these authors stated incorrectly that the mesopresternum of *australis* is reduced to two lateral triangles, whereas in the type series as well as all other available specimens this sclerite is actually continuous albeit very slender medially. Antennal segment IV always bears two stout sense cones, the fore tarsal tooth is broadly based and arises medially on the tarsus, and tergite IX setae S2 are sub-equal in length to setae S1 with their apices varying from broadly capitate to very weakly capitate. The pronotal am setae are capitate in all specimens, but are much smaller in males than females.

***Apterygothrips sparsus* Mound & Walker:** Previously known only from New Zealand, where this thrips is widespread across North and South Islands, this species is here newly recorded from Australia. Considerable numbers were taken on Norfolk Island from lushly growing Kikuyu Grass, but with some also from dead branches; on 25.xii.2007 three females were collected from grass on Lord Howe Island. This thrips was commonly taken in association with large populations of mites, and the species is possibly predatory rather than phytophagous. Males remain unknown, but winged and wingless females were taken at various sites across Norfolk Island in March 2014 as well as in December of all three years of this survey, including Ball Bay Reserve, Stockyard Road and Bullocks Hut Road. In contrast to *australis*, this species has the pronotal am setae minute and acute, the mesopresternum is not narrowed medially, the inner apex of the fore tarsus bears a minute forwardly directed tooth, and tergite IX setae S2 are finely pointed and longer than the tube. Although described originally as having three sense cones on antennal segment IV, some of the available specimens from Norfolk Island lack one of the sense cones on the external apical margin of this segment on one or both antennae.

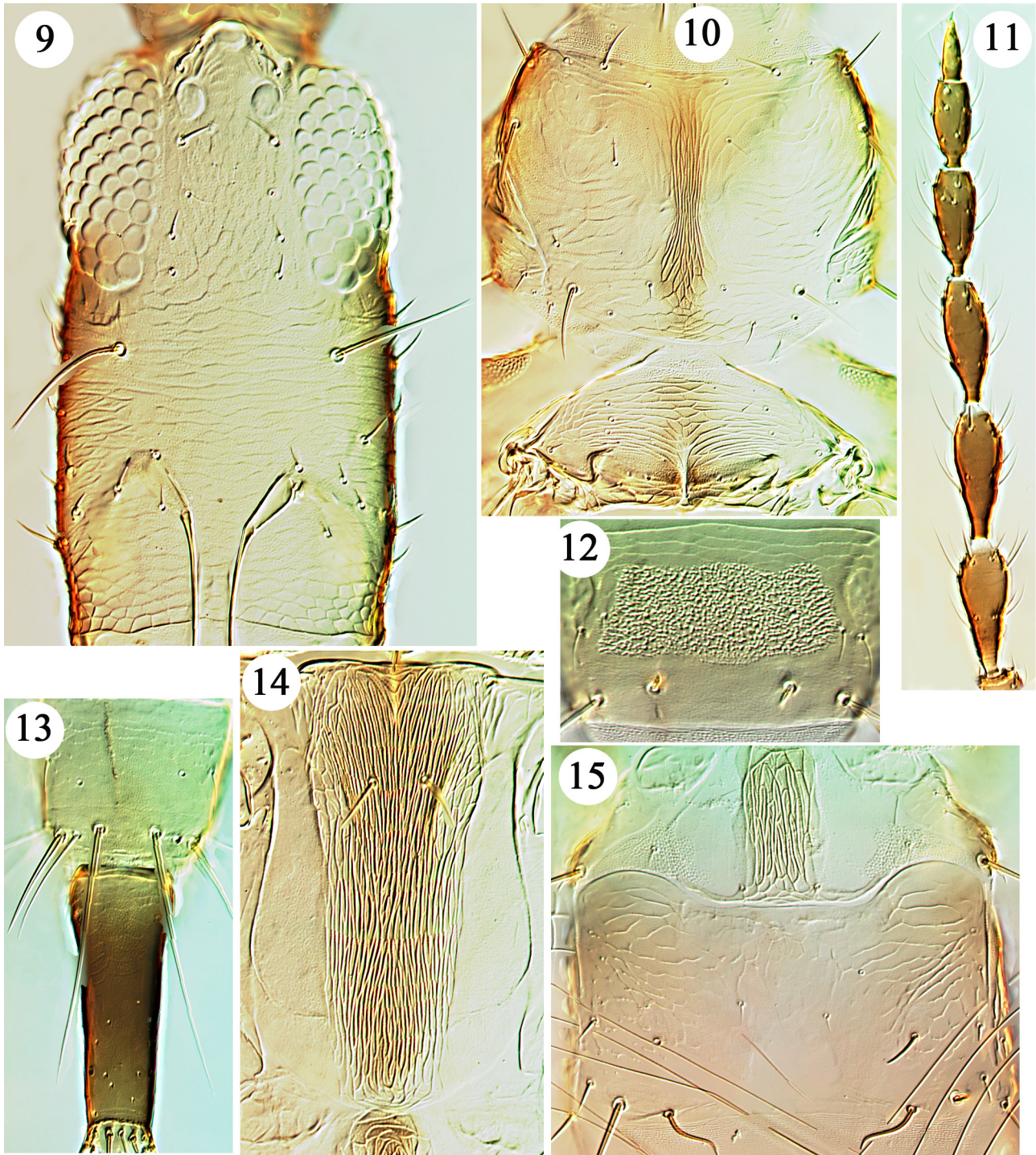
***Baenothrips moudi* (Stannard)** (Fig. 8): A widespread species in eastern Australia, where it lives in leaf-litter and on dead branches, feeding on fungal hyphae, this species is known also from Lord Howe Island and New Zealand. It is one of the Phlaeothripinae with an elongate last abdominal segment (Mound 1972), and on Norfolk Island it is widespread and common on dead twigs and dead leaves, including dead banana leaves.

***Bamboosiella cingulata* (Hood)** (Fig. 16): This is a sharply bicoloured species, with the body largely brown but the first seven abdominal segments bright yellow. It is similar in colour to *Karnyothrips melaleucus*, but has very short maxillary stylets that are scarcely retracted in front of the posterior margin of the head (Mound & Minaei 2007). Females, but no males, are recorded widely throughout tropical countries, living at the base of grasses, where they are possibly predatory on other small arthropods. On Norfolk Island it was found in large numbers at the base of clumps of Kikuyu Grass on Bullocks Hut Road.

### ***Buffettithrips* gen.n.**

Erected for the single new species described below (Fig. 17), this new genus is presumably endemic to Norfolk Island. The species is fungus-feeding, and is often abundant in the National Park where it breeds on the dead fallen

leaves of the endemic plant *Cordyline oblecta* (Asparagaceae), the Norfolk Island Breadfruit that is sometimes known as Rauti. The new genus shares most character states with *Adraneothrips*, a genus of leaf-litter species that is widespread in tropical countries (Dang *et al.* 2013). It is distinguished by the remarkable sculpture of the metanotum and pelta (Figs 14, 15), and the unusually pale colour of the body. In contrast, species of *Adraneothrips* are either dark brown or bicoloured, and all of them lack any strong surface sculpture. Moreover, the head of the new species is long and projects in front of the eyes, and in contrast to *Adraneothrips* species the prosternal basantra are not completely absent.



**FIGURES 9–15.** *Buffettithrips rauti* sp. n. (9) Head; (10) Pronotum and mesonotum; (11) Antennal segments III–VIII; (12) Male sternite VIII; (13) Male tergites IX–X; (14) Metanotum; (15) Pelta and tergite II.

**Generic diagnosis.** Head long with cheeks slightly constricted behind large eyes, weakly projecting in front of eyes (Fig. 9); postocular setae arising behind inner margin of eyes; stylets less than 1/5 of head width apart, not retracted as deeply as postocular setae; antennae 8-segmented (Fig. 11), III with 3 sense cones, IV with 4; pronotum with 5 pairs of major setae; notopleural sutures complete or weakly incomplete (Fig. 10); basantra weak, ferna broadly triangular but not meeting in mid-line, mesopresternum transverse; metathoracic sternopleural sutures absent; fore tarsal tooth not developed; fore wings not constricted medially, without duplicated cilia; pelta elongate bell-shaped (Fig. 15); tergites II–VII with 2 pairs of wing-retaining setae, each posterior pair thicker than anterior pair; tergite IX with setal pair iS half as long as S1; tube with straight sides, shorter than head; male sternite VIII with rectangular pore plate. Type species *Buffettithrips rauti* **sp. n.**

***Buffettithrips rauti* sp. n.**

(Figs 9–15, 17)

This new species is unique in its body colour and sculpture, and is highly specific in its biology, being found only on the dead leaves of one particular plant species that is endemic to Norfolk Island.

*Female macroptera:* Body and legs largely yellow, with light brown marginal shadings laterally on head and thorax, and light brown median line on thorax; tibiae and femora with weak marking medially; tube and antennal segments II–VIII dark brown; fore wings pale. With the structural characters in the diagnosis above; head nearly twice as long as wide, eyes longer on upper than ventral surface; postocular setae bluntly pointed to weakly capitate; cheeks with several small setae; vertex weakly sculptured posterior to eyes. Antennal segments III–IV with sense cones small, V–VII pedicillate, VIII with broad pedicel. Pronotum with prominent longitudinal band of striate reticulation medially (Fig. 10); am and aa bluntly pointed, ml and pa variably weakly capitate, epim capitate. Metanotum with similar striate sculpture medially (Fig. 14); metapleuron strongly reticulate. Pelta with striate reticulation, campaniform sensilla present; tergites with 2 pairs of long posterolateral capitate setae, lateral pair acute on V–VII, setae on IX acute and about as long as tube. Sternites with marginal setae arising submarginally, transverse row of about 10 discal setae.

**Measurements** (holotype female in microns). Body length distended 2150. Head, length 275; width across cheeks 140; po setae 55. Pronotum, length 140; width 185; major setae—am 20, aa 25, ml 35, epim 55, pa 40. Fore wing length 850; distal width 50; sub-basal setae 35, 35, 60. Tergite III lateral setal pairs 65, 70. Tergite IX setae, S1 110, iS 55, S2 135, S3 100. Tube, length 140; anal setae 115. Antennal segments III–VIII length 68, 73, 65, 60, 45, 35.

*Male macroptera:* Similar to female but smaller; tergite IX setae S2 shorter and stouter (Fig. 13); sternite VIII with large pore plate (Fig. 12).

**Measurements** (paratype male in microns). Body length distended 1950. Head length 270. Tergite IX setae, S1 115, iS 50, S2 55. Tube length 125.

**Specimens studied:** Holotype female, **Norfolk Island**, Palm Glen, *Cordyline oblecta* dead leaf, 23.xii.2013 (LAM 5884).

Paratypes, all from *Cordyline oblecta* dead leaves; 4 females, 3 males and larvae taken with holotype; same site, 1 female, 22.xii.2012, 3 females, 8 males, 11.vii.2013, 1 female, 2 males, 21/22.x.2013; Red Road, National Park, 1 male, 12.vii.2013; 4 females, 2 males 27.iii.2014; 1 male 30.xi.2014; Mission Road Forest, 1 female, 27.iii.2014; Mt Pitt, 1 female, 1 male, 22.xii.2013.

***Deplorothis* species:** Species of this genus live on dead branches and presumably feed on fungal hyphae. The genus is common in New Zealand, although only a single species has been named, several un-named species are known from eastern Australia, and eight species have been described from Southeast Asia between Malaysia, Japan and The Philippines. The species of *Deplorothis* are polymorphic, with considerable differences between the sexes and between winged and wingless individuals. As a result of this variation, description of new species requires further study. However, both sexes of three very different looking species of *Deplorothis* were found on Norfolk Island, on dead branches of *Citrus jambhiri* in the National Park at Palm Grove Track, and on Red Road, Mt Bates and Mt Pitt.





**FIGURES 16–21.** Phlaeothripidae species. (16) *Bamboosiella cingulata*; (17) *Buffettithrips rauti*; (18) *Haplothrips gowdeyi*; (19) *Holoengythrips maynardae*; (20) *Hoplandrothrips leai*, male; (21) *Priesneria akestra*.

***Giraultithrips nigricoxa* (Girault)**: This species was known only from five females, of which three were collected at three separate sites in SE Queensland, and two were taken together in the Botanic Gardens, Canberra (Mound & Tree 2014b). One female was taken on Red Road in December 2013 in association with a population of *Lissothrips taverni*, also one female and one male on Mt. Bate in November 2014. Nothing is known of its biology, but it is possibly predatory on mites.

***Haplothrips avius* Mound & Minaei**: Described from four females, taken separately at three widely separated sites in South Australia and one in Queensland, one male and one female of this species were taken from *Lantana* flowers at Burnt Pine in October 2013, and three females with four males from dead branches of *Hibiscus insularis* at Two Chimneys Road in November 2014. It is an unusual member of the genus, with no duplicated cilia on the fore wings, and females have both pairs of major setae capitate on the ninth tergite. Nothing is known of the biology of this thrips, but it is possibly predatory on other small arthropods. Identification keys are available to the *Haplothrips* species known from Australia (Mound & Minaei 2007).

***Haplothrips bituberculatus* (Girault)**: This thrips is widespread in eastern Australia, where it is usually found in low numbers on dead branches. It has been found at several localities on Norfolk Island, and is probably a predator on other small arthropods on dead branches.

***Haplothrips gowdeyi* (Franklin)** (Fig. 18): Adult females of this pantropical species appear to disperse readily and are thus often found individually or in low numbers. However, substantial populations of females with larvae were found in the flowers of various plants, particularly several weedy Asteraceae such as *Bidens* and *Galinsoga*, but also *Chenopodium* and *Trifolium*, as well as the flowers of some tall Poaceae species. The species is common in several horticultural areas of Norfolk Island, and can usually be recognised in the field by the yellow antennal segments.

***Haplothrips leucanthemi* (Schrank)**: This is a widespread European species that commonly breeds in the flowers of Ox-eye Daisies (*Chrysanthemum leucanthemum*), but is also known from Red Clover flowers (*Trifolium pratense*). A single female was taken on Norfolk Island, on clover at 100 Acre Farm.

***Haplothrips robustus* Bagnall**: A single female of this flower-living species was taken at Norfolk Island airport in December 2012, and two further females in March 2014 from lucerne at 100 Acre Farm. The species is found widely across Australia, but may have come originally from some other part of the world, such as eastern Africa.

***Holoengythrips maynardae* Mound & Tree** (Fig. 19): Both sexes of this impressive species have been taken on Norfolk Island from dead branches, along Bird Rock Track and Red Road. Presumably endemic to Norfolk Island, it is the type species of a genus that includes several similar fungus-feeding species that live on dead branches in eastern Australia (Mound & Tree 2014a).

***Hoplandrothrips leai* (Karny)** (Fig. 20): This species was described by Karny (1925) from two specimens collected on Norfolk Island by AM Lea of the South Australian Museum. No trace of these two specimens has been found in any museum collection, in Australia or Europe. However, in December 2013 breeding populations, including bright red larvae, of this fungus-feeding species were found at several sites on the island, living superficially on dead branches of various trees. Within the forest it was found on *Elaeodendron curtispiculum*, and outside the forest it was found on *Toona* at Prince Philip Drive, on *Melia* and *Prunus* at Highland Lodge, and on *Grevillea robusta* at 100 Acre Reserve. Within the genus *Hoplandrothrips*, this species is similar to several Australian and New Zealand species in the presence of minor setae on the anterior third of the metanotum. It is particularly similar to *howei* from Lord Howe Island (Mound & Tree 2013), but that is more uniformly dark brown, with the head longer and antennal segment III paler and more slender. A single specimen from New Caledonia was mentioned by Mound and Tree (2013) as possibly representing *leai*, but that specimen has darker tibiae and tarsi, a longer tube, and the metanotum with equiangular reticulation medially. The original description lacks structural details, and so a formal description is provided here:

*Female macroptera*: Brown to dark brown with extensive red hypodermal pigment; tarsi yellow, also base and

apex of tibiae, and basal stems of antennal segments III–V. Head with cheeks rounded, constricted to base and protruding behind eyes; dorsal surface reticulate, weak medially; postocular setae capitate, shorter than eye length; stylets retracted to eyes, close together in mid-line; mouth cone pointed, extending across prosternum. Antennae 8-segmented, III with 3 sense cones, IV with 4, VI–VII strongly pedicellate. Pronotum with 5 pairs of pale major setae, with fringed, capitate asymmetric apices; notopleural sutures complete. Fore tarsus with stout tooth. Metanotum with elongate linear reticulation, median setae small and capitate, with about 4 minor discal setae on anterior third. Prosternal basantra absent, ferna often united medially into transverse band; mesopresternum transverse. Fore wing parallel sided, with about 12 duplicated cilia. Pelta bell-shaped; tergites each with 2 pairs of wing-retaining setae, major posteromarginal and posteroangular setae with apices strongly asymmetric and fringed; tergite IX setae S1 and S2 weakly capitate, S3 acute, is half as long as S1; tube shorter than head, anal setae no longer than tube. Sternites with long, acute posteromarginal setae, and transverse row of about 15 discal setae.

*Male macroptera*: Small male similar to female, large male with more prominent cheek setae, fore femora swollen, fore tarsal tooth larger; pronotal anteroangular setae longer; mesopresternum narrower; tergal major setae not fringed at apex; tergite IX setae S2 short and pointed; sternite VIII posterior half with broad pore plate.

***Hoplothrips corticis* (De Geer)**: This Holarctic species is known from New Zealand (Mound & Walker 1986), and is here recorded from Australia for the first time. Winged and wingless females, together with one wingless male, were taken from dead branches on Norfolk Island, Bridle Track, in December 2012. These specimens are closely similar in structural detail to European specimens of the species, but have unusually dark antennal segments with IV and V scarcely paler at the base, and even segment III extensively brown. It is distinguished from the following species by the shorter antennal sense cones, and the broader pelta on the abdomen.

***Hoplothrips orientalis* Ananthkrishnan**: Colonies of this fungus-feeding species were found on Norfolk Island living on dead branches in forest at Palm Grove Track and on cut branches at Stockyard Road. This thrips is probably widespread in the Old World tropics, but under other names. Described from India, it has been taken on Lord Howe Island, New Zealand, and also in eastern Australia.

***Karnyothrips flavipes* (Jones)**: Known to be a predator of scale insects (Mound & Minaei 2007), females of this worldwide species have been seen from various sites on Norfolk Island. One was taken at Stockyard Road in July 2013 from dead sugar cane with another at that site in November, 2014 from coriander flowers. Two were taken on cultivated *Citrus* trees in September 2013 and May 2014 at Two Chimneys Road, and two from dead *Lagunaria* at Captain Cook Reserve in February 2014.

***Karnyothrips melaleucus* (Bagnall)**: Widespread around the world as a predator of other small insects, including scale insects (Mound & Minaei 2007), females of this species have been taken at many sites across Norfolk Island. Commonly associated with dried grasses, a considerable population was found living at the base of Kikuyu Grass in 100 Acre Reserve in March 2014, and in similar grass at the *Eucalyptus* Plantation in November 2014.

***Lissothrips taverni* Mound & Tree**: The species of this genus all live in association with mosses, and are widespread in the warmer parts of the world (Mound & Tree 2015). The species recorded here is presumably endemic to Norfolk Island, and was taken at several sites in the National Park. It was particularly abundant on mosses and lichen growing on the dead branches of a fallen *Elaeodendron curtispiculum* on Red Road, but was also taken from dead *Lagunaria* branches at Prince Philip Drive, and from mossy dead branches on Mt Bates.

***Macrophthalthrips neocaledonensis* Bournier** (Fig. 27): Previously known only from New Caledonia, this species is here newly recorded for Australia. It is a fungus-feeding species, and large numbers were found on dead branches of *Araucaria*, *Toona* and *Melia* at several sites on Norfolk Island, including Bird Rock Track, Red Road, and Highland Lodge. As with other members of this genus, this species is brightly coloured, with large red eyes and the body black, white and yellow. It is sexually dimorphic, and many of the males have greatly expanded fore femora bearing a large tooth.

***Plectrothrips australis* Okajima** (Fig. 28): This species was known previously only from the original specimens

that were taken in quarantine at Boston, U.S.A., “under bark” said to have originated from Australia. During the course of the present studies one female and three males of *australis* have been studied from Mt Glorious, Queensland. On Norfolk Island, considerable numbers of *australis* were beaten from dead branches of *Toona* and *Lagunaria* at Prince Philip Drive in March and November 2014. Most of these specimens were males, and these varied greatly in size—the distended body length of males ranging from 1900 to 3200 microns, with the largest female 3500 microns long. Moreover, large individuals of both sexes have a tubercle on the inner apex of the fore tibia that is not developed in small individuals, and these small individuals have no indication of the scale-like sternal areas that are so extensive in large individuals. Although most specimens were micropterous, with a few macropterae, three specimens were hemimacropterous with the wings slightly longer than the thorax width. *P. australis* has two stout thorn-like setae at the apex of the mid-tibiae. However, a few specimens have been seen from Norfolk Island with only one pair of stout setae on the mid-tibiae, and these possibly represent a further unidentified *Plectrothrips* species.

### ***Priesneria akestra* sp. n.**

(Figs 21–26)

The genus *Priesneria* currently includes five species, of which three (including the type species, *P. kellyana* Bagnall) are from Australia, with one from Hawaii and the other from India. All of these species have the third antennal segment with a remarkable, sub-basal, shelf-like ridge (Mound & Minaei 2007). Four of the five species have only two sense cones on the fourth antennal segment, whereas *longistylusa* Pitkin from Australia shares with the new species described here the condition of four sense cones on this segment. Similarly, four of the five species have the major setae on the head and pronotum with capitate apices, and only *peronis* Mound & Minaei has these setae pointed and rather short. The new species shares with *longistylus* the character states of the antennal sense cones and also the slender form of antennal segment VIII, but it is unique in the genus in having the setae on the head and pronotum (Figs 22, 25) exceptionally long and finely pointed. The biology is unknown, but like other members of the genus this species is probably predatory on other small arthropods.

*Male microptera*: Body light brown, tube and antennae darker; tarsi yellow, tibiae yellow with brown shadings; major setae all pale. Antennae 8-segmented (Fig. 24), segment VIII long, slender and constricted at the base; segment III with prominent shelf-like thickening sub-basally, with 2 sense cones, IV with 4 sense cones. Head longer than wide, with cheeks surrounding compound eyes laterally, ocelli small; maxillary stylets retracted to eyes, less than one-fifth of head width apart medially, with distinct but weak maxillary bridge; vertex weakly sculptured only posterolaterally (Fig. 22); postocular setae finely acute, longer than half of head width. Pronotum transverse (Fig. 25), almost without sculpture, notopleural sutures complete; with 5 pairs of long, finely acute major setae. Fore tarsus inner apical margin with minute forward-pointing tooth. Basantra well developed, ferna transverse, mesopresternum complete but slender medially, metathoracic sterno-pleural sutures absent. Mesonotum (Fig. 23) weakly sculptured, lateral setae long and acute; metanotum almost without sculpture medially; fore wing lobe with 3 long and finely acute setae. Pelta D-shaped (Fig. 26); tergites II–VII each with 2 pairs of small, fine and straight, wing-retaining setae, posteroangular setae very long; major setae on IX longer than tube, S2 as long as S1; anal setae longer than tube. Sternites without pore plates, marginal setae very long.

**Measurements** (holotype male in microns). Body length 1550. Head, length 160; width 135; po setae 90. Pronotum, length 110; width 190; major setae, am 60, aa 70, ml 100, epim 80, pa 85. Fore wing lobe 100, basal setae 65. Tergite VI lateral two pairs of setae 130. Tergite IX setae S1 160, S2 190. Tube, length 110, anal setae 200. Antennal segments III–VIII length 35, 47, 47, 42, 40, 35.

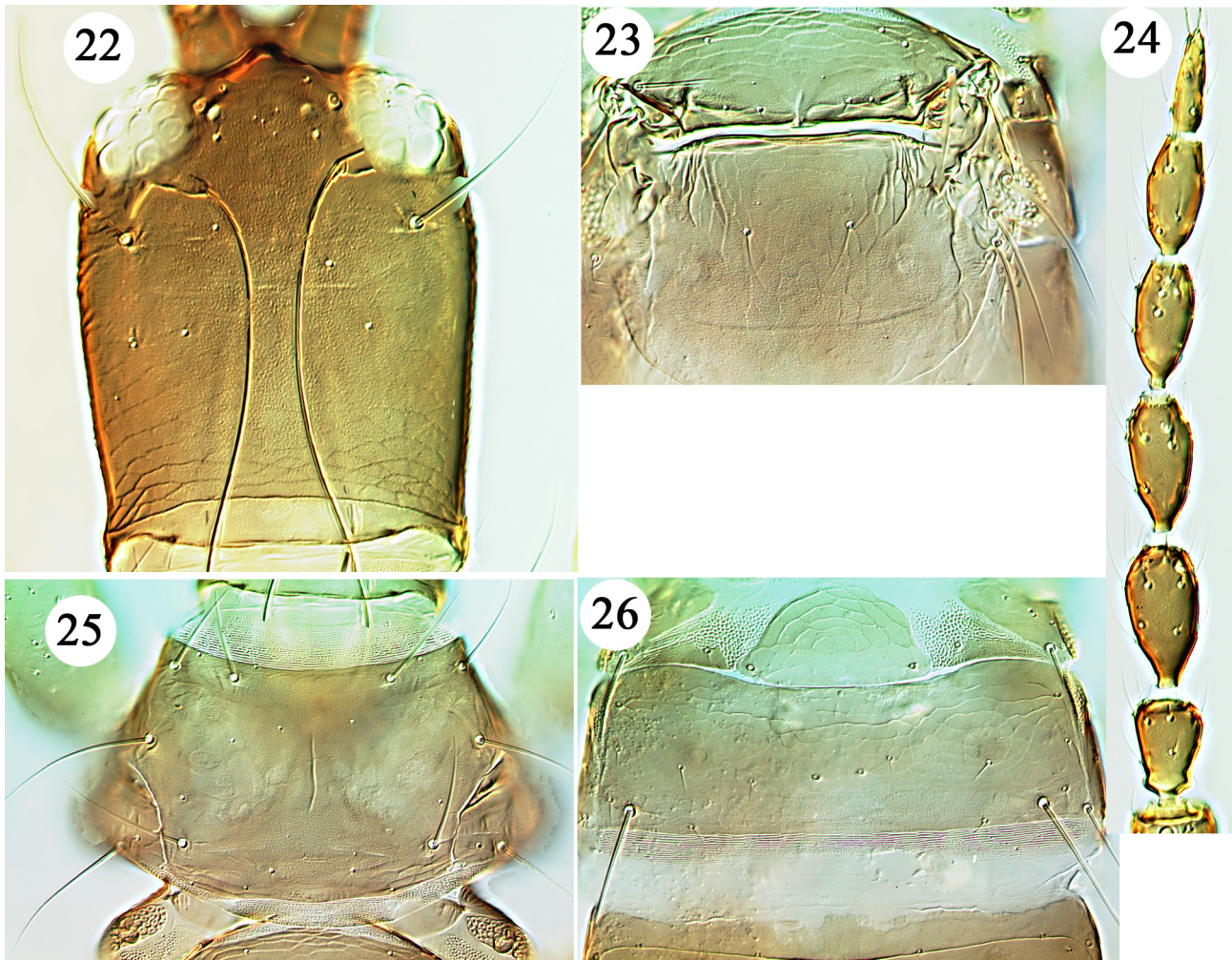
*Female macroptera*: Essentially similar to male in colour and structure; tergal wing-retaining setae larger and sigmoid, particularly posterior pairs on IV and V; fore wing weakly constricted medially, with only 2 duplicated cilia.

Measurements (paratype female in microns). Body length 1800. Head, length 185, width 155, postocular setae 80. Fore wing length 600. Tergite IX setae S1 185, S2 200. Tube length 110.

**Specimens studied**: Holotype male microptera, **Norfolk Island**, Palm Glen, beating twigs and *Cordyline obtecta* dead leaves, 30.xi.2014 (AW 14/66).

Paratype female macroptera, **Norfolk Island**, Mission Road Forest, from dead branches, 23.xii.2013 (LAM5878).





**FIGURES 22–26.** *Priesneria akestra* sp. n. (22) Head; (23) Mesonotum and metanotum; (24) Antennal segments III–VIII; (25) Pronotum; (26) Pelta and tergite II.

***Psalidothrips taylori* Mound & Walker** (Fig. 29): Described from Australia, where it is now known to be widespread, this species is also recorded widely from the North and South Islands of New Zealand. Adults are usually wingless, and the species is a fungus-feeder living at the base of grasses and in leaf-litter. Wingless specimens of both sexes, also fully winged females, were extracted from leaf litter under Olive trees at the edge of forest near Captain Cook Point in March 2014. One macropterous female of an undescribed species of *Psalidothrips* was taken from leaf-litter under *Araucaria* and *Toona* trees at Prince Philip Drive.

***Sophiothrips martinae* Mound & Tree** (Fig. 30): Wingless individuals of both sexes of this small, fungus-feeding thrips have been found on dead branches along the following tracks in the Norfolk Island National Park: Bird Rock, Bridle, and Palm Grove, also at Highland Lodge, 100 Acre Reserve, and on Mt Pitt. As with other members of this genus, there is considerable variation in body size, and the largest males have a small horn ventrally on the head between the bases of the antennae. It is a distinctively bicoloured species, largely yellow with brown spots on the head, pronotum and legs. In structure it is particularly similar to *Sophiothrips aleurodisci*, a dark brown species known only from New Zealand, but *martinae* is probably a Norfolk Island endemic.

***Stephanothrips barretti* Mound** (Fig. 31): Members of *Stephanothrips* are similar to those of *Baenothrips* in having the last abdominal segment exceptionally long, with long anal setae, but differ in having antennal segments III–V fused into a single unit (Mound 1972). Single females of this wingless, fungus-feeding thrips have been taken on Norfolk Island at several localities in leaf-litter and on dead twigs. It is a widespread species in eastern Australia, but is usually taken in very low numbers.





**FIGURES 27–32.** Phlaeothripidae species. (27) *Macrophthalthothrips neocaledonensis* large male; (28) *Plectrothrips australis*; (29) *Psalidothrips taylori* apterous female; (30) *Sophiothrips martinae* male; (31) *Stephanothrips barretti*; (32) *Stephanothrips occidentalis*.

***Stephanothrips occidentalis* Hood & Williams** (Fig. 32): Described from the Caribbean island of St Croix, this is the most common species in this genus. It is widespread around the tropics, including Queensland in Australia, living in leaf-litter and on dead branches (Mound 1972). On Norfolk Island, females have been collected from dead leaves and dead branches at various sites across the island.

***Strepterothrips* species:** Populations of an apparently undescribed species of this genus were found widely across the island, but particularly in the National Park at Red Road and on Bird Rock Track. It is a fungus-feeding species, and shares many character states with *S. tuberculatus*, a species that is common on dead branches across Australia and also occurs in New Zealand (Mound & Ward 1971). More detailed studies on the various species of this genus in Australia are needed before the Norfolk Island populations can be described as a new species.

***Yarnkothrips kolourus* Mound & Walker:** Described from New Zealand, this species has subsequently been found in Australia from Tasmania, south-eastern New South Wales, the Australian Capital Territory, and south of Darwin at Litchfield National Park in the Northern Territory. This species, the only named member of the genus, is unusual in its structure. The pronotum has incomplete notopleural sutures, the posteroangular setae are close to the epimeral setae, and the mesopresternum is largely fused to the mesoeusternum. *Y. kolourus* lives on dead branches, but as no more than one specimen has ever been taken at any one site it is probably a predator on other small arthropods. At least ten specimens were taken individually on Norfolk Island at various sites, including Captain Cook Point, Mt Pitt, Highland Lodge, Prince Philip Drive, and Bird Rock Track.

## THRIPIDAE

Most pest species of thrips are members of the Thripidae, but despite extensive searching of a wide range of flowers and leaves, including mature plants and seedlings, surprisingly few members of this family have been found on Norfolk Island. Only two endemic species of Thripidae have been found, and there is little evidence of any relationship to the Australian fauna of this family. *Pseudanaphothrips* and *Scirtothrips* both include many species in Australia, but no species of the first of these genera has been found on Norfolk Island, although one new species in the second genus is described below living only on the young leaves of Norfolk Island Pine trees. Similarly, among the many native Australian species in the genera *Anaphothrips* and *Thrips*, only one of each has been seen from the island. This is a particularly surprising situation, because the thrips fauna of Lord Howe Island has many Australian thripid elements (Mound 1999). Of the two endemic Thripidae on Norfolk Island, both of which are described below, *Scirtothrips araucariae* is possibly related to species from Australia, but *Thrips merae* is a member of a species-group that is native to New Zealand. The most abundant flower thrips on Norfolk Island, *Thrips novocaledonensis*, is possibly native, and is known otherwise only from New Caledonia and Vanuatu. The other recorded Thripidae all appear to be tramp species.

Four subfamilies are recognised in the family Thripidae, but no species of Sericothripinae has been found on Norfolk Island. The recorded genera and species are listed below alphabetically under the other three recognised subfamilies—Dendrothripinae, Panchaetothripinae, and Thripinae.

## THRIPIDAE—DENDROTHRINAE

<http://www.ozthrips.org/terebrantia/thripidae/dendrothripinae/>

***Asprothrips seminigricornis* (Girault):** This is a minute white thrips with black antennae, and the adults are easily misidentified as larvae in the field. Described from Queensland, and under two other names from New York and also Hawaii, this species was found on Norfolk Island at several widely separated sites, including Two Chimneys Road, Prince Philip Drive, and Highland Lodge. It was breeding on the young leaves of Peach (*Prunus persica*), Tung Tree (*Vernicia fordii*), Granadilla (*Passiflora ligularis*), Mulberry (*Morus alba*), and also *Citrus* trees. However, no leaf damage was observed in association with these populations.

***Dendrothrips diaspora* Mound**: Native to Australia, this species is widespread across the Australian continent in association with the leaves of various species of Oleaceae. It is common on Norfolk Island, and substantial breeding populations were found on the leaves of the native Oleaceae tree, *Nestegis apetala*, at the start of Palm Glen Track, at Prince Philip Drive, and on Mt Bates. However, as the specific epithet implies, the adults of this thrips are remarkably dispersive, and single individuals of both sexes were taken widely across the island on many different plant species.

***Ensiferothrips primus* Bianchi**: Described from New Caledonia, and recorded from eastern Australia, this species was found on Mt Bates during several months, breeding on the leaves of *Streblus pendulinus* (Moraceae). It is a highly distinctive thrips with three pairs of large black, longitudinally ridged setae on the posterior margin of the pronotum.

## THRIPIDAE—PANCHAETOTHRINAE

<http://www.ozthrips.org/terebrantia/thripidae/panchaetothripinae/>

***Bhattithrips frontalis* (Bagnall)**: Previously, there has been no reliable host association for this species, although isolated adults have been taken widely in eastern Australia. On Norfolk Island a breeding population was found regularly, between December 2012 and December 2014, near Captain Cook Point on the leaves of *Commelina cyanea* (Commelinaceae), often in association with *Hercinothrips bicinctus*. Specimens of *frontalis* were also taken on *Commelina* at 100 Acre Reserve in November 2014, but the species was not found elsewhere on this widespread plant despite frequent searches. However, a few single females were beaten from dead branches in Palm Glen in November 2014, and two females were found on the leaves of cultivated *Passiflora* at a plant nursery.

***Heliothrips haemorrhoidalis* (Bouché)**: Originally from Peru, the worldwide Greenhouse Thrips is widespread out of doors in eastern Australia. It is known to breed on a wide range of different plants, including tea, *Pinus*, and various ferns, and sometimes builds up large populations on the leaves of plants that are growing sub-optimally. The Norfolk Island climate would seem to be ideal for this species but curiously, only a very few specimens have been found. On the leaves of an *Azalea* shrub, planted in front of the airport, this thrips was found together with *Thripobius javae*, a well-known parasitic wasp of the family Eulophidae that has been used for biological control of thrips.

***Hercinothrips bicinctus* (Bagnall)** (Fig. 41): In December 2012 this thrips was abundant on Norfolk Island, and was the dominant leaf-feeding thrips throughout the island. In subsequent months, including December 2013 and 2014, populations were generally lower, although extensive leaf damage was observed on some stands of *Commelina cyanea*, and on one occasion on the endemic *Euphorbia norfolkiana*. This thrips was common on the leaves of many different plants across the island, in vegetable areas, in flower gardens, and in forests, with a few adults sometimes being found in flowers. Very large breeding populations were observed on banana fruits, also on a single leaf of one Taro plant, and in both situations there was serious tissue damage, as there was also on *Commelina* and *Euphorbia*. This thrips is probably the cause of the blackened skins of many banana fruits on the island, because the skin reacts to thrips oviposition and feeding by producing latex. The thrips then avoid the area with exuding latex, and feeding progresses across each fruit, particularly where two bananas touch. Originally from Africa, *H. bicinctus* is widespread around the world, and is common on Lord Howe Island and in the coastal regions of eastern Australia.

***Hercinothrips femoralis* (Reuter)**: This worldwide leaf-feeding thrips is sometimes known as the Banana Silvering Thrips, although it can breed on a wide range of plants. Found throughout the tropics and subtropics, and also in greenhouses in temperate areas, only two females have been seen from Norfolk Island, taken at 100 Acre Reserve in May 2014.

***Parthenothrips dracaenae* (Heeger)**: This worldwide leaf-feeding species is sometimes called the Parlour Palm



Thrips, because it can build up large populations on cultivated palms of the genus *Chamaedorea*. One female has been studied from Norfolk Island, taken on *Dracaena* in May 2014. It is similar to *Heliothrips* in having the head strongly reticulate, but the fore wings are unusually broad with a strong reticulate pattern.

## THRIPIDAE—THRIPINAE

<http://www.ozthrips.org/terebrantia/thripidae/thripinae/>

***Anaphothrips dubius* (Girault)** (Fig. 33): Endemic to eastern Australia, where it is widespread and sometimes abundant, several females of this species were taken from garden plants at Highland Lodge and Two Chimneys Road, as well as at Prince Philip Drive and Headstone Reserve, but no obvious host association could be established. At Canberra, populations of both sexes have been recorded severely damaging the garden plant, *Xerochrysum bracteatum* (Asteraceae), and further north in New South Wales females were taken in considerable numbers from *Dodonaea* leaves.

***Anaphothrips obscurus* (Müller)**: This worldwide thrips breeds on the leaves of grasses, sometimes causing linear markings on the leaves of cereal crops. Females are either fully winged or have the wings shorter than the width of the thorax, but males of this species are known only from Iran. Two females have been seen from Norfolk Island, taken from grasses in February 2014.

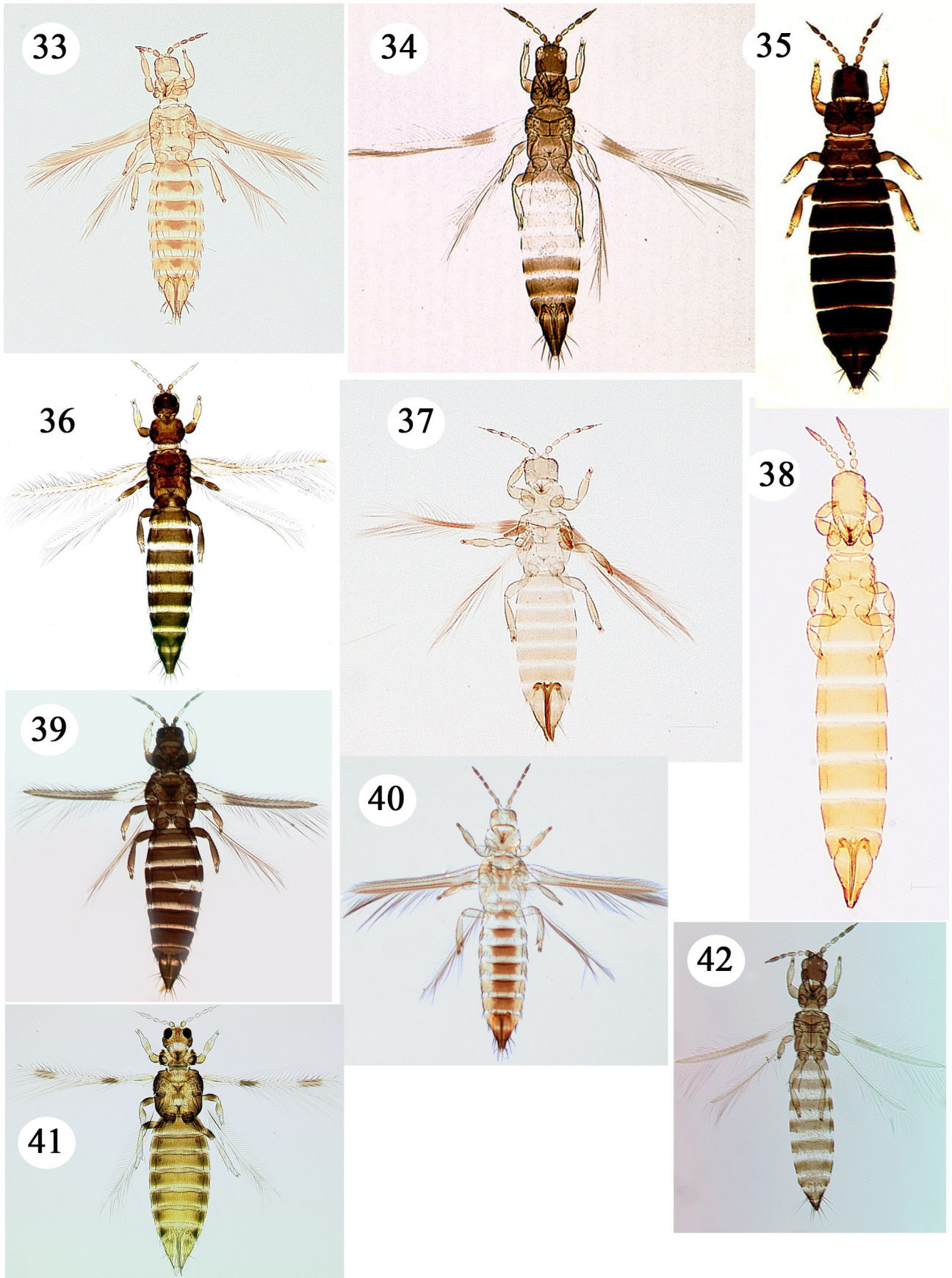
***Anaphothrips sudanensis* Trybom** (Fig. 34): Widespread in the sub-tropics throughout the world, breeding on grasses and sometimes a minor pest on wheat crops, this sharply bicoloured species is common in northern Australia. It has been found on various grasses at many sites on Norfolk Island.

***Apterothrips apteris* (Daniel)** (Fig. 35): This species is common on the coast of California on *Erigeron* (Asteraceae), and it occurs southward through Mexico, Panama and Chile to the Falkland Islands in association with short grasses. It has been found on lucerne in Western Australia and New Zealand, and on garlic plants in Tasmania. On Norfolk Island one large population was found on a moribund potted Asteraceae plant at Two Chimneys Road in December 2013. The species was not found in March 2014, but in November 2014 a single female was found at this site, also one at the airport on *Trifolium*, and several at the roadside in Mission Road on *Arachis pintoii*.

***Aptinothrips rufus* (Haliday)** (Fig. 38): Breeding only on the leaves of many grass species, this wingless thrips is one of the most widespread insects in temperate countries worldwide, although it is not usually found in warmer climates. In southern Australia it is quite common, but on Norfolk Island only a few specimens were found, on Stockyard Road, and 100 Acre Farm, despite frequent searching of suitable host grasses.

***Chaetanaphothrips orchidii* (Moulton)** (Fig. 37): This is a widely recorded species in eastern Australia that has been considered a pest of *Citrus* in Florida. During visits to Norfolk Island in 1912 and 1913 only a few single females of this thrips were taken, at various sites across the island. However, in March 2014, a very large population was found inducing leaves to roll into cylinders on a single stand of the herb *Commelina cyanea* at 100 Acre Reserve, although nearby stands of this plant were not affected. In November 2014 few individuals of *orchidii* could be found, but the extensive *Commelina* stands were severely damaged by large numbers of *Hercinothrips bicinctus*.

***Frankliniella schultzei* (Trybom)**: This worldwide pest species, the tomato thrips, was not recorded on Norfolk Island until April 2014 when a single female was collected from a flower of *Ipomoea cairica* in the gardens of the Airport. Subsequently, adults of both sexes were taken in large numbers from flowers of this plant species at several sites, including 100 Acre Reserve, Two Chimneys Road, and near Collins Head. Moreover, at two widely separated sites, Mission Road and Two Chimneys Road, large populations of *schultzei* were taken from the flowers of *Arachis pintoii*. Despite these widespread populations, this pest species was not found at any of the vegetable cropping areas or plant nurseries.



**FIGURES 33–42.** Thripidae species. (33) *Anaphothrips dubius*; (34) *Anaphothrips sudanensis*; (35) *Apterothrips apteris*; (36) *Tenothrips frici*; (37) *Chaetanaphothrips orchidii*; (38) *Aptinothrips rufus*; (39) *Thrips novocaledonensis*; (40) *Thrips australis*; (41) *Hercinothrips bicinctus*; (42) *Plesiothrips perplexus*.

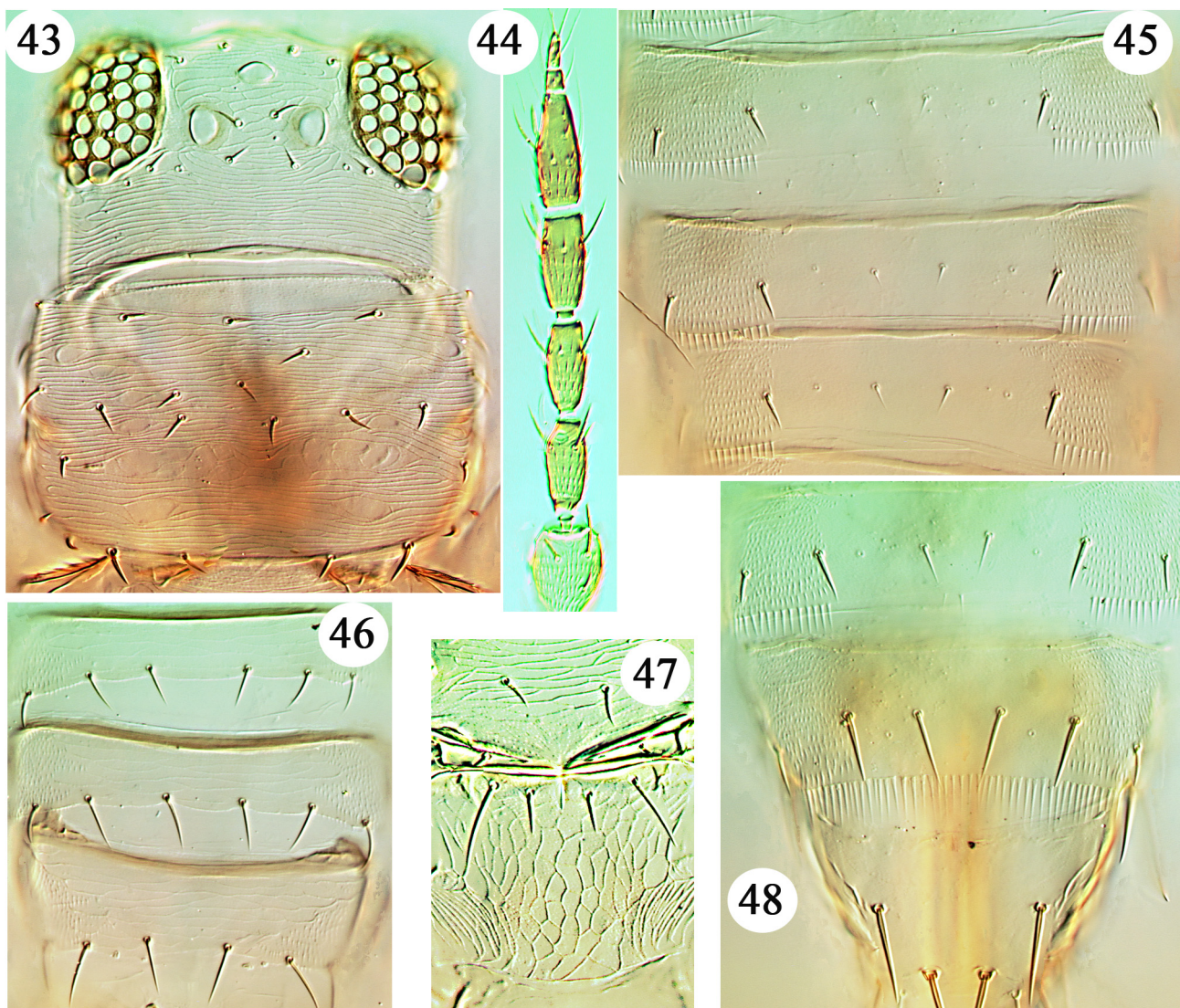


*Plesiothrips perplexus* (Beach) (Fig. 42): This grass-living species is widespread in the Americas, apparently breeding within the florets of particular Poaceae, including sugar cane. In March 2014, but not on any of the other visits, it was found widely across Norfolk Island on various grasses.

***Scirtothrips araucariae* sp. n.**

This species (Figs 43–48) is widespread across the island, but breeds only on the young terminal leaf tissues of *Araucaria heterophylla*. It is either endemic to the island or, like *Neophyllaphis araucariae* that occurs in low numbers on the same trees, possibly a natural immigrant from an *Araucaria* species on New Caledonia or eastern Australia. According to the key to Australian species of *Scirtothrips* (Hoddle & Mound 2003) it is similar in many character states to *S. australis*, including the absence of microtrichia on abdominal tergites IX and X. However, in contrast to this new species, *australis* has one pair of pronotal posteromarginal setae about 50 microns long, and the postocular setal row lacks a minute seta between the two major setae.

*Female macroptera*: Body and legs pale brownish-yellow with no dark markings except antecostal ridge shaded on sternites IV–VII (Fig. 46); antennal segment I as pale as head, II usually slightly darker, III–VIII light brown; fore wing and clavus weakly shaded, setae brown.



**FIGURES 43–48.** *Scirtothrips araucariae* sp. n. (43) Head and pronotum; (44) Antennal segments II–VIII; (45) Tergites IV–VI; (46) Sternites V–VII; (47) Mesonotum and metanotum; (48) Tergites VII–IX.

Antennae 8-segmented (Fig. 44), forked sense cone on III–IV short, not reaching more than one-third the length of succeeding segment; external sense cone on VI stout. Ocellar triangle on head with transverse reticulate striae; ocellar setae III not longer than length of one posterior ocellus, arising between hind ocelli; postocular setae I and III slightly shorter than ocellar setae III, postocular setae II and IV minute, usually shorter than diameter of basal pore (Fig. 43) [postocular seta I sometimes absent on one or both sides]. Pronotum closely striate, with irregular median transverse row of 6 discal setae; 4 pairs of posteromarginal setae, pair S2 less than twice as long as S1. Metanotum reticulate, median setae short and arising just posterior to anterior margin (Fig. 47). Fore wing second vein with 3 setae; first vein with group of 3 setae sub-basally, then about 4 setae, and 3 (or 4) setae on distal half; clavus with 4 veinal and one discal setae; distal posteromarginal cilia straight, but some cilia wavy nearer middle of wing. Abdominal tergites II–III with median setae (S1) small and closer together than their length, but on IV–VII S1 setae increasingly long and further apart; lateral microtrichial fields with only 2 discal setae; VIII with marginal comb of microtrichia, but no discal microtrichia medially (Fig. 48); IX–X with no discal microtrichia. Sternites with lateral microtrichial fields scarcely extending mesad of marginal setal pair S2 (Fig. 46).

**Measurements** (holotype female in microns). Distended body length 900. Head, length 85; width across eyes 150; ocellar setae III 12. Pronotum, length 90, width 160; posteromarginal setae S1 10, S2 15. Metanotum median setae 15, submedian setae 25. Fore wing, length 600; veinal setae 10–20. Tergite median setal length, on III 10, distance between their bases 15; on VII 15, distance between their bases 25. Antennal segments III–VIII length 40, 30, 35, 40, 6, 12.

*Male*: Not known.

*Larvae*: Yellow, weakly shaded anterolaterally on head, also antennal segment II and apex of abdominal segment X. Body surface very finely granulate with no reticulate sculpture; major setae finely pointed, scarcely 10 microns long except 25 microns on tergite IX; mesothoracic spiracles well developed, remaining spiracles very small.

**Specimens studied**: Holotype female, **Norfolk Island**, Highland Lodge, from young terminal leaves of *Araucaria heterophylla*, 21.iii.2014 (LAM 5908).

Paratypes, all from Norfolk Island and same host plant: 6 females taken with holotype and larvae; Palm Glen Track, 7 females, 21.iii.2014; Ball Bay Reserve, 4 females, 24.iii.2014; Capt. Cook Reserve, 3 females, 24.iii.2014; Burnt Pine, 2 females, 26.ii.2014; Red Road, 1 female from shrubs growing beneath *Araucaria*, 27.xii.2012; Mt Bates, 5 females with larvae, 25.xi.2014.

***Scirtothrips inermis* Priesner**: During December 2013 and May 2014 females were found in good numbers on the young leaves of peach and citrus trees at several localities across the island, including Two Chimneys Road and Highland Lodge. This thrips has been taken in low numbers on Lord Howe Island and also mainland Australia, and has been reported as possibly native to the Canary Islands. Although common and widespread, *inermis* does not seem to be considered a serious crop pest, in contrast to some members of this genus. Particularly curious is the apparent absence of any species of *Scirtothrips* on tree ferns on Norfolk Island, in contrast to the situation in eastern Australia and Lord Howe Island (Mound & Hoddle 2003).

***Tenothrips frici* (Uzel)** (Fig. 36): This southern European species is widespread around the world. In south-eastern Australia it breeds in the yellow flowers of weedy Asteraceae that are often called “dandelions”. The species was not common on Norfolk Island, but a small population was found in *Hieraceum* flowers in December 2013 at Bullocks Hut Road, and in the same week two females were taken in a yellow pan-trap near the start of Palm Grove Track. However, in November 2014 adults were found on *Hieraceum* flowers at several sites across the island, including Anson Bay, Mission Road, and Prince Philip Drive.

***Thrips australis* (Bagnall)** (Fig. 40): The gum-tree flower thrips is abundant across most of Australia, breeding in the flowers of many species of *Eucalyptus*, and commonly existing as vast populations (Mound & Masumoto 2005). On Norfolk Island it was found in large numbers in the flowers of trees in the National Park *Eucalyptus* plantation. One large sample was beaten from the leaves of *Dodonaea* at the top of Mt Pitt in March 2014. This sample comprised newly emerged adults of both sexes that presumably had come from trees flowering in the *Eucalyptus* plantation at the foot of Mt Pitt.

***Thrips imaginis* Bagnall:** At the time of the surveys reported here this species had NOT been found on Norfolk Island, although as indicated above, adults were taken on Phillip Island in October 2014. This island is approximately 2km square and lies 6km south of Kingston Jetty on Norfolk Island. It was heavily denuded by rabbits and goats for at least 100 years, but the National Park authorities have an active programme of re-vegetation. Currently there is no explanation concerning how this abundant Australian thrips species has become established on Phillip Island but not on Norfolk Island itself.

### ***Thrips merae* sp. n.**

This species (Figs 49–55) is a member of a species-group within *Thrips* genus that is otherwise known only from New Zealand (Mound & Masumoto 2005). Members of this species-group have three pairs of posteromarginal setae on the second abdominal sternite, whereas species of this genus from the rest of the world have only two pairs. This new species is closely similar to *Thrips obscuratus*, the New Zealand flower thrips that is abundant throughout that country, and is similarly variable in size and colour. However, *T. merae* differs particularly in having the metanotum much less closely striate. Moreover, even when compared with specimens of *obscuratus* of equal wing length, *merae* females have a shorter third antennal segment, fewer pronotal discal setae, and shorter microtrichia medially to the comb on tergite VIII. The males have sternal pore plates that are never more than four times as wide as long, and all available specimens have only seven antennal segments. In contrast, males of *obscuratus* have pore plates that are six or more times as wide as long, and both sexes commonly have eight antennal segments. Populations of this new species have been found only in association with the Norfolk Island critically endangered endemic plant, *Myoporum obscurum*, of which there are small numbers growing in the National Park as well as a few cultivated specimens in other parts of the island. In New Zealand, *T. obscuratus* is highly polyphagous, and breeds in the flowers of a very wide range of native and introduced plants.

*Female macroptera:* Body, legs and antennae brown, tarsi paler (teneral individuals light brown), fore wings brown but slightly paler at base. Head transversely striate, ocellar triangle almost without sculpture; ocellar setae pair III as long as an ocellus, arising just outside the triangle; postocular setae pairs I, III and V as long as ocellar setae (Fig. 49). Antennae 7-segmented. Pronotum (Fig. 49) usually transversely striate/reticulate, with less than 10 discal setae; posterior margin with 3 (or 4) pairs of marginal setae. Fore tarsus simple, without a terminal claw. Fore wing (Fig. 55) with two complete rows of setae; clavus with 5 marginal and one long discal setae, terminal and subterminal marginal setae subequal. Mesonotum transversely reticulate, anterior campaniform sensilla present. Metanotum (Fig. 51) transversely striate at anterior, with irregular striations on posterior half, median setae long and arising behind anterior margin; campaniform sensilla present. Tergite II with 3 lateral marginal setae; II–IV with lines of sculpture extending just mesad of median setae and campaniform sensilla; V–VIII with paired ctenidia laterally; VIII with posteromarginal comb of small, irregular microtrichia (Fig. 52); X with short median split. Sternites II–VII each with 3 pairs of marginal setae, II with no discal setae, III–VI with about 10, VII with about 7 discal setae (Fig. 54).

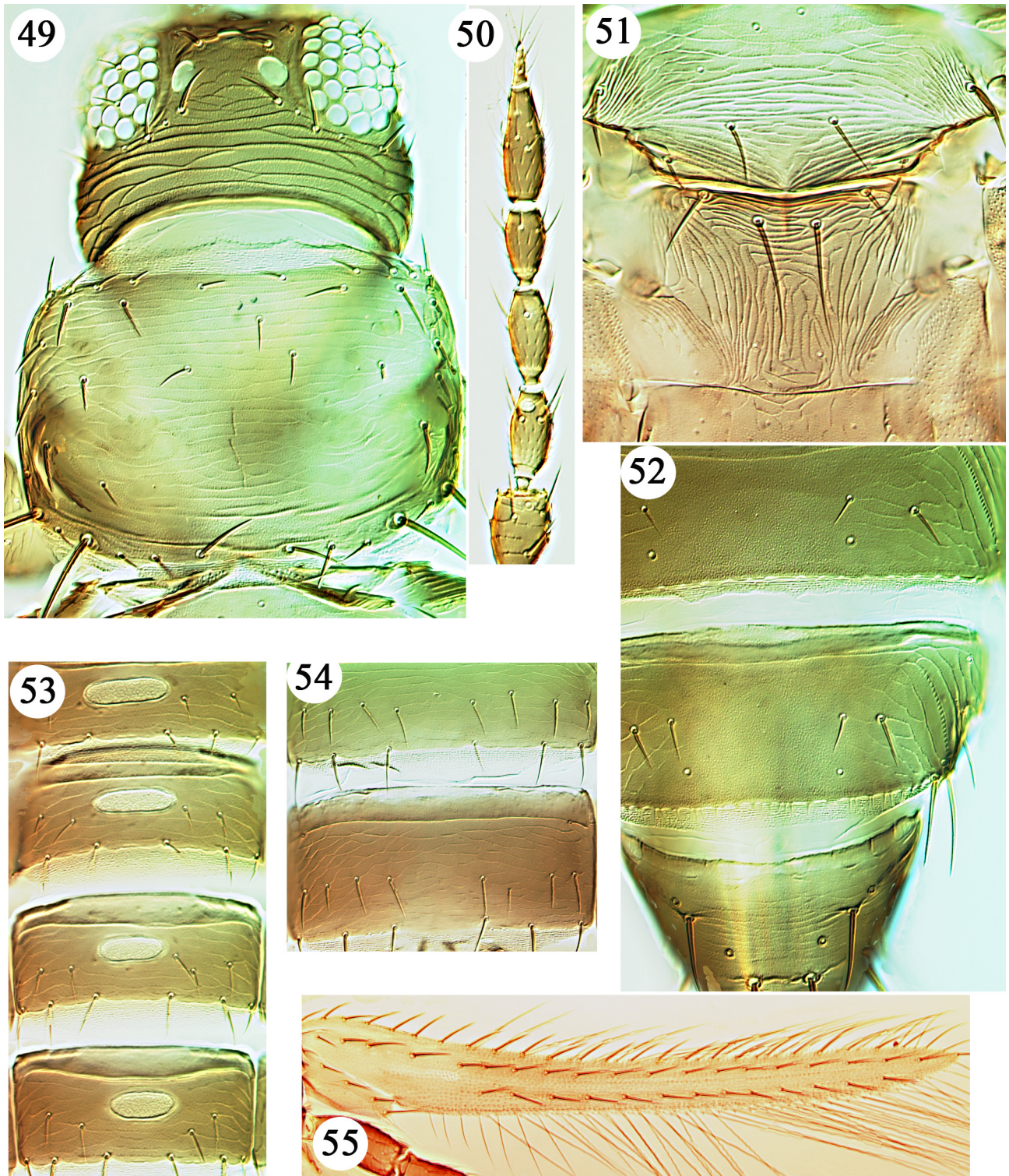
**Measurements** (holotype female in microns). Distended body length 1500. Head, length 85; width across eyes 155; ocellar setae III 25. Pronotum, length 130, width 200; posteroangular setae 65. Metanotum median setae 45. Fore wing, length 800. Antennal segments III–VII length 45, 43, 35, 55, 20.

*Male macroptera:* Similar to female in colour and structure, but smaller with abdomen more slender; tergite VIII without posteromarginal comb, IX with four setae arising in transverse row with median pair longer than lateral pair; sternites III–VII each with transversely oval pore plate, larger on anterior than on posterior segments, maximum width varying but less than four times as wide as median length (Fig. 53).

**Specimens studied:** Holotype female, **Norfolk Island**, Mt Bates, from flowers of *Myoporum obscurum*, 22.iii.2014 (LAM5917).

Paratypes: 10 females, 16 males taken with holotype; same site, 1 female, 1 male from dead *Rhopalostylis* frond, 24.x.2013, 1 male, beaten from foliage, 24.xii.2013; Palm Glen Track, from *M. obscurum*, 1 female 24.iii.2014, 2 females 24.xi.2014; Mt Pitt, 1 male from *Dodonea* leaves, 26.iii.2014; Burnt Pine, Hillies Restaurant, 3 males from *M. obscurum*, 24.xi.2014.





**FIGURES 49–55.** *Thrips merae* sp. n. (49) Head and pronotum; (50) Antennal segments II–VIII; (51) Mesonotum and metanotum; (52) Tergites VII–IX; (53) Male sternites IV–VII; (54) Female sternites VI–VII; (55) Fore wing.

*Thrips nigropilosus* Uzel: This species is found worldwide in temperate areas, breeding on many different plant species, particularly lettuce and pyrethrum. In December 2012, the lower leaves of a crop of young Cos lettuce plants on Bullocks Hut Road were found to have considerable damage in association with large numbers of this thrips. The only other specimens of *nigropilosus* found were also on a lettuce crop, in February 2014.

*Thrips novocaledonensis* Bianchi (Fig. 39): This species occurs in abundance everywhere on Norfolk Island. It

appears to breed only in flowers, and was found in virtually every type of flower on the island that was examined—in gardens, vegetable areas, and forests. The original specimens studied by Palmer (1992) that provided the basis for the record of *Thrips hawaiiensis* from Norfolk Island (Smithers 1998) have been re-examined and correctly identified as *T. novocaledonensis*. This species is not known from the Australian mainland, but was described from New Caledonia and is recorded from Vanuatu. Frequently males were observed on Norfolk Island forming aggregations, sometimes on individual flowers, but sometimes on the leaves of plants that did not bear any flowers. The significance of these aggregations to breeding behaviour remains unknown.

***Thrips simplex* (Morison):** The gladiolus thrips is found worldwide, wherever *Gladiolus* is cultivated, although it presumably originated in South Africa. Feeding damage usually takes the form of streaking on the flowers. One population was found on Norfolk Island, on some flowering *Gladiolus* plants growing as weeds on open land near the start of Palm Grove Track.

***Thrips tabaci* Lindemann:** The onion thrips is found throughout the world, except in the wet tropics. It is highly polyphagous, and large numbers of females were found on Norfolk Island on leeks and shallots, as well as carrots, young cabbages, and young bean plants, often in association with considerable leaf damage. It was particularly abundant in November 2014 after several months during which little rain had fallen.

## References

- Bournier, J.P. & Mound, L.A. (2000) Inventaire commenté des Thysanoptères de Nouvelle- Calédonie. *Bulletin de la Société Entomologique de France*, 105, 231–240.
- Coyne, P. (2011) *Norfolk Island's Fascinating Flora*. Petaurus Press, Belconnen, Australia, 192 pp.
- Dang, L.H., Mound, L.A. & Qiao, G.X. (2013) Leaf-litter thrips of the genus *Adraneothrips* from Asia and Australia (Thysanoptera, Phlaeothripinae). *Zootaxa*, 3716 (1), 1–21.  
<http://dx.doi.org/10.11646/zootaxa.3716.1.1>
- Eow, L.X., Mound, L.A., Tree, D.J. & Cameron, S.L. (2014) Australian species of spore-feeding Thysanoptera in the genera *Carienthrips* and *Nesothrips* (Phlaeothripidae: Idolothropinae). *Zootaxa*, 3821 (2), 193–221.  
<http://dx.doi.org/10.11646/zootaxa.3821.2.2>
- Green, P.S. (1994) *Norfolk Island & Lord Howe Island*. pp. 1–26 in *Flora of Australia, Vol. 49, Oceanic Islands I*. Australian Biological Resources Study, Canberra, 681 pp.
- Hoddle, M.S. & Mound, L.A. (2003) The genus *Scirtothrips* in Australia (Insecta, Thysanoptera, Thripidae). *Zootaxa*, 268, 1–40.
- Hoddle, M.S., Hoddle, C.D. & Mound, L.A. (2008) An inventory of Thysanoptera collected from French Polynesia. *Pacific Science*, 62, 509–515.  
[http://dx.doi.org/10.2984/1534-6188\(2008\)62\[509:IOTCFE\]2.0.CO;2](http://dx.doi.org/10.2984/1534-6188(2008)62[509:IOTCFE]2.0.CO;2)
- Holloway, J.D. (1977) The Lepidoptera of Norfolk Island, their biogeography and ecology. *Series Entomologica*, 13, 1–29.
- Karny, H. (1925) On a new *Phloeothrips* (Thysanoptera) from Norfolk Island. *Records of the South Australian Museum*, 3, 37–39.
- Mound, L.A. (1972) Species complexes and the generic classification of leaf-litter thrips of the Tribe Urothripini (Phlaeothripidae). *Australian Journal of Zoology*, 20, 83–103.  
<http://dx.doi.org/10.1071/ZO9720083>
- Mound, L.A. (1974) Spore-feeding thrips (Phlaeothripidae) from leaf litter and dead wood in Australia. *Australian Journal of Zoology*, Supplement, 27, 1–106.  
<http://dx.doi.org/10.1071/AJZS027>
- Mound, L.A. (1983) Natural and disrupted patterns of geographical distribution in Thysanoptera (Insecta). *Journal of Biogeography*, 10, 119–133.  
<http://dx.doi.org/10.2307/2844623>
- Mound, L.A. (1999) Thysanoptera from Lord Howe Island. *Australian Entomologist*, 25, 113–120.
- Mound, L.A. & Dang L.H. (2013) New Australian records of Asian or New Zealand Phlaeothripidae (Thysanoptera). *Australian Entomologist*, 40 (3), 113–117
- Mound, L.A. & Masumoto, M. (2005) The genus *Thrips* (Thysanoptera, Thripidae) in Australia, New Caledonia and New Zealand. *Zootaxa*, 1020, 1–64.
- Mound, L.A. & Minaei, K. (2007) Australian insects of the *Haplothrips* lineage (Thysanoptera – Phlaeothripinae). *Journal of Natural History*, 41, 2919–2978.  
<http://dx.doi.org/10.1080/00222930701783219>
- Mound, L.A. & O'Neill, K. (1974) Taxonomy of the Merothripidae, with ecological and phylogenetic considerations

- (Thysanoptera). *Journal of Natural History*, 8, 481–509.  
<http://dx.doi.org/10.1080/00222937400770411>
- Mound, L.A. & Palmer, J.M. (1983) The generic and tribal classification of spore-feeding Thysanoptera (Phlaeothripidae: Idolothripinae). *Bulletin of the British Museum (Natural History). Entomology*, 46, 1–174.
- Mound, L.A., Tree, D.J. & Paris D. (2012) *OzThrips — Thysanoptera in Australia*. Available from: <http://www.ozthrips.org/> (accessed 22 April 2015)
- Mound, L.A. & Tree, D.J. (2013) Fungus-feeding thrips from Australia in the worldwide genus *Hoplandrothrips* (Thysanoptera, Phlaeothripinae). *Zootaxa*, 3700 (3), 476–494.  
<http://dx.doi.org/10.11646/zootaxa.3700.3.8>
- Mound, L.A. & Tree, D.J. (2014a) Fungus-feeding phlaeothripine Thysanoptera in the genus *Holothrips* from Australia and New Caledonia, with a structurally similar new genus, *Holoengythrips*. *Zootaxa*, 3860 (2), 125–148.  
<http://dx.doi.org/10.11646/zootaxa.3860.2.2>
- Mound, L.A. & Tree, D.J. (2014b) Generic relationships of two obscure Australian Thysanoptera species described by A.A.Girault. *Australian Entomologist*, 41 (4), 205–210.
- Mound, L.A. & Tree, D.J. (2015) Species of *Lissothrips* and *Williamsiella* from mosses and lichens in Australia and New Zealand (Thysanoptera, Phlaeothripinae). *Zootaxa*, 3946 (3), 361–373.  
<http://dx.doi.org/10.11646/zootaxa.3946.3.4>
- Mound, L.A. & Ward, A. (1971) The genus *Strepterothrips* Hood and its relatives with a description of *S. tuberculatus* (Girault) comb.n. (Thysanoptera). *Journal of the Australian Entomological Society*, 10, 98–104.  
<http://dx.doi.org/10.1111/j.1440-6055.1971.tb00015.x>
- Mound, L.A. & Walker, A.K. (1982) Terebrantia (Insecta: Thysanoptera). *Fauna of New Zealand*, 1, 1–113.
- Mound, L.A. & Walker, A.K. (1986) Tubulifera (Insecta: Thysanoptera). *Fauna of New Zealand*, 10, 1–140.
- Mound, L.A. & Walker, A.K. (1987) Thysanoptera as tropical tramps: new records from New Zealand and The Pacific. *New Zealand Entomologist*, 9, 70–85.  
<http://dx.doi.org/10.1080/00779962.1987.9722497>
- Palmer, J.M. (1992) *Thrips* from Pakistan to the Pacific: a review. *Bulletin of the British Museum (Natural History). Entomology*, 61, 1–76.
- Smithers, C.N. (1998) A species list and bibliography of the insects recorded from Norfolk Island. *Technical Reports of the Australian Museum*, 13, 1–55.  
<http://dx.doi.org/10.3853/j.1031-8062.13.1998.1282>
- ThripsWiki (2015) ThripsWiki—providing information on the World's thrips. Available from: [http://thrips.info/wiki/Main\\_Page](http://thrips.info/wiki/Main_Page) (accessed 22 April 2015)