VICARIANCE OR DISPERSAL – TRANS-TASMAN FAUNAL RELATIONSHIPS AMONG THYSANOPTERA (INSECTA), WITH A SECOND SPECIES OF *LOMATOTHRIPS* FROM *PODOCARPUS*

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(with one plate)

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Lomatothrips pinopsidis sp.n. (Insecta:Thysanoptera) is described as the second species of the genus. This species is widespread in Australia on *Podocarpus* and *Callitris* male cones, but the only other species in the genus is from New Zealand breeding in vegetative buds of *Podocarpus*. This is possibly an example of trans-Tasman vicariance, although the thrips fauna of New Zealand is shown to be largely dispersed from Tasmania and mainland Australia.

Key Words: biogeography, thrips, vicariance, Australia, New Zealand, Tasmania.

INTRODUCTION

Tasmania and the mountains of southeastern mainland Australia are subject frequently to a strong westerly air-stream. These winds, occurring at times when high summer temperatures and the rising air masses associated with bushfires lift small organisms high into the air, are known to result in the dispersal of a wide variety of organisms across the Tasman Sea to New Zealand (Close *et al.* 1978). The dispersal of several species of butterflies and moths from Australia to New Zealand was documented by Fox (1978), and this dispersal has more recently been shown to include various Microlepidoptera (Hoare 2001). Moreover, many Australian insects that are specialist feeders on *Eucalyptus* species have become established on planted gum trees in New Zealand, including during the past 20 years five of the small species of jumpingplant lice (Psyllidae) (Withers 2001). These westerly air-streams vary in direction and intensity with the seasons, but in summer, 83% of all low-level air parcels from the Sydney area were found to pass over central New Zealand within five days (Sturman *et al.* 1997), and dust particles have been shown to be transported by winds from Australia to New Zealand in 1.5 days (Collyer *et al.* 1984).

Given our lack of knowledge of the Tasmanian fauna of many groups of small organisms, including the insects known as thrips, the existence of trans-Tasman dispersal leads to problems in evaluating endemism, and thus distinguishing vicariance from trans-oceanic dispersal. For example, Stannard (1962) described the Thysanoptera genus *Cartomothrips* for two species, one from Victoria and the other from New Zealand, and inherent in this was the assumption of a trans-Tasman speciation event. In contrast, Mound & Walker (1982a) expressed doubt concerning this possibility, and suggested that the putative New Zealand endemic *C. manukae* Stannard might have dispersed from Tasmania. Subsequently, this species was found in Tasmania (Mound 1996), in association with the same host-plant "Manuka", *Leptospermum scoparium*.

The present paper concerns another Thysanoptera species that is currently considered a New Zealand endemic, *Lomatothrips paryphis* Mound & Walker. This species has recently been found breeding near Auckland in the leaf buds of the native Gymnosperm, *Podocarpus totara* (Martin & Mound 2005). In publishing that host record it was pointed out that a second, undescribed, species of *Lomatothrips* had been taken in southeastern Australia in association with *P. lawrencei*. The purposes of this paper are to describe this second species, indicate its distribution and host range in Australia, and to discuss the distribution of the two *Lomatothrips* species in the light of Thysanoptera faunal relationships between New Zealand and southeastern Australia including Tasmania, these seeming to result more from recent dispersal than vicariance. A further purpose is to draw attention to how little is known of the native thrips fauna of Tasmania.

THRIPS TRANS-TASMAN FAUNAL RELATIONSHIPS

Dispersal from Tasmania and mainland Australia to New Zealand was recognised for seven species of Thysanoptera-Terebrantia (Mound & Walker 1982b), but to these should now be added three of the 19 species that were then considered to be New Zealand endemics (table 1). Of the resultant 10 species, *Karphothrips dugdalei* Mound & Walker is widespread in Tasmania and southern Australia on species of the sword grass genus *Gahnia*, and *Anaphothrips varii* Moulton, *A. woodi* Pitkin and *Parabaliothrips montanus* (Girault) are all associated with various grasses in southeastern Australia. Similarly, *A. dubius* (Girault) sometimes produces large populations on the leaves of various native herbaceous Asteraceae in eastern Australia. Establishment in New Zealand of all five of these thrips species has probably been facilitated by the lack of competing thrips on their favoured host plants. Similarly, the gum tree flower thrips, *Thrips australis* (Bagnall), finds a vacant ecological niche in New Zealand in the flowers of *Eucalyptus*, and suitably vacant niches are similarly available to the Australian orchid thrips, *Dichromothrips spiranthidis* (Bagnall), and Kelly's citrus thrips, *Pezothrips kellyanus* (Bagnall). In contrast, the vastly common Australian plague thrips, *Thrips imaginis* Bagnall, is known in New Zealand from very few specimens, despite being one of the most abundant insects in southern Australia. The failure of this thrips to develop substantial populations might be due to competition from the abundant and equally polyphagous

TABLE 1
Native Australian Thysanoptera species in New Zealand

Terebrantia: Thripidae
Anaphothrips dubius (Girault)
Anaphothrips varii Moulton
Anaphothrips woodi Pitkin
Dichromothrips spiranthidis (Bagnall)
(= *Dichromothrips maori* Mound)
Karphothrips dugdalei Mound & Walker
Pezothrips kellyanus (Bagnall)
Parabaliothrips montanus (Girault)
(= *Pseudanaphothrips annettae* Mound & Palmer)
Pseudanaphothrips achaetus (Bagnall)
Thrips australis (Bagnall)
Thrips imaginis Bagnall

Tubulifera: Phlaeothripidae - Phlaeothripinae
Apterygothrips australis Pitkin
Apterygothrips collyerae Mound & Walker
Baenothrips moundi (Stannard)
Cartomothrips manukae (Stannard)
Cartomothrips neboissi Mound & Walker
Haplothrips salicorniae Mound & Walker
Hoplothrips poultoni (Bagnall & Kelly)
Lissothrips gersoni Mound & Walker
Macrophthalmothrips argus (Karny)
Psalidothrips taylori Mound & Walker
Sophiothrips greeensladei Mound & Walker
Strepterothrips tuberculatus (Girault)
Teuchothrips annulosus (Priesner)
Teuchothrips disjunctus (Hood)

Tubulifera: Phlaeothripidae - Idolothripinae
Carientothrips badius (Hood)
Carientothrips loisthus Mound
Emprosthiothrips bogong Mound
Heptathrips cumberi Mound & Walker
Idolothrips spectrum Haliday

New Zealand flower thrips, *Thrips obscuratus* (Crawford). However, such a suggestion of competitive exclusion does not seem to apply to another polyphagous Australian flower thrips, *Pseudanaphothrips achaetus* (Bagnall), because this has been found in New Zealand in considerable numbers.

Considering the Thysanoptera-Tubulifera fauna of New Zealand, Mound & Walker (1986) indicated that 17 species appeared to be immigrants from Australia. This total has subsequently risen to 19 (table 1), and most of these species are also now known from Tasmania. Again, the biology of these species pre-adapts them to be successful trans-Tasman migrants. All five listed Idolothripinae feed on fungal spores, and six of the Phlaeothripinae feed on fungal hyphae (*Baenothrips moundi* Stannard and *Psalidothrips taylori* Mound & Walker in leaf litter; *Hoplothrips poultoni* (Bagnall & Kelly), *Macrophthalmothrips argus* (Karny), *Sophiothrips greensladei* Mound & Walker and *Strepterothrips tuberculatus* (Girault) on dead twigs). The other species exhibit a range of biologies; *Apterygothrips australis* Pitkin lives in grasses; *Apterygothrips collyerae* Mound & Walker is predatory on mites and possibly thrips larvae on shrubs and trees; the two *Cartomothrips* species live on plants, *Kunzea* and *Leptospermum* species, that themselves have a trans-Tasman distribution; *Haplothrips salicorniae* Mound & Walker is common on the widespread salt-marsh plants known as glassworts or samphires; *Lissothrips gersoni* Mound & Walker lives amongst mosses and liverworts; *Teuchothrips annulosus* (Priesner) feeds on the leaves of species of *Ozothamnus* and possibly *Cassinia*; *Teuchothrips disjunctus* (Hood) distorts the leaves of the common garden plant *Callistemon citrinum*. Thus 18 of these species may well have dispersed into New Zealand naturally on the westerly winds, although the last one mentioned has more probably been moved by the horticultural trade. A further species with a trans-Tasman distribution is *Nesothrips propinquus* (Bagnall), but this spore-feeding thrips that lives amongst dead grasses is considered to have originated in New Zealand, from where it has been widely distributed along the sailing ship route to Europe, presumably in hay and straw (Mound 1983).

Given the large number of Thysanoptera species that apparently have dispersed across the Tasman and successfully established in New Zealand, it is not possible to assume that the distribution of the two species of *Lomatothrips* represents vicariance. The New Zealand species *L. paryphis* has not been found in Australia on any of the available gymnosperms. However, no surveys for thrips have been conducted on Tasmanian gymnosperms at suitable times of the year. The two species of *Lomatothrips* appear to have very different larval biologies; *L. paryphis* has been reared from vegetative terminal buds, whereas the new species described below is associated with male cones on various Pinopsida, presumably feeding on pollen. On balance, the distribution of *Lomatothrips* seems likely to be due to vicariance, but this suggestion requires field testing in Tasmania by surveying potential gymnosperm host plants.

Lomatothrips Mound & Walker

Lomatothrips Mound & Walker, 1982b: 67. Type species *L. paryphis*, by monotypy.

Lomatothrips shares an interesting synapomorphy with the members of the Australian genus *Pseudanaphothrips* Bagnall as well as those of the large genus *Frankliniella* Karny that is so dominant throughout the Americas but particularly in the Neotropics (Mound & Marullo 1996). This shared character state is the presence of paired ctenidia anterolateral to the spiracles on the eighth abdominal tergite. Mound (2002) suggested that *Pseudanaphothrips* might be the sister-genus of *Frankliniella*, but in any future analysis of generic relationships *Lomatothrips* will also need to be considered. The species of all three genera also share the following two character states, although these are probably plesiomorphies: three pairs of ocellar setae on the head; both pairs of metanotal setae close to the anterior margin of this sclerite (see below). In contrast to the other two genera, both *Lomatothrips* species have the setal row on the first vein of the forewing widely interrupted not continuous, their antennae have seven not eight segments, and they share the curious autapomorphy of a craspedum on the posterior margin of the second to seventh abdominal tergites. The original and detailed generic diagnosis also applies to the new species described below, except for the character states indicated in the key. Despite this, the original statement that the metanotal median setae are "not at the anterior margin" requires comment. The position of these setae is variable

in the available material of both species, being within the anterior quarter of this sclerite but with one or both setae occasionally close to or at the anterior margin.

Key to *Lomatothrips* species

1. Abdominal tergite VIII posteromarginal comb of microtrichia interrupted medially; pleurotergites with a craspedum; ocellar setae pair III arising on tangent joining anterior margins of posterior ocelli; forewing first vein with 3 setae on distal half; mouth cone extending to fore coxae ..... *paryphis*
-. Abdominal tergite VIII posteromarginal comb of microtrichia complete medially; pleurotergites without a craspedum; ocellar setae pair III arising between posterior ocelli posterior to tangent joining their anterior margins; forewing first vein with 2 setae on distal half; mouth cone extending well beyond fore coxae ..... *pinopsidis*

Lomatothrips paryphis Mound & Walker

Lomatothrips paryphis Mound & Walker, 1982b: 67.

This, the original species in this monobasic genus, was based on 22 female specimens extracted from leaf litter at several sites in both North and South Island, New Zealand. Unfortunately, although 11 of these specimens were micropterae there was no precise host plant association available with any of them. Subsequently, the species was found breeding near Auckland, and larvae were reared in the leaf buds of the New Zealand native Gymnosperm, *Podocarpus totara* (Martin & Mound 2005). No males have been seen, despite considerable numbers of larvae and adults being collected in two successive years.

Lomatothrips pinopsidis sp. n.

Female macroptera. Colour of body and legs mainly yellow; tergites II – VII with median light brown area; abdominal segment X brown at apex, major setae on IX – X light brown; ocellar region sometimes slightly shaded, compound eyes with 4 ommatidia pigmented and slightly enlarged; mouth cone apex often dark; antennal segment I white, II – VII brown; forewing pale. Head broad (pl. 1A); ocellar triangle wider than long, ocellar setae I small and arising near inter-antennal projection, III arising between posterior ocelli; frons with 6 pairs of setae, 2 long pairs at anterior, 3 shorter pairs close to eyes, 1 long pair postero-medially; mouth cone massive, extending across prosternum, maxillary palps with 3 segments. Antennae 7-segmented (pl. 1B), segment I without a pair of dorso-apical setae. Pronotum with weak transverse striae; 4 pairs of posteromarginal setae pesent, also 2 pairs of posteroangular setae of which the external pair is much shorter than the inner pair. Mesonotal median setae near posterior margin (pl. 1C). Metanotum with weak sculpture medially, median setae usually slightly posterior to anterior margin (pl. 1C). Mesothoracic furca with weak spinula, metafurca usually with no spinula. Tarsi all 2-segmented. Forewing clavus with 5 marginal and 1 discal setae; first vein with 7 setae on basal third and 2 setae on distal third; second vein with 11 to 13 setae; posteromarginal cilia strongly undulating. Tergite I with transverse sculpture but no craspedum; tergites II – VII with sculpture medially progressively weaker on succeeding segments, posteromarginal craspedum entire; tergite II with 3 lateral marginal setae; tergite VIII posteromarginal comb complete, ctenidia present anterolateral to spiracles (pl. 1D); tergite X with split reaching only mid-point. Pleurotergites with no craspedum; sternites III – VII with marginal craspedum shorter than diameter of a setal base.

Measurements of holotype female in microns. Body length 1300 (paratypes LAM 4404 largest and smallest 1550, 950). Head, dorsal length 75; length to mouth cone apex 250; width 140; ocellar setae III 15. Pronotum, length 125; width 165; posteroangular setae, inner 30, outer 16. Forewing length 650. Antennal segments III – VII length 35, 35, 30, 45, 20.

Male macroptera. Similar to female but paler and smaller (body length 800), with mouth cone less elongate; antennal segment II as pale as segment I; tergite VIII with very reduced ctenidia, posteromarginal comb complete; tergite IX with 4 setae in irregular transverse row; sternites III – VII with transverse glandular area anterior to antecostal ridge(pl. 1E); parameres fringed laterally and aedeagus with row of teeth near apex.

Type material. Holotype ♀ **Australian Capital Territory**, Black Mt, from flowering *Callitris rhomboidea*, 1.xii.2005 (LAM 4763). Paratypes: 7♀♀ 9♂♂ taken with holotype; **A.C.T.**, Black Mt, Australian National Botanic Gardens, 7♀♀ 5♂♂ from *Athrotaxis cupressoides*, 1.xii.2005; Mt Gingera, 16♀♀ from male cones of *Podocarpus lawrencei*, 25.xii.2003 (LAM 4404).

COMMENTS

The variation in body size is remarkable, both between the sexes and between females from the same population. In the vicinity of Canberra, the largest female studied is almost twice as long as the smallest female, and the males are usually only half as long as females. The males have particularly unusual sternal glandular areas that, instead of being in the centre of each sternite as is typical of Thripidae, are in front of each sternal antecostal ridge (pl. 1E). Males from *Callitris* near Dalby in southern Queensland are similar to those of the type series, but males from *Callitris* at two sites in northern and western New South Wales (Narrabri and Mutawindji) have a glandular area only on the third sternite. Females from these sites cannot be distinguished from those of the type series. The males of the New Zealand species, *L. paropsidis*, have not yet been found.

HOST RANGE OF *L. PINOPSIDIS*

Because of the wide geographic range of this species in Australia, and the great variation in size of females within any single sample, the type series is limited to material taken in the vicinity of Canberra. In this area the species has been found in considerable numbers on *Podocarpus lawrencei* on Mt Gingera, on *Callitris rhomboidea* on Black Mt, and on cultivated *Athrotaxis cupressoides* at the Australian National Botanic Gardens. However, apparently identical specimens have been found on *Callitris* species at various sites across New South Wales, at Dalby in southern Queensland, and at Darwin in the Northern Territory. At each of these sites the thrips was found only on *Callitris* trees that were producing pollen, and although different host-plant species

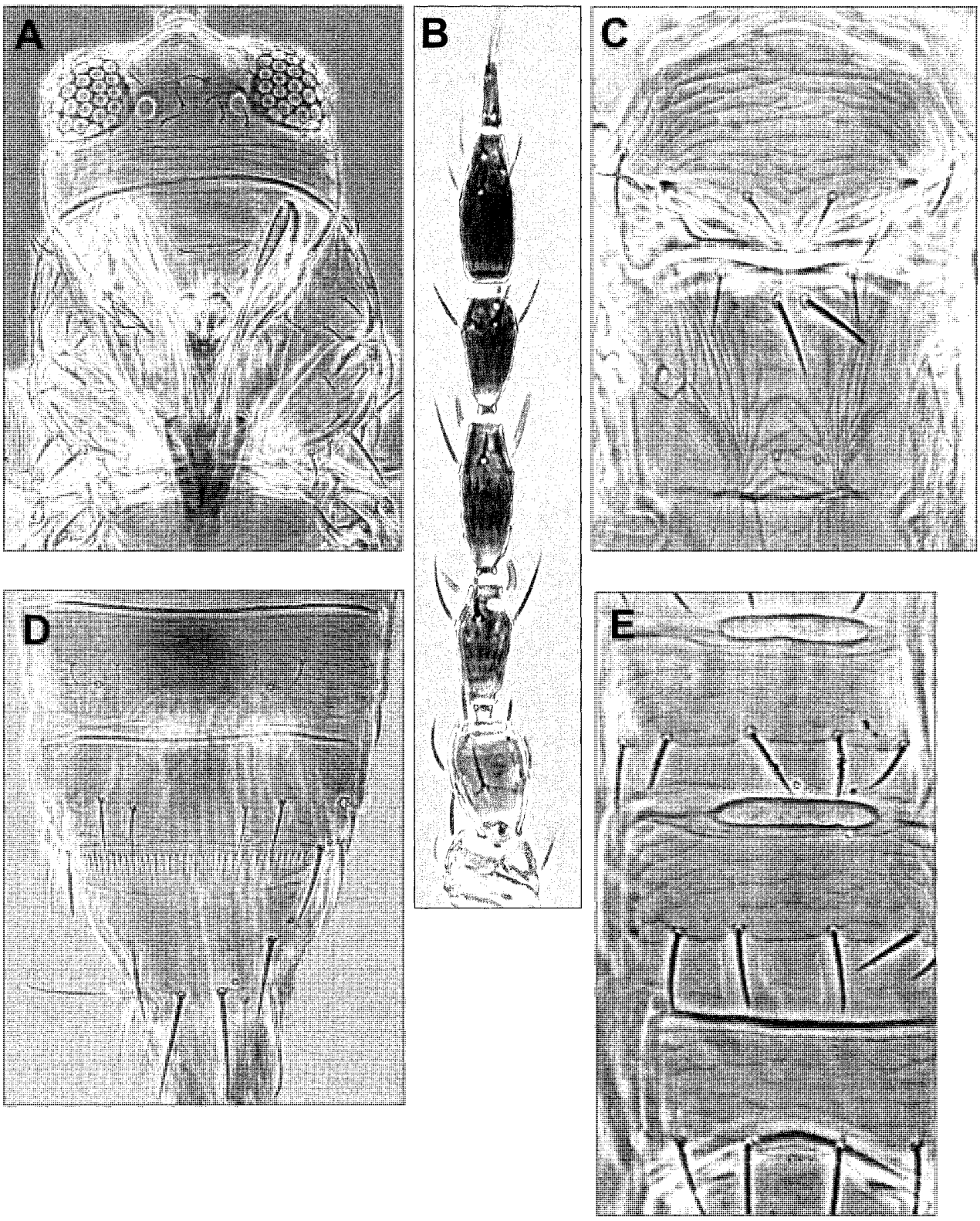

PLATE 1

Lomatothrips pinopsidis. *(A) Head and prothorax; (B) Antenna; (C) meso and metanota; (D) Abdominal tergites VII – X of female; (E) Sternites VI – VIII of male.*

are involved there is no evidence that more than one thrips species is represented.

The three host plant genera of *L. pinopsidis* represent three of the families of the Pinopsida (Cupressaceae, Podocarpaceae and Taxodiaceae). Isolated winged females have been taken on a wide range of other plants around Canberra at various times, not always in the immediate vicinity of *Callitris*, suggesting that the species although host-restricted is behaviourally dispersive. However, it has not been found in the male cones of any of the introduced species of *Pinus*, and thus within the Pinopsida it exhibits some level of host specificity. In this connection it should be noted that the only other Australian species of Thripidae known to be associated with Pinopsida is recorded from two further families (Araucariaceae and Pinaceae). *Pseudanaphothrips araucariae* Mound & Palmer has been found breeding in the male cones of two species of *Araucaria* as well as the cones of two species of *Pinus*. At one locality in Queensland the populations on *Pinus* were so large that they constituted a public nuisance (Mound *et al.* 2002).

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