Further evidence of the coextinction threat for jumping plant-lice: three new
cothreatened *Acizzia* (Psyllidae) and *Trioza* (Trioziidae) from Western Australia

GARY S. TAYLOR¹ & MELINDA L. MOIR^{2, 3}

¹*Australian Centre of Evolutionary Biology & Biodiversity, School of Earth & Environmental
Sciences, The University of Adelaide, South Australia 5005, Australia
(Email: Gary.Taylor@adelaide.edu.au).*

²*ARC Centre for Excellence in Environmental Decisions, School of Botany, The University of
Melbourne, Parkville, Victoria 3010, Australia
(Email: mmoir@unimelb.edu.au).*

³*ARC Centre for Excellence in Environmental Decisions, School of Plant Biology, The
University of Western Australia, Crawley, Western Australia 6009, Australia*

Authors: Taylor & Moir
Running title: New rare and cothreatened plant-bugs
Corresponding Author: Email: Gary.Taylor@adelaide.edu.au
Higher taxon name: Hemiptera: Psylloidea: Psyllidae/Trioziidae
Number of new species: 3
Abstract word count: 113
Total word count: 7350
References: 37
Tables: 6
Plates: 4; Figures: 36

Abstract

Three new species of jumping plant-bugs (Psylloidea) are described from Western Australia. *Acizzia hughesae*, sp. n. occurs on *Acacia veronica* Maslin (Fabaceae: Mimosoideae), *A. mccarthyi*, sp. n. on an undescribed species of *Grevillea* (Proteaceae) identified by the Western Australian State Government as in need of conservation action (*Grevillea* sp. ‘Stirling Range’) and *Trioza barrettae*, sp. n. from the critically endangered *Banksia brownii* (Proteaceae). These new species of jumping plant-bug are considered rare, and at risk of extinction, or coextinction, as they are recorded from plant species with highly restricted distributions in the south-west of Western Australia. Indeed, the Western Australian State Government recently classified two of the three new plant-bug species as threatened.

Keywords

Host-specificity, insect herbivores, insect-plant interactions, short-range endemic, species loss.

INTRODUCTION

Jumping plant-bugs or ‘psyllids’ (Hemiptera: Psylloidea) often show a high level of host fidelity (e.g., Hodkinson 1974; Yen 2002; Hollis 2004; Taylor & Moir 2009; Taylor et al. 2010, 2011). For this reason, when they are associated with plant species that are threatened with extinction, these insects are often considered ‘cothreatened’ (Moir et al. 2011). The potential for their extinction is further compounded if they are not found uniformly across all populations of their host (see Taylor & Moir 2009).

Here, we describe three new species of jumping plant-bug (two species of *Acizzia*; Psyllidae, and one species of *Trioza*; Triozidae). Their restricted biogeographic ranges classify them as a short-range endemic species that could be threatened (see Harvey 2002), or cothreatened, as they occur on plant species with conservation listings. The host plants are *Banksia brownii* (Proteaceae: Grevilleoideae: Banksieae) with restricted and highly fragmented populations in the south-west of Western Australia (Western Australian State Government conservation status of ‘Declared Rare’ see <http://florabase.calm.wa.gov.au/conservationtaxa> for descriptions of conservation codes), and

Acacia veronica Maslin (Fabaceae: Mimosoideae: Acacieae) with a restricted distribution in the Stirling Range of Western Australia (Western Australian State Government conservation status of 'Priority 3'). The third host plant is an undescribed *Grevillea* species, herein called *Grevillea* sp. 'Stirling Range' (Proteaceae: Grevilleoideae: Hakeinae. Taxonomy follows Weston & Barker 2006), which also has a recognised restricted distribution in the Stirling Range (Western Australian State Government conservation status of 'Priority 2').

MATERIALS AND METHODS

Specimens were collected by beating or vacuuming 30 individuals of each plant species, at each site, in the Stirling Range National Park and surrounding areas, Western Australia. Collecting occurred during September to December 2007 and again in October 2008. Other plant species at the same sites, or related to the target plant species, were sampled to determine the level of host-specificity of captured insect species by using the host-breadth models of Vesik et al. (2010). Moir et al. (2012a) provides details of the sampling regime employed, methods and site details. Precise locality data of type material have been withheld for conservation reasons.

Dried, point-mounted specimens were soaked in the surfactant 3% Decon-90 for 8 hours, then prepared and mounted in Gurr DePex mounting medium on microscope slides as described by Taylor *et al.* (2013). Slide specimens comprise: the head mounted dorsal uppermost under one cover-slip; the pronotum and fore-legs, mesoscutum and fore wings (dorsally), ventral mesothorax and mid-legs, and metathorax and hind legs on another; and abdomen, laterally on a third cover-slip; all three cover-slips were placed on a single microscope slide.

Images were prepared from dried or slide-mounted specimens using a Canon EOS 7D digital camera on a Visionary Digital BK Imaging System (Visionary Digital, USA) and collated with Zerene automontage software version 4.02 (Syncroscopy, Cambridge, UK). Drawings were made using an Olympus Drawing Tube mounted on an Olympus BX53 compound microscope, scanned, digitally prepared using a WACOM Intuos PTZ-930 digitiser board and digital pen, and collated in Adobe Illustrator CS4.

Habitus measurements were taken from dried, point-mounted specimens, other measurements were from slide mounts; all using a dissecting microscope with an eyepiece graticule. All measurements are in millimetres and refer to maximum (outer) dimensions.

Morphological terminology mostly follows Ossiannilsson (1992) and Hollis (2004). Abbreviations for morphological measurements and ratios follow Taylor *et al.* (2013).

Abbreviations and ratios of morphological characters: AEBL, length of basal segment of aedeagus; AEDL, length of distal segment of aedeagus; AL, length of antenna including scape, pedicel and flagellomeres; AF1L, length of first antennal flagellomere; BL, length of body; CL, length of female circumanal pore ring; CPL, length of nymphal caudal plate; CPRW, width of nymphal circumanal pore ring; CPW, width of nymphal caudal plate; cu1 cell value, ratio of marginal width of cell cu1 to length of vein cu1b; FPL, length of female proctiger; GCL, length of genal cones; HW, width of head; M1M, ratio of length of vein M1+2 to length of vein M stem; m1 cell value, ratio of length of vein M1+2 to marginal width of cell m1; MPL, length (height) of male proctiger; PL, length of male paramere; SL, length of female subgenital plate; TL, length of hind tibia; VL, length of vertex; VW, width of vertex; WL, length of adult forewing or nymphal forewing pad; WW, width of forewing.

Abbreviations for collections and institutions in which material is deposited: MLM, Melinda Moir private collection, Perth; WAM, Western Australian Museum, Perth; WINC, Waite Insect and Nematode Collection, University of Adelaide, Adelaide.

Systematics

Family Psyllidae

Genus *Acizzia* Heslop-Harrison, 1961

Acizzia Heslop-Harrison, 1961: 418. Type species: *Psylla acaciae* Maskell, 1894: 171, by original designation.

Acizzia hughesae, sp. n.

(Figs 1–8, 24–27; Tables 1–5)

Types. AUSTRALIA, Western Australia: Holotype: 1 ♂ (dried), Stirling Range NP, 308 m., M.L. Moir, 5.ix.2007, ex *Grevillea* sp. ‘*Stirling Range*’ (WAM E 83796). Paratypes: 2 ♀ (dried) same data as holotype (WAM E 83796); 1 ♀ (dried) same data (MLM 00875); 1 ♂ (slide) same data (WINC); 1 ♀ (slide) same data, except ex *Calothamnus preissii* (WINC).

Description. Adult (Figs 1–8). Colouration. Male: Vertex pale yellow-brown with brown marking in vicinity of fovea; genal processes pale yellow-brown; eyes greyish; antennal segments 1–2 yellow-brown, segments 3–8 with very brown apices giving antennae a banded appearance, segments 9–10 dark brown to almost black; thorax pale yellow-brown: pronotum with a pair of brown markings laterally; mesopraescutum with a pair of indistinct pale orange longitudinal submedial markings anteriorly; mesoscutum with a medial longitudinal stripe and two pairs of indistinct pale orange submedial markings; fore wings clear with a uniform pale grey brown infuscation and indistinct grey brown maculations more dense in apical third; wing veins brown; legs pale yellow-brown; abdominal tergites and sternites yellow brown to brown; proctiger, subgenital plate and parameres yellow-brown; apices of parameres black. Female: as for male except proctiger and subgenital plate pale yellow-brown with brown apices.

Structure. Measurements as in Tables 1–5. Body short, broad (Figs 1–4). Head (Figs 5–6) deflexed in about 40° from longitudinal axis of body; vertex flat, subtrapezoidal, 0.64–0.68 times as long as wide, with a pair of submedial rounded lobes; genal processes moderate in length, 0.43–0.44 as long as vertex, very wide with broadly rounded apices, produced in about same plane as vertex; antenna moderate in length, 1.67–1.71 times longer than width of head, with a single subapical rhinarium on each of segments 4, 6, 8 and 9; segment 10 with two long pointed apical setae. Fore wing (Figs 7–8) 3.07–3.33 times as long as head width, 2.31–2.39 times as long as wide, short with broadly rounded apex; pterostigma long, widest at costal break, evenly narrowing to terminus of vein Rs little short of wing apex; costal break present; vein Rs long; vein M short; veins M_{1+2} and M_{3+4} long, evenly diverging with corresponding high m_1 cell value: 2.44–2.53; veins Cu_{1a} long, moderately arched and Cu_{1b} long, recurved to hind margin, each widely divergent with corresponding low cu_1 cell value: 0.81–1.12; radular areas elongate triangular, in cells m_1 and m_2 and cu_1 ; metacoxa with thin pointed meracanthus; metatibia 0.66–0.70 times as long as head width, longer than metafemur, with one outer and four inner sclerotised apical spurs; metabasitarsus with one lateral sclerotised spur. Male terminalia (Figs 24–26); proctiger with elongate upright anal tube (reclinate anal tube in Fig. 24 may be an artefact) and broadly rounded basal lateral lobes bearing a prominent sclerotised hook; subgenital plate broadly rounded; paramere (Figs 24–25) broad, blade-like, narrow basally, expanding with a posterior lobe at three-quarter length and an anterior subapical heavily sclerotised ridge before narrowing to incurved sclerotised apices; basal segment of aedeagus strongly curved; distal portion of aedeagus (Fig. 26) gently curved with an apical anterior projection and thin posterior process;

sclerotised end tube of ductus ejaculatorius short, weakly curved. Female terminalia (Fig. 27) proctiger triangular with a tapering, upwardly inflected sclerotised apex; distal portions of proctiger with a few sparse long setae and apex with close short setae; circumanal pore ring sinuate consisting of a single rows of pores; subgenital plate triangular, with tapering, straight sclerotised apex; apex of subgenital plate with a few sparse short setae; valvulae dorsalis cuneate, valvulae ventralis moderately curved lacking apical teeth; valvulae lateralis broadly rounded.

Comments

Acizzia hughesae is only the second species of *Acizzia* to be described from Western Australia, and is considered endemic to that State. Only four other described species of *Acizzia* have been recorded from Western Australia: *A. acaciaedecurrentis* (on *A. cyclops*: Van Der Berg 1980), *A. acaciaebaileyanae*, *A. uncatoides* (Hollis 2004) and *A. veski* (Taylor & Moir 2009). However, only *A. hughesae*, together with *A. veski* and *A. mccarthyi* (see below), is likely to be endemic to Western Australia, the other species possibly introduced into Western Australia on their ornamental hosts (Taylor & Moir 2009).

Acizzia hughesae is very similar morphologically to *A. hakeae* Tuthill but can be separated from it by the following characters: thorax generally pale yellow-brown with indistinct pale orange markings anteriorly in *A. hughesae*, compared with ‘boldly coloured in orange, brown and white’ in *A. hakeae* (Tuthill 1952, Dale 1985); fore wings with a uniform pale grey brown infuscation and indistinct grey brown maculations, more dense in apical third in *A. hughseae*, compared with ‘strongly marked’ (forewings clear, with distinct dark markings) in *A. hakeae* (Tuthill 1952, Dale 1985); and paramere with an anterior subapical heavily sclerotised ridge in *A. hughesae*, compared with an unsclerotised ridge in *A. hakeae* (Dale 1985).

Etymology. Named in honour of Professor Lesley Hughes, for her work on the impact of climate change on biodiversity. In addition, she has provided continual intellectual support towards research on the coextinction of Australian insects that has resulted in the discovery of this new species.

Host-plant association

Grevillea contains approximately 362 species, the majority of which are endemic to Australia, but a few species are found in Papua New Guinea, New Caledonia and Sulawesi

(Weston & Barker 2006). Within the southwest of Australia, there are approximately 230 species and subspecies of native *Grevillea* (see <http://florabase.dec.wa.gov.au/>). *Grevillea* ‘Stirling Range’ is a small, spindly shrub (approximately 1 m high) found only on the sand plains of the Stirling Range National Park of Western Australia, and is associated with sand plain heath vegetation. Although undescribed, it has been recognised as in need of conservation listing (as ‘Priority 2’) because of its restricted distribution, and low number of populations (three known: Barrett pers. comm. 2011). Key threatening processes are currently unknown but may include inappropriate fire regime and the disease Dieback (*Phytophthora cinnamomi*), which threatens many other plant species within the southwest botanical province (see Barrett et al. 2008). Two close relatives of *Grevillea* ‘Stirling Range’; *G. teretifolia* and *G. anethifolia* were also sampled to determine whether *A. hughesae* was able to feed on multiple, closely related species, but the insect was not found on these other potential hosts. Furthermore, the psyllid was not found on a further three species of *Grevillea*, or 29 other Proteaceae species, that were sampled in the Stirling Range National Park. Of the two populations of *Grevillea* ‘Stirling Range’ sampled (by MLM), only one yielded *A. hughesae*, suggesting that although the host has a ‘priority 2’ conservation status, the psyllid may be critically endangered.

***Acizzia mccarthyi*, sp. n.**

(Figs 9–16, 28–31; Tables 1–5)

Types. AUSTRALIA, Western Australia: Holotype: 1 ♂ (dried) Stirling Range NP, Mt Talyuberlup, 351 m., M.L. Moir & K.E.C. Brennan, 18.x.2007, ex *Acacia veronica* (WAM E 82757). Paratypes: 1 ♀ (slide) same data as holotype (WAM E 83798); 3 ♀ (dried) same data (WAM E 83799 – E 83801); 2 ♂, 2 ♀ (slide), 2 ♂, 2 ♀ (dried) same data as holotype, except, 17.x.2007, ex *Acacia veronica* (WINC); 1 ♂, (dried) same data (MLM); 2 ♂, 1 ♀ (slide), 4 ♀ (dried) same data (WAM); 1 ♀ (dried) same data, except 29.x.2007, ex *Gastrolobium bilobum* (WINC); 2 ♀, (dried) same data as holotype (MLM 00873-4); 3 ♀, 1 undet. [abdomen missing] (dried) Stirling Range NP, Paper Collar Creek, 261 m., M.L. Moir, 6.x.2008, ex *Acacia veronica* (WAM E 83802 – E 83805).

Description. Adult (Figs 9–16). Colouration. Male: Vertex pale yellow-brown with a thick black longitudinal medial stripe and dark brown marking in vicinity of fovea; genal processes black; eyes reddish brown; antennal segments 1–2 yellow-brown with brown infuscation,

segments 3–10 progressively darker brown to black; pronotum pale yellow brown with a thick black medial stripe and a pair of black lateral markings; mesopraescutum and mesoscutum orange with a thick black medial stripe; mesoscutellum black; fore wings clear with a uniform very light grey brown infuscation; wing veins brown; legs pale yellow-brown with grey brown dorsal infuscation; abdominal tergites dark brown; sternites pale yellow medially, dark brown laterally; internal (intersegmental) colouration of abdomen pale green; proctiger, subgenital plate and parameres yellow-brown: proctiger with dark brown colouration on anterior face; apices of parameres dark brown to black. Female: as for male except proctiger dark brown to black; subgenital plate pale yellow-brown with apices dark brown to black.

Structure. Measurements as in Tables 1–5. Body elongate, broad (Figs 9–12). Head (Figs 13–14) deflexed in about 30° from longitudinal axis of body; vertex flat, reclinate subtrapezoidal, 0.64–0.76 times as long as wide, genal processes long, 0.54–0.69 as long as vertex, conical, contiguous medially with rounded apices, deflexed from vertex; antenna very long, 2.90–3.14 times longer than width of head, with a single subapical rhinarium on each of segments 4, 6, 8 and 9; segment 10 with a long pointed and a short truncate seta. Fore wing (Figs 15–16) 3.80–4.38 times as long as head width, 3.04–3.25 times as long as wide, elongate with rounded apex; pterostigma very long and narrow, widest at costal break, evenly narrowing to terminate over mid-way to wing apex; costal break present; vein Rs long, terminating little short of wing apex; vein M short; veins M_{1+2} and M_{3+4} very long, evenly diverging with corresponding very high m_1 cell value: 2.33–3.24; veins Cu_{1a} very long, moderately arched and Cu_{1b} long, recurved to hind margin, each widely divergent with corresponding moderate cu_1 cell value: 1.86–2.31; radular areas elongate triangular, midway on hind margin in cells m_1 and m_2 , proximal to vein Cu_{1a} in cell cu_1 ; metacoxa with elongate pointed meracanthus; metatibia 0.75–0.82 times as long as head width, longer than metafemur, with two outer and three inner sclerotised apical spurs; metabasitarsus with a pair of small, indistinct lateral sclerotised spurs. Male terminalia (Figs 28–30); proctiger with elongate anal tube and short basal lateral lobes; subgenital plate with broadly rounded ventral margin and flat dorsal margin from lateral aspect; paramere (Figs 28–29) elongate, bulbous basally, strongly recurved from lateral aspect and evenly rounded to incurved apices; parameres with a short row of long, thick setae on basal anterior margin and inward-projecting long setae subapically; basal segment of aedeagus strongly curved; distal portion of aedeagus (Fig. 30) thickened basally, thin distally and terminating in a complex bulb. Female terminalia (Fig. 31) short, quadrate, broadly rounded proximally with broad, flat,

heavily sclerotised apex; circumanal pore ring consisting of two unequal rows of pores; subgenital plate broadly triangular, with straight weakly sclerotised apex; distal portion of proctiger with dense long curved setae, apex bearing short hooked setae; valvulae dorsalis cuneate; valvulae ventralis moderately curved lacking apical teeth; valvulae lateralis broadly rounded.

Comments

Acizzia mccarthyi is the third species of *Acizzia* described from Western Australia and is considered endemic to that State (see comments above for *A. hughesae*). It shares its host, *Acacia veronica*, with another highly restricted psyllid, *A. veski*. *Acizzia veski* has recently been listed for conservation as ‘vulnerable’ by the Western Australian State Government. The single record of *A. maccarthyi* from *Gastrolobium bilobum* is likely to be incidental as this plant was in close proximity to the *Acacia veronica* population at the same site.

Acizzia mccarthyi is atypical of many species of *Acizzia* but is placed in this genus pending further collection of new material. It is readily diagnosed by its large size, elongate habitus and orange colouration with distinctive black medial stripe. It differs from most *Acizzia* in that the genal processes are long (GCL:VL 0.54–0.69), conical, contiguous medially compared with shorter (GCL:VL typically less than 0.50), conical with divergent apices; antennae are extremely long (AL:HW 2.90–3.14; compared with typically less than 2.50); fore wing narrow elongate 3.04–3.25 times as long as wide compared with generally much shorter and broader (WL:WW typically less than 2.50), elongate with rounded apex; proctiger with short basal lateral lobes compared with large rounded basal lateral lobes, sometimes with a sclerotised process.

Etymology. Named in honour of Associate Professor Michael McCarthy, for his work on efficient environmental management decisions, particularly with regard to conservation. In addition, he has provided on-going support for the investigation into the coextinction of Australian insects that resulted in the discovery of this new species.

Host-plant association

We have described the plant genus *Acacia* and the host, *A. veronica*, in detail previously (see Taylor & Moir 2009). *Acacia veronica* is restricted to the Stirling Range National Park and has no close relatives in Western Australia, therefore we sampled other, more common *Acacia* species of similar habit (e.g., *A. saligna* and *A. acuminata*) for *A. mccarthyi*. This

species was not recorded from any of these other acacias, or from 19 other genera sampled within the Fabaceae. Furthermore, it has not been previously observed in any entomological collections viewed by us, or collected as a part of other survey work in Western Australia and elsewhere in Australia. As previously recorded (Taylor & Moir 2009), one of us (MLM) searched for known populations of *A. veronica*, which resulted in five populations of the plant rediscovered, four previously recorded populations found to be extinct, and a newly discovered population located. There remain a further seven populations of *A. veronica* that were not searched for insects (Barrett pers. comm. 2011). However, of the six populations of *A. veronica* sampled, only two yielded *A. mccarthyi*. This suggests that the psyllid could be highly threatened, like *A. veski*, although the host has a relatively low ‘priority 3’ conservation status (Moir, unpublished data).

Family Triozidae

Genus *Trioza* Förster, 1848

Trioza Förster, 1848: 67. Type species: *Chermes urticae* Linnaeus, 1761, by subsequent designation see Oshanin 1912: 128. (Systematics obtained from Hollis 2004)

Trioza barrettae, sp. n.

(Figs 17–23, 32–36; Tables 1–5)

Types. AUSTRALIA, Western Australia: Holotype: 1 ♂ (dried) Stirling Range NP, Mt Hassell, 558 m., M.L. Moir, 1.x.2007, ex *Banksia brownii* (WAM E 82758). Paratypes: 1 ♀ (dried, on same card as holotype) (WAM E 83806); 2 ♂ (slide) same data as holotype (WAM E 83807, E 83808); 1 ♂ (slide) same data (WINC); 1 ♀ (dried) same data, except 30.x.2007 (WAM E 83809); 1 ♀ (slide) same data, except ex *Kunzea montana* (WAM E 83810); 1 ♂ (dried) Torndirrup NP, 23 m., M.L. Moir, 7.x.2008, ex *Banksia brownii* (MLM 00766); 1 ♀ (slide) same data (WINC); 1 ♀ (dried) Vancouver Peninsula, 23 m., M.L. Moir, 7.x.2008, ex *Banksia brownii* (MLM 00761).

Description. Adult (Figs 17–19). Colouration. Male: Vertex pale yellow-brown with indistinct marking in vicinity of fovea; genal processes pale yellow-brown; eyes greyish; antennal segments 1–7 yellow-brown with very lightly infuscated apices, segments 8–10 dark

brown to almost black; thorax pale yellow-brown; mesopraescutum with a pair of indistinct longitudinal submedial markings anteriorly; mesoscutum with two pairs of indistinct submedial markings; fore and hind wings clear; wing veins brown; legs pale yellow-brown; abdominal tergites yellow with a narrow dark brown to black transverse bands on segments 1–5; sternites pale yellow; internal colouration of abdomen pale green; proctiger, subgenital plate and parameres yellow-brown; apices of parameres black. Female: as for male except with generally darker grey markings in vicinity of fovea, on mesopraescutum, mesoscutum and abdominal tergites; proctiger and subgenital plate pale yellow-brown with apices dark brown to black.

Structure. Measurements as in Tables 1–5. Body short, narrow (Figs 17–19). Head (Figs 20–21) deflexed in about 30° from longitudinal axis of body; vertex flat, subtrapezoidal, 1.00–1.04 times as long as wide, produced forward with a pair of submedial rounded lobes; genal processes short, 0.15–0.19 as long as vertex, conical, with divergent rounded apices, deflexed from vertex; antenna short, 1.09–1.13 times longer than width of head, with a single subapical rhinarium on each of segments 4, 6, 8 and 9; segment 10 with a long pointed and a short truncate seta. Fore wing (Figs 22–23) 4.28–4.80 times as long as head width, 2.67–3.11 times as long as wide, elongate with pointed apex; pterostigma and costal break absent; vein Rs short terminating well short of wing apex; vein M long; veins M_{1+2} and M_{3+4} short, broadly diverging with corresponding low m_1 cell value: 1.20–1.53; veins Cu_{1a} long, arched and Cu_{1b} long, each widely divergent with corresponding low cu_1 cell value: 1.09–1.50; radular areas elongate triangular in cells m_1 , m_2 and cu_1 ; metacoxa with thin pointed meracanthus; metatibia 1.02–1.16 times as long as head width, longer than metafemur, with one outer and two inner sclerotised apical spurs; metabasitarsus without lateral sclerotised spurs. Male terminalia (Figs 32–34); proctiger conoid, without lateral lobes; subgenital plate broadly rounded; paramere (Figs 32–33) short, broad, blade-like, evenly tapering to incurved sclerotised apices with two terminal pointed processes; basal segment of aedeagus strongly curved; distal portion of aedeagus (Fig. 34) short, straight with asymmetrical, ovate apical expansion; sclerotised end tube of ductus ejaculatorius short, weakly curved. Female terminalia (Fig. 35) elongate, broadly rounded proximally with a tapering, upwardly inflected sclerotised apex; circumanal pore ring sinuate consisting of a single row of pores; subgenital plate elongate-triangular, with tapering, straight sclerotised apex; distal portions of proctiger and subgenital plate with sparse long setae; valvulae dorsalis cuneate; valvulae ventralis weakly curved, lacking apical teeth; valvulae lateralis broadly rounded.

Egg (Fig. 36). (From within abdominal cavity of slide specimen): Elongate elliptical, broadly rounded anteriorly with an anteriobasal pedicel, narrowing evenly to a pointed posterior with a short terminal filament; length 0.30–0.32 mm; dorsal chorion with quadrate tubercles, as seen from lateral aspect.

Comments

Trioza barrettae is the first species of *Trioza* to be described from Western Australia, and is considered endemic to that State. Only four other triozids are recorded from WA:

Casuarinicola australis Taylor, and the Western Australian endemics *Acanthocasuarina acutivalvis* Taylor, *Ac. campestris* Taylor and *Aacanthocnema huegelianae* Taylor (Taylor et al. 2010, 2011).

Trioza barrettae is very closely related to *T. banksiae*, but differs in the shape of the male parameres (pyriform in *T. barrettae*, basally bulbous with a thin angular apex in *T. banksiae*). Both *T. barrettae* and *T. banksiae* are pale yellow in colour, with medial black markings on the first 5 abdominal tergites, and share the same host genus. When live, *T. barrettae* is a brighter yellow orange in colour. Recently collected specimens from *B. serrata* from Kangaroo Island are referred to *T. banksiae* following comparison with the type (male holotype on slide: wing and genitalia only; and female dried specimen: entire, but in very poor condition). It is possible that the Kangaroo Island material represents a new species, especially given the distance and biogeographic barriers (Kangaroo Island, SA *versus* Sydney, NSW). The types of *T. banksiae* are, however, in too poor a condition to determine morphological differences, and confident species identification requires the collection of fresh specimens from the type locality.

Etymology. Named in honour of Dr Sarah Barrett, Regional Flora Conservation officer, for her dedication towards preserving the highly speciose flora of the southwest coastal region, of the southwest Australia biodiversity hotspot. Furthermore, she originally suggested *Banksia brownii* as a good candidate for the investigation into the coextinction of insects, and has continued to assist with field logistics regarding *B. brownii* and its insect assemblage that resulted in the discovery of this new species.

Host-plant association

Within Australia there were 80 species of *Banksia*, however Mast and Thiele (2007) synonymised the genus *Dryandra* with *Banksia*, therefore bringing the total number of

species to 173, the majority of which are endemic to south-west Western Australia. *Banksia brownii* is a large shrub to small tree (1–6 m), with five populations growing in montane heath in the Stirling Ranges of Western Australia. A further 12 scattered populations also occur in coastal heath south and east of Albany, and in marri (*Corymbia calophylla*) woodlands between the Stirling Range and coastal populations (Coates & McArthur 2009). Its conservation listing is as ‘Declared Rare’ because of its restricted and fragmented distribution, and susceptibility to the *Phytophthora* dieback disease. This disease has extinguished 10 populations in the last 15 years, reducing the current number of populations to 17 (Coates & McArthur 2009).

Further sampling of 19 *Banksia* species, including one of the closest relatives of *B. brownii*, *B. littoralis* (Thiele & Ladiges 1996), did not uncover *T. barrettae* on any other hosts. In addition, 16 Proteaceae species from other genera in south-west Western Australia, plus three *Banksia* species and ten Proteaceae species from other genera in New South Wales, failed to yield further specimens of *T. barrettae*.

Of the three highly fragmented populations of *B. brownii* sampled, *T. barrettae* was recorded from those in the Stirling Range National Park and at Vancouver Peninsula. These populations of *B. brownii* are over 80 km apart and represent genetically distinct host populations (Coates & McArthur 2009). *Trioza barrettae* was not recorded from a young translocated population between the two natural populations at West Kamballup (Moir et al. 2012a). Sampling of other extant natural populations of *B. brownii* is on-going date (Moir & Leng, unpublished data). It would be interesting to determine whether *T. barrettae* also occurs on these other wild populations, particularly given that we have shown previously (Taylor & Moir 2009), and in the cases of *A. mccarthyi* and *A. hughesae*, that Psylloidea species can be restricted to a small subset of the existing populations of the host species. There is particular urgency in determining the biogeographical range of *T. barrettae*, given the rapid decline of the host due to dieback disease. Moir et al. (2012b) also suggested that to assist in the conservation of this trioza (cited within as *Trioza* sp. 03), translocations onto other populations of the host plant should be considered, and are currently undergoing such trials (Moir & Leng 2013).

DISCUSSION

Jumping plant-bugs (including Psyllidae and Triozidae) appear to contain many species restricted in host-breadth to single host species, which therefore put these insects at greater

risk of coextinction than more polyphagous or oligophagous insect herbivores (Moir et al. 2010, 2011). For example, despite the threatened plant species *Acacia veronica* having only 13 populations remaining, we have recorded two new *Acizzia* species (*A. veski* and *A. mccarthyi*) that appear host-specific to the plant (Taylor & Moir 2009). In November 2012, two newly described Psylloidea from this paper, *T. barrettae* and *A. maccarthyi*, received conservation protection by the Western Australian State Government in recognition of their high extinction risk (as *Trioza* sp. 03 and *Acizzia* sp. 70: see <http://www.dec.wa.gov.au/management-and-protection/threatened-species/listing-of-species-and-ecological-communities.html>). They join *A. veski* as the only jumping plant-bugs listed by the State government. No species of Psylloidea are currently listed on the International Union for Conservation of Nature and Natural Resources *Red List* (IUCN 2012a), or by the Federal Australian Government. A recent nomination of *A. veski* for listing on the *Red List* (IUCN 2012a) was accepted, and will be published in mid-2013. *Acizzia veski* has been nominated to the Federal government twice since 2009, without success to date, along with *A. keithi* from New South Wales. Although *A. keithi* has subsequently been discovered on a second host species of *Pultenaea* (Powell et al. 2011), it may still require conservation management due to several factors. Firstly, only a small percentage of the population of *A. keithi* may occur on the non-threatened *Pultenaea* species, as potentially indicated by the low numbers of individuals discovered over the longer time period in the Powell et al. (2011) survey versus that of the Taylor & Moir (2009) study. Secondly, insects on multiple, closely related species of host plant may still face extinction if the insect is restricted to only a small part of the range of all the hosts (e.g., the insect may only occur on *Pultenaea* species in the Sydney basin). Thirdly, the hosts could all be threatened by a similar disturbance which reduces or extinguishes their populations and therefore is detrimental to even oligophagous herbivores; for a discussion of this factor see the section “correlated host extinctions” in Moir et al. (2010). At the very least, *A. keithi* requires further survey effort to determine its host-specificity, extent of occurrence and area of occupancy before it can be considered “not threatened”.

Acizzia are associated with a broad range of plant families, however, the majority (about 60% of the described Australian species) only occur on single plant species (e.g., Yen 2002). Their hosts have been recorded as *Acacia* and *Albizia* (both Fabaceae: Mimosoideae) (Yen 1977, 2002; Hollis 2004; Taylor & Moir 2009), *Amyema* mistletoes (Loranthaceae) (Taylor 1999, Hollis 2004), *Apophyllum* and *Capparis* (Capparidaceae) (Yen 1977, Hollis

2004), *Dodonaea* (Sapindaceae) (Taylor 1976, Hollis 2004), and *Solanum* (Solanaceae) (Kent & Taylor 2010; Taylor & Kent 2013).

The psyllid fauna associated with the Proteaceae now comprise only five described species in three genera in three psyllid families (Table 6). The psyllid fauna associated with *Banksia* comprise just three species in two genera, *Cecidopsylla* and *Trioza*, in two families, Calophyidae and Triozidae, respectively. Only two described species of *Acizzia*, *A. hakeae* and *A. hughesae* are recorded from *Grevillea* and *Hakea*, although undescribed species are represented in recent collections from 18+ species of *Hakea* and *Grevillea* in south-western WA: *G. caleyi*, *G. buxifolia* and *G. sericea*, Sydney, NSW; *G. huegellii*, Gawler Ra., SA; *H. leucoptera*, northern SA; *H. muelleriana* and *H. rostrata*, Kangaroo Island, SA (GST & MLM, unpublished data).

Given the proportion of jumping plant-bugs that appear specific to their host plants, there is the possibility that other species will qualify for State, Federal and International conservation listing (as defined using the protocols of Moir et al. 2011 and IUCN guidelines, IUCN 2012b). The management of these very small insects poses additional challenges, when the majority remain undescribed and knowledge of their ecological requirements is exceptionally depauperate.

ACKNOWLEDGEMENTS

We gratefully acknowledge funding (to GST) from the Australian Biological Resources Study (ABRS) National Taxonomy Research Grant Program (RF210-13) for support of this research. We are grateful for grants (to MLM) from the Australian Research Council (DP0772057), Australia & Pacific Science Foundation (APSF 07/3), and the National Climate Change Adaptation Research Facility (TB1106) for additional support for this work. This work was conducted under Western Australian Department of Environment & Conservation collecting licences SF006007, SF008165, and export licence ES002186. We thank S. Barrett (WA Department of Environment & Conservation) for assistance with locating populations of host plants, D.J. Coates (DEC) for discussions on *Banksia brownii*, and K.E.C. Brennan for assistance with fieldwork.

REFERENCES

- Barrett, S., Shearer, B.L., Crane, C.E. & Cochrane, A. (2008) An extinction-risk assessment tool for flora threatened by *Phytophthora cinnamomi*. *Australian Journal of Botany* **56**: 477–486.
- Coates, D.J. & McArthur, S. (2009) Assessing the taxonomic status of *Banksia brownii* and patterns of genetic diversity in extinct and extant populations. In: *Bankwest Landscape Project*. Western Australian Department of Environment and Conservation, Perth, p 8.
- Dale, P.J. (1985) *A review of the Psylloidea (Insecta: Hemiptera) of the New Zealand subregion*. Unpublished PhD Thesis. (The University of Auckland: Auckland).
- Fitzpatrick, M.C., Gove, A.D., Sanders, N.J., & Dunn, R.R., (2008) Climate change, plant migration, and range collapse in a global biodiversity hotspot: the *Banksia* (Proteaceae) of Western Australia. *Global Change Biology* **14**: 1337–1352.
- Froggatt, W.W. (1901) Australian Psyllidae. Part II. *Proceedings of the Linnean Society of New South Wales* **26**: 242–298.
- Harvey, M.S. (2002) Short-range endemism amongst the Australian fauna: examples from non-marine environments. *Invertebrate Systematics* **16**: 555–570.
- Heslop-Harrison, G. (1961) The Arytainini of the subfamily Psyllinae Hemiptera-Homoptera, family Psyllidae II. *Annals and Magazine of Natural History* **3**: 417–439.
- Hodkinson, I.D. (1974) The biology of the Psylloidea (Homoptera): a review. *Bulletin of Entomological Research* **64**: 325–339.
- Hollis, D. (2004) *Australian Psylloidea: Jumping plantlice and lerp insects*. Australian Biological Resources Study, Department of the Environment and Heritage, Canberra, 216 pp.
- International Union for Conservation of Nature and Natural Resources (IUCN). (2012a) *The IUCN Red List of Threatened Species. Version 2012.2*. <http://www.iucnredlist.org> . (Accessed March 2012)
- International Union for Conservation of Nature and Natural Resources (IUCN). (2012b) *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0*. Gland, Switzerland and Cambridge, UK: IUCN. iii + 41 pp.
- Kent, D.S. & Taylor, G.S. (2010) Two new species of *Acizzia* Crawford (Hemiptera: Psyllidae) from the Solanaceae with a potential new economic pest of eggplant, *Solanum melongena* L. *Australian Journal of Entomology* **49**: 73–81.
- Mast, A.R. & Thiele, K. (2007) The transfer of *Dryandra* R.Br. to *Banksia* L.f. (Proteaceae). *Australian Systematic Botany* **20**: 63–71.

- Moir, M.L., Vesk, P.A., Brennan, K.E.C., Keith, D.A., Hughes, L. & McCarthy, M.A. (2010) Current constraints and future directions in estimating coextinction. *Conservation Biology* **24**: 682–690.
- Moir, M.L., Vesk, P.A., Brennan, K.E.C., Keith, D.A., McCarthy, M.A., & Hughes, L. (2011) Identifying and managing cothreatened invertebrates through assessment of coextinction risk. *Conservation Biology* **25**: 787–796.
- Moir, M.L., Vesk, P.A., Brennan, K.E.C., Hughes, L., Keith, D.A., McCarthy, M.A., Coates, D.J. & Barrett, S. (2012a) Preliminary assessment of changes in plant-dwelling insects with the translocation of host plants. *Journal of Insect Conservation* **16**: 367–377.
- Moir, M.L., Vesk, P.A., Brennan, K.E.C., Hughes, L., Keith, D.A., McCarthy, M.A. & Coates, D.J. (2012b) Considering extinction of dependent species during ex situ conservation, translocation and assisted migration of threatened hosts. *Conservation Biology* **26**: 199–207.
- Moir, M.L. & Leng, M.C. (2013) *Developing management strategies to combat increased coextinction rates of plant-dwelling insects through global climate change*. National Climate Change Adaptation Research Facility, Gold Coast, Australia. 110 pp.
- Morgan, F.D. (1984) *Psylloidea of South Australia*. Government Printer, Adelaide, 136 pp.
- Ossiannilsson, F. (1992) *The Psylloidea (Homoptera) of Fennoscandia and Denmark*. *Fauna Entomologica Scandinavica*, 26: 346 pp. E. J. Brill, Leiden (Netherlands).
- Percy, D.M., Rung, A. & Hoddle, M.S. (2012) An annotated checklist of the psyllids of California (Hemiptera: Psylloidea). *Zootaxa* **3193**: 1–27.
- Powell, F.A., Hochuli, D.F. & Cassis, G. (2011) A new host and additional localities for the rare psyllid *Acizzia keithi* Taylor & Moir (Hemiptera: Psyllidae). *Australian Journal of Entomology* **50**: 441–444.
- Taylor, G.S. (1999) New species of *Acizzia* Heslop-Harrison (Hemiptera: Psyllidae from Australian mistletoe (Loranthaceae). *Journal of the Australian Entomological Society* **38**: 66–71.
- Taylor, G.S. & Moir, M.L. (2009) In threat of co-extinction: new species of *Acizzia* Heslop-Harrison (Hemiptera: Psyllidae) from vulnerable species of *Acacia* and *Pultenaea*. *Zootaxa* **2249**: 20–32.
- Taylor, G.S. & Kent, D.S. (2013) Potential developing economic pests of solanaceous crops: a new species of *Solanum*-feeding psyllid from Australia and first record from New Zealand of *Acizzia solanicola* (Hemiptera: Psyllidae). *Zootaxa* **3613**: 257–273.

- Taylor, G.S., Austin, A.D., Jennings, J.T., Purcell, M.F., & Wheeler, G.S. (2010) *Casuarinicola*, a new genus of jumping plant lice (Hemiptera: Triozidae) from *Casuarina* (Casuarinaceae). *Zootaxa* **2601**: 1–27.
- Taylor, G.S., Jennings, J.T., Purcell M.F. & Austin A.D. (2011) A new genus and ten new species of jumping plant-lice (Hemiptera: Triozidae) from *Allocasuarina* (Casuarinaceae) in Australia. *Zootaxa* **3009**: 1–45.
- Taylor, G.S., Jennings, J.T., Purcell, M.F. & Austin, A.D. (2013) Three new Australian species of *Trioza* Foerster (Hemiptera: Triozidae) with a remarkable adaptation to oviposition on articulate branchlets of *Allocasuarina* (Casuarinaceae). *Australian Journal of Entomology* **52**: 42–52.
- Taylor, K.L. (1976) Records of *Psylla dodonaeae* Tuthill (Hemiptera: Psyllidae) in Australia, with notes on its biology. *Journal of the Australian Entomological Society* **15**: 347.
- Taylor, K.L. (1984) Two new species of *Cecidopsylla* Kieffer (Homoptera: Psylloidea) from Australia forming pit galls on *Banksia* and *Geigera*. *Journal of the Australian Entomological Society* **23**: 277–283.
- Thiele, K. & Ladiges, P.Y. (1996) A cladistic analysis of *Banksia* (Proteaceae). *Australian Systematic Botany* **9**: 661–733.
- Tuthill, L.D. (1952) On the Psyllidae of New Zealand (Homoptera). *Pacific Science* **6**: 83–125.
- Van Der Berg, M.A. (1980) Natural enemies of *Acacia cyclops* and *Acacia saligna* in Western Australia: 3. Hemiptera-(Heteroptera). *Phytophylactica* **12**: 223–226.
- Vesk, P.A., McCarthy, M.A., & Moir, M.L. (2010) How many hosts? Modelling host breadth from field samples. *Methods in Ecology and Evolution* **1**: 292–299.
- Weston, P.H., & Barker, N.P. (2006) A new suprageneric classification of the Proteaceae, with an annotated checklist of genera. *Telopea* **11**: 314–344.
- Yen, A.L. (1977) Redescription of the species of *Psylla* Geoffroy (Hemiptera: Psyllidae) originally described by Froggatt. *Journal of the Australian Entomological Society* **16**: 7–20.
- Yen, A.L. (2002) Short-range endemism and Australian Psylloidea (Insecta: Hemiptera) in the genera *Glycaspis* and *Acizzia* (Psyllidae). *Invertebrate Systematics* **16**: 631–639.

Captions to figures

Figs 1–8. *Acizzia hughesae*, sp. n. (1), habitus, male (dorsal aspect); (2), habitus, female, (dorsal aspect); (3), habitus, male (lateral aspect); (4), habitus, female (lateral aspect); (5), head, male (dorsal aspect, from slide); (6), head, female (dorsal aspect); (7), fore wing, male (from slide); (8), fore wing, female. Scale = 1.0 mm.

Figs 9–16. *Acizzia mccarthyi*, sp. n. (9), habitus, male, (dorsal aspect); (10), habitus, female (dorsal aspect); (11), habitus, male (lateral aspect); (12), habitus, female (lateral aspect); (13), head, male (dorsal aspect, from slide); (14), head, female (dorsal aspect); (15), fore wing, male (from slide); (16), fore wing, female. Scale = 1.0 mm.

Figs 17–23. *Trioza barrettiae*, sp. n. (17), habitus, female (dorsal aspect); (18), habitus, male (lateral aspect); (19), habitus, female (lateral aspect); (20), head, male (dorsal aspect, from slide); (21), head, female (dorsal aspect); (22), fore wing, male (from slide); (23), fore wing, female. Scale = 1.0 mm.

Figs 24–37. Terminalia and egg of new species of co-threatened psylloids: Figs 24–27: *Acizzia hughesae*, sp. n. (24), male terminalia (lateral aspect); (25), paramere (inner face, lateral aspect); (26), distal portion of aedeagus; (27), female terminalia, (lateral aspect); Figs 28–31: *Acizzia mccarthyi*, sp. n. (28), male terminalia (lateral aspect); (29), paramere (inner face, lateral aspect); (30), distal portion of aedeagus; (31), female terminalia, (lateral aspect); Figs 32–36: *Trioza barrettiae*, sp. n. (32), male terminalia (lateral aspect); (33), paramere (inner face, lateral aspect); (34), distal portion of aedeagus; (35), female terminalia, (lateral aspect); (36), egg (lateral aspect). Scale = 0.1 mm.

Table 1. Measurements for adults of new species of *Acizzia* and *Trioza*. Measurements in mm. *From dried specimens.

Species	Sex	n	BL (vertex to terminalia)	BL (vertex to apex of folded wings)	HW	GCL	VL	VW	AL	AFIL
<i>A. hughesae</i>	♂	1	1.38	2.14	0.56	0.09	0.21	0.33	0.96	0.23
	♀	1	1.80	2.66	0.63	0.11	0.25	0.37	1.05	0.23
<i>A. mccarthyi</i>	♂	4	1.66–1.76	2.79–2.93	0.58–0.60	0.14–0.16	0.25–0.26	0.33–0.35	1.68–1.82	0.39–0.42
	♀	4	1.86–2.03	3.24–3.38	0.63–0.65	0.16–0.18	0.25–0.26	0.38–0.40	1.86–1.98	0.42–0.46
<i>T. barrettae</i>	♂	3	1.72–1.79	2.59–2.62	0.44–0.46	0.04–0.05	0.25–0.26	0.24–0.25	0.51–0.53	0.10–0.11
	♀	2	1.72–2.28	2.79–2.86	0.46–0.47	0.04–0.05	0.26–0.27	0.25–0.26	0.50–0.53	0.10–0.11

Table 2. Measurements for adults of new species of *Acizzia* and *Trioza*. Measurements in mm.

Species	Sex	n	WL	WW	Vein Rs	Vein M stem	Vein M1+2	Marginal width cell m1	Marginal width cell cu1	Vein Cu1b
<i>A. hughesae</i>	♂	1	1.72	0.72	1.05	0.60	0.61	0.25	0.30	0.37
	♀	1	2.10	0.91	1.35	0.74	0.81	0.32	0.47	0.42
<i>A. mccarthyi</i>	♂	4	2.28–2.34	0.72–0.76	1.37–1.49	0.70–0.91	0.70–0.81	0.28–0.32	0.56–0.61	0.26–0.30
	♀	4	2.66–2.79	0.85–0.90	1.72–1.84	0.91–0.96	0.96–1.07	0.33–0.37	0.65–0.72	0.33–0.35
<i>T. barrettae</i>	♂	3	1.97–2.03	0.69–0.76	0.80–0.82	0.96–1.04	0.30–0.39	0.25–0.28	0.36–0.40	0.26–0.33
	♀	2	2.21–2.24	0.72–0.76	0.82–0.96	1.09–1.11	0.35–0.40	0.27–0.28	0.42–0.44	0.32–0.37

Table 3. Measurements for adults of new species of *Acizzia* and *Trioza*. Measurements in mm.

Species	Sex	n	TL	MPL	PL	AEBL	AEDL	FPL	CL	SL
<i>A. hughesae</i>	♂	1	0.37	0.32	0.32	0.28	0.21			
	♀	1	0.44					0.47	0.18	0.35
<i>A. mccarthyi</i>	♂	4	0.45–0.47	0.25–0.26	0.25–0.26	0.25–0.26	0.18–0.19			
	♀	4	0.47–0.53					0.42–0.44	0.15–0.17	0.26–0.28
<i>T. barrettae</i>	♂	3	0.47–0.51	0.19–0.21	0.18–0.19	0.19–0.21	0.16–0.18			
	♀	2	0.48–0.49					0.42–0.44	0.15–0.16	0.49–0.53

Table 4. Ratios for adults of new species of *Acizzia* and *Trioza*.

Species	Sex	n	GCL:VL	VL:VW	VL:HW	AL:HW	TL:HW	MPL:HW	FPL:HW	FPL:CL	FPL:SL
<i>A. hughesae</i>	♂	1	0.43	0.64	0.38	1.71	0.66	0.57			
	♀	1	0.44	0.68	0.40	1.67	0.70		0.75	2.61	1.34
<i>A. mccarthyi</i>	♂	4	0.54–0.64	0.71–0.76	0.42–0.43	2.90–3.03	0.75–0.79	0.42–0.43			
	♀	4	0.62–0.69	0.64–0.67	0.40–0.41	2.95–3.14	0.75–0.82		0.67–0.70	2.59–2.80	1.56–1.69
<i>T. barrettae</i>	♂	3	0.16–0.19	1.00–1.04	0.54–0.59	1.11–1.20	1.02–1.16	0.41–0.48			
	♀	2	0.15–0.19	1.04	0.55–0.59	1.09–1.13	1.04		0.91–0.94	2.75–2.80	0.83–0.86

Table 5. Ratios for adults of new species of *Acizzia* and *Trioza*

Species	Sex	n	WL:HW	WL:WW	M1M	m1 cell value	cu1 cell value
<i>A. hughesae</i>	♂	1	3.07	2.39	1.02	2.44	0.81
	♀	1	3.33	2.31	1.09	2.53	1.12
<i>A. mccarthyi</i>	♂	4	3.80–4.03	3.04–3.25	0.77–1.27	2.33–2.89	2.03–2.31
	♀	4	4.22–4.38	3.09–3.21	1.01–1.15	2.59–3.24	1.86–2.18
<i>T. barrettae</i>	♂	3	4.28–4.55	2.67–2.90	0.29–0.39	1.20–1.44	1.09–1.50
	♀	2	4.77–4.80	2.91–3.11	0.32–0.36	1.30–1.53	1.04–1.38

Table 6. Species of Psylloidea associated with Proteaceae

Family	Species	Host	Locality	Reference
Calophyidae	<i>Cecidopsylla putealis</i> Taylor	<i>Banksia marginata</i>	Australia, SA	Taylor (1984)
Psyllidae	<i>Acizzia hakeae</i> (Tuthill)	<i>Grevillea banksii</i>	USA, California	Percy <i>et al.</i> (2012)
		<i>Grevillea</i> ‘Noellii’	USA, California	Percy <i>et al.</i> (2012)
		<i>Grevillea robusta</i>	New Zealand	Dale (1985)
		<i>Hakea acicularis</i>	New Zealand	Tuthill (1952) , Dale (1985)
		<i>Hakea suaveolens</i>	USA, California	Percy <i>et al.</i> (2012)
	<i>Acizzia</i> sp., near <i>hakeae</i>	<i>Hakea dactyloides</i>	Australia, NSW	Tuthill (1952)
	<i>Acizzia hughesae</i>	<i>Grevillea</i> ‘Stirling Range’	Australia, WA	This study
Triozidae	<i>Trioza banksiae</i> (Froggatt)	<i>Banksia serrata</i>	Australia, NSW	Froggatt (1901)
	<i>Trioza barrettae</i>	<i>Banksia brownii</i>	Australia, SA Australia, WA	Morgan (1984), this study This study

Figure