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Mimicry of host plant fruits by adults of the Australian leaf beetle *Procrisina pictipennis* (Boheman) (Coleoptera: Chrysomelidae)

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Abstract: The mimicry (procrypsis) of adults of the endemic Australian leaf beetle *Procrisina pictipennis* (Boheman, 1859) (Coleoptera: Chrysomelidae) with fruits (developing capsules) of its host plant *Leptospermum polygalifolium* Salisb. ssp. *polygalifolium* (Myrtaceae) is described. The behaviour and colour pattern appear to provide camouflage for the adults which feed and mate at or near the ends of the branches of the *Leptospermum* host plants, mostly on stems with developing capsules but also on foliage. The known host (food) plants of *P. pictipennis* are also reviewed.

Zusammenfassung: Die Mimikry der Adulten des endemischen australischen Blattkäfers *Procrisina pictipennis* (Boheman, 1859) (Coleoptera: Chrysomelidae) mit sich entwickelnden Kapselfrüchten ihrer Wirtspflanze *Leptospermum polygalifolium* Salisb. ssp. *polygalifolium* (Myrtaceae) wird beschrieben. Das Verhalten und die Farbmuster scheinen die Tarnung der Altkäfer zu gewährleisten, die an oder nahe bei den Zweigenden der Wirtspflanze *Leptospermum* fressen und sich vermehren, so meist an den Stielen sich entwickelnder Fruchtkapseln, aber auch auf Blättern. Die bekannten Wirtspflanzen (Nahrungspflanzen) von *P. pictipennis* werden vorgestellt.

Introduction

Procrisina pictipennis (Boheman, 1859) (Coleoptera: Chrysomelidae: Chrysomelinae) is a medium-sized leaf beetle occurring in the coastal and adjacent montane areas of eastern New South Wales (HAWKESWOOD & JOLIVET 2001). The adults usually measure 6.5–7.5 mm long and the body is coloured reddish-brown and is mottled with small cream spots and bands on the elytra. A coloured illustration of the adult is provided by LAWRENCE & BRITTON (1994). A review of the host plants of the species has been provided recently by HAWKESWOOD & JOLIVET (2001). JOLIVET & HAWKESWOOD (1995) noted that the genus *Procrisina* Asiam, 1968 occurs on *Leptospermum* (Myrtaceae) in Australia. Presently it appears that biological data are only available for one species of the genus, namely *Procrisina pictipennis*.

Host plants

Like most Australian chrysomelids, very little has been recorded on the biology and host-plants of *P. pictipennis*. FROGGATT (1907) briefly noted that the small green larvae of this species (cited as *Paropsis pictipennis*) fed upon the foliage of *Leptospermum* (plant species not identified). CUMPSTON (1939) also noted that this species (as *Paropsis pictipennis*) fed on *Leptospermum*. WEBB (1986) recorded this species (as *Procris pictipennis*) from the flowers of *Leptospermum lanigerum* (Aiton) Sm. (Myrtaceae) in the Bombala area, New South Wales. HAWKESWOOD & JOLIVET (2001) recorded *Kunzea ericoides* (A. Rich.) J. Thompson and *Leptospermum polygalifolium* Salisb. (Myrtaceae) as host plants from the lower Blue Mountains and Armidale areas, New South Wales. The egg, larva and pupa of the species have been described by CUMPSTON (1939).

Observations

(a) Description of the body shape and size and colour pattern of *P. pictipennis*

The body shape of this species is typical of the subfamily being domed (i.e. convex). The head, pronotum, underside of body and the legs in both sexes are coloured buff-brown. The elytra are dark brown with two irregular dull yellow fasciae on the elytra, one fascia is median and the other

is post-median in position. The median fascia is wider and more confluent than the post median one. There are small dull yellow spots mostly in the basal area of the elytra before the premedian fascia, a few spots in the area between the two fasciae and numerous similar spots between the post-median fascia and the apices of the elytra. The postmedian fascia is produced into a continous yellow band extending to the elytral margin (rim) then along the margin to the apex of each elytron. The yellow spots and fasciae of the elytra appear to be golden to the human eye when the beetles are in the field and the sun is being reflected from their bodies. The males are slightly smaller [6.5–7.0 mm long (excluding antennae) × 4.6–5.0 mm wide] than the females [6.9–7.6 mm long × 5.0–5.5 mm wide]. The yellow bands and spots vary slightly in size and shape from specimen to specimen but this variation does not appear to be sex-linked.

(b) Behaviour of *P. pictipennis* adults in the field

During early January 2001, the author in the company of Mr Richard Wells of Sydney, New South Wales were undertaking an environmental survey at Colo Heights, New South Wales. The area has been partially cleared in the past but is composed mostly of a *Eucalyptus punctata – E. sclerophylla* woodland in sandy soil. The area is very diverse botanically with a good representation of native species of Myrtaceae, Mimosaceae, Casuarinaceae as the main tree layers of the plant community and many species of grasses, herbs, small shrubs as the ground/shrub strata. Along a sandy creek, the shrub *Leptospermum polygalifolium* Salisb. (Myrtaceae) grew commonly. (This plant is described more fully below). Moderate numbers of *P. pictipennis* were noted on the shrubs, usually as singletons or less commonly as pairs (mating) on the foliage or amongst fruits or resting on leaves near the fruit capsules. An average total of one to two beetles (occasionally three) were found on plants and approximately 20% of the host plants in the area possessed beetles. Beetles were either resting or mating at the time of observations (10.00–11.00 hrs, Eastern Australian Standard Time). The weather was warm 25–27 °C, clear and with little wind. Those beetles which were sighted on the seed capsules near the ends of branches 1.5–2.0 metres above ground level, appeared to be well camouflaged. The immature seed capsules were greenish and the valves at the top of the fruits were reddish brownish in colour at the time (Note: when mature and dry, they become greyish in colour and become wrinkled). As with the reflections of golden-yellow from the fascia and spots on the bodies of *P. pictipennis*, there was also glistening from the slightly shiny, smooth, membranous valves. On the leaves, beetles were mostly observed on the underside of leaves where they were less easily observed. When disturbed, especially during mating, the adults usually exhibited a free-fall into the foliage below them or occasionally onto the ground below. Flight was not observed although the beetles are winged and probably regulary fly during certain times.

(c) Description of *Leptospermum polygalifolium* Salisb. ssp. *polygalifolium* (Myrtaceae)

This native host-plant species was previously known as *Leptospermum flavescens* Sm. and because of this scientific name is vernaculary known as the Yellow Tea Tree. [The species is also known as the Lemon-scented Tea Tree because the leaves were sometimes used as a tea substitute in the early days of Australian settlement]. This species is mostly a slender, often weeping shrub growing to 2 metres high but can be a tree to 7 metres high. It has smooth but firm bark and the younger stems are softly pubescent. The leaves are oblanceolate to elliptic or linear-elliptic in shape, mostly 10–20 mm long, 2–3 mm wide, acute, flat or with recurved margins, the lower surface often much paler and have a strong, citrus-like smell when crushed. Many young leaves are reddish or orange-red in colour. The flowers measure about 10–12 mm in diameter and are greenish or creamy white in colour. Flowering occurs from October to December. The fruit is a woody, domed capsule, usually 5 valved, mostly 7–10 mm in diameter and are arranged on all sides of the stem usually in the one area. The species grows in heathlands or dry sclerophyll forests and woodlands usually in deep sand or in skeletal soil, usually on sandstone and often in moist depressions or along watercourses. The flowers attract numerous insect pollinators during early summer (see HAWKESWOOD 1987 b) as well as some Chrysomelidae (see discussion) and at least *P. pictipennis* is known to feed on the foliage of non-flowering plants. At the time of observations, flowering had ceased and the new seed capsules were in an advanced state of development.

Discussion

In terms of host plant selection, *Procrisina pictipennis* appears to be restricted to the genus *Leptospermum* and the related *Kunzea ericoides* [this species was originally classified as a species of *Leptospermum* – viz. *L. phylicoides*]. The relative host plant specificity exhibited by this beetle is in accordance with the very close botanical relationships of the three identified species of Myrtaceae recorded as hosts for the species. *Leptospermum* and the very closely related *Kunzea* are no doubt monophyletic as they are a distinctive group amongst the Myrtaceae of eastern Australia where they are particularly well developed in terms of species diversity and are grouped closely together in flora treatments (e.g. HARDEN 1991, CAROLIN & TINDALE 1994, ROBINSON 1997).

The present observations indicate that adults of *P. pictipennis* are wary and are well camouflaged (i.e. procryptic) as they rest on stems or amongst the newly developing seed capsules or amongst tightly clustered leaves at the ends of branches of *L. polygalifolium*. As mentioned previously, many beetles were observed as single individuals resting on or between the young capsules where they were well camouflaged. The brown of the elytra appears to closely match the colour of the valves of the young fruiting capsules while the yellow spots and fasciae of the elytra appear to act as a break-up pattern and reflect light and resemble the reflections from the shiny valves of the young *Leptospermum* capsules. The buff-brown colour of the head, legs and underside of the body appear to merge in with the general stem and capsule colour, although this coloration is not exactly the same shade as the stems and leaves. The body size of adults is similar to the size dimensions of many of the developing fruits. It appears that the behaviour, colour pattern and resting positions are acting as a defence mechanism for this species against possible predators such as birds. In addition, feeding on the leaves of *Leptospermum* which contain numerous oils and fragrances may contribute to the beetles being distasteful to predators. However, this latter suggestion needs further investigation.

The relationships of *Procrisina* have not yet been studied in detail but the genus is obviously very closely related to the endemic Australian genera *Paropsis* Olivier, 1807 and *Chrysophtharta* Weise, 1901 in the tribe Chrysomelini Reitter, 1912 (DACCORDI 1994). These genera also exhibit close relationships with the Myrtaceae, although *Eucalyptus* species are the host plants usually selected (see e.g. BROOKS 1965; CANDY et al. 1992; CARNE 1966; CUMPSTON 1939; DE LITTLE 1983; DE LITTLE et al. 1990; DE LITTLE & MADDEN 1975; ELLIOT & DE LITTLE 1984; ELLIOT et al. 1992; FROGGATT 1907; GREAVES 1966; HAWKESWOOD 1987a, 1988; HAWKESWOOD & JOLIVET 2001; JOLIVET 1998; JOLIVET & HAWKESWOOD 1995; KELLY 1985; LAWRENCE & BRITTON 1994; RAMSDEN & ELEK 1998; TILLYARD 1926; ZBOROWSKI & STOREY 1998).

It appears (at least from the data at hand) that very few species of Australian Chrysomelidae have adapted to feed on the foliage of *Leptospermum* species. *Eboo viridula* (Erichson) (Eumolpinae) has been recorded from foliage of *Leptospermum myrtifolium* Sieb. ex DC. in New South Wales by REID (1993) but this may only be an accidental record since no definite host plant association was confirmed by that author. On the other hand, it is apparent that some other native Australian Eumolpinae definitely feed on flowers of *Leptospermum*. *Cleptor inermis* Lefèvre has been recorded feeding on the nectar, pollen and floral parts of *L. polygalifolium* [cited as *L. flavescens*] in south-eastern Queensland (HAWKESWOOD 1987a; HAWKESWOOD & JOLIVET 1988). The poorly studied genus *Edusella* is also known to be floricolous (presumably) on *Leptospermum*. *Edusella chrysura* Germeine has been recorded from the flowers of *L. juniperinum* Sm. and *Kunzea ericoides* (A. Rich.) Thompson (= *L. phylicoides*) (WEBB 1986) and probably feeds on the pollen, nectar and/or floral parts of the creamy-white *Leptospermum* and *Kunzea* flowers. Likewise, *Edusella puberula* Boheman has been recorded from the flowers of *Leptospermum attenuatum* Sm. by WEBB (1986) but again it is not clear whether the beetle feeds on pollen, nectar or both, but this would appear highly likely. [It is also not clear whether foliage is eaten by these species of leaf beetles]. Clearly, much more field research is needed in order to determine the true feeding relationships of these chrysomelids. In my experience, *P. pictipennis* appears not to feed from flowers and I have always found specimens on non-flowering host plants.

Mimicry of seeds and/or fruits of host plants or non-host plants is a phenomenon which has evolved in numerous species of Chlamisinae and in the related chrysomelid subfamilies of

Cryptocephalinae and Clytrinae (e.g. BRIGGS 1905; ERBER 1988; JOLIVET 1978; JOLIVET & HAWKESWOOD 1995; KARREN 1989; NEAL 1989; ROOT & MESSINA 1983; WOOD 1966). With most of these taxa the mimicry is very marked and striking, much more so than in the case with *P. pictipennis*. Nevertheless, the camouflage coloration and behaviour of *P. pictipennis* may be as effective in predator avoidance as the elaborate coloration and behaviour of the Chlamisinae and others.

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