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Observations on the biology and host plants of the Australian tortoise beetle, *Cassida compuncta* (Boheman), with a description of the larva, pupa and adult (Insecta: Coleoptera: Chrysomelidae)

With 3 Figures

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Abstract: The larva, pupa and adult of the Australian tortoise beetle *Cassida compuncta* (Boheman) (Coleoptera: Chrysomelidae: Cassidinae) are described from material collected during February to March 1997 on the north-eastern coast of New South Wales. The adult description is based on live material which display different colours from those of dead adults. The larvae and adults feed on the fresher foliage (but not flowers) of the introduced twining vine, *Ipomoea cairica* (L.) Sweet (Convolvulaceae), which has not been recorded previously as a host plant for *C. compuncta* or any other Australian Cassidinae. Published distribution records are reviewed and other localities, based on collections/observations of the first author, are included. The species is mostly subtropical and coastal in distribution, and appears to be monophagic on *I. cairica* in north-eastern New South Wales.

Zusammenfassung: Die Larven, Puppen und Imagines des australischen Schildkäfers *Cassida compuncta* (Boheman) (Coleoptera: Cassidinae) werden anhand von Material beschrieben, das im Februar und März 1997 an der nordöstlichen Küste von Neusüdwales gesammelt wurde. Die Beschreibung der adulten Tiere basiert auf lebendem Material, das Farben ausprägt, die von jenen toter Imagines abweichen. Die Larven und Imagines fressen von frischen Blättern (nicht von Blüten) der eingeführten Prachtwinde *Ipomoea cairica* (L.) Sweet (Convolvulaceae), die bisher noch nicht als Wirtspflanze von *C. compuncta* oder irgend einer anderen Art der australischen Cassidinae festgestellt wurde. Die bisher veröffentlichten Fundfeststellungen wurden überprüft und andere Fundpunkte einbezogen, die auf Aufsammlungen und Beobachtungen des erstgenannten Autors beruhen. Die Art ist subtropisch und im Küstenbereich verbreitet und scheint monophagisch auf *I. cairica* im Nordosten von Neusüdwales zu leben.

Introduction

The Cassidinae (Coleoptera: Chrysomelidae) of Australia are represented by the genera *Aspidimorpha* Hope, *Austropsecadia* Hincks, *Cassida* L., *Emdenia* Spaeth, *Laccoptera* Boheman, *Merascalsis* Spaeth, *Notosacantha* Chevrolat and *Thlaspidula* Spaeth (SEENO & WILCOX 1982). Biological, ecological, distributional and behavioural aspects of these genera within Australia are mostly lacking and the early life-stages are poorly known or not known at all. However, HAWKESWOOD (1982, 1987, 1988) recently provided biological data on *Aspidimorpha deusta* (Fabricius) (as *Aspidomorpha*) and *A. maculatissima* (Boheman) from the Townsville district, north-eastern Queensland, while HAWKESWOOD (1987, 1989, 1994) provided biological data on *Notosacantha dorsalis* (Westwood) (as *Hoplionota*) from southern Queensland.

The genus *Cassida* L. is represented in the Australian mainland by 8 species, viz. *C. aureola* Spaeth, *C. compuncta* (Boheman), *C. denticulata* (Boheman), *C. diomma* Boisduval, *C. mera* Germar, *C. navicella* Boheman, *C. sappho* (Boheman) and *C. sexguttata* Boisduval (BOROWIEC 1990). Published biological/host plant data exist for only one species, *C. diomma*. HAWKESWOOD (1987, 1988) provided some biological/ collection notes on this species (as *Metriona holmgreni* Spaeth) from north-eastern Queensland. Apart from the brief observations provided by LEBRETON & HAWKESWOOD (1993) of a *Cassida compuncta* adult overwintering or sheltering in the tightly clustered, erect, slender leaves of the monocot *Gahnia erythrocarpa* R. Br. (Cyperaceae) at King-

scliff, north-eastern New South Wales (28° 17′S, 153° 34′E), there have been no biological data for the species. BOROWIEC (1990) listed certain localities for this species, but provided no biological details. The host-plant, larva, pupa and adult of this species are described below based on recent field work by the first author. The adult is also redescribed below based on live specimens which appear much different from the dead specimens. From the descriptions provided by BOHEMAN (1855) and BOROWIEC (1990), it is obvious that these authors never saw live adults.

Descriptions

Cassida compuncta (Boheman, 1855)
Coptocycla compuncta Boheman, 1855: 290; 1862: 440.
Metriona compuncta: Spaeth, 1914: 142; 1915: 235.
Cassida compuncta: Borowiec, 1990; 24; Le Breton & Hawkeswood, 1993: 35.

Adult (Fig. 1). Body 5.0–5.5 mm in length and 3.8–4.2 mm in width; pronotum 1.8–2.0 mm in length and 2.7–3.0 mm in width; broadly oval to almost circular in dorsal view; bright leafy green with elytral disc almost wholly occupied with chocolate-brown and with irregular, golden to silver-golden markings.

Head bright leafy green, with a tinge of yellow, without visible puncturation; eyes large and black; clypeus about 1.2–1.3 times as wide as long, flat and microreticulate; anterior margin bisinuate. Prosternal process broad, leafy-green, strongly expanded apically and non-sculptured. Antennae moderately long, 1st to 5th segments pale buff-brown, 6th darker brown, 7–11th blackish-brown; 6–11th pubescent with appressed setae; 1–6th slender, 1st about 4.0 times as long as wide, 6th and 7th conical, 8–10th mostly cylindrical, 11th the longest and conical at the apex. Pronotum 1.5–1.6 times as wide as long, widest at the middle; lateral margins rounded; pronotal disc moderately convex, bright leafy green, impunctate and indistinctly microreticulate; explanate margins (pronotal flanges) broad, with leafy green reticulations (honey-comb pattern)

Fig. 1. *Cassida compuncta* (Boheman) adult, dorsal view. Scale line = 2 mm. (Photo: H. Takizawa)

which become narrower and paler (more yellowish-green) towards the laterad. Scutellum dark brown with a greenish tinge. Elytra wider than pronotum at base, anterior margin slightly crenulate, elytral disc strongly and regularly convex, highest at anterior third to half of body; the external margin of the dark pattern is regular at eighth row of punctures, without emarginations; surrounding the dark pattern is a border of leafy-green which extends into the honeycomb-patterns of the broad, elytral flanges; suture dark-brown except for the extreme apex; postscutellar depressions shallow, golden to silvery-golden markings along disc slightly elevated, not forming a distinct X-shaped postscutellar elevation; puncturation of disc regular but rows partially interrupted by the elytral relief; intervals as wide as or two-thirds wider than the diameter of punctures; punctures usually with a dark aureolus and seemingly larger than their real size; surface of intervals glabrous and shiny; marginal interval as wide as submarginal one; punctures of marginal row as large as or slightly larger than those of submarginal row. Abdominal sternites brownish-yellow with bright leafy-green margins with green honeycomb-patterns extending into the more or less transparent elytral flanges. Legs moderately elongate, green except for area near the femur/tibia joint and tarsi; midfemora without subapical projections, tibiae slender without external, longitudinal projections; tarsi broad and pale yellow-buff; last tarsal segment as long as third one, claws simple but apparently appendiculate.

Material examined: 2 exs., Hastings Point, New South Wales, 28 Feb. 1997, T. J. Hawkeswood, found feeding and resting on the underside of leaves of *Ipomoea cairica* (Convolvulaceae) (T. J. Hawkeswood collection); 3 exs., Hastings Point, New South Wales, 24 March 1997, T. J. Hawkeswood, from *I. cairica* (T. J. Hawkeswood & H. Takizawa collections).

Last instar larva (Fig. 2a–e): Body oblong ovate, 5–6 mm in length, 3.3–4.0 mm in width excluding lateral projections; dirty cream yellowish, with supra-anal processes light brownish in alcoholic specimens; dorsum glabrous, flat with 16 pairs of lateral projections and a pair of long supra-anal processes; lateral projections rather short; spiracles not elevated.

Head weakly chitinized, transverse and subparallel-sided; frontal sutures absent; vertex with 4 pairs of short setae; frons medially depressed with about 8 pairs of short setae; antennae two-segmented, with the 2nd slender and cylindrical; labrum gently and deeply incised at anterior margin. Pronotum with 1st and 2nd projections fused basally; mesothorax with several minute setae medially on the dorsum; 4th projection (numbered from prothorax to posteriorly) with about 13 spinules laterally and with 6 smaller ones ventrally; 9th one distinctly shorter than half the width of 1st abdominal segment; relative length of lateral projections as: 15th > 16th > 1st > 4th = 8th = 10th > 2nd = 3rd = 5th = 6th = 7th > 9th > 11th > 14th > 12th = 13th; 15th almost 2.5 times as long as 14th; supra-anal processes slender and sinuate, almost twice as long as 15th; 1st and 2nd abdominal segments weakly thickened medially on venter.

Pupa (Fig. 2f–h): Body glabrous, narrow-oval to elliptical, 5.5 mm in length and 3.5 mm in width (excluding the cast skins of larvae); pale yellow-green with most projections and the pronotal flange pale yellow. Head glabrous, pronotum more or less flat with a small, sub-median depression on both sides of the median line, with 45–60 marginal spinules; two pairs of anterior spinules slightly longer than the others, spinules not apparently fused to any others at the base. Abdomen with broad, well-developed lateral projections on first 5 segments; each projection acuminate distally, with about 7–10 whitish spinules; 6th segment with only a small, blunt projection; 7th with a slender, seta-like projection; 8th with a similar one, closely appressed to body; 9th with a pair of very long, slender apical projections, which are longer than twice the 7th; 1st to 5th abdominal spiracles produced, 4th about twice as high as wide.

Material examined: 17 larvae (mostly last instar), 7 pupae, Hastings Point, New South Wales, 15–18, 18–24 March, 1997, T. J. Hawkeswood, from leaves of *Ipomoea cairica* (L.) Sweet (Convolvulaceae) (T. J. Hawkeswood & H. Takizawa collections).

Distribution: (Fig. 3). Australia: Queensland–Maryborough, Brisbane, Southport (Gold Coast) (Borowiec 1990). New South Wales – Hastings Point, Kingscliff, Pottsville, Brunswick Heads, Ballina, Lismore, Murwillumbah (this paper), Clarence River, Hunter River, Manning River (Borowiec 1990).

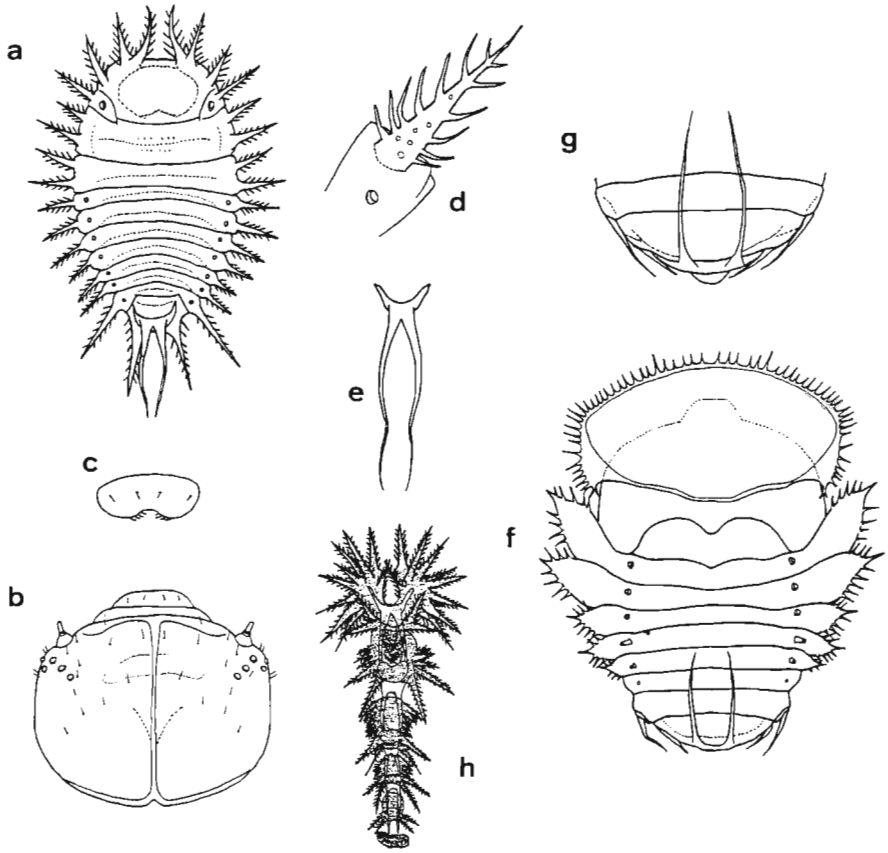

Fig. 2. Larva (a–e) and pupa (f–h) of *Cassida compuncta*. Larva: a, dorsal view; b, head; c, labrum; d, mesothoracic lateral projection; e, supra-anal processes. Pupa: f, dorsal view; g, 7th–9th abdominal segments; h, cast skins. (Illustrations: H. Takizawa)

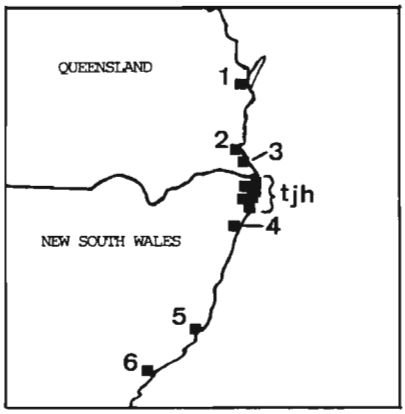

Fig. 3. Distribution of *Cassida compuncta*. 1 = Maryborough, 2 = Brisbane, 3 = Southport, 4 = Clarence River, 5 = Manning River, 6 = Hunter River, tjh = localities collected by the senior author, in decreasing order down the coast: Kingscliff, Hastings Point, Pottsville, Murwillumbah (slightly inland), Brunswick Heads, Ballina, Lismore (slightly inland). (Map: T. J. Hawkeswood)

Host plants: Adults and larvae feed on the foliage of the introduced climbing plant, *Ipomoea cairica* (L.) Sweet (Convolvulaceae). *Ipomoea cairica* is a twining, herbaceous perennial, with alternate leaves lacking stipules, measuring 1–5 cm long; they are digitately divided into 5–7 lobes. The corolla of the pink, purple or white flowers is campanulate but is constricted into a tube towards the base and measures 3–5 cm long. The plants are common on the north coast of New South Wales and in other areas. BEADLE et al. (1976) stated that the species is cosmopolitan, but is probably introduced to Australia. In north-eastern New South Wales, the species is often common on roadsides and in cleared paddocks where it climbs on fences and over logs and trees. It is a colonizing species and grows most profusely in semi-exposed situations.

One adult of *C. compuncta* has been recorded overwintering in the tightly clustered leaves of the sedge *Gahnia erythrocarpa* R. Br. (Cyperaceae) at Kingscliff, New South Wales (28° 17′ S, 153° 34′ E) on 28 August 1992 (LEBRETON & HAWKESWOOD 1993), indicating the utilization of another plant species for part of the beetle's life cycle. *Gahnia erythrocarpa* is a perennial herb, growing to about 2 metres in height, with terete, ± solid, stiff, erect stems; the long-linear leaves, which measure about 1.0–1.5 metres long and 8–10 mm wide, are situated at the base of the stems and usually have closed sheaths which overlap the adjacent leaf bases. In the Kingscliff-Hastings Point area, the plant grows on relatively flat ground in damp sandy areas in vine thickets and along creeks or soaks and in pale grey sand (lithosol) in heathlands and closed woodlands (LEBRETON & HAWKESWOOD 1993).

Feeding behaviour of larvae and adults: Feeding by the larvae and adults of *C. compuncta* occurs mostly on the underside of the leaves and results in small to medium-sized, irregular to rounded holes measuring 2–8 mm in diameter or larger eaten-out sections. Foliage is chewed so that most of the palisade mesophyll is consumed. Larvae are cryptically coloured in bright green and are very difficult to find amongst the tightly packed foliage at the tops of plants where twining is greatest. In one instance, many early to later instar larvae were observed/collected resting/feeding on the upper surface of a number of leaves at the end of a branch section where they were orientated parallel to the main leaflet veins. With their faecal shields held over the dorsum of the body, they were often difficult to find, as the green matched the colour of the leaflets and the narrow shield of cast skins resembled curled up necrotic, dead leaf margins etc. Adults were much less common than the larvae and were mostly found on the undersurface of the leaflets. In response to direct sunlight, the larvae will orientate their bodies in a direct line with the incidence of light and place the row of cast skins over their bodies for protection, but if the heat is too intense, they will seek cover under the leaves. Adults are particularly wary and will fly from the plants during hot periods of the day if disturbed. During other times, they may simply drop to the ground where they are usually indistinguishable amongst leaf and twig debris. Though no parasitoids are known to attack this species, three among 7 examined pupae each had 7 or 8 parasitoid-larvae in their bodies.

Comments

This species is characterized on biological basis by: 1) larvae bear cast skins in a ladder-like fashion on the supra-anal processes of successive instars; 2) first instar larvae only bear a small mass of faeces on the supra-anal processes; 3) pupation takes place on leaf-surface with all the cast skins of larvae (TAKIZAWA 1980). These characters are commonly shared with some species of the subgenus *Taiwania* Spaeth, viz. *C. versicolor* Boheman and *C. circumdata* Herbst. The larva of *C. compuncta* is also similar to these species morphologically. The subgenera of this large genus are too often artificial and a thorough revision of the groups is necessary. Characters of the immature stages should provide some useful input into such a revision in association with adult morphology.

JOLIVET (1988) and JOLIVET & HAWKESWOOD (1995) have reviewed the host plant genera utilized by the world Cassidinae. *Cassida*, an enormous, cosmopolitan genus, has been recorded from a large number of plant genera and species in numerous families, although the Convolvulaceae family takes some precedence, with the genus *Ipomoea* one of the most readily utilized as

food by adults and larvae. In New South Wales, *C. compuncta* appears to be monophagic on *Ipomoea cairica*, but as this is an introduced plant species, the beetle must utilize one or some of the native Convolvulaceae. But which ones remain undetermined, and their identity requires further field research. *Ipomoea cairica* is the first published host plant for *C. compuncta* and this plant has not been recorded as host for any other Australian Cassidine. However, HAWKESWOOD & FURTH (1994) have recorded *I. cairica* as an adult host plant for the leaf beetle *Chaetocnema calida* Blackburn, an alticine which shares this niche on *Ipomoea* leaves with *C. compuncta* (although *C. compuncta* tends to inhabit plants which are not being utilized by *C. calida*, so there may be some niche differentiation occurring here). Two species of Australian *Cassida* have now had their hostplants recorded in the literature. HAWKESWOOD (1988) recorded *Ipomoea triloba* L. and *I. batatas* (L.) Poir. (Convolvulaceae) as hosts for *Cassida diomma* Boisduval (cited as *Metriona holmgreni* (Boheman)) from the Townsville district, north-eastern Queensland. Further research should show that other *Cassida* species from the Australian mainland also utilize the foliage of *Ipomoea*.

The presence of larval parasitoids in about 50% of the pupae of *C. compuncta* examined, is of interest and such a high level of parasitism is probably the main reason why adults of *C. compuncta* are not as common as larvae in the field. Despite the presence of defensive attributes, such as the larval faecal shield (and cast skins on the caudal processes) and cryptic coloration and behaviour, tortoise beetle populations in the field can be heavily infested by natural enemies, since slow-moving larvae and stationary pupae can be particularly more vulnerable to attack (OLMSTEAD 1996). It would be of interest to detect and identify the larval/pupal parasitoids of *C. compuncta* and to study their role in population regulation, since so very little has been published on this aspect of predator/host biology, at least for the Australian species of Cassidinae. Only one host record apparently exists for an Australian Cassidinae, viz. HAWKESWOOD (1982) recorded an unidentified species of *Pediobius* (Hymenoptera) as a parasitoid of *Aspidimorpha maculatissima* (Boheman) in the Townsville district, north-eastern Queensland (see also OLMSTEAD 1996).

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