

Review of the history, biology and host plants of the Australian weevil *Chrysolopus spectabilis* (Fabricius)

(Coleoptera: Curculionidae: Aterpinae)

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The larval and adult host plants of the Australian weevil *Chrysolopus spectabilis* (Fabricius) (Coleoptera: Curculionidae: Aterpinae) are reviewed from the literature, unpublished museum records and from personal observations of the author. Published biological and historical data are also reviewed. The known larval hosts are as follows: *Acacia baileyana*, *A. decurrens*, *A. longissima*, *A. pycnantha*, *A. suaveolens* and *A. terminalis* (Mimosaceae). There are at least 29 recorded adult host plants, mostly *Acacia* species (Mimosaceae): *Acacia armata*, *A. aulacocarpa*, *A. baileyana*, *A. dealbata*, *A. decurrens*, *A. elata*, *A. falciformis*, *A. filicifolia*, *A. fimbriata*, *A. holosericea*, *A. implexa*, *A. leiocalyx*, *A. leptostachya*, *A. linifolia*, *A. longifolia*, *A. longissima*, *A. mangium*, *A. mearnsii*, *A. melanoxylon*, *A. parramattensis*, *A. parvipinnula*, *A. penninervis*, *A. podalyriifolia*, *A. retinodes*, *A. sophorae*, *A. spectabilis*, *A. suaveolens*, *A. terminalis* and *Eucalyptus pilularis* (Myrtaceae).

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Introduction

The distinctive and attractive metallic blue and black weevil, *Chrysolopus spectabilis* (Fabricius) (Fig. 1), popularly known as the Botany Bay Diamond Beetle (Weevil), is distributed from coastal northern Queensland to Victoria and eastern South Australia (Chadwick, 1978; Chadwick & Brunet, 1985; Hawkeswood, 1987). The beetle most commonly occurs in eastern New South Wales, where both larvae and adults are closely associated with a large number of *Acacia* species (Mimosaceae). The type specimens were probably collected from Cooktown, north-eastern Queensland by J. Banks, C. Solander and other naturalists on the Endeavour expedition up the east coast of Australia during August 1770 (see Radford, 1981 for details on the type collection). The beetle was commonly collected by residents of the colonial days at Botany Bay, hence the vernacular name. This paper attempts to summarize the biology and host plants of *C. spectabilis* from the published literature and personal observations of the author made during 1965–1989 in various areas of eastern Australia. In addition, previously unpublished data from the Australian National Insect Collection (ANIC) in Canberra, Australian Capital Territory, are recorded here.

The association of *C. spectabilis* with *Acacia* species (Mimosaceae) has been noted many times over the past 100 years by Froggatt (1893, 1902, 1907, 1923, 1927), Gurney (1911), Gallard (1916), Illidge



Fig. 1. Adult female on the leaf of *Acacia leiocalyx* (Domin) Pedley at Brisbane, south-east Queensland. Photograph: author. Scale line = 7 mm.

(1922), Tillyard (1926), McKeown (1944), Brooks (1948), Britton (1970), Healey & Smithers (1971), Moore (1978), Chadwick (1978), van den Berg (1982), Chadwick & Brunet (1985), Hawkeswood (1987) and Rheinheimer (1989). These papers and articles will be reviewed in the following sections.

Biology

a. Larval host plants

The first published observations on the biology of *C. spectabilis* were those of Froggatt (1893: 37-38), who recorded the beetle breeding in the stems of *Acacia terminalis* Salisb. (= *A. botrycephala* Vent., = *A. discolor* (Andr.) Willd.), in the Sydney district (Rose Bay), New South Wales.* (Voucher collections for this record are in the Australian Museum (AM) collection, Sydney; Chadwick, 1978: 24). Froggatt (1893) also bred adults from the roots of *A. longissima* Wendl (listed as *A. linearis* Sims) and *A. suaveolens* (Sm.) Willd., from the Sydney district. (Voucher collection from *A. suaveolens* is in the AM collection; Chadwick, 1978: 24). Froggatt (1902: 703-704) vaguely indicated that *C. spectabilis* bred in *A. decurrens* (Wendl.) Willd. Froggatt (1907, 1923) provided further biological notes but did not add any further larval host records. Gurney (1911: 57-58) noted that *C. spectabilis* was a wattle tree insect with "wood-boring grubs" but failed to list the *Acacia* species that were hosts. Gur-

* Froggatt (1893: 38) also recorded "*Acacia laurifolia*" as a larval host but I have checked this name in standard reference works such as Beadle et al (1972) *Flora of the Sydney Region*, and Pedley (1978) *Austrobaileya* 1: 75-234, but it does not appear, so it is apparent that Froggatt used an invalid name and so the record must be disregarded.

ney (1911) also briefly noted that although *C. spectabilis* was a common beetle, little was known of its biology. Obviously he was unaware of the previous research of Froggatt (1893, 1902) on the species. Gallard (1916: 113) recorded the species as a borer of *A. decurrens* but did not provide any other biological details. Illidge (1922: 62) noted that larvae of *C. spectabilis*, as well as other wood-boring insects, had destroyed an *A. baileyana* F. Muell. in a Brisbane suburb, Queensland. No further details were provided. Froggatt (1927: 13) bred an adult from the stem of *Acacia pycnantha* Benth at Wee Waa, New South Wales. R. H. Mulder in Chadwick (1978: 25) recorded larvae of *C. spectabilis* tunnelling in the stems of *A. suaveolens* (Sm.) Willd. and *A. longissima* Wendl. (listed as *A. linearis*) at Helsenburgh, New South Wales on 10 March 1968.

b. Adult Host (Food) Plants

1. Bipinnate *Acacia* species

I *Acacia baileyana* F. Muell. (Cootamundra Wattle)

New host record: During December and January 1973 and 1974, I collected several adults from branches and leaves of young plants (1.3–1.8 m high) of this wattle, growing along a roadside at Wagga Wagga, New South Wales.

II *Acacia dealbata* Link (Silver Wattle)

Records: Sydney district, New South Wales (Froggatt, 1893: 38); 1 adult, from Green Hills (Pine Plantation), Australian Capital Territory (Jan.) in ANIC.

III *Acacia decurrens* (Wendl.) Willd. (Green Wattle)

Records: Sydney district, New South Wales (Froggatt, 1893: 38; Froggatt, 1902: 704); 3 adults, 14 km south of Berrima (Black Bobs Creek), New South Wales (Dec.) in ANIC; van den Berg (1982: 52) recorded *C. spectabilis* feeding on phyllodes of *A. decurrens* in eastern Australia but failed to provide exact locality data etc.; On 4 Dec. 1981, Brunet in Chadwick & Brunet (1985: 106) collected a malformed adult from *A. decurrens* at "Oak Flats", Araluen Valley, New South Wales; During December and January 1976 and 1977, I observed adults feeding and mating on this wattle at various localities in dry sclerophyll forests in the Glenbrook-Lapstone area, lower Blue Mountains, New South Wales.

IV *Acacia elata* A. Cunn. (Mountain Cedar Wattle)

Record: Van den Berg (1982: 54) recorded *C. spectabilis* feeding on phyllodes of *A. elata* in eastern Australia but failed to provide exact locality data.

V *Acacia filicifolia* Cheel et Welch (Fern-leaf Wattle)

New host record: During November 1976 and 1977, I observed several adults on minor branches and trunks of young, non-flowering plants (1.0–1.5 m high) at Armidale, Ebor, New England National Park, Wolloumobi, Dangars Falls and near Grafton, New South Wales.

VI *Acacia mearnsi* De Wild. (Black Wattle)

Records: Froggatt (1923: 108) noted that the weevil was common on the foliage of the Black Wattle; 16 km SW of Braidwood, New South Wales, 26. Jan. 1963, C. E. Chadwick (Chadwick, 1978: 24); During 1965-67 in the Glenbrook-Lapstone area of the lower Blue Mountains, New South Wales, I observed adults feeding on stems, branches and occasionally leaves of non-flowering young plants during November to January; van den Berg (1982: 54) recorded *C. spectabilis* feeding on the phyllodes of *A. mearnsii* in eastern Australia (exact locality not listed).

VII *Acacia parramattensis* Tindale (Parramatta Wattle)

Records: North Richmond, New South Wales, 9 Dec. 1973, C. E. Chadwick (Chadwick, 1978: 25); During November to January 1965-67 in the lower Blue Mountains, New South Wales, I observed numerous adults on stems and minor branches of young plants (1.0-1.5 m high) commonly growing in disturbed areas in woodlands and dry sclerophyll forests- they fed on the thin green bark of living plants.

VIII *Acacia parvipinnula* Tindale

New host record: During January 1977 I observed two adults mating on a branch of this wattle near Katoomba, higher Blue Mountains, New South Wales – the female was also chewing the bark of the branch.

IX *Acacia spectabilis* A. Cunn. ex Benth.

New host record: During December 1983, I observed one adult weevil feeding on a portion of stem of this plant at Brisbane, Queensland – the site was a residential garden.

X *Acacia terminalis* (Salisb.) MacBride (Sunshine Wattle)

Record: Sydney district, New South Wales (Froggatt, 1893: 38) (listed as *A. discolor*).

2. Phyllodinous *Acacia* species

I *Acacia armata* R. Br.

Record: Canberra, Australian Capital Territory, 1 Mar. 1986, J. Rheinheimer (Rheinheimer, 1989: 29).

II *Acacia aulacocarpa* A. Cunn. ex Benth.

New host record: During November to December, 1980-1981, I observed several adults feeding and mating on stems and branches of young plants (1.0-2.5 m high) of this wattle growing in disturbed habitats alongside roads in the Townsville-Bowen district, northern Queensland.

III *Acacia falciformis* DC.

Records: Mittagong, New South Wales, 23 Mar. 1968, C. E. Chadwick, "chewing leaves" (Chadwick, 1978: 25); Hampton, New South Wales, 27 Dec. 1968, C. E. Chadwick (Chadwick, 1978: 25).

IV *Acacia fimbriata* A. Cunn. ex G. Don (Fringed Wattle)

New host record: During December to January 1985 and 1986, I observed several adults feeding and mating on the stems and branches of semi-mature plants (1.5-2.5 m high) growing in *Eucalyptus crebra* dry sclerophyll forest, north-east of Toowoomba, Queensland.

V *Acacia holosericea* A. Cunn. ex G. Don

New host record: During November to December 1980 and 1981, I observed many adults feeding and mating on mature plants (1.5-1.8 m high) of this wattle in *Eucalyptus alba-E. drepanophylla* woodland/dry sclerophyll forest on the James Cook University grounds, Townsville, north-eastern Queensland.

VI *Acacia implexa* Benth. (Lightwood)

Record: Arcadia, Sydney, New South Wales, 4 Jan. 1964, J. Burdett (Chadwick, 1978: 24).

VII *Acacia leiocalyx* (Domin) Pedley subsp. *leiocalyx*

New host record: During December and January 1982 to 1985, I observed several adults each season on young plants (0.5-2.0 m high) growing in open woodlands in the Brisbane area, south-eastern Queensland (viz. Griffith University campus, Capalaba, Burbank, Rochedale, Mt. Coot-tha).

VIII *Acacia leptostachya* Benth.

New host record: On 26 November 1981, I collected one adult from a minor branch of one plant 1.5 m in height, growing in open woodland on the James Cook University campus, Townsville, north-eastern Queensland.

IX *Acacia linifolia* (Vent.) Willd.

Record: Lindfield, Sydney, New South Wales, 28 Mar. 1962, C. E. Chadwick, "on flowering shoot" (Chadwick, 1978: 24).

X *Acacia longifolia* (Andr.) Willd. (Sydney Golden Wattle)

Records: Sydney district, New South Wales (Froggatt, 1893: 38); van den Berg (1982: 53) recorded

C. spectabilis feeding on phyllodes of this wattle in eastern Australia (exact localities not listed); 2 adults, Port Macquarie, New South Wales, (Dec.) in ANIC; During 1975 to 1979, I observed many adults mating and feeding on young plants (1.2-1.5 m high) of this wattle during December to January in dry sclerophyll forest in the Glenbrook area, lower Blue Mountains, New South Wales.

XI *Acacia longissima* Wendl.

Record: Loddon River, north-east of Austinmer, New South Wales, 11 April 1948, C. E. Chadwick, "eating stamens" (Chadwick, 1978: 24) (listed as *A. linearis* Sims).

XII *Acacia mangium* Willd.

Record: Brooks (1948: 7) noted adults fed on the leaves of *A. mangium* in north-eastern Queensland.

XIII *Acacia melanoxylon* R. Br. ex Ait. (Blackwood)

Record: Hampton, New South Wales, 27 Dec. 1968, C. E. Chadwick (Chadwick, 1978: 25); 2 adults, Snobs Creek Fish Hatchery, Victoria (Jan.) in ANIC.

XIV *Acacia penninervis* Sieb. ex DC.

New host record: During December to January 1985 and 1986, I observed several adults feeding and mating on stems and branches of semi-mature plants (1.0–1.5 m high) growing in *Eucalyptus crebra* dry sclerophyll forest, north-east of Toowoomba, Queensland. Weevils were also on *Acacia fimbriata* in the same area (see also notes under this plant).

XV *Acacia podalyriifolia* A. Cunn. ex G. Don (Queensland Silver Wattle)

New host record: During January and February 1985 and 1986, I observed several adults feeding and resting on main stems of this wattle (c. 1.5 m high) in dry sclerophyll forest near Toowoomba, south-eastern Queensland. (The weevils were also on *Acacia fimbriata* and *A. penninervis* in the same area, see also notes under these plants).

XVI *Acacia retinodes* Schlecht.

New host records: 1 adult, Hacks Bridge, South Australia (Jan.) in ANIC; 1 adult, Mt. Lofty, South Australia (Dec.) in ANIC.

XVII *Acacia sophorae* (Labill.) F. Muell.

New host record: During December 1977, I observed several adults on young plants (0.5–1.0 m high) of this wattle growing in a heathland habitat at Hungry Head, New South Wales; During December and January 1984–1986, I observed a few adults feeding and resting on the stems of young plants (0.8–1.2 m high) growing in coastal heathland at Hastings Point, northern New South Wales.

XVIII *Acacia suaveolens* (Sm.) Willd. (Sweet Wattle)

Records: Sydney district, New South Wales (Froggatt, 1893: 38); Killcare, New South Wales, 2 Dec. 1973, C. E. Chadwick (Chadwick, 1978: 25).

3. Other adult host plants

Chadwick (1978: 25) also listed the record of *Eucalyptus pilularis* Sm. (Myrtaceae) as a host from Olney State Forest, west of Morisset, New South Wales on 10 Jan. 1966, by K. M. Moore.

c. General biology and behaviour

Froggatt (1893: 38, 1923: 108) provided the first biological notes on the species on which other authors have based their information: The female weevil usually attacks the stem of the host just above the surface of the ground, where the beetle gnaws the bark into small, roughened spots, under each of which is deposited a single egg; sometimes up to 20 of these rough patches, situated close together, may be counted on a single tree; the larva upon hatching, bores down into the main roots, which are completely hollowed out by the gnawing larva; the larva leaves behind compacted frass and cast larval cuticles in the cylindrical tunnels; the life-cycle is completed within a year under normal conditions,

although some late emerging individuals appear much later in the summer season. Froggatt (1893, 1923) also noted that the species was very plentiful in the Sydney district, New South Wales, where dozens could be collected in an afternoon in areas with abundant growth of young wattles. Froggatt (1907: 185-186), Tillyard (1926: 243), McKeown (1944: 160), Britton (1970: 619), Healey & Smithers (1971: 109), Moore (1978: 138-140), van den Berg (1982: 54) and Hawkeswood (1987: 118) have all noted that *C. spectabilis* is often a common beetle in eastern Australia, associated with *Acacia* species (Mimosaceae), but have not added significantly to the biological data provided by Froggatt (1893, 1902, 1923). Rheinheimer (1989: 29), on 1 March 1986, recorded a pair of weevils feeding on a globular gall (2 cm in diameter) caused by a fungus (*Uromycladium* sp.) on a branch of *Acacia armata* R. Br. at Canberra, Australian Capital Territory; over a period of approximately one day, the pair of weevils had consumed half the volume of the gall.

d. Defence mechanisms

Hawkeswood (1987: 118) noted that the adults were very wary and usually dropped to the ground upon disturbance. Occasionally they will also cling tenaciously to the branch of the host with all six legs and are difficult to dislodge. On 10 January 1984, I collected a large female from *Acacia filicifolia* Cheel et Welch, 20 km west of Armidale, New South Wales, which exuded a very large droplet of a green gut solution through the mouth when handled.

e. Teratology

Chadwick & Brunet (1985: 106, 108) have described teratology for the first time in an Australian weevil. The specimen in question is a malformed female collected by B. L. Brunet on 4 December 1981, from "Oak Flats", Araluen Valley, New South Wales (now housed in the Australian Museum, Sydney). The deformity consists of two parts, arising from different portions of the prothorax and which partly overlap externally. For a complete description of the complex abnormal structures see Chadwick & Brunet (1985).

Life-stages

a. Larva

The only published description of the larva is that of Froggatt (1893: 37-38): Larva white, with shining ferruginous head, stout black jaws, and rounded, obese, much wrinkled body; above the head slightly tinged with a ferruginous band; thoracic and abdominal segments very much corrugated with many fine, transverse furrows, so that observed from above, the divisions of the segments are very indistinct, broadest about the middle rounded at the anus, a faint parallel furrow down the centre of the back; a few scattered hairs on sides. The larva has been crudely illustrated by Tillyard (1926: 183).

b. Pupa

The pupa has not been described or illustrated.

c. Adult

The adult was first described in two lines by Fabricius (1775: 155) and later briefly redescribed and illustrated in colour by Donovan (1805) who first introduced the vernacular name of Botany Bay Diamond Beetle (Weevil) for the insect. Froggatt (1893, 1902, 1923) again briefly described the adult and noted that they varied in size and colour – those that emerged early in the season tended to be more brightly tinted with green than the later emergents which were more metallic blue. The general adult coloration is bronze-black to black with the sides of the snout, undersurface of the head and three pa-

rallel bands on the pronotum rich metallic green to blue; the elytra are irregularly mottled with metallic green to blue, forming irregular markings merging together on the sides and densely covered with scales on the underside of the body. The adult is also figured by Froggatt (1902, 1907), Britton (1970), Healey & Smithers (1971), Moore (1978) and Hawkeswood (1987).

Discussion

Despite being one of the most distinctive and common Australian weevils, very little has been recorded on its lifestages and larval food plants. Most of the data on the species deals with adult hosts. A total of 6 larval hosts have been recorded while 29 adult host plants are known (Hawkeswood, this paper). It should be noted that all of the known larval hosts (with the exception of *A. pycnantha*) are also utilized as food by the adults so it may not be surprising with more research to find that the other 23 *Acacia* species listed here as adult hosts are also larval food sources of *C. spectabilis*. Of the 29 recorded adult hosts, 28 are from the genus *Acacia* (Mimosaceae) and only one from *Eucalyptus* (Myrtaceae). During my 15 years of observations on *C. spectabilis* in eastern Australia I have never found them on any plant other than *Acacia* species, so the record of *Eucalyptus pilularis* Sm. as a host must be regarded as very rare and unusual and deserving of further field observations when the opportunity arises. The available evidence suggests that *C. spectabilis* is very closely associated with bipinnate and phyllodinous *Acacia* species. From my observations in eastern Australia, *C. spectabilis* seems to prefer the bipinnate wattles in the more heavily timbered habitats such as the dry sclerophyll forests of the Blue Mountains of New South Wales and the phyllodinous *Acacia* species in the coastal heathland and open woodland habitats such as in south-eastern Queensland and northern New South Wales. The wattles preferred by *C. spectabilis* are usually thick-stemmed, large, shrubby species with thick mucilaginous bark and dense foliage. However, the phyllodinous species such as the „prickly moses“ wattles, e. g. *Acacia ulicifolia* (Salisb.) Court, *A. brownii* (Poir.) Steud., *A. vomeriformis* A. Cunn. ex. Benth., which have very much reduced and pointed (prickly) phyllodes, appear not to be normally utilized by *C. spectabilis*, probably because these species are small plants with limited foliage and bark and small roots and are therefore not suitable for larval and adult nutrition. In the lower Blue Mountains of New South Wales, I recorded over 20 species of *Acacia* indigenous to the area, and of these, only 5 species (4 bipinnate and 1 phyllodinous) were utilized by *C. spectabilis*, viz. *A. decurrens* (Wendl.) Willd., *A. mearnsii* De Wild., *A. parramattensis* Tindale, *A. terminalis* (Salisb.) MacBride (bipinnate) and *A. longifolia* (Andr.) Willd. (phyllodinous). Such species as *A. ulicifolia* (Salisb.) Court, *A. echinula* DC., *A. myrtifolia* (Sm.) Willd. and *A. linifolia* (Vent.) Willd., species often common in many habitats in the lower Blue Mountains, were avoided by *C. spectabilis*. Adult feeding appears to be restricted to the bark of stems and branches of the young *Acacia* plants and occasionally leaves, but only rarely are *Acacia* flowers consumed. In my experience, most adults occupy young, non-flowering *Acacia* plants, often growing in exposed situations in disturbed sites. The record of Rheinheimer (1989) of *C. spectabilis* feeding on a gall caused by a fungus is noteworthy and further observations on gall-feeding would be of interest.

As noted by Chadwick (1978), *C. spectabilis* is more common east of the Great Dividing Range and becomes scarcer or absent further west of the Range. This distribution is strongly correlated with higher density of *Acacia* species and higher rainfall in the areas east of the Range. Apparently *C. spectabilis* is not adapted to semi-arid or arid habitats. Also, *C. spectabilis* appears to be absent from the rainforests of eastern Australia – this would appear to be a result of a lack of *Acacia* species in Australian rainforests and not a result of very high rainfall or temperatures. Therefore, it would appear that the distribution of *C. spectabilis* is determined by the presence of preferred *Acacia* hosts and moderate rainfall.

Being one of the first insects collected and named by Europeans from Australia, *C. spectabilis* is of interest from an historical point of view. The exact locality from where the original (type) specimens

were collected, remains a mystery. Britton (1970: 619) stated that *C. spectabilis* was taken by Joseph Banks at Botany Bay, New South Wales, but I tend to disagree with this statement and believe that *C. spectabilis*, along with most of the other insects collected from eastern Australia by the naturalists of the Endeavour expedition, were procured at the Endeavour River, near the present settlement of Cooktown. Captain James Cook's expedition arrived at Botany Bay on 29 April 1770 during autumn. Later the expedition remained for about two weeks during August 1770 at the Endeavour River while the crew repaired damages to the ship. During this time in tropical Australia, insects of many species are abundant, and the naturalists would have had plenty of time to procure numerous specimens. April in the Sydney district is usually cold and wet and most adult beetles are scarce or absent by this time. Hence collecting there in autumn would not have been very productive for Cook's naturalists. However, Chadwick (1978: 25) noted that although most *C. spectabilis* in New South Wales had been collected from November to January during the Australian summer, only a few or no beetles had been collected in the remaining months. (The 206 collections examined by Chadwick (1978) span over 100 years). As noted previously, the period April-May is usually cold and wet in the Sydney district and under these conditions and the time of the year, adults of *C. spectabilis* would not normally be present. August in north Queensland is warm and relatively dry and hence more conducive for the early emergence of adults. Therefore, for these reasons I feel that the type collection was made in tropical north-eastern Queensland.

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