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Further observations on the biology and host plants of the Australian longicorn beetle *Agrianome spinicollis* (Macleay) (Coleoptera: Cerambycidae)

With 1 Table and 1 Figure

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Abstract: New larval host plant records and further biological data are recorded for the large and distinctive Australian longicorn beetle, *Agrianome spinicollis* (Macleay) (Coleoptera: Cerambycidae). The presently known larval host plants are listed and original references cited. The adults are not known to feed and no data on adult hosts have ever been recorded. The suite of published larval host plants indicate that rainforest as well as woodland and sclerophyll forest communities are inhabited by this beetle. Since *Agrianome* species are primitive cerambycids, it is suggested here that *A. spinicollis* originated (evolved first) in rainforest and as the Australian continental landmass dried out climatically, and sclerophylly evolved, the beetle adapted to plants belonging to these new plant communities.

Zusammenfassung: Neufeststellungen von Wirtspflanzen der Larven und überdies biologische Daten für den großen, erhabenen australischen Bockkäfer *Agrianome spinicollis* (Macleay) (Coleoptera: Cerambycidae) werden mitgeteilt. Alle gegenwärtig bekannten Wirtspflanzen der Larven werden unter Angabe der Literaturquellen aufgelistet. Von Wirtspflanzen der Imagines sind keinerlei Daten jemals registriert worden; auch ist nicht bekannt, daß adulte Käfer Nahrung brauchen. Die Reihe der veröffentlichten Wirtspflanzen für Larven zeigt, daß sowohl Regenwald als auch Savanne (Woodland) und Hartlaub-Gesellschaften von diesem Käfer bewohnt werden. Weil die *Agrianome*-Arten primitive Bockkäfer sind, wird hier angenommen, daß *A. spinicollis* ursprünglich im Regenwald entstand und dann mit dem klimatischen Austrocknen der australischen kontinentalen Landmasse und dem damit zusammenhängenden Auftreten von Hartlaubgewächsen sich an Pflanzen anpaßte, die zu diesen neuen Pflanzengesellschaften gehören.

Introduction

Agrianome spinicollis (Macleay) (Cerambycidae: Prioninae) (Fig. 1d), is one of the most distinctive and ecologically interesting of those Australian native Cerambycidae which occur in the rainforests, sclerophyll forests and woodlands of eastern Australia. Although it is apparently widespread, the species is generally not regarded as being common and comparatively few specimens are held by museums and private collections. The biology and host plants of *A. spinicollis* have been reviewed previously by HAWKESWOOD & DAUBER (1991) and HAWKESWOOD (1992). Further larval host plant records and biological observations on the species are presented and discussed here. The suite of larval host records and their supporting references are listed in this paper (Table 1), and a brief discussion on the evolutionary implications of host selection by this cerambycid is also included.

Observations

On 16 March 1985, TJH collected two mature larvae of *A. spinicollis* from the base of a partially dead, small specimen of *Delonix regia* (Boj. ex Hook.) Raf. (Caesalpiniaceae), growing in a residential property about 8 km south-west of Nimbin, north-eastern New South Wales (c. 28° 34′ S, 153° 18′ E). The location of the larvae was disclosed by piles of frass on the ground below the area of attack on the tree.

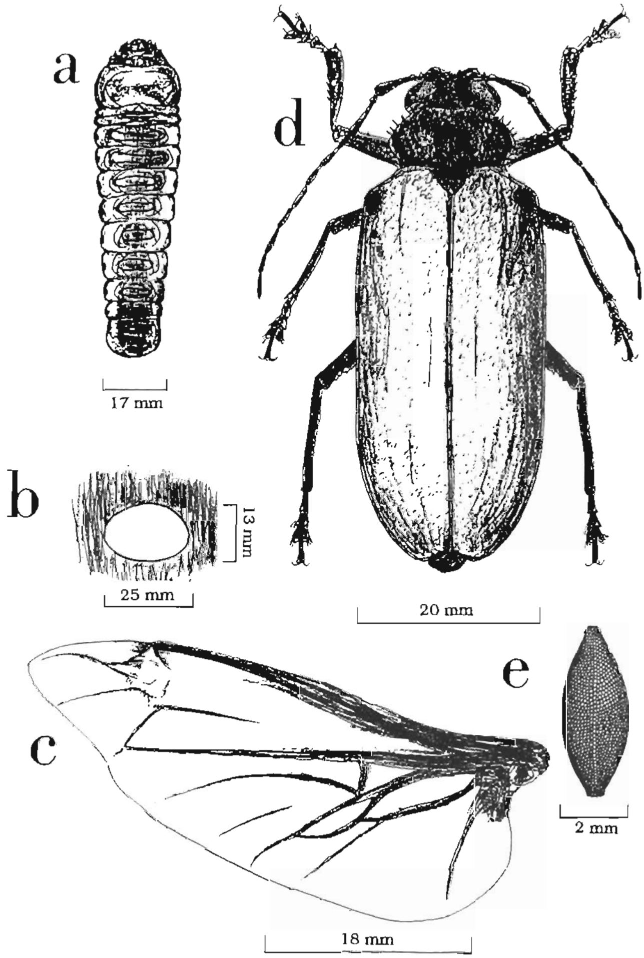

Fig. 1. *Agrianome spinicollis* (Macleay). (a): Larva, dorsal view, showing ampullae; (b): Exit hole in host *Brachychiton populneus*; (c): Left wing of adult, dorsal view; (d) Adult (dorsal habitus); (e) Egg, showing reticulated epidermis. (Illustration: J. R. TURNER)

During 20–21 Oct. 1991, TJH collected several larvae of *A. spinicollis* from the base of a large, dead and partially decayed specimen of *Acacia maidenii* F. Muell. (Mimosaceae) located in grey clay soil near the margins of rainforest and wet sclerophyll forest on private property at Blue Knob, north of Nimbin, north-eastern New South Wales (c. 28° 31´S, 153° 13´E). The larvae had caused severe damage to the tree where a number of large exit holes were also observed. Fragments of a dead adult of *A. spinicollis* which had failed to emerge were found upon dissection of some of the outer wood and bark of the dead tree.

During 1–2 Jan. 1994, TJH and RWW noted extensive damage to the base of a mature willow, *Salix babylonica* L. (Salicaceae), growing on the northern bank of the Hawkesbury River, 5 km ESE of Wilberforce, New South Wales (33° 33´S, 150° 41´E). The tree had a diameter at breast height of 75–80 cm and displayed extensive damage from about 1–2 metres above ground level. A number of large exit holes and channels filled with frass were also observed. Chopping into the very dense wood with an axe was not very fruitful, but some of the outer wood was able to be removed which soon revealed extensive tunnelling which extended further into the wood. Initially, no larvae or adults were observed; however, *A. spinicollis* was strongly implicated, since the tunnels and damage were identical to that observed by TJH in *Acadia maidenii* at Nimbin (noted above), and it was probable that some larvae were still present in the tunnels further down in the centre of the *Salix* trunk. Later on 2 Jan. 1994, a section of the trunk of the *S. babylonica* had been cut off for firewood by locals camped by the river; inspection of the cut part of the tree revealed a large larva of *A. spinicollis*, thereby confirming earlier suspicions. The following day, TJH examined a remnant patch of *Eucalyptus* open woodland in agricultural land about 500 metres north of the *S. babylonica* site, and at about 15 metres altitude. A dead fallen trunk of *Eucalyptus moluccana* Roxb. (Myrtaceae), in an advanced state of decay, was inspected and two adults and one larva of *A. spinicollis* were located. The specimens were all situated in the centre of the log and one adult was teneral. The extensive presence of larval tunnels (some measuring over 1 metre in total length) was also noted. (It is also worth recording, that the fallen log containing these specimens was deposited on the hillside as flotsam during a major flooding episode of the Hawkesbury River in 1991).

On 3 July 1994, JRT visited the Lake Cargelligo area of central western New South Wales. During a visit to Euabba Station, a 25,000 acre property on the banks of the Lachlan River, situated about 35 km west of Lake Cargelligo (c. 33° 18′ S, 146° 05′ E), JRT examined a kurrajong tree, *Brachychiton populneus* (Schott. & Endl.) R. Br. (Sterculiaceae). The tree had been cut down some weeks earlier by local fishermen who had collected beetle larvae infesting the wood as fish bait. A number of these larvae were also collected by JRT from several billets cut from the trunk of the tree. The largest larva measured 10 cm in length. Two adults of *A. spinicollis* emerged from these billets over a period of a week, on 31 Nov. 1994 and on 7 Dec. 1994. The larval chambers were situated mostly in the centre of the timber and were often aggregated. The chamber of a mature larva measured 2.5 cm × 1 cm in cross-section and the exit hole measured 2.5 cm wide and 1.3 cm deep (see Fig. 1 b). A female beetle that emerged from the wood material from Euabba Station is herein illustrated (Fig. 1 d) as well as its left wing (Fig. 1 c) and an egg which was laid before the specimen died (Fig. 1 e). One of the larvae from *B. populneus* is illustrated (Fig. 1 a).

Discussion

The larval host plants and biology of *A. spinicollis* have been reviewed in detail by HAWKESWOOD & DAUBER (1991) and HAWKESWOOD (1992). Since then, WEBB (1993) added another larval host record, *Populus deltoides* Marsh (Salicaceae), but this host was previously listed by WEBB (1987). The presently known larval host plants and references for *A. spinicollis* are outlined in Table 1 (this paper).

As noted by HAWKESWOOD & DAUBER (1991) and HAWKESWOOD (1992), *A. spinicollis* is a nocturnally active cerambycid in the adult stage and is polyphagous in the larval stage, feeding upon a wide variety of hardwood trees. HAWKESWOOD & DAUBER (1991) and HAWKESWOOD (1992) noted that some of the larval host records needed confirmation in the light of insufficient information; some of the plant genera in this category included *Acacia* (Mimosaceae) and *Delonix* (Caesalpiniaceae). We can now confirm that *A. spinicollis* develops in the wood of both of these plant genera. The original record of *Acacia* sp. as host was made at Warwick, south-eastern Queensland in 1946 (WEBB 1987), and the record of *Delonix regia* (Boj. ex Hook.) Raf. was earlier listed by DUFFY (1963) without any supporting collection data (HAWKESWOOD & DAUBER 1991; HAWKESWOOD 1992). Our records of *Acacia maidenii* F. Muell., *Eucalyptus moluccana* Roxb. and *Salix babylonica* L. are new, although WEBB (1987) had previously recorded an unidentified *Salix* sp. as a larval host from the Sydney area, New South Wales (Table 1). The earlier record of *Brachychiton populneus* (Schott ex Endl.) R. Br. was made from the Cobar area, New South Wales (WEBB 1987), which is about 180 km south of our more recent record for this host from Euabba Station, in semi-arid western New South Wales.

As previously noted by LEA (1916), HAWKESWOOD & DAUBER (1991) and HAWKESWOOD (1992), *A. spinicollis* occurs in a wide range of habitats in Queensland, New South Wales and Lord Howe Island. It has a coastal and inland distribution in wet and dry sclerophyll forests, rainforests and woodlands (HAWKESWOOD & DAUBER 1991; HAWKESWOOD 1992). The larval host spectrum

Table 1
Summary of the known (published) larval host plant records for *Agrianome spinicollis* (Macleay) [Data from HAWKESWOOD & DAUBER (1991), HAWKESWOOD (1992), WEBB (1993) and the present paper).] (* = introduced/naturalized plant species) (plants arranged in alphabetical order within families).

Host plant species	Host plant family	References
Monocotyledonae		
Howea forsteriana (C. Moore & F. Muell.) H. Wendl. et Drude	Arecaceae	LEA (1916)
Dicotyledonae		
**Schinus areira* L.	Anacardiaceae	DUFFY (1963); WEBB (1987)
**Bauhinia forficata* Link	Caesalpiniaceae	HOCKEY & DE BAAR (1988)
**Delonix regia* (Boj. ex Hook.) Raf.	Caesalpiniaceae	DUFFY (1963); HAWKESWOOD, TURNER & WELLS (this paper)
Casuarina sp.	Casuarinaceae	WEBB (1987)
Flindersia schottiana F. Muell.	Flindersiaceae	WILSON (1921)
Acacia maidenii F. Muell.	Mimosaceae	HAWKESWOOD, TURNER & WELLS (this paper)
Acacia sp.	Mimosaceae	WEBB (1987)
Ficus macrophylla Desf. ex Pers.	Moraceae	WEBB (1987)
Ficus watkinsiana F. M. Bail.	Moraceae	HOCKEY & DE BAAR (1988)
Ficus sp.	Moraceae	LEA (1916)
Angophora floribunda (Sm.) Sweet	Myrtaceae	DUFFY (1963)
Eucalyptus acmenioides Schau.	Myrtaceae	DUFFY (1963)
Eucalyptus moluccana Roxb.	Myrtaceae	HAWKESWOOD, TURNER & WELLS (this paper)
Eucalyptus saligna Sm.	Myrtaceae	DUFFY (1963)
Grevillea robusta A. Cunn. ex R. Br.	Proteaceae	DUFFY (1963); WEBB (1987)
**Citrus sinensis* (L.) Osbeck	Rutaceae	LEA (1916)
**Malus pumila* Miller	Rosaceae	WEBB (1987)
**Populus deltoides* Marsh	Salicaceae	WEBB (1987); WEBB, WILLIAMS & DEKEYSER (1988); WEBB (1993)
**Populus nigra* Miller	Salicaceae	WEBB (1987)
**Populus* sp.	Salicaceae	WEBB (1987)
**Salix babylonica* L.	Salicaceae	HAWKESWOOD, TURNER & WELLS (this paper)
**Salix* sp.	Salicaceae	WEBB (1987)
**Solanum mauritianum* Scop.	Solanaceae	HOCKEY & DE BAAR (1988)
Brachychiton populneus (Schott. & Endl.) R. Br.	Sterculiaceae	WEBB (1987); HAWKESWOOD, TURNER & WELLS (this paper)

of *A. spinicollis* is of particular interest as it may indicate aspects of this species' evolutionary biology as demonstrated by insect/plant relationships. Of the known suite of larval hosts, the more primitive (ancient) plant taxa belong to the genera *Howea* (Arecaceae), *Ficus* (Moraceae) and *Flindersia* (Flindersiaceae), which form part of rainforest communities and/or wet sclerophyll forests. Although probably not the most ancient cerambycid occurring in Australia, *A. spinicollis* does belong to a relatively primitive group, the Prioninae, about which much biological data still needs to be collected for the Australian and New Guinean species in particular. It is possible that either *Howea, Ficus, Flindersia* or other rainforest tree genera were among the original and preferred larval host plants for *A. spinicollis* and/or its ancestors. The diversification of the world's flora occurred mostly during the Cretaceous Period, some 100–120 million years B. P. Most of the Australian flora appears to have originated during the Cretaceous/Tertiary Periods and the Tertiary is usually regarded as the most significant period of geological time when aridity became the main factor affecting the Australian continent (WHITE 1990). An arid interior resulted from the drying out of the continental landmass and associated with this development was the spread of scrublands and grasslands and the continuation of rainforest and the evolution of sclerophyllous vegetation

(WHITE 1990). The spectrum of larval host plants now utilised by *A. spinicollis* may indicate, that as the drying of the continent occurred, this species managed to adapt to increasingly marginal habitats as a result of the larvae being able to feed and develop on the wood of sclerophyllous and more arid-adapted tree species such as *Eucalyptus*, *Angophora* (Myrtaceae), *Grevillea* (Proteaceae), *Acacia* (Mimosaceae) and *Brachychiton* (Sterculiaceae) (and possibly *Casuarina*, Casuarinaceae). All of these genera speciated and adapted to new niches during the Cretaceous Period and possess many xeromorphic or xerophytic adaptations, e.g. sclerophyllous leaves with sunken stomates and thick cuticles, hard wood with copious gum or resin, or in the case of *Brachychiton populneus*, water storage tissue in the trunks. The continued survival of this originally mesic-evolved species of cerambycid as the continent rapidly became drier climatically and the original rainforest habitat contracted, may have been due largely to the pre-adaptation of the larvae of *A. spinicollis* for feeding on hardwood tree species with differing chemistries and physical properties. Such hardwood tree-use by larvae could have permitted the survival of this species in changing environments, in effect, indicating that the critical larval stage of some Cerambycidae is more adaptable to major environmental changes. But what of the adult stage? The survival of a once rainforest-inhabiting beetle to a more open and drier environment would be enhanced if that species possessed adults which are nocturnal, which possess cryptic behaviour and which resist moisture loss through structural adaptations. These features are indeed applicable to the adults of *A. spinicollis*. But more importantly, adult *A. spinicollis* apparently do not need to feed, thus reducing dietary selection pressure which would normally result from the altering of food resources which can be associated with environmental changes. The ability of *A. spinicollis* to rapidly expand its host range as a response to environmental change can be appreciated in the relatively recent shifts in selection to introduced trees. Of the 25 host plant species listed in Table 1, 11 (44%) are introduced/naturalised taxa in Australia. Some of them, such as *Schinus*, *Citrus*, *Populus* and *Salix* are trees which have been planted extensively in urban and rural areas cleared of native vegetation during less enlightened periods of the country's history. Thus, the survival of *A. spinicollis* appears to be maintained by the beetle shifting its preferences to introduced plants (HAWKESWOOD & DAUBER 1991).

To conclude, although *A. spinicollis* is a primitive beetle, with a probable long evolutionary history, the larvae display adaptiveness to the differing chemistries and physical properties of a wide variety of trees, both native and introduced and can survive as a species in otherwise unsuitable, marginal or highly degraded habitats, such as farmlands and residential areas in cities, where its usual native hosts are absent or low in numbers. Its apparent adaptive plasticity in the larval stage may result in *A. spinicollis* being one of the few large cerambycid species being able to survive in the future when further degradation and destruction of Australia's natural environment is likely to have occurred. Further observations on this species' biology and host plant preferences, should reveal an expanded list of larval host plant species and perhaps demonstrate a wider distribution for this beetle.

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zwecks Artbestimmung (Tüpfelsumpfhuhn!) systematisch Dunenjunge gefangen wurden. Für diese aufwendige Nachweisführung konnte die Ferienzeit genutzt werden.

Bei Kiebitz, Flußregenpfeifer und Möwen wurden die sichtbar brütenden Altvögel, bei Waldkauz, Waldohreule und den Spechtarten anhand ihrer Balzrufe die Reviere gezählt. Dabei fanden die Zählungen der Lachmöwen mehrmals im Laufe der Brutzeit statt, um die maximale Größe der Kolonie zu erfassen. Von den Eulen und allen Spechtarten sind auch besetzte Bruthöhlen gefunden worden.

Die Zahl der Beutelmeisen-Brutreviere wurde anhand der Zählung fertiggestellter Nester bestimmt, die wohl in allen Fällen zur Brut genutzt worden waren. Wie bei der Wacholderdrossel wurden auch bei der Gebirgsstelze regelmäßig die bekannten Neststandorte (zumeist am Pleißelauf) überprüft. Bei den übrigen Arten, so den meisten Singvögeln, den Tauben u. a., war das über längere Zeit stabile Revierverhalten (Balz, Reviergesang, Revierverteidigung, Fütterung der Jungvögel) das Kriterium für eine Zählung der Brutreviere, wobei die Rohrsänger zeitweise mit Tonbandaufnahmen provoziert wurden, um einzuschätzen, wieviele Beobachtungsgänge bei bloßer Registrierung des Reviergesangs für eine annähernd vollständige Erfassung nötig wären. Im allgemeinen erwiesen sich die Übersichtlichkeit des Gebietes, die Ortskenntnis des Beobachters und die zeitliche Dichte der Beobachtungsgänge als günstige Bedingungen, die Brutbestände (Brutpaare = BP) in klassischer, wenn auch aufwendiger Weise zu ermitteln.

Die Angaben in Tab. 3–7 beruhen auf Nachweisen der Kategorien C4 bis D16 der Meßtischblatt-Kartierung der DDR (vgl. GNIELKA 1990).

5. Der Brutvogelbestand und seine Verteilung im Gebiet in den Jahren 1953–1996

Haubentaucher, *Podiceps cristatus*: Auf den Windischleubaer Teichen war der Haubentaucher auch am Ende des 19. Jahrhunderts ein regelmäßiger Brutvogel (KOEPERT 1896). In unserer Zeit nistete er auf dem Seebischteich (max. 4 BP: 1987), Schafteich (max. 4 BP: 1992), Stausee (max. 4 BP: 1966), den beiden Vorbecken (max. 10 BP: 1969, 1977, 1980) und ausnahmsweise auf dem Poschwitzer Teich (1 BP: 1985). Die meisten Nester standen im wasserseitigen Röhricht, am Seebischteich regelmäßig auch einzelne am Ufergebüsch. Der Stausee, dessen Wasserstand und Uferlinien starken Schwankungen unterliegen, war weniger ein Brutplatz, aber zeitweise ein bevorzugtes Nahrungsgewässer bei der Jungenaufzucht. In bestimmten Jahren holten die Altvögel von dort das Futter für die Jungen (pulli) auf Vorbecken und Schafteich. Der Brutbestand erlitt 1967/68 große Einbußen durch Schilfschnitt.
Maximal 16 BP im Gebiet (1977, 1986), vgl. Tab. 3.
Literatur: HÖSER 1979, KARG 1963, KOEPERT 1896.

Rothalstaucher, *Podiceps griseigena*: Noch am Beginn des Jahrhunderts brütete der Rothalstaucher regelmäßig auf dem Seebischteich und Schafteich (HILDEBRANDT 1919), in unserer Zeit nur 1952–1970 im Gebiet, und zwar auf dem Seebischteich (1 BP: 1952, 1960–1965; 2 BP: 1966–1969), den er nach fischwirtschaftlicher Umgestaltung mit Reduzierung des Röhrichts als Brutplatz aufgab, auf den Vorbecken (1 BP: 1959, 1962, 1967, 1970) und auf dem Stausee (1 BP: 1966). Alle gefundenen Nester befanden sich im Rohrkolben-Röhricht. Der bevorzugte Seebischteich liegt in einem Forst.
Maximal 3 BP im Gebiet (1966, 1967), vgl. Tab. 3.
Literatur: FRIELING 1963a, FRIELING u. TRENKMANN 1968, FRIELING u. HÖSER 1973, HILDEBRANDT 1919, KARG 1963.

Zwergtaucher, *Tachybaptus ruficollis*: Der Zwergtaucher nistete bisher auf 10 von 16 Teichen des Gebietes. Der kleinste besiedelte Teich (nördlicher Steinbruchteich, 1967) hatte 0,2 ha Fläche. Regelmäßige Bruten fanden im Beobachtungszeitraum auf dem Seebischteich (max. 4 BP: 1962), dem Schafteich (max. 6 BP: 1961, 1962), den Vorbecken (max. 8 BP: 1971) und dem Stausee (max. 5 BP: 1974) statt, um 1970 auch auf dem Straßenteich und dem Wiesenteich (max. 2 BP). Nicht besiedelt wurden der Poschwitzer Teich, der Angerteich, der südliche Steinbruchteich und der Oberteich, die alle keinen Röhrichtgürtel besitzen. Die Nester befanden sich überwiegend im schütteren Rohrkolben-Röhricht, weniger oft im deckungsärmeren Ufergebüsch (Klosterteich, Seebischteich, u. a.) und vereinzelt im schwach verkrauteten Flachwasserbereich der Verlandungszonen. Letzteres war besonders der Standort von jährlich 1–4 Nestern bei der Insel im Stausee 1969–1978 und von 1–2 Nestern am Ostufer des Schafteichs.
In den Jahren 1972–1982 nahm der Brutbestand stark ab (Tab. 3).
Maximal 19 BP im Gebiet (1962).
Literatur: KARG 1963.

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