mainland, with the exception of some that may move into the *Rhagodia* or be concealed under granite slabs.

The number of seals ranged from one to 56 (av. 27), the numbers ashore increasing from dawn to dusk. Although there is a considerable range in the numbers found in any month, there is a peak in July and August with the minimum numbers seen in November. No evidence of breeding was found.

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NOTES ON THE BIOLOGY AND DISTRIBUTION OF TWO SPECIES OF DIADOXUS (COLEOPTERA : BUPRESTIDAE) IN WESTERN AUSTRALIA

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ABSTRACT

The available literature on the general biology of two of the three species of the endemic Australian genus *Diadoxus* is briefly summarized. Additional data are supplied on their distribution, potential adult food plants and procrypsis based on observations in Western Australia.

INTRODUCTION

The genus *Diadoxus* Thomson is a small genus of three species endemic to Australia (Carter, 1929). *Diadoxus scalaris* Laporte & Gory and *Diadoxus erythrurus* (White) are commonly known as the cypress pine jewel beetles since their larvae have been found to feed in the conductive tissues of branches and trunks of native cypress pines (*Callitris* spp.) and introduced *Cupressus* trees (both genera belong to the Cupressaecae). Attack by *D. erythrurus* on cypress pines was first recorded by Von Lendenfeld (1885) in western New South Wales. Since then, French (1911), Froggatt (1923, 1927), Peseott (1932), Zeek (1955) and Hadlington and Gardner (1959) have considered the bionomics of the two species. Saunders (1868) provided redescriptions of both buprestids. Blackburn (1899) described another species *D. jungi* from Yorke Peninsula, South Australia (he does not give a specific locality), but nothing has been recorded of its biology.

DISTRIBUTION

D. scalaris, the largest of the three species is known to occur in association with *D. erythrurus* (Hadlington and Gardner, 1959). Froggatt (1923) believed that *D. erythrurus* would be found wherever native *Callitris*

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species were distributed. Hadlington and Gardner noted that the distribution of *D. erythrurus* in New South Wales had been extended on the coast and highlands of N.S.W. since the introduction of *Cupressus* spp. to those areas. Carter (1929) listed the distribution of both species as New South Wales, Victoria and South Australia. However, Froggatt stated that *D. scalaris* had a wide range over Australia, from Sydney (N.S.W.) to Kalgoorlie (W.A.).

One of us (M.P.) has recently observed five specimens of *D. scalaris* from near the N7T Radio Transmitter, 64 km E of Southern Cross, Western Australia (c. 31°55'S, 120°05'E) (about 120 km W of Kalgoorlie) during early October 1977. Specimens of *D. scalaris* in the Western Australian Museum (WAM) have been collected from Kellerberrin (31°38'S, 117°43'E), Menzies (29°41'S, 121°02'E), Norseman (32°12'S, 121°46'E), Boulder (30°47'S, 121°29'E) and from the Perth suburbs of Cannington and Wembley. Specimens in the Western Australian Department of Agriculture (WADA) have been collected recently from Cundeelee (c. 30° 50'S, 123°30'E).

On the 14 October 1978, a specimen of *D. erythrurus* was observed by Mr. M. Golding, after it had fallen from a pine tree (*Pinus* sp., Pinaceae), which was growing in his garden at Attadale (Perth). A further specimen of *D. erythrurus* was observed by Mr. M. Powell, 16 km W of Wurarga (c. 28°26'S, 116°06'E) on the 28 October 1978. Specimens of *D. erythrurus* in WAM have been collected from Northam (31°40'S, 116°40'E), Cranbrook (34°18'S, 117°33'E), Kings Park (Perth) and from the Perth suburb Victoria Park. Specimens in WADA have been collected from Dedari (31°01'S, 120°38'E), Corrigin (32°20'S, 117°51'E) and the Perth suburbs of Lesmurdie, Claremont and Cannington. The distributions of both species are shown in Fig. 1.

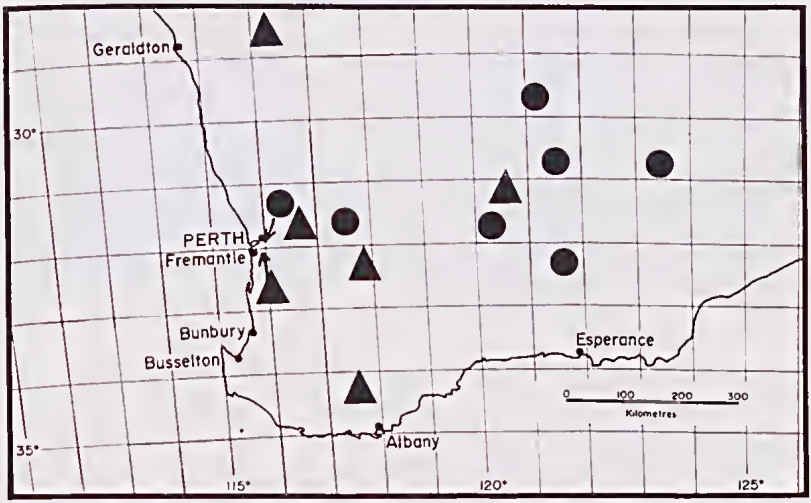

Fig. 1.—Distribution of *Diadoxus scalaris* (●) and *D. erythrurus* (▲) in Western Australia (based on collections in WAM, WADA and personal observations).

The records from Perth suburbs probably represent the most westerly distributions of *Diadoxus* in south-western Australia. Observations by Messrs. Peterson, Powell and Golding have suggested that beetles are uncommon in the areas where they were observed. Since specimens of *Diadoxus* appear to be relatively uncommon in the field and there is a paucity of material in museum collections, little is known at present about their past or present distribution. However, it is likely that the two

species have a wider distribution today than in the past due to accidental introduction of infested timber for building purposes.

HOST PLANTS

Presently, little has been published on the larval and adult food plants of Australian Buprestidae. The larvae of jewel beetles are generally known to feed in the stems or roots of various plants, while adults may feed on nectar, pollen, leaves or sap from the larval food plant or from alternative plants. There appear to be no published data on adult food plants of *Diadoxus*. The only information available is on larval hosts.

(a) Larval

The larvae of *Diadoxus* are typical of Buprestidae larvae in being yellow and elongate, with the thoracic segments dorso-ventrally flattened and wider than the abdominal segments. After hatching from the eggs (which may be laid in crevices in bark of trees or more usually in fire scars or other wounds on trunks (Pescott, 1932), the larvae commence feeding on the phloem adjacent to the sapwood. They eteh the outer surface of the sapwood while feeding (Hadlington and Gardner, 1959) and the infested portion may become riddled with irregular, oval (in cross section) galleries or channels firmly packed with faeces and chewed wood which is not swallowed (Anon., 1958; Hadlington and Gardner, 1959). When fully grown, the larvae (about 2.5 cm in length at this stage) cut narrow oval burrows into the sapwood and pupate in these chambers (Anon., 1958). The main larval host plants are *Callitris hnegelii* (Carr.) Franco and *C. endlicheri* (Parl.) F. H. Bail. (Hadlington and Gardner, 1959). French (1911) and Prescott (1932) have recorded the introduced tree *Cupressus macrocarpa* var. *lambertiana* Gordon, as a host of *D. erythrurus*, in the Melbourne area, Victoria. French (1911) believed that *Acacia aneura* F. Muell. (Mimosaceae) was a host plant since he collected specimens of *D. erythrurus* from an area where no species of *Callitris* or *Cupressus* occurred.

(b) Adult

M. Peterson observed adults of *D. scalaris* on the leaves of non-flowering *Casuarina campestris* Diels (Casuarinaceae) and flowering *Grevillea eriostachya* Lindl. (Proteaceae), east of Southern Cross during late 1977. Trees of an unknown species of *Callitris* were common in the area but no adults were observed on these plants. It is possible that the species breeds in *Callitris* but adults emerge to feed on alternative plants such as *Grevillea eriostachya*.

Near Wurarga *D. erythrurus* was observed on *Callitris verrueosa* (A. Cunn. ex Endl.) F. Muell., and at Attadale was collected from an unknown species of *Pinus*. Although feeding by the jewel beetle on *C. verrueosa* was not observed it is probable that it utilizes this plant for food in the adult stage. The collection of *D. erythrurus* from Attadale possibly indicates that the species has been either introduced in pine timber (since native *Callitris* pines are rare in the Perth area) or breeds in native *Casuarina*. The species has probably established itself in species of *Pinus* or *Casuarina* in some suburbs of the metropolitan area e.g. Victoria Park, Attadale, Cannington and Claremont.

OBSERVATIONS ON PROCRYPSIS

Procrypsis refers to the concealment of an insect (or other animal) by the use of coloration, morphology or behaviour (all or a combination of these) in order to escape the attention of a predator. Procrypsis is distinct from anticrypsis where the concealing coloration and behaviour enables predators to approach their prey, or on the other hand, allows the predator to remain concealed while the prey approaches unsuspecting.

The following observations on procrypsis displayed by *D. scalaris* on *Casuarina campestris* were made by one of us (M.P.) east of Southern Cross during October 1977. Observations were undertaken between 1100 and 1430 hrs. (W.S.T.). Beetles were particularly adept and agile and remained well hidden amongst foliage where they moved quickly from

branchlet to branchlet usually remaining vertically orientated. They betrayed their presence only by producing a short buzzing sound with the wings and elytra immediately before taking flight. Flight was observed to be fast, straight and directed horizontally outwards from the *Casuarina* bushes.

The adult of *D. scalaris* is a slender, almost cylindrical beetle measuring about 2.5 cm in length. The ground colour of the pronotum and elytra is light reddish-brown. The pronotum is short and broad and has yellow longitudinal stripes in the centre and near the lateral margins. The elytra have an elongate oval blotch on the basal region and three smaller, yellow spots down the centre of each elytron. The adult of the smaller species, *D. erythrurus*, is similar in morphology and colour to *D. scalaris*. It measures about 2 cm long and is brown or black with green or yellow markings on the upper surface. The undersurface is green, red-brown and yellow. The green coloration fades to a dull yellow after death.

Fig. 2.—*Diadoxus scalaris* in a vertical resting position on *Casuarina campestris*. Photograph by M. Peterson).

The vivid coloration of the underside of the live beetle appears to match the green of the *Casuarina* branchlets. The nodal region of the branchlets is a straw-yellow colour. The disruptive markings of the lateral margins of the apical sternites on the undersurface of *D. scalaris* appear to match the yellow coloration of the nodal region of the branchlets upon which beetles rest. Figure 2 shows an individual of *D. scalaris* resting vertically amongst branchlets of *Casuarina campestris*. The black and white reproduction does not illustrate the crypsis as well as the colour transparency from which it was taken but does give some indication of the resting posture of the insect and the disruptive patterning of its undersurface. Figure 3 shows *D. erythrurus* on *Callitris verrucosa*. The green of the beetle's undersurface matches the coloration of the pine leaves. However, the apparent crypsis is not as pronounced as with *D. scalaris* on *Casuarina*, since yellow is absent from the *Callitris* leaves.

Although more observations are needed, especially on predator/prey relationships, it appears likely from the present observations, that *Diadoxus* species are afforded protection from predation by adopting a vertical

resting position in the central region of *Callitris* trees and *Casuarina* bushes. It is probable that *Casuarina* plants afford more protection since the alternation of yellow and green on the branchlets better fits the undersurface pattern of *Diadoxus*. In this way, the habit of beetles frequenting *Casuaria* may result in a lower incidence of predation on buprestid

Fig. 3.—*Diadoxus erythrurus* on leaves of *Callitris verrucosa*. (Photograph by D. Knowles).

populations in areas where pines and *Casuarina* occur sympatrically, in comparison to that in areas where only *Callitris* occur. The most likely predators of *Diadoxus* are birds such as magpies and butcherbirds. We find these observations of interest since such marked procrypsis like this example does not appear to occur in many other Australian buprestid beetles (Hawkeswood, Peterson and Knowles, unpublished data).

CONCLUDING REMARKS

We would like to conclude this paper by stating that little has been published on the general biology of the Australian Buprestidae. This is surprising since jewel beetles occupy diverse habitats throughout Australia. Many species are abundant on native flowers and leaves of plants during spring and summer.

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AN EARLY PLEISTOCENE MACROPOD FROM JANDAKOT, WESTERN AUSTRALIA

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Two tooth fragments which, when fitted together formed a complete premolar tooth (Western Australian Museum catalogue number 79.2.13), were found by V. A. Ryland, Department of Palaeontology, Western Australian Museum (W.A.M.), in material recovered from Paulik's bore, Jandakot. One fragment of the tooth was found in a sediment sample from 25.0 m below the top of the bore and the other from the next sample up the bore at 24.7 m. The two pieces were fitted together and registered as from 24.7 m, being the first occurrence of the specimen during drilling. This position lay 3.2 m below Australian Height Datum (m.s.l.).

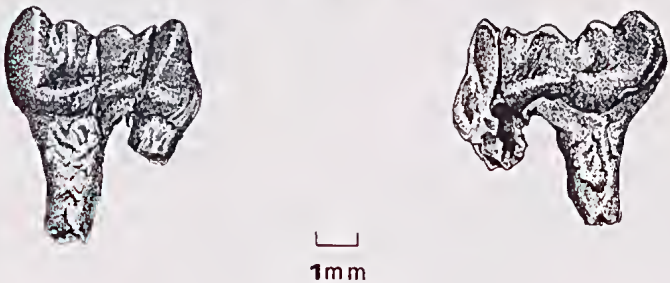

Fig. 1.—Premolar tooth from Paulik's bore, Jandakot, Western Australia. A. lingual view. B. buccal view.

Paulik's bore is situated at the eastern end of lot 41, Semple Road, Jandakot (latitude 32°6'47" S, longitude 115°50'39" E), which is on the Swan Coastal Plain about 20 km south of Perth. The bore was drilled