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From the Editors

Over the long history of *The Victorian Naturalist* the journal has continued to provide a record of studies by both scientifically-trained and amateur researchers of what was observed at a given time and place. These records have often provided a valuable basis, through comparison, for observing change over time in aspects of natural history.

The current issue maintains these traditions, with the papers illustrating such changes. We publish here the first study of the decapods of the Pilliga Scrub in New South Wales, details of an extension of the Victorian range of a species of skink, and observations on an undescribed species of fungi.

The range of subject matter in these papers also highlights, once again, the diversity that exists of both interest and study regarding the natural world.

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Front cover: *Pluteus* sp. 'yellow' fruit-body. Photo by Jurrie Hubregtse. See page 111.
Back cover: Freshwater Crab *Austrothelphusa transversa* from West Pilliga Scrub. Photo by MJ Murphy. See page 96.

A field survey of the decapod crustaceans (Malacostraca: Decapoda) of the Pilliga Scrub in northern inland New South Wales

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Abstract

The Pilliga Scrub is a large semi-arid woodland area in northern inland New South Wales with limited freshwater habitats and a frequent scarcity of surface water. A survey of the area's decapod crustacean fauna in 2009-2010 identified five species: the crayfish *Cherax destructor* (Parastacidae), crab *Austrothelphusa transversa* (Parathelphusidae), shrimps *Caridina mccullochi* and *Paratya australiensis* (Atyidae) and prawn *Macrobrachium australiense* (Palaemonidae). The decapod diversity is low at the species level but relatively high at the family level, and reflects the location of the Pilliga Scrub in a transitional zone between faunal assemblages of southern and northern Australia. *Cherax destructor* and *Austrothelphusa transversa* are well suited to the variable aquatic conditions in the Pilliga Scrub and can survive prolonged drought in burrows. *Caridina mccullochi, Paratya australiensis* and *Macrobrachium australiense*, in contrast, are dependent on surface water at all life cycle stages, and their survival in the Pilliga Scrub relies on the few small permanent waterholes along larger intermittent streams or, if these dry out, re-colonisation from downstream perennial river channels during occasional stream flow events. An increase in aridity due to anthropogenic climate change could result in the local extinction of these three species, representing a 60% reduction in local decapod species diversity. (*The Victorian Naturalist* **128**(3) 2011, 96-105)

Keywords: decapod diversity, Pilliga Scrub, Murray-Darling Basin, intermittent streams

Introduction

Australia is one of the world's driest continents, with relatively limited freshwater habitats (Jones and Morgan 1994). Despite this, Australia has a diverse range of freshwater crustaceans, many with specialised life history traits enabling them to survive and even thrive under extremely variable conditions. The decapod crustacean fauna (Malacostraca: Decapoda) found in Australian freshwater habitats consists of crayfish (Parastacidae), shrimps (Palaemonidae and Atyidae) and crabs (Parathelphusidae and Hymenosomatidae) (Jones and Morgan 1994; Davie 2002a and b). The biogeographical origin of this fauna is varied, ranging from ancient Gondwanan relicts such as the parastacid crayfish (Merrick 1993) to relatively recent colonisers from south-east Asia, such as the Parathelphusid (potamid) freshwater crabs (Bishop 1963). Decapod crustaceans play a key ecological role in many freshwater ecosystems, often comprising a significant part of the macroinvertebrate biomass, feeding at multiple trophic levels and forming an important food source for fishes and waterbirds (Sheldon and Walker 1998; Richardson and Cook 2006; Giling *et al.* 2009). Larger species are also of cultural significance to Australian Aboriginal people as a traditional bush food. Freshwater decapod faunas are of conservation concern in many parts of the world (Martin and Wicksten 2004; O'Brien 2007; Crandall and Buhay 2008; Cumberlidge *et al.* 2009). The present study examined the decapod crustacean fauna of the Pilliga Scrub in northern inland New South Wales (NSW). This is the first published study of the decapods of this area. The aim of the study was to identify the species present and document information on local distribution, habitat preferences and status.

Study area and methods

The Pilliga Scrub is a 450 000 ha area of semi-arid woodland in *Gamilaraay* Aboriginal Country in the Brigalow Belt South bioregion in northern inland NSW (Fig. 1). The landform ranges from low sandstone hills and wide sandy valleys in the east to a flat outwash sand plain in the west and north, and has an elevation range of 160-640 m above sea level (Australian Height Datum). The Pilliga Scrub is within the Murray-Darling Basin: most of the area drains north to the Namoi River while the southern and south-western fringes drain south or west to the Castlereagh River. Rainfall is generally low and irregular

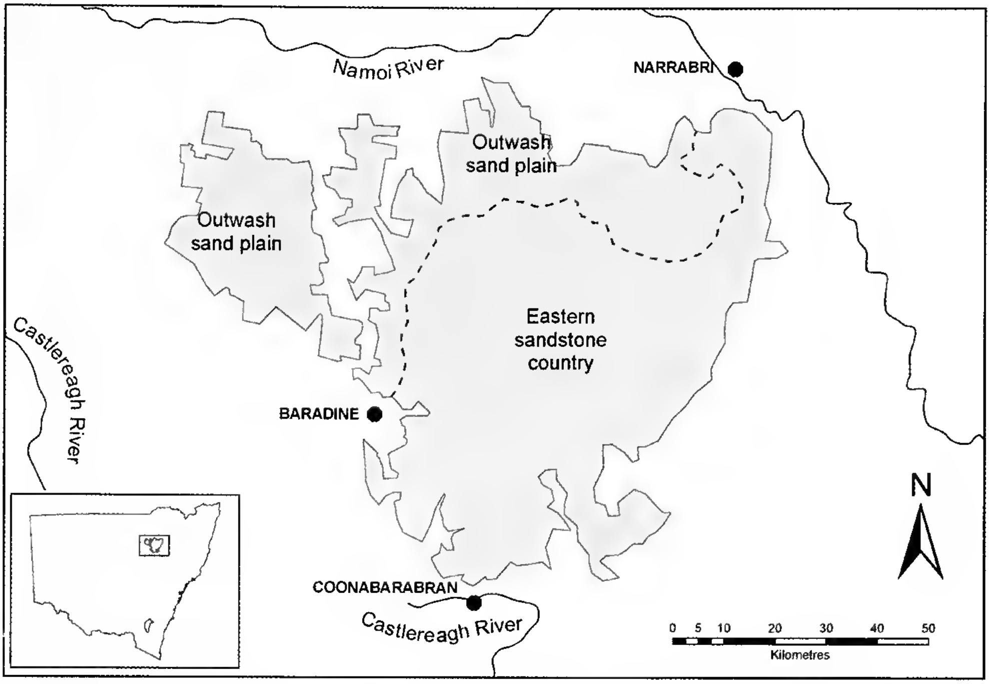

Fig. 1. Map of the Pilliga Scrub study area. The shaded area represents the approximate extent of the Pilliga Scrub. The dotted line marks the boundary between the eastern sandstone country and the outwash sand plain.

and the intermittent streams in the Pilliga Scrub represent an extremely variable and unpredictable aquatic environment, fluctuating between a few small isolated waterholes along dry stream beds for most of the year and temporarily flowing streams and shallow ephemeral wetlands following rare heavy rain events. Small earth-wall ground tanks used as a fire fighting resource provide some additional aquatic habitat.

A field survey of the decapod crustacean fauna of the Pilliga Scrub was done between September 2009 and June 2010. Considerable rainfall over the summer and autumn of 2010 resulted in strong stream flow events during part of the study period. Survey methods comprised funnel-type yabby traps baited with tinned cat food or chicken, dip-netting using a hand-held net, lifting timber debris and loose rocks around water edges, spotlighting at night along water edges and searching water edges and dry water bodies for exoskeleton material. Twenty primary survey sites were identified to systematically investigate broad patterns of habitat usage within the study area, and were stratified between the eastern sandstone country and the outwash sand plain and between natural streams/waterbodies and constructed ground tanks (Appendix 1). Opportunistic records from additional sites were also documented; generally based on observations of exoskeleton material but also including some opportunistic trapping and dip-netting. Taxonomic nomenclature in this paper follows Davie (2002a, 2002b). Voucher specimens of all species recorded in the study were deposited in the collection of the Australian Museum (Sydney).

Results

In total, 58 records of decapod crustacea were documented in the Pilliga Scrub study area, comprising five species from four families (Table 1). Overall site richness, based on the 20 primary survey sites, averaged 1.3 species per site (range 0–3 species). Site richness and species occurrence varied between the eastern sandstone country and the outwash sand plain and between natural streams/waterbodies and ground tanks (Table 1). Natural streams and

Table 1. Decapod site richness and species occurrence in the Pilliga Scrub. [1]Based on primary survey sites. [2]Based on primary and opportunistic records. [3]Opportunistic record.

	Proportion of sites where species was recorded [1]					Average species richness per site [1]	Overall species diversity [2]	Species present [2]
	Cherax destructor	*Austrothelphusa transversa*	*Paratya australiensis*	*Caridina mccullochi*	*Macrobrachium australiense*			
Natural streams/waterbodies - outwash sand plain	80%	20%	20%	0%	20%	1.4	5	*C. destructor* *A. transversa* *P. australiensis* *C. mccullochi* [3] *M. australiense*
Ground tanks – outwash sand plain	80%	0%	20%	0%	0%	1.0	2	*C. destructor* *P. australiensis*
Natural streams/waterbodies – sandstone country	100%	0%	60%	0%	20%	1.8	3	*C. destructor* *P. australiensis* *M. australiense*
Ground tanks – sandstone country	100%	0%	0%	0%	0%	1.0	1	*C. destructor*

waterbodies in the eastern sandstone country had the highest average species richness per site while natural streams and waterbodies on the outwash sand plain had the highest overall species diversity. Ground tanks in the eastern sandstone country had the lowest diversity.

The Common Yabby *Cherax destructor* Clark, 1936 (Parastacidae) (Fig. 2) was found to be common and widespread across the Pilliga Scrub (Fig. 3), recorded at 90% of the primary survey sites and found in a wide range of habitats including flowing streams, billabongs, natural waterholes, gilgai wetlands and ground tanks. Live animals were captured in water by trap and dip-net or were found in burrows beneath timber debris and loose rocks in drying waterbodies. Capture rates at several sites exceeded 10 animals per trap-night. Many of the opportunistic decapod records in this study were of exoskeleton remains of this species

Fig. 2. Common Yabby *Cherax destructor* from Baradine Creek, Pilliga Scrub. Photo by MJ Murphy.

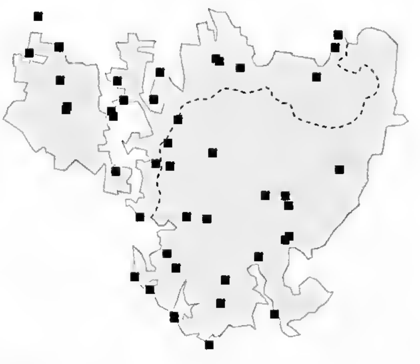

Fig. 3. Records of *Cherax destructor* in the Pilliga Scrub study area.

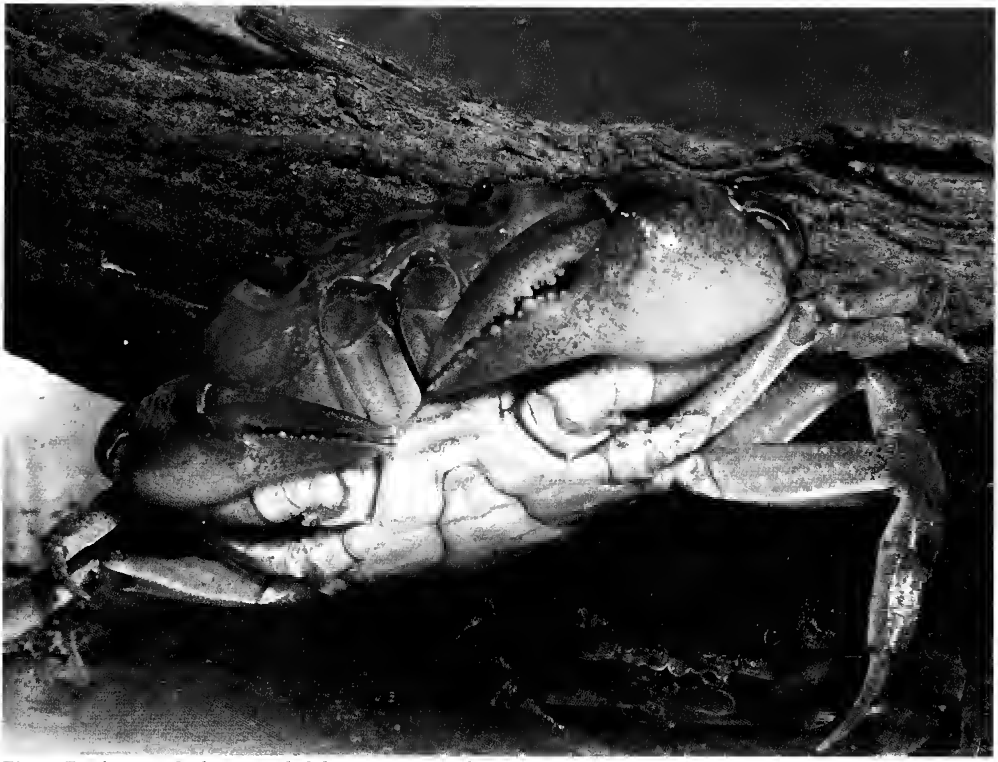

Fig. 4. Freshwater Crab *Austrothelphusa transversa* from Box Creek on the western margin of the Pilliga Scrub. Australian Museum specimen P.83245. Photo by MJ Murphy.

Fig. 5. Records of *Austrothelphusa transversa* in the Pilliga Scrub study area.

(usually the robust chelae) found on the water's edge or on the floor of dry waterbodies.

The Freshwater Crab *Austrothelphusa transversa* (Martens, 1868) (Parathelphusidae) (Fig. 4) was recorded at only one site (5% of primary survey sites), a tree-lined minor stream in the far west of the outwash sand plain (Fig. 5). This site, where exoskeleton remains of the species had been found on the dry stream bed during drought in August 2007, was revisited in January 2010 when the stream was flowing after extensive local rain over the previous month. Adult crabs were active at night in shallow water along the edge of the stream, retreating to burrows amongst inundated tree roots when disturbed. About 12 were seen in 15 minutes along a 50 m creek transect. Crabs were also trapped overnight.

The Glass Shrimp *Paratya australiensis* Kemp, 1917 (Atyidae) (Fig. 6) was recorded at 25% of the primary survey sites and opportunistically at several other sites (Fig. 7). Although records in the study area were widely distributed, most were from larger or more permanent waterholes along major streams, up to 150 km upstream of the Namoi River, with one additional record from a ground tank in the northern outwash sand plain. Shrimp were caught by dip-

Fig. 6. Glass Shrimp *Paratya australiensis* from Baradine Creek, Pilliga Scrub. Australian Museum specimen P.82090. Photo by MJ Murphy.

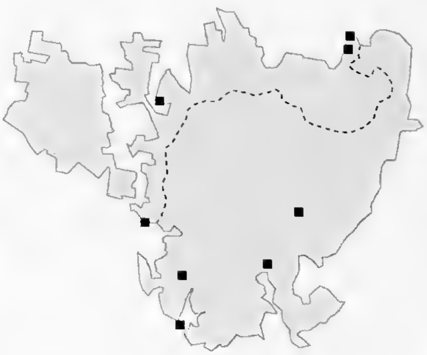

Fig. 7. Records of *Paratya australiensis* in the Pilliga Scrub study area.

net by day and were often taken near rushes and reeds.

McCulloch's Shrimp *Caridina mccullochi* Roux, 1926 (Atyidae) (Fig. 8) was not recorded at any of the primary survey sites but was recorded opportunistically at one site, a large, shallow reed-edged remnant waterhole on a dry major stream in the north-east of the outwash sand plain, only 24 km upstream of the Namoi River (Fig. 9). At this site *Caridina mccullochi* was sympatric with *Paratya australiensis* and *Cherax destructor*. Shrimp were caught by dipnet by day in March 2010.

The Common Australian River Prawn *Macrobrachium australiense* Holthuis, 1950 (Palaemonidae) (Fig. 10) was recorded at three sites (10% of primary survey sites and one opportunistic site) (Fig. 11). All sites were on major streams, up to 120 km upstream of the Namoi River. One site was in the eastern sandstone country and two on the outwash sand plain. The eastern site was a natural rocky waterhole which is permanent in all but extreme drought. The outwash sites were tree-lined pools in a shallow flowing stream following a strong stream flow event. Immature animals were trapped overnight at these sites in February–May 2010. The large adult animal pictured (Fig. 10) was found at the eastern site during drought in September 2007, sheltering by day under a rock when the waterhole was reduced to a small muddy puddle.

Discussion

The low species diversity of decapod crustaceans found in the Pilliga Scrub is not surprising, given the limited extent and variety of freshwater habitats present. The geographical position of the Pilliga Scrub is also outside Australia's major centres of freshwater decapod species diversity in the south-east highlands (Par-

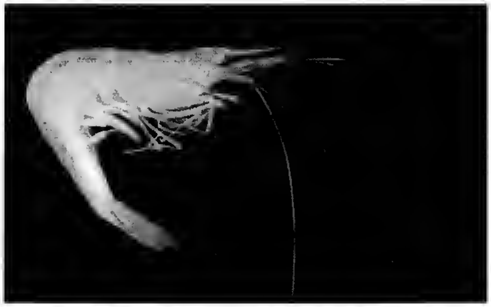

Fig. 8. McCulloch's Shrimp *Caridina mccullochi* (preserved specimen) from Bohena Creek, Pilliga Scrub. Australian Museum specimen P.83249. Photo by Roger Springthorpe © Australian Museum.

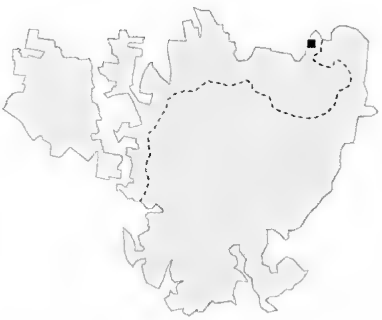

Fig. 9. Records of *Caridina mccullochi* in the Pilliga Scrub study area.

Fig. 10. Common Australian River Prawn *Macrobrachium australiense* from Borah Creek, Pilliga Scrub. Photo by MJ Murphy.

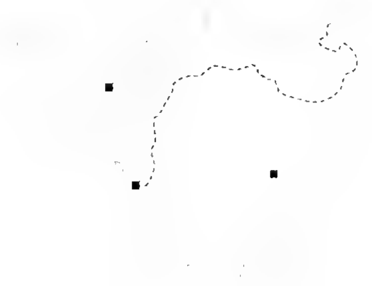

Fig. 11. Records of *Macrobrachium australiense* in the Pilliga Scrub study area.

astacidae) (Merrick 1993; Crandall and Buhay 2008), Cape York Peninsula (Parathelphusidae) (Bishop 1963) and northern Australia (Atyidae and Palaemonidae) (Riek 1953; Short 2004).

The Pilliga Scrub's decapod diversity at the family level, however, is relatively high. Four of the five freshwater decapod families known from Australia (Jones and Morgan 1994; Davie 2002a, 2002h) are represented in the Pilliga Scrub fauna. The only family not present is the Hymenosomatidae (false spider-crabs), of which the single Australian freshwater species occurs in the lower Murray-Darling Basin and coastal rivers of South Australia, Victoria and Tasmania (Lucas 1980; Davie 2002b). On a global scale the four decapod families in the Pilliga Scrub can be compared to two families (23 species) in the Apalachicola River system of the southern USA (Hobbs and Hart 1959), three families (20 species) in the Nile Basin of Africa (Cumberlidge 2009), three families (19 species) in Vanuatu in the western Pacific (Marquet *et al.* 2002), six families (25 species) in Pulau Tioman in Peninsular Malaysia (Yeo *et al.* 1999) and six families (64 species) in the Guayana Shield region of northern South America (Magalhaes and Pereira 2007). A factor contributing to the diversity of freshwater decapod families represented in the Pilliga

Scrub is its geographical position in an overlap zone between faunal assemblages of southern and northern Australia.

Cherax destructor is the most widely distributed freshwater crayfish species in Australia, occurring naturally in inland waters of south-eastern and central Australia (Merrick 1993; Hughes and Hillyer 2003) and playing a key role in the ecology of aquatic ecosystems (Giling *et al.* 2009). It is a hardy species, well suited to the variable aquatic conditions in the Pilliga Scrub, being tolerant of poor water quality and able to survive droughts by retreating to water-filled chambers at the end of burrows below dry stream beds (Healy and Yaldwyn 1971; Jones and Morgan 1994). This was the only decapod species regularly found in ground tanks in the Pilliga Scrub study area. It is possible that populations in some ground tanks are the result of local translocation of animals for the purpose of founding recreational fishing stock.

Austrothelphusa transversa is found in streams, swamps, waterholes and ground tanks in northern and north-eastern Australia, and the Pilliga Scrub is at the south-eastern edge of the species' distribution (Bishop 1963; Healy and Yaldwyn 1971). This species is well adapted to arid and semi-arid areas. It does not have a planktonic larval stage (the eggs hatching as small crabs), it can breathe effectively in both air and water and can survive several years of drought by sheltering in burrows up to 1 m deep with the entrance closed with a clay plug (Bishop 1963; Greenaway *et al.* 1983; Davie 2002b). *A. transversa* is very difficult to detect in areas that have been dry for any length of time (Bishop 1963), and in the Pilliga Scrub roads are often impassable after wet weather, when the species is likely to be active. Although recorded in this study at only a single site, this cryptic species is probably sparsely distributed through the western part of the Pilliga outwash sand plain.

Paratya australiensis occurs in south-eastern Australia and coastal Queensland in habitats ranging from inland rivers to upland rainforest streams and estuaries (Walsh and Mitchell 1995; Hancock and Bunn 1997). It is most commonly found in rivers, streams and billabongs and can also occur in lakes, reservoirs, farm dams and ditches (Williams 1977; Sheldon and Walker 1998). In rivers and streams *P. australiensis* favours backwater areas sheltered from the direct stream flow (Humphries *et al.* 2006; Richardson and Cook 2006). Unlike the preceding two species, *Paratya australiensis* lacks a life cycle stage able to survive the drying of waterbodies (Williams 1977). Its occurrence in the Pilliga Scrub must therefore depend on either survival of remnant populations in the few small permanent waterholes along major intermittent streams or, if even these dry out, re-colonisation upstream from the Namoi or Castlereagh rivers during extended stream flow events.

Caridina mccullochi occurs in the Murray-Darling Basin and south-east coastal area of southern Australia where it is a local but sometimes common inhabitant of quiet weedy waters in lowland streams and rivers (Benzie 1982; Davie 2002a). Although superficially very similar to, and often found with, *Paratya australiensis*, *Caridina mccullochi* is more strongly associated with sheltered backwaters and is apparently more vulnerable to the effects of river regulation (Richardson *et al.* 2004; Humphries *et al.* 2006; Richardson and Cook 2006). Like *P. australiensis*, *C. mccullochi* lacks a life cycle stage able to survive drying. The present study suggests that *Caridina mccullochi* has been considerably less successful than *P. australiensis* in taking advantage of temporary stream flows to colonise the Pilliga Scrub.

Macrobrachium australiense is found in rivers, streams, billabongs, lakes and reservoirs in inland and coastal areas of eastern and northern Australia and is the only member of its family found in the Murray-Darling Basin (Murphy *et al.* 2004; Short 2004; Richardson and Cook 2006). In rivers and streams *M. australiense* larvae favour sheltered backwater areas while adults prefer flowing channel habitats (Richardson and Cook 2006). Large-scale upstream migration by this species has been observed following rain (Lee and Fielder 1979). This is another species vulnerable to desiccation at all life cycle stages and therefore dependent on surface waters for survival. An increase in aridity due to anthropogenic climate change could see the disappearance from the Pilliga Scrub of the few small permanent waterholes providing critical surface water refugia for *P. australien-*

sis, *C. mccullochi* and *M. australiense* during dry periods, as well as a reduction in frequency and duration of the stream flow events required for recolonisation. The local extinction of these three species would represent a 60% reduction in local decapod species diversity.

Genetics research has indicated that both *Paratya australiensis* and *Caridina mccullochi* may be species complexes comprising multiple lineages and previously unrecognised cryptic species (Baker *et al.* 2004; Page *et al.* 2005; Cook *et al.* 2006; Cook *et al.* 2008). Taxonomy is always a 'work in progress' and it is important to lodge voucher specimens from field surveys in Museum collections so that identifications can be substantiated and to provide reference material in the event of future taxonomic revisions. Voucher specimens from the present study (Appendix 2) comprised material from all sites where *Austrothelphusa transversa*, *Paratya australiensis*, *Caridina mccullochi* and *Macrobrachium australiense* were found and a representative sample of *Cherax destructor*.

Additional decapod crustacean species known from the Murray-Darling Basin in NSW but not recorded in this study include the Swamp Yabby *Cherax rotundus*, Burrowing Crayfish *Engaeus cymus*, Murray Crayfish *Euastacus armatus* and Sutton's Crayfish *Euastacus suttoni* (Parastacidae) (Merrick 1993; Austin *et al.* 2003; McCormack 2008). *Cherax rotundus*, *Engaeus cymus* and *Euastacus armatus* are found only in the southern part of the Murray-Darling Basin, while *Euastacus suttoni* is restricted to highland rivers of the New England Tableland and southern Queensland (Merrick 1993; Austin *et al.* 2003; McCormack 2008). None are expected to occur in the Pilliga Scrub.

The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (including lowland reaches of the Namoi and Castlereagh Rivers and all tributary streams and floodplains) is currently listed as an endangered ecological community (EEC) under the NSW *Fisheries Management Act* 1994 (NSW Fisheries Scientific Committee 2003). The listing includes all native aquatic invertebrates and fishes and covers all but the southern fringe of the Pilliga Scrub study area (which is within the upland catchment of the Castlereagh River). Threatening processes affecting this EEC include river regulation, water extraction, clearing of riparian vegetation, stock access to riparian areas, removal of instream timber debris, introduced species, insecticide and fertiliser run-off from agriculture, and overfishing (Koehn 1993; NSW Fisheries Scientific Committee 2003; Reid *et al.* 2008). As noted above, anthropogenic climate change should also be considered a threat.

The majority of the lowland catchment of the Murray-Darling Basin has been cleared for agriculture. In the Brigalow Belt South bioregion, for example, 64% of the bioregion's original native vegetation had been cleared by the late 20th century (State of the Environment Advisory Council 1996). The Pilliga Scrub is the largest surviving woodland area within the lowland catchment of the Darling River system in NSW and, despite the frequent scarcity of surface water and limited freshwater habitats, supports a rich aquatic macro-invertebrate community. In addition to the five decapod crustaceans documented here, other crustaceans recorded in the Pilliga Scrub during this study include fairy shrimps (Anostraca), shield shrimps (Notostraca) and clam shrimps (Conchostraca) (Murphy pers. obs.). A high diversity of aquatic molluscs is also present, including species rare in NSW such as the mussel *Velesunio wilsonii* (Hyriidae) and the freshwater snails *Notopala* sp. (Viviparidae) and *Bayardella cosmeta* (Planorbidae) (Murphy 2009). The high proportion of native woodland vegetation comprising stream catchments in the Pilliga Scrub is probably a major factor in the survival there of a relatively intact and significant example of the lowland Darling aquatic EEC macro-invertebrate fauna.

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Appendix 1. Location of primary survey sites.

Natural streams/waterbodies - outwash sand plain	
Baradine Creek, Baradine-Pilliga Road at Gwabegar bridge	30°37'51.0"S, 148°58'8.3"E
Old Coghill Waterhole, Pilliga National Park	30°29'29.5"S, 149°18'17.4"E
Creek north of Hollywood Boundary Road	30°33'30.5"S, 148°35'15.4"E
Yellow Creek, Pilliga-Coonamble Road	30°27'27.5"S, 148°48'5.6"E
Bohena Creek, Cains Crossing	30°24'45.1"S, 149°40'26.2"E
Ground tanks – outwash sand plain	
Bens dam, Pilliga State Conservation Area	30°35'53.4"S, 149°6'2.9"E
Trap Yard dam, Merriwindi State Conservation Area	30°47'38.5"S, 148°58'59.3"E
Camp Reserve dam, Pilliga National Park	30°32'53.6"S, 148°59'7.1"E
Middle dam, Pilliga West State Conservation Area	30°37'45.1"S, 148°49'30.9"E
Dead Filly tank, Pilliga West State Conservation Area	30°34'48.1"S, 148°46'44.1"E
Natural streams/waterbodies – sandstone country	
Yearinan Creek bridge, Coonabarabran-Baradine Road	31°10'58.8"S, 149°10'33.2"E
Timmallallie Creek bridge, Newell Highway	30°51'4.8"S, 149°27'26.3"E
Swindle Well Crossing, Timmallallie National Park	31°3'6.8"S, 149°10'48.2"E
Salisbury Waterholes, Pilliga Nature Reserve	30°52'44.3"S, 149°31'49.9"E
Dandry Creek, Narawa Road	31°8'46.4"S, 149°19'20.3"E
Ground tanks – sandstone country	
Timmallallie dam, Timmallallie National Park	30°55'8.0"S, 149°16'26.7"E
Bark Hut dam, Timmallallie National Park	30°54'45.9"S, 149°12'33.8"E
Delwood dam, Pilliga East State Conservation Area	30°46'46.4"S, 149°41'17.6"E
Lizard dam, Yarrigan National Park	31°4'40.0"S, 149°2'56.3"E
Cocaboy dam, Pilliga East State Conservation Area	30°51'10.1"S, 149°31'12.2"E

Appendix 2. Voucher specimens collected during this study and deposited in the Australian Museum, Sydney.

Cherax destructor	P.82091, P.82092, P.82095, P.83246
Austrothelphusa transversa	P.83245
Caridina mccullochi	P.83249
Paratya australiensis	P.82089, P.82090, P.82093, P.82094, P.83242, P.83248, P.83250, P.84121, P.84122
Macrobrachium australiense	P.83247, P.83251, P.84120

A record of Spencer's Skink *Pseudemoia spenceri* from the Victorian Volcanic Plain

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Abstract
During a survey of vertebrate fauna at a site in Yan Yean, north of Melbourne on the Victorian Volcanic Plain, a small population of Spencer's Skink *Pseudemoia spenceri* was found inhabiting a heritage dry stone fence. Spencer's Skink is normally found in wet schlerophyll forest and cool temperate environments, and the species is not considered a grassland inhabitant. There are no other records of Spencer's Skink occurring in any part of the Victorian Volcanic Plain. (*The Victorian Naturalist* **128**(3) 2011, 106-110)

Keywords: Spencer's Skink *Pseudemoia spenceri*, Volcanic Plain, grasslands, dry stone fences.

Introduction

The Growling Frog Golf Course (GFGC) is situated on the Victorian Volcanic Plain in Yan Yean (37° 33'S, 145° 04'E), approximately 33 km north-north-east of the Melbourne Central Business District. The course was established in 2005 by the City of Whittlesea under strict environmental conditions that required the preservation of important natural and heritage features. These included protection of stony knolls, ephemeral wetlands and an area of Plains Grassy Woodland; preservation of all River Red Gums *Eucalyptus camaldulensis* and several rare plant species; and retention of heritage dry stone fences. Dry stone fences exist along most of the eastern and western boundaries of the golf course (Fig. 1).

Surveys of vertebrate fauna have been conducted at the property since 2007 (P Homan unpubl. data). The purpose of the surveys has been to assess conservation works and to determine which species of mammals, reptiles, amphibians and birds were inhabiting the site. A key aim has been to determine which vertebrate species were using dry stone fences as habitat. During these surveys a wide range of vertebrates have been recorded, including several species listed as threatened (DSE 2007). These include Growling Grass Frog *Litoria raniformis*, Hardhead *Aythya australis*, Australasian Shoveler *Anas rhynchotis*, White-bellied Sea-Eagle *Haliaeetus leucogaster* and Glossy Grass Skink *Pseudemoia rawlinsoni*. A number of herpetofauna species have been recorded using the dry stone fences as habitat. These include Large Striped Skink *Ctenotus robustus*, Bougainville's Skink *Lerista bougainvillii*, Lowland Copperhead *Austrelaps superbus*, Little Whip Snake *Parasuta flagellum*, Southern Bullfrog *Limnodynastes dumerilii* and Spotted Marsh Frog *Limnodynastes tasmaniensis*.

Record of Spencer's Skink *Pseudemoia spenceri* inhabiting dry stone fence

On 26 March 2010, staff and students from the School of Life and Physical Sciences, RMIT University, visited the GFGC to examine a habitat enhancement program near the dry stone fence on the western boundary of the property. During surveys commissioned by the City of Whittlesea, students observed two small skinks basking on the fence, but were unable to make positive identification of the specimens at that stage. On the morning of 29 March 2010, the site was visited by the author to commence a four day vertebrate survey (Homan 2010a). Heavy rain had fallen across the property overnight, but by early morning the rain had ceased and by mid morning the western boundary stone fence was bathed in brilliant sunshine. Within a short time several small skinks emerged from the rocks to bask. On this occasion close examination was possible and the specimens were identified as Spencer's Skink *Pseudemoia spenceri* (Fig. 2). Each specimen displayed prominent broad, cream dorsolateral stripes, a diagnostic feature of this species (Cogger 2000; Wilson and Swan 2008). Over the next hour ap-

Fig. 1. Heritage dry stone fence at Growling Frog Golf Course, Yan Yean.

proximately 12 specimens of various sizes were detected along a 50 m section of the western boundary fence. The property was visited again on the morning of 3 May 2010, when several more Spencer's Skinks were seen on the western fence. On this occasion, one specimen was observed to catch a small grasshopper that had landed on the fence.

Discussion

Spencer's Skink is a small, arboreal lizard which is usually found in wet sclerophyll forests and cool environments (Cogger 2000; Wilson and Swan 2008). The range of the species extends from the Blue Mountains in New South Wales through much of the Great Dividing Range in Victoria as far west as the Grampians (Cogger 2000; Wilson and Swan 2008). Spencer's Skink is also found near the coast, especially in East Gippsland, Wilsons Promontory and the Otway Ranges (Fig. 3). Throughout its range, it is not considered to be a species that inhabits grasslands (Wilson and Swan 2008). Spencer's Skink has well developed limbs and is an excellent climber. In February 2010, one specimen was observed approximately 15 m above ground on a dead section of a Southern Blue Gum *Eucalyptus globulus,* near Lorne in the Otway Ranges (P Homan pers. obs.). The species also inhabits rocky habitat, where large numbers can sometimes be found under exfoliations (P Robertson pers. comm., 18 April 2010).

Dry stone fences are a common feature of rural landscapes throughout the world, at sites where loose surface rock is available for their construction. Several studies have recorded numerous species of reptiles using these man-made structures as habitat (Madsen 1984; Hutchinson and Rawlinson 1995; Ahern *et al.* 1998; Turner 2010; G Peterson unpubl. data; P Robertson unpubl. data). Many herpetofauna studies have been conducted in various sections of Victoria's Volcanic Plain, including sites with dry stone fences, especially on the outskirts of metropolitan Melbourne (Beardsell 1997; Ahern *et al.* 1998; Clemann 2003; Heard and Robertson 2004; Homan 2004; Carr *et al.* 2006; Homan 2007; Turner 2007; Homan 2010b; Peterson and

Fig. 2. Spencer's Skink *Pseudemoia spenceri* on heritage stone fence.

Rohr 2010; P Robertson unpubl. data). None of these studies have detected populations of Spencer's Skink, and no other records are available for this species on any part of the Victorian Volcanic Plain (Victorian Biodiversity Atlas). A detailed study of the area now occupied by the GFGC was conducted over several years from 1988 to 1991 (Beardsell 1997). During that study stony knolls and stone fences were systematically and carefully searched on numerous occasions. Several species of grassland reptiles were recorded; however, no records of Spencer's Skink were reported.

It is not unusual for species of herpetofauna to be deliberately or accidentally moved between locations. When this occurs, specimens may escape or be released into local environments (Pescott 1976; Gillespie and Clemann 2000; Clemann 2005). The nearest records for Spencer's Skink are from Mountain Ash *Eucalyptus regnans* forest in the Mt Disappointment area approximately 18 km north-north-east of the GFGC (P. Robertson pers comm., 18 April 2010). It is highly unlikely that individuals of this species reached the GFGC by natural dispersal or migration from that area. The GFGC is also several kilometres from human habitation, so it is unlikely that the species was deliberately released at the site. Most likely the population that now inhabits the stone fence on the property reached the site by accident. The species may have reached this location only in recent times. During the vertebrate surveys conducted since 2007, the stone fences have been examined closely many times for basking reptiles; however, Spencer's Skink had not been seen before March 2010. The last occasion, prior to the current survey, on which the fences were examined was March 2009. Several past and current staff of the City of Whittlesea and contractors who have carried out works at the site, using various types of earth-moving equipment, live in areas in the Kinglake Ranges and Yarra Ranges where Spencer's Skink has been recorded. The most likely explanation is that the species reached the GFGC by accident,

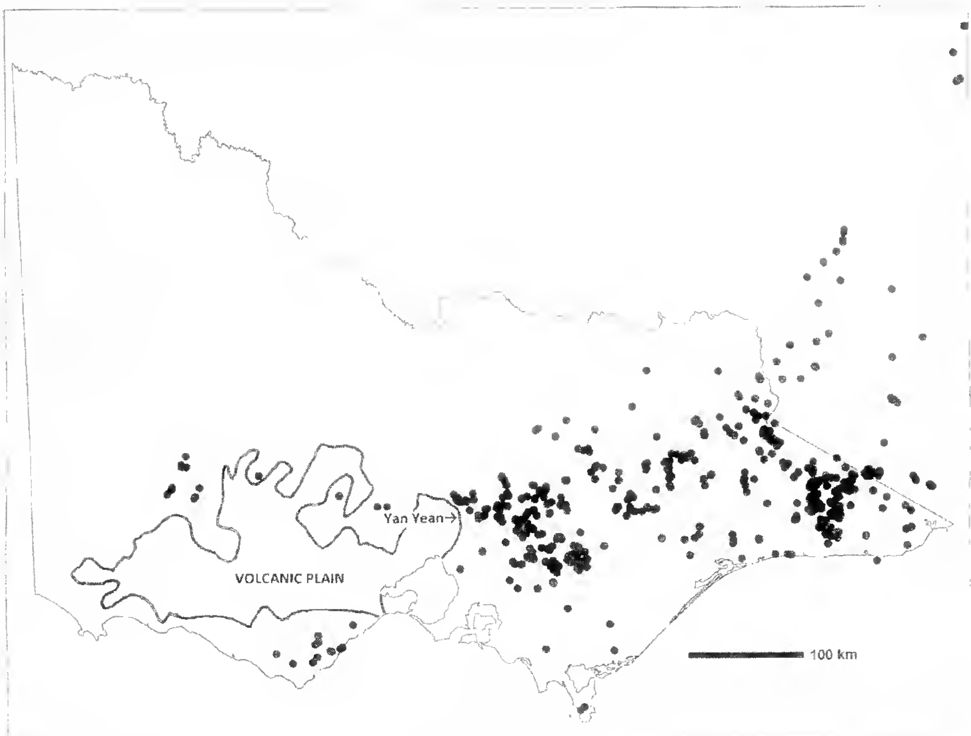

Fig. 3. Victorian distribution map for Spencer's Skink *Pseudemoia spenceri* (Victorian Biodiverity Atlas, Department of Sustainability and Environment).

perhaps as a stow-away in some form of industrial equipment or vehicle or in material, such as timber, brought to the golf course.

Nevertheless, the dry stone fences on the property provide excellent habitat for Spencer's Skink, with many feeding and basking opportunities and quick escape routes from any predator into the maze of rocks. The number of individual skinks observed, including several small specimens which appeared to be juveniles, suggests that the species is breeding at this location. Further monitoring will determine whether or not Spencer's Skink can survive on a long-term basis in a grassland environment.

Acknowledgements

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One hundred and one years ago

THE GENUINE AND THE SPURIOUS LOCUST FUNGUS.

By. D. McAlpine, Government Vegetable Pathologist

(From 'The Romance of plant pathology' (Read before the Field Naturalists' Club of Victoria, 8th August, 1910)

This is an instance of a scientific blunder which led to various complications, and some of these are sufficiently amusing to be worthy of record here.

The locust plague, in some seasons, is very destructive in Australia, as well as in other parts of the world, and various attempts have heen made to cope with it. It was found in South Africa that a parasitic fungus attacked and destroyed them wholesale, and if this fungus could be used for infecting them artificially it would be a valuable discovery. Accordingly, cultures were made at the Cape and sent out in tubes as the "South African Locust Fungus." Several of these tubes reached me in October, 1899, from the Director of the Bacteriological Institute at the Cape, accompanied by the following note:– "I may mention that many thousands of tubes have been used in this colony with unfailing success in wet weather, if properly applied. In dry weather the fungus is not so certain in its results: but even then it has been extremely satisfactory in the hands of the locust experts sent out by the Government, who are practised in its use. The fungus has been despatched to Cyprus, Algeria, Palestine, South America, and many other parts of the world." Accompanied by such a strong recommendation, it is no wonder that the cultures were used by Mr. French, the Government Entomologist, and others.

My interest in the fungus consisted in determining its systematic position, in order to know its nature and whether it was likely to affect other forms of life. It was determined to be a Mucor, one of the common bread-moulds, and this was afterwards supported by Massee, of Kew. The interest of this determination lies in the fact that the true locust fungus is not a Mucor at all, and the wrong one was sent out by mistake. How it came about was this: The parasitic fungus which killed the locusts was *Empusa grylli*, but Mucor was also present on the dead locusts, and so, by an unfortunate mistake, the locust fungus, which was sent out in tubes with gelatine, was a species of Mucor, or a mould which is not a parasite. The locust destroyer will only grow on the living tissues of the locust, and has never been cultivated on dead substances. It is closely related to the parasite on the common house-fly (*Empusa muscce*). Everyone is familiar with the dead fly stuck to the window-pane and a white halo surrounding its body.

From *The Victorian Naturalist* **XXVII**, pp. 132-133, November 10, 1910

Preliminary observations on an undescribed yellow *Pluteus* species

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Abstract

A yellow to olive-yellow *Pluteus* species (Fungi, Agaricales) has been observed on a number of Field Naturalists Club of Victoria Fungi Group forays. It was thought to be *P. lutescens* based on images found in some fungi field guides. Detailed examination of the pileus cuticle (pileipellis) revealed a cutis in transition to a trichoderm with long cylindrical terminal cells. This is inconsistent with *P. lutescens*, which has a hymenoderm layer of almost spherical inflated cells. The characteristics of this *Pluteus* were compared with a number of other species, namely *P. pauperculus* (= *P. lutescens* sensu K. Griffiths), *P. romellii*, *P. chrysophlebius* and the species in *Pluteus* stirps *Leoninus* for which our species seemed to have an affinity. It was concluded that the characteristics did not match any of the species examined, which would suggest that this species is undescribed. (*The Victorian Naturalist* **128**(3) 2011, 111-115)

Keywords Pluteaceae, *Pluteus lutescens*, *Pluteus romellii*, *Pluteus leoninus*

Introduction

On a number of Field Naturalists Club of Victoria Fungi Group forays, a yellow to olive-yellow *Pluteus* species (Fig. 1 and front cover) now referred to as *Pluteus* sp. 'yellow', has been observed growing on decaying wood. In Victoria it has been seen at Maits Rest in the Otway Ranges, Bunyip State Forest, Emerald Lake in the Dandenong Ranges and Greens Bush in the Mornington Peninsula National Park. We were also able to confirm, from dried specimens sent to us by Dr Genevieve Gates, that this species is present in Tasmania.

There has been a debate among some of the Club members as to the name of this species. Similar looking species are illustrated in Australian literature as *Pluteus lutescens*, e.g. Fuhrer (2005), McCann (2003) and Griffiths (1985). In overseas literature Arora (1986), Breitenbach and Kränzlin (1995), and Phillips (2006) also illustrate similar looking species such as *Pluteus lutescens*, *Pluteus romellii* and *Pluteus leoninus*. To resolve the problem of the identity of *Pluteus* sp. 'yellow', a detailed examination was made and the results were compared to similar looking known species.

Methods

A number of fruit-bodies of *Pluteus* sp. 'yellow' were collected from various locations. Three fruit-bodies were used to make the microscopic measurements. Mounts for microscopic examination were made from dried and fresh material, measurements were made in 5% potassium hydroxide solution or in Congo Red with 10% ammonia. The drawings of spores, basidia, and cystidia were made by tracing over digital micrographs in Photoshop™. Some of the material examined has been deposited in the National Herbarium, Royal Botanic Gardens, Melbourne.

Description of *Pluteus* sp. 'yellow'

Pileus to 35 mm broad; when young convex, expanding to plane; surface dry, dull, not hygrophanous, very finely fibrillose or granular, not glabrous, translucent striate towards the margin; colour when very young brown to yellowish brown, becoming dull yellowish to olive-yellow with age.

Lamellae free; moderately close; ventricose, up to 7 mm deep; colour whitish at first, then pale buff, becoming pale pinkish yellow as spores mature.

Stipe centrally attached; generally up to 40 mm long and 3 mm thick; cylindrical, usually with a yellow basal disc, basal mycelium white; surface sometimes smooth, usually covered with white fibrils; colour very pale yellow to lemon yellow for mature and immature fruit-bodies, usually paler at apex.

Fig. 1. View of lamellae of *Pluteus* sp. 'yellow' fruit-body (see also front cover)

Basidiospores 7.0–7.7 × 5.5–6.5 µm, broadly ellipsoidal to subglobose, smooth. **Basidia** four-spored, 22–26 × 9–11 µm, clavate. **Cystidia:** cheilocystidia 55–80 × 16–25 µm, clavate to fusoid-ventricose; pleurocystidia 60–75 × 18–25 µm, fusoid-ventricose, lageniform. **Pileipellis** a cutis with transition to a trichoderm, with long, cylindrical terminal hyphae 100-130 × 21–23 µm (Fig. 2.). The trichoderm hyphae and cystidia are thin-walled (not metuloid). These characteristics suggest that this species should be placed in the *Pluteus* Section *Hispidoderma* (Singer 1962; Minnis and Sundberg 2010).

No clamp connections were found.

Discussion

For all the species of *Pluteus* of interest, measurements of the spores, basidia, cheilocystidia and pleurocystidia offer little assistance in identification, because there is little variation between these species, as can be seen in Table 1. The two features that show most variation are the hyphal structure of the pileipellis and the shape of the cystidia (Table 1). These features predominantly were used to separate *Pluteus* sp. 'yellow' from the other species of *Pluteus*.

***Pluteus lutescens* sensu K. Griffiths (1985)**

The illustration of *P. lutescens* in Griffiths (1985: 34) depicts a fruit-body with a brown pileus and a yellow stipe with a distinct red base. The only known *Pluteus* in Australia that matches this description is *P. pauperculus* (Horak 2008) = *P. flammipes* var. *depauperatus* (Horak 1983). This species is restricted to New Zealand and Australia and was initially found in Western Australia.

Pluteus sp. 'yellow' differs from *P. pauperculus*, which can have a bright orange to reddish base to its stipe, and a brown pileus. Its pileipellis is a hymeniderm consisting of clavate and vesiculose cells (Horak 2008), which puts it in the *Pluteus* Section *Celluloderma* (Horak 1983; 2008).

***Pluteus romellii* (Britzelm.) Sacc.**

Synonyms:- *Pluteus lutescens* (Fr.) Bres., and *Pluteus nanus* var. *lutescens* (Fr.) P. Karst.

A description of Australian material is given by Grgurinovic (1997) where it has been given the species name *P. nanus*. Since the description in Grgurinovic (1997) is a direct transcription from Cleland (1934-1935), who called the species *P. nanus* var. *lutescens*, it is reasonable to assume that the description in Grgurinovic (1997) is that of *P. nanus* var. *lutescens*. Grgurinovic expanded upon Cleland's original description by including microscopic details. The description in Grgurinovic (1997) is consistent with *Pluteus romellii*.

Pluteus sp. 'yellow' differs macroscopically from *P. romellii*, which normally has a uniformly brown or olive brown pileus with a glabrous surface towards the margin (Homola 1972; Grgurinovic 1997; Minnis and Sundberg 2010). Microscopically, the pileipellis of *P. romellii* is a hymeniderm composed of pyriform to clavate cells, which puts it in the *Pluteus* Section *Celluloderma*.

***Pluteus chrysophlebius* (Berk. & Ravenel) Sacc.**

Synonyms:- *Pluteus admirabilis* (Peck) Peck, *Pluteus aurantiacus* Murr., *Pluteus melleus* Murr., and *Pluteus rugosidiscus* Murr.

Pluteus sp. 'yellow' differs from *P. chysophlebius*, the pileipellis of which is a hymeniderm composed of pyriform to clavate cells and therefore belongs in the *Pluteus* Section *Cel-*

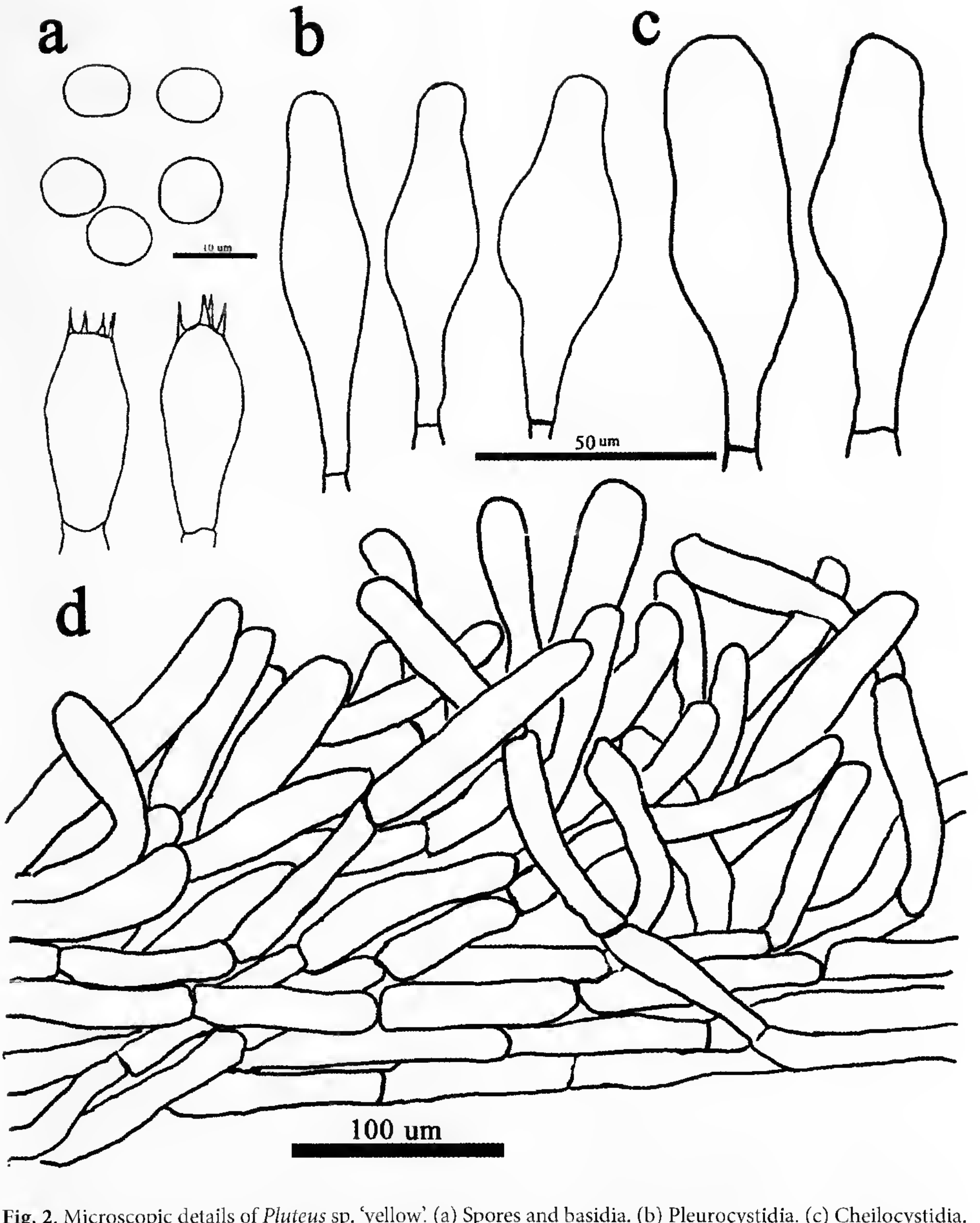

Fig. 2. Microscopic details of *Pluteus* sp. 'yellow'. (a) Spores and basidia. (b) Pleurocystidia. (c) Cheilocystidia. (d) Pileal cells. (a. Scale bar = 10 µm. b, c. Scale bar = 50 µm. d. Scale bar = 100 µm.)

Table 1. Microscopic characteristics and their size in micrometres. (1) Homola 1972, (2) Minnis and Sundberg 2010, (3) Grgurinovic 1997, (4) Breitenbach and Kränzlin 1995, (5) Horak 2008.

	Spores µm	Basidia µm	Cheilocystidia µm	Pleurocystidia µm	Pileipellis cells µm
Pluteus sp. 'yellow'	7.0–7.7 × 5.5–6.5	22–26 × 9–11	55–80 × 16–25	60–75 × 18–25	100–130 × 21–23
Pluteus romellii (1)	5.8–7.0 × 5–6.1	18–20 × 7–9	31–60 × 9–26	48–74 × 14–49	23–62 × 17–52
Pluteus romellii (2)	6.2–7.9 × 4.8–6.6	22–29 × 7–9	23–61 × 12–36	52–62 × 14–30	20–61 × 15–40
Pluteus romellii (3)	6.2–8 × 5.6–7.1	23–34 × 7–11	22.8–68 × 17–47	34–96 × 17–51	22–48 × 10–30
Pluteus chrysophlebius (1)	6.0–7.0 × 4.5–5.8	20–24 × 7–8	30–46 × 10–23	40–60 × 12–18	18–29 × 11–19
Pluteus chrysophlebius (2)	.3–7.9 × 4.8–7.0	20–32 × 6–11	24–41 × 13–18	44–67 × 12–22	23–42 × 12–42
Pluteus leoninus (4)	6.5–8.1 × 4.8–6.7	20–37 × 7–10	2 5–55 × 9–15	35–80 × 12–22	90–300 × 12–30
Pluteus pauperculus (5)	5.5–6.5 × 4.5–5.5	20–30 × 6–9	30–80 × 12–17	50–80 × 17–35	35–50 × 15–30

luloderma (Singer 1958; Homola 1972; Breitenbach and Kränzlin 1995; Minnis and Sundberg 2010).

Pluteus leoninus **(Schaeff. ex Fr.) Quél.**
Pluteus sp. 'yellow' differs from *P. leoninus*, which has a white stipe when immature, and a trichodermal pileipellis composed of large fusiform cells with subacute to acute apices (Singer 1956; Breitenbach and Kränzlin 1995).

The morphological characteristics of *Pluteus* sp. 'yellow' suggest that it has an affinity with *P. leoninus* and that it can be placed with *Pluteus* species in Section *Hispidoderma* stirps *Leoninus* as defined by Singer (1962: 442). This Section consists of approximately ten species, which have a pileus and/or stipe coloured red, yellow, orange, bronze, etc. A cursory examination of the species in this Section shows that *P. leoninus* (= *P. luteomarginatus*, = *P. sororiatus*, see Justo and Castro 2004), and *P. longipes* (= *P. whiteae*, see Singer 1959), *P. roseipes*, and *P. glabrescens* differ from *Pluteus* sp. 'yellow' because their pileipelli consist of large fusiform cells with subacute to acute apices (Singer 1956, 1959). *Pluteus flavofuligineus* differs from *Pluteus* sp. 'yellow' by having cystidia with tiny nodulose or sterigmatoid appendages (Singer 1956). *Pluteus conizatus* differs from *Pluteus* sp. 'yellow' by having smooth (no prongs) metuloid cystidia (Singer 1956). *Pluteus rubrotomentosus* differs from *Pluteus* sp. 'yellow' by having a red pileus (Singer 1958). *Pluteus glyphidatus* differs from *Pluteus* sp. 'yellow' by having differently shaped pileipellis hyphae (Singer 1956), and *P. citrinus* differs by having smaller spores, lacks a striate margin, and has a cream coloured stipe (Murrill 1941; Singer 1956).

It is clear that *Pluteus* sp. 'yellow' is neither *P. lutescens* sensu K. Griffiths, nor *P. romellii*, nor *P. chrysophlebius* because of the differences outlined above. *Pluteus* sp. 'yellow' seems to have some affinity to the species in *Pluteus* stirps *Leoninus*, but because of the differences mentioned above it can be concluded that it is not one of those species. Since it has not been possible to identify *Pluteus* sp. 'yellow' by comparing it with most of the likely known species, it is probable that *Pluteus* sp. 'yellow' is an unnamed species.

Conclusion

From this preliminary examination of *Pluteus* sp. 'yellow' it is evident that it is not *P. lutescens* sensu K. Griffiths, nor *P. romellii*, nor *P. chrysophlebius*, nor any of the species in *Pluteus* stirps *Leoninus*. It is most probable that *Pluteus* sp. 'yellow' is an undescribed species. Therefore it is suggested that the field name *Pluteus* sp. 'yellow' be given to this species until it is officially named.

Acknowledgements

Thank you to Dr Tom May, Royal Botanic Gardens Melbourne, for generous assistance and valuable comments on a draft, to Dr Genevieve Gates, School of Plant Science, University of Tasmania, for allowing us to examine some of her *Pluteus* specimens, and to referee Dr David Ratkowsky for many helpful suggestions that improved the manuscript.

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One hundred and one years ago

A NEW FORM OF VEGETABLE CATERPILLAR (?)

By. D. McAlpine, Government Vegetable Pathologist

(From 'The Romance of plant pathology' (Read before the Field Naturalists' Club of Victoria, 8th August, 1910)

A distinguished entomologist in a neighbouring State sent me specimens of what he called a new form of Cordyceps. Accompanying the specimens there was the following description :— "The lepidopterous caterpillars (Agrotis or other Noctuid) are under an inch; the stalk whitish, less than a millimetre at base, and gradually attenuated to about .2 mm. or less, the dark stroma short and thread-like. No indication of branching, though *Cordyceps hawkesii* appears to be the only one comparable in form."

Now, the recipe given in Mrs. Glasse's cookery book for the preparation of jugged hare is very appropriate here—"First catch your hare"; and before attempting to name or describe a fungus, it is well to make sure that there is one. As a matter of fact, the specimen was the rat-tailed larva of the drone or bee-fly (*Eristalis tenax*), which is figured in Froggatt's "Australian Insects," and the larvae are described as "dirty-white maggots, with slender rat-tails at the tip of the body, and they live in all kinds of rotten or semi-liquid refuse." Instead of being a Cordyceps, it was simply a natural appendage, and this pardonable mistake is only another illustration of the necessity for careful examination before jumping at conclusions.

From *The Victorian Naturalist* **XXVII**, pp. 134-135, November 10, 1910

A note on predation of Eastern Grey Kangaroo in the eastern Otway Ranges

I have been studying and collecting data on the predation of large animal and carrion-eating behaviour in western Victoria and south-eastern South Australia since 1990. My primary study area is in the eastern Otway Ranges. An arbitrary size limit has been set on the species preyed on or eaten as carrion that are included in the study. It includes all macropods that can attain a weight greater than 20 kg: the koala, common wombat, all deer species, domestic sheep, goats, alpacas, pigs, cattle and horses. Feral forms of any of the domestic animals are included also, as are the dog and emu.

To date, data on macropods including the eastern grey kangaroo, western grey kangaroo, swamp wallaby and red necked wallaby and on domestic stock including sheep, goat, alpaca, cattle and horse have been recorded as preyed on and also eaten as carrion. The fallow deer has been recorded as eaten as carrion only. I have recorded over 50 large mammal kills within a 20 km radius of the hamlet of Bambra in the eastern Otway Ranges. A widespread network of rural residents, agricultural professionals and recreational hunters provide information regarding the location of large animal carcases that may be prey.

Most of the animals located have been killed by severe trauma to the neck with separation of cervical vertebrae 1 and 2, sometimes with penetrative wounds to the cranium or with a single crushing or suffocating bite to the throat. Usually the feeding process has consisted of the thorax being opened and the ribs sheared off close to the spine. The heart, lungs and liver were then removed. On the following or subsequent nights the carcases have often been removed to heavy cover nearby, often bracken fern, where the hams and back straps were eaten. Frequently, after five days the prey item has remained as only a skin with skull attached.

In spring 2007 a foal of a few days of age was recorded in the same district as being alive and well and feeding from its dam at 2330 hours and then being killed and reduced to a skeleton by 0830 hours the next morning. Its skull and neck displayed significant trauma.

One particular carcase was found in a very fresh state and was photographed. In the mid-morning of Saturday 19 February 2005, in the eastern Otway Ranges (approximate location: 38° 36'S; 143° 93'E) the author, in the company of a local bushman, found the remains of an adult female Eastern Grey Kangaroo *Macropus giganteus*. The carcase had been distinctively mutilated but still maintained substantial body heat; rigor mortis had not yet commenced. On inspection the marsupium was found to be elastic and the oversized teat in use expressed milk when squeezed. This indicated it had contained a large pouch young that had been lost only very recently.

Fig. 1 illustrates the amount of tissue and bone that had been removed prior to the carcase being located. The head, neck, and left forelimb were gone; ribs were exposed and sheared off, and the heart, lungs and liver had been removed. There was also damage to the right side hind limb. The right metatarsals were separated from the tibia and remained joined by a fragment of skin. No breaks to the long bones or other penetrative damage to the rest of the carcase could be found. The volume of meat removed from the carcase when originally found—including head and neck, organs, left forelimb, shoulder, and ribs—was conservatively estimated at 10 l. This was based on my experience of butchering such animals.

A motion sensor camera was set up on 20 February 2005, some 5 m from the carcase, but no record was made of any animal visiting as it decomposed. The entire carcase, in a state of

Fig. 1. Dead Eastern Grey Kangaroo *Macropus giganteus* found by the author in the Eastern Otway Ranges 19 February 2005.

advanced decomposition, disappeared on 24 February. No remnants, save a stain of body fluids, remained at the site.

The styles of killing and eating illustrated were not consistent with those of feral pigs, feral dogs, foxes or Wedge-tailed Eagles. Feral pigs and feral dogs are not resident in the district and their field sign is not found. Foxes and Wedge-tailed Eagles are common in the district but they do not have the capacity to remove such an amount of flesh from such a carcase in a short time.

It may be that anecdotal reports of large feline in various parts of southern Australia, including the eastern Otway Ranges, need to be investigated with more rigour by the relevant authorities. Material from subsequent kills located will be submitted for DNA analysis to a relevant laboratory in a timely manner for analysis to determine the predator species involved.

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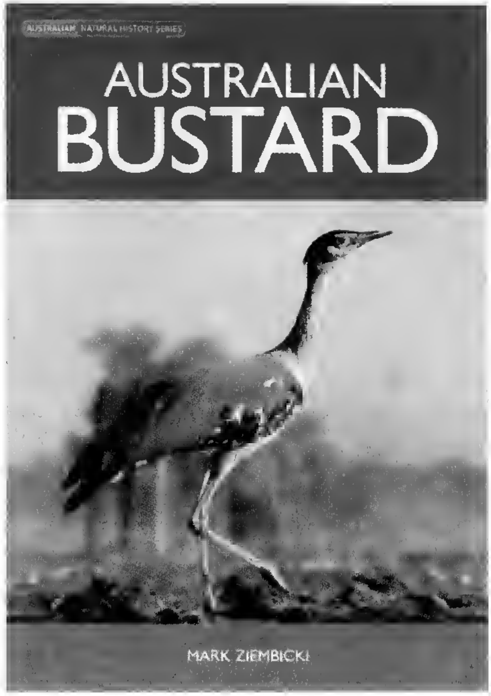
Australian Bustard

by Mark Ziembicki

Publisher: *CSIRO Publishing, Collingwood, Victoria 2010. 102 pages, paperback; colour and black and white illustrations. ISBN 9780643096110. RRP $39.95*



In this instalment of CSIRO Publishing's Australian Natural History Series, the author shares his clear passion for Australian Bustard and presents data from his PhD studies, and well-researched accounts of the cultural significance of the species to both Aborigines and Europeans. Taxonomy, habitat, distribution, behavioural and general ecology, and other topics are covered in a series of chapters, culminating in a chapter on conservation. One of the pitfalls of the modern scientific tradition is that a wealth of information on natural history is necessarily omitted from the highly constrained, theoretically focused scientific papers produced by postgraduate research students. The detailed natural history of their study species often remains only in their theses – documents which are often effectively out of public reach. Thus, books such as this one play an important role in communicating the knowledge accumulated by students such as Mark, which otherwise might not be readily accessible. Both the author and the publisher are to be congratulated for generating and communicating the updated natural history of an Australian species, in a climate where many academics, publishers (and conservation managers) shift focus away from individual species and their natural history.

Most chapters feature well-written accounts of current zoological theory (e.g. the discussion of leks) and then describe what is and what is not known about the Bustard, with an understandable emphasis on the author's own work. The treatment is thus somewhat uneven, so aspects apparently studied by the author are presented in great detail, while others (e.g. vocalisations) are dealt with much more briefly. I could not help wondering how this book compares to the detailed species account in the *Handbook of Australian, New Zealand and Antarctic Birds* (HANZAB), written in 1993 by a team of writers which included me! The book under review is not as comprehensively detailed as HANZAB, but is more readable and adds substantial amounts of additional, recent information, especially with regard to movements, habitat and space use. It is also much cheaper! I particularly enjoyed the chapters that discussed the ethno-ornithology of the species, and in this case the treatment was far more detailed than that of HANZAB. Unlike HANZAB, references are not provided in the running text, but a good reference list is provided. On balance, I suggest these two publications are complementary, and that the strategy of 'covering all the ground' while emphasising new knowledge is a good one, and a strategy worth making explicit.

Inevitably, a few improvements could be made. The target audience for this book is unclear: much of the writing is relaxed and entertaining, while in other parts data are presented in fairly raw form; tables are used in several places where figures could have been used to greater effect. While generally excellent, in places the writing is clumsy. Some technical terms are usefully defined (e.g. holotype), while other technical terms such as 'standard error' and 'sample size' (why not simply 'number of birds measured' for a lay reader?) are not. I also harbour a little disappointment at the production values. One of the most interesting figures, that of the satellite track of an individual bustard, is reproduced with such small font it is almost impossible to read the dates of the fixes or the nearby locations. At least one other figure (5.2) is virtually unreadable because of the small size of the reproduction, and minute uncoloured patterns used; this is immediately followed by a similar larger figure, provided in colour, which is easy to read! A number of plates presented in colour could easily have made way for figures that require colour, and in at least a couple of cases the same photograph has been reproduced both in black and white and in colour. These concerns are unlikely to detract from the enjoyment of the book by most readers.

The Australian Bustard is an icon and deserves to have books written about it, and this offering would be a welcome addition to the bookshelf of anybody with an interest in Australian birds or natural history. The author's aim to 'convey some of the charm and mystery' of this species has been attained.

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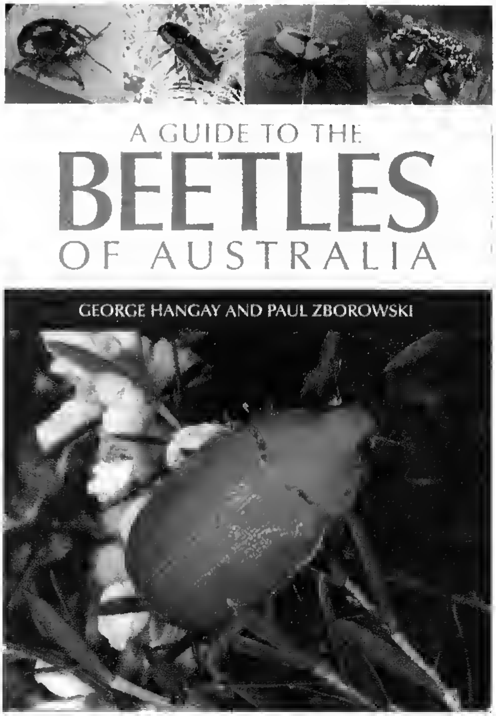
A Guide to the Beetles of Australia

by George Hangay and Paul Zborowski

Publisher: *CSIRO Publishing, Collingwood, Victoria 2010. 238 pages, paperback, colour photographs. ISBN 9780643094871. RRP $44.95*

In my early days of beetle interest, the popular literature available consisted mostly of sketchy works like those by John Child, Walter Froggatt, Charles French and Keith McKeown. The 1926 book by Robin Tillyard, *Insects of Australia and New Zealand*, was more detailed and professional but almost completely lacked photographs. Even Lawrence and Britton's 1994 adaptation of the CSIRO's 1991 authoritative account of Australia's beetles is now 17 years old and taxonomically somewhat out of date. Eric Matthews' eight volume work *A Guide to the Genera of Beetles of South Australia* is an extremely useful production but is principally a set of pictorial dichotomous keys to beetle genera rather than an ecological account of Australia's beetle families. Undoubtedly my most cherished book was *Gulliver in the Bush, wandering of an Australian Entomologist* of 1933 by the exemplary Australian coleopterist Herbert Carter, who produced a wonderful book of beetle collecting anecdotes, together with species lists of unequalled precision and detail. Even so it's devoid of any beetle photographs and lacks any general account of biology or taxonomy of beetles. In contrast George Hangay and Paul Zborowski's book *A Guide to the Beetles of Australia*, presented in a similar style as Trevor Hawkeswood's 1987 book *Beetles of Australia* and Barry Moore's 1980-96 *A Guide to the Beetles of south-eastern Australia*, particularly excels in interesting and detailed information, and current taxonomic order and nomenclature, together with beautiful colour photographs. It has x + 238 A5 sized well bound, semi-gloss pages.

The introductory sections of the book make for fascinating reading. It starts with a general introduction of the abundance and ubiquity of beetles, their roles and relationships with humans, and the value of studying beetles, whether by amateurs or professionals. The following section titled 'What makes a beetle?' describes the unique morphological features of the group. The subsequent sections deal in detail with



beetle anatomy, reproduction and development, food and survival, and higher taxonomy.

The remainder of the book deals with family descriptions, and covers 91 of the 117 beetle families known to be represented in Australia. It is pleasing to see that a common name for each beetle family is included. The sequential placement of families largely follows that of Lawrence and Britton (1994) and the suborder and superfamily position is mentioned for each family. All of the family names are up to date, for example the name Sphaeriusidae is used instead of Microsporidae and Bolboceratidae instead of Geotrupidae. The authors recognise that some families, such as Pselaphinae, Languriinae, Colydiinae, have been reduced in rank to subfamilies while the subfamily Ulodinae has been raised to family level.

A very useful short list of the most important diagnostic characteristics is given for each family. The family accounts are invariably informative and interesting and provide information on both adult and larval stages. They include a description of some distinguishing morphological features, comments on behaviour and ecology including feeding habits and the family's distribution within Australia. Finally, the number of Australian genera and species in each family is indicated. Occasionally an account is given of the more important or conspicuous subfamilies, especially of some of the larger families such as the scarabs, darkling beetles and leaf beetles. Scattered throughout the text of family descriptions are occasional vignettes on the biology of fascinating components of the fauna.

Representative specimens of each family are illustrated by excellent quality colour photographs, predominantly of living beetles, or by black and white or even colour drawings, mostly from CSIRO (1990) or Moore (1980-92). Many of the photographed beetles are specimens from North Queensland, giving the book a tropical flavour.

Included in the book are a very useful glossary and endnotes of 53 entries, predominantly pertinent references. There are two indices, one of common names and the other of scientific names.

In my opinion, *A Guide to the Beetles of Australia* is a very attractive and valuable handbook that adds substantially to the popular treatment of Australia's colourful and diverse world of beetle life. It will doubtlessly encourage enthusiasm, among children and adults alike, for this beautiful group of invertebrates. A greater awareness and experience of the natural world can not only provide endless enjoyment but can also promote an interest in nature conservation.

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Rainforest Restoration Manual for south-eastern Australia

by Bill Peel

Publisher: *CSIRO Publishing, Collingwood, Victoria 2010. Paperback and CD, 352 pages. ISBN 9780643094710. RRP $120.00*

This book is excellent. There are a number of typos but that easily is overlooked because of the sheer volume of information provided and the careful thought that has gone into presenting this step by step manual for rainforest restoration. In the section 'How to use this Manual' it is claimed that

> By using both the Manual and its supporting documents, you can aspire to be a 'rainforest restoration chef', rather than just a cook: being empowered to develop your own tools and techniques that can be adapted to the idiosyncrasies of your site or the social milieu in which you operate.

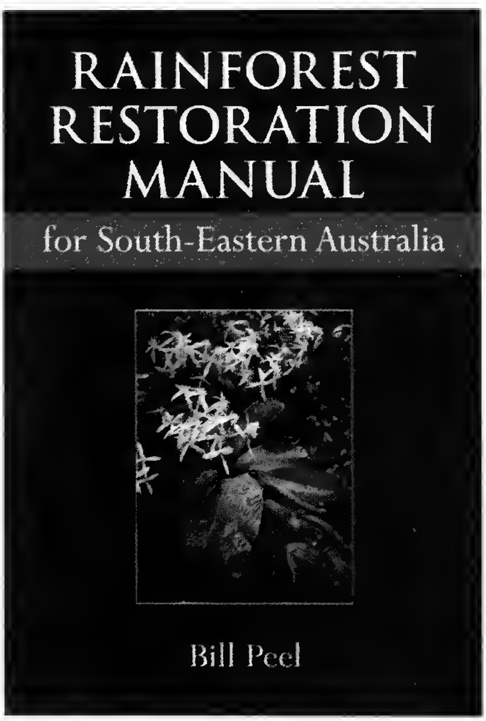
This is not a false boast. As well, it can be used as a template for restoration of other vegetation types, in that the concepts underlying restoration procedures can be translated to other situations.

Chapter 1 provides the necessary background information for anyone contemplating rainforest restoration. It explains the unique character of rainforests, their threats and what to do about them. It also explains the scientific basis for ecological restoration in a clear and easy to understand manner. Chapter 2 leads the reader along a journey towards understanding their rainforest and 'applying first aid'. At this stage of the book, the reader already will have become aware of the massive amount of research that serves as its foundation, which instills belief that rainforest restoration is possible. Then follow the ten steps for rainforest restoration.

Each step is presented in a separate chapter and includes:

- Objectives: what you will be able to do, know or achieve at the end of each Step;
- Summary: key points;
- Relevant reading;
- Further assistance: suggestions of where to go should you require help.

Step 1 (Chapter 3) details how to determine whether rainforest ever occurred at a given site and provides a series of decision trees to illustrate the logical sequence used in development of the Rainforest Divination Tool. Step 2 enables the detective know-how to elucidate the Ecological Vegetation Class and Floristic Community that is or was present. Again, each task is explained succinctly and unambiguously. Step 3 explains how to determine what a site requires for recovery and explains the ecological brakes that could be preventing rainforest recovery and what adaptive management responses might need to be applied. Some useful case studies are provided. Step 4 makes you stop and take



a realistic look at the task and your abilities, and whether or not you need some expert help. Step 5 provides a key for selecting your rainforest restoration method, then continues to give a full account of each method. Step 6 examines what resources and money are needed. Step 7 provides the means for carrying out a site assessment and developing a project management plan. It also gives ideas on funding applications. Step 8 deals with project implementation. This is very detailed and covers: landscape and site assessment, site preparation and seed collection; plant propagation, planting and maintenance; various techniques used depending on restoration method, resources available, season and limitations that might arise. Step 9 explains how to measure success and Step 10 explains how to do an annual health assessment, what is needed to maintain the restored rainforest. It concludes with a reminder that ecological management also requires anticipation of new threats and changes that might need to be accommodated.

At the back of the manual is a CD that contains supporting material with 32 appendices, a propagation manual for 735 rainforest plants of the region, an illustrated glossary and resources for teachers. Planting guides also are provided.

Bill Peel is an expert on rainforests – and he's not bad at writing manuals for their restoration. Throughout the book, his knowledge, passion and enthusiasm are evident and contagious. He has produced an excellent piece of work that is suitable for all. It is well written, well put together and easily understood. I highly recommend the book.

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Dingo

by Brad Purcell

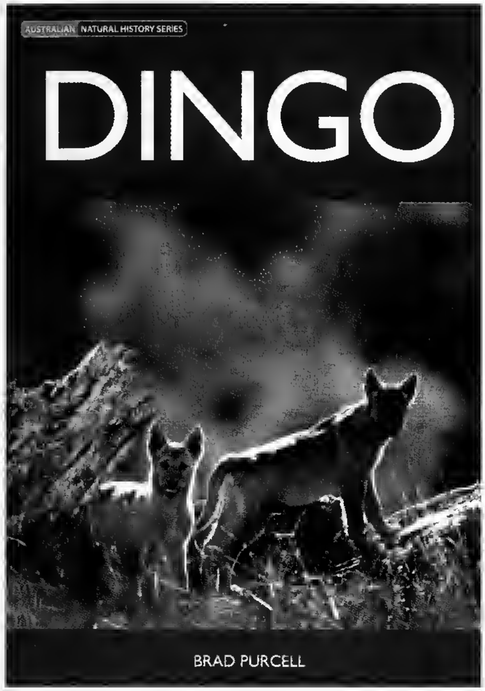
Publisher: *CSIRO Publishing, Collingwood, Victoria, 2010. 166 pages, paperback, colour photographs. ISBN 9780643096936. RRP $39.95*

Dingo raises serious questions in my mind; questions not, unfortunately, on the subject of dingoes, but on publishing standards and editorial responsibility. To be blunt: as it stands, this book should not have been published. I don't question the value or originality of Purcell's work, or doubt that it could provide the basis of a popular book about dingoes, but this isn't it.

The Australian Natural History Series already includes Laurie Corbett's *The Dingo in Australia and Asia*, published in 1995. Given the lapse of time and the developments in molecular systematics, in particular, a new treatment of the species is clearly desirable. But the likelihood of *Dingo* improving your understanding of the animal is minimal.

The book, based on Purcell's 2010 PhD thesis, a study of dingoes living in a 220 000-ha area of the Greater Blue Mountains World Heritage Area, is seriously flawed in at least three respects. First, there is reason to doubt the adequacy of both Purcell's dingo expertise and his general biological knowledge. It is clear, for instance, that his grasp of evolutionary biology is shaky. And you have to wonder when he writes that the dingo's canine teeth are for 'mastication and shearing flesh' (they aren't) or that the dingo has large 'main teeth' (which would they be?) or that kangaroos have an 'ephemeral' rather than a femoral artery. He notes the divergence of opinion as to whether or not dingoes bark, but makes no attempt to resolve the question: surely a dingo 'expert' should have a view?

Second, a large part of the book is devoted not to Purcell's own work, but to reviewing the literature, particularly that bearing on the



controversial questions of the dingo's origin, identity and relationships. This is a complex and difficult area; certainly a clear and readable summary is badly needed, but the book doesn't supply it. The account given is rambling and repetitive and by the end of it I felt little the wiser. As I struggled through it I kept looking forward to the moment when Purcell would bring his own work into the picture; but again I was to be disappointed. He never actually spells out how many packs he studied, for instance, or what their composition was. There is a colourful diagram on p. 72 showing genetic relatedness between 53 individual dingoes in the study area, but it emerges only incidentally and elsewhere that there is a correspondence between genetic groupings and packs. And the accounts of his own work are jumbled up with data derived from studies of wolves and other canids, so that sometimes it isn't clear whether what is said applies to dingoes or not.

Third, and responsible for massively exacerbating the other problems, is the fact that Purcell seems incapable of writing grammatical, lucid and readable English. The book may actually have more useful substance than I am crediting it with, but I became so tired of having to read sentences two or three times to try to extract their meaning that I found it impossible to maintain my concentration. In referring to the oft-cited Russian farm-fox study, as just one instance, he writes 'The general aim of the experiment was to observe adaptations in behavioural traits from the foxes that retained standard phenotype, biological function and wildness to that of domestication and conditioning of fox behaviour due to the presence of human beings.' I have no idea what this means. Comparable obscurity, accompanied by a plague of ambiguities, *non-sequiturs*, and grammatical lapses can be found on almost every page. There is an equally profuse sprinkling of illiteracies such as 'begs the question' for 'raises the question', 'reigns' for 'reins', 'slinked' for 'slunk', 'predate' for 'prey on', 'omit' for 'emit', 'proceeding' for 'preceding', and so on. If anyone critically read either the manuscript or the proofs there isn't any sign of it.

My major criticism, however, is not of Purcell, but of CSIRO Publishing. Why was an unpublished recent PhD graduate invited to undertake an important and ambitious project for which he was so ill-equipped? And why (if there was a compelling reason for giving him the commission) was he then not also given the support that he so evidently needed, in the form of advice, critical appraisal, correction and proofreading? *Dingo* is an embarrassment to the author, a slight on the reputation of the CSIRO, and, most importantly, an insult to readers and to other contributors to the Australian Natural History Series. Shame on you, CSIRO Publishing.

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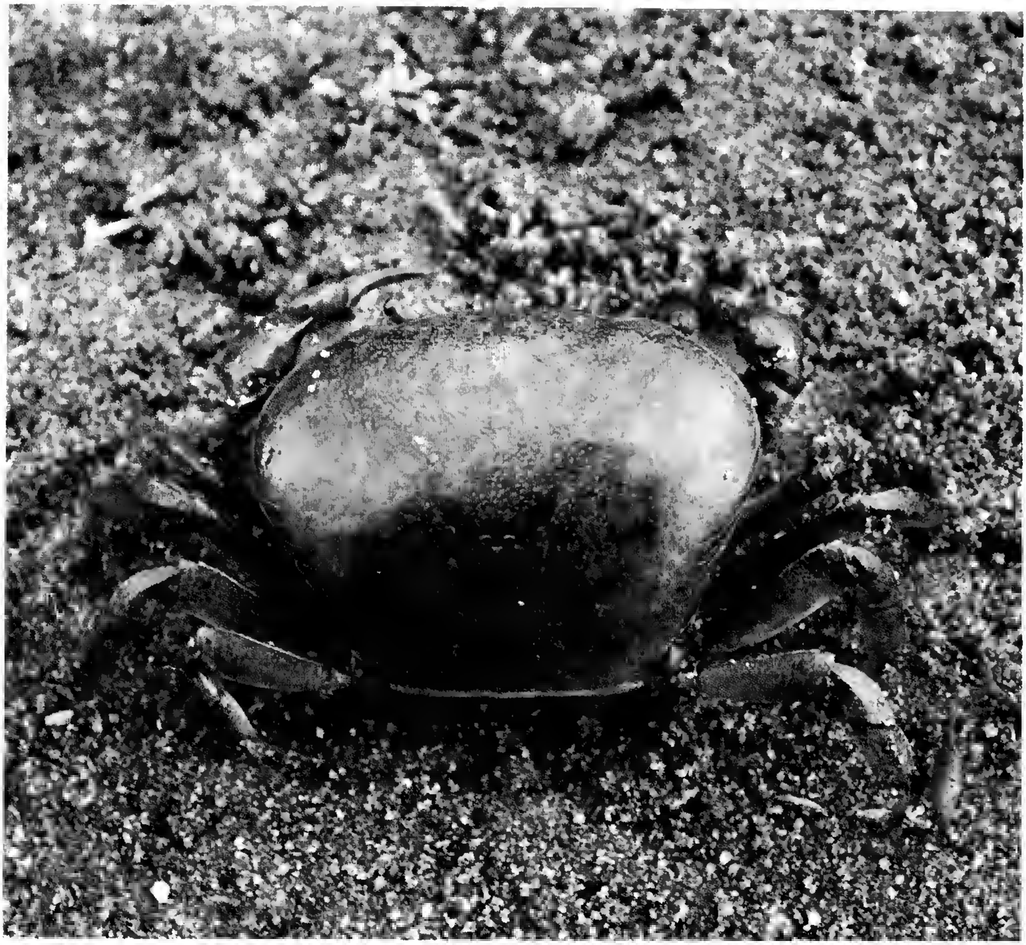

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