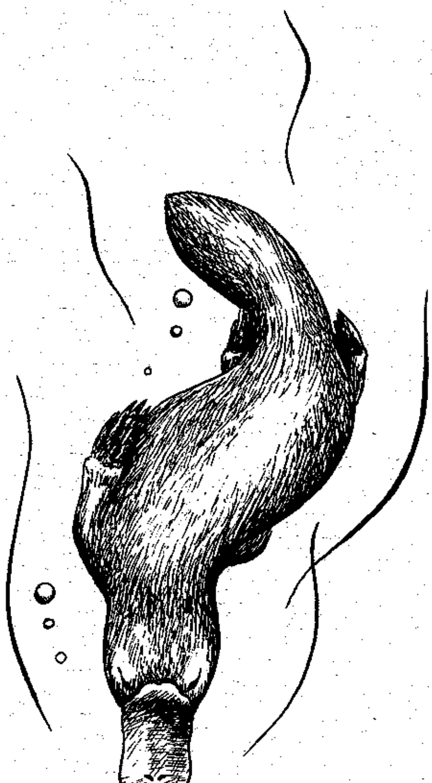
The Tasmanian Naturalist

Number 128
2006



Published by
Tasmanian Field Naturalists Club Inc.

VOLUME 128 (2006) ISSN 0819-6826

T.F.N.C.

THE TASMANIAN NATURALIST

EDITOR: SIMON GROVE

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Published annually by The Tasmanian Field Naturalists Club Inc., G.P.O. Box 68A, Hobart, Tasmania 7001

Native land snails of Schouten Island, eastern Tasmania

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Abstract

This paper documents a recent survey of the native land snails of Schouten Island, south of the Freycinet Peninsula. Twenty species were recorded, of which one (*Tornatellinops jacksonensis*, only its third Tasmanian record) may have been introduced. The fauna is similar to that of nearby Maria Island and more diverse than that of some significantly larger Tasmanian islands. Several significant range extensions are documented.

Introduction

Schouten Island is a rugged 3439 hectare island separated from the Frecyinet Peninsula on Tasmania's central east coast by a channel that is about one kilometre wide at its narrowest point. The island is of natural history interest because it is divided by a north-south running fault into an eastern section of granite crags and a slightly less mountainous western section of sandstone and dolerite. This division is mirrored dramatically in the island's vegetation communities (Harris and Kirkpatrick, 1982) – the eastern portion is rocky with sparse eucalypt cover while the western side includes grassy dry eucalpypt forests and areas of dense wet forest (the latter mainly on south-facing slopes).

Schouten Island has previously been only very lightly sampled for land snails. Smith and Kershaw (1981) recorded no native land snails from Schouten Island, although they did record the introduced *Cernuella vestita* (Rambur, 1868). *Bothriembryon tasmanicus* (Pfeiffer, 1853) was recorded by M. Johnstone in 1986 (QVMAG records) and Robert Taylor added *Caryodes dufresnii* (Leach, 1815), *Helicarion cuvieri* Ferussac, 1821 and *Tasmaphena ruga* (Legrand, 1871) in about 1993 (author's notes). On the adjacent Freycinet Peninsula, there has been a moderate degree of sampling around Coles Bay, but relatively little south of Hazards Beach.

This survey was conducted as one of a series of surveys of selected insufficiently sampled Tasmanian islands of likely biogeographical interest for land snails.

Methods

This survey consisted of seven samples (Table 1), each taken loosely and informally over a radius of up to 100 metres. The aim of sampling was to find as many species as possible, both on the island as a whole and at each sampling site. Sites were searched by hand searching (chiefly of rocks, logs, leaf litter, bark, moss and other shelters) for between one and two hours. Sites were selected subjectively with the aim of achieving reasonable spatial coverage while sampling a wide variety of habitats. Due to the ruggedness of the island and scarcity of tracks, it was not possible to achieve a thorough spatial coverage of the island in the time available. Furthermore, most sites surveyed were on the western (dolerite) side of the island, which supported forests considered likely to support far more snail diversity than the often bare granitic eastern side.

Table 1. Grid references and summary habitat characteristics of the study sites.

Site 1: (6054 3159) Eucalypt/sheoak coastal scrub on sandstone

Site 2: (6063 3163) Significantly taller and denser eucalypt/sheoak forest on granite

Site 3: (6045 3152) Open dry forest on dolerite

Site 4: (6045 3141) Dense low wet forest on dolerite

Site 5: (6049 3137) Grassy eucalypt woodland on steep dolerite slope

Site 6: (6034 3167) Sheoak scrub and tussocks on sand dune

Site 7: (6046 3163) *Bedfordia* and coastal shrubs on steep loose dolerite escarpment

RESULTS

Table 2 gives results of sampling at each of the seven main sites. Specimen numbers include both live and dead specimens and are estimates in three cases where over 50 specimens of a species were seen at a site. Additionally, the following incidental records were made:

GR 6046 3132, 9 Jan 06, one live *Bothriembryon tasmanicus* clinging to a reed in a dried-up pond.

GR 6045 3139, 9 Jan 06, two dead *Laomavix collisi* in blackwood leaf litter on a steep slope in wet forest.

GR 6053 3159, 9 Jan 06, one dead *Caryodes dufresnii* on an escarpment.

GR 6056 3159, 10 Jan 06, one dead *Helicarion cuvieri* on beach.

With the arguable exception of *Tornatellinops jacksonensis* (see below), no introduced species were recorded.

Table 2. Number of specimens of each species observed or collected at each of the seven main sites listed in Table 1. Use of "cf." indicates a species that is not referrable to any valid taxon but may be referrable to a name currently listed as a synonym. Tags for undescribed species follow the system used by Bonham (2003). * denotes species not previously recorded from the Freycinet Peninsula or Schouten Island.

	1	**2**	**3**	**4**	**5**	**6**	**7**
Achatinellidae							
Tornatellinops jacksonensis (Cox, 1864)*							9
Rhytididae							
Tasmaphena ruga (Legrand, 1871)		18	1		1		
Tasmaphena cf. *quaestiosa* (Legrand, 1871)				10			
Prolesophanta nelsonensis (Brazier, 1871)*		3		2	1		
Caryodidae							
Caryodes dufresnii (Leach, 1815)		4	7	32	1		
Bulimulidae							
Bothriembryon tasmanicus (Pfeiffer, 1853)	3	2	2	16	13	6	2
Punctidae							
Paralaoma caputspinulae (Reeve, 1854)	4	1	10		4	25	
Paralaoma cf. *halli* (Legrand, 1871)*		1	2		1		
Paralaoma cf. *mucoides* (Tenison-Woods, 1879)*			1				
Laomavix collisi (Brazier, 1877)	150	120				12	5
Trocholaoma parvissima (Legrand, 1871)*				4			
Magilaoma penolensis (Cox, 1868)	7					2	1
Charopidae							
*"Discocharopa" mimos*a (Petterd, 1879)*				5			
Elsothera ricei (Brazier, 1871)			1	16	1		
Allocharopa sp. "Freycinet"					5		
Pernagera tasmaniae (Cox, 1868)*				22			
Pernagera sp. "Paradise"*				2			
Pernagera officeri (Legrand, 1871)	30					6	15
Thryasona diemenensis (Cox, 1868)*				80			
Helicarionidae							
Helicarion cuvieri Ferussac, 1821		8			1	3	1
Total species	5	8	7	10	9	6	6
Total specimens	194	157	24	189	28	54	33

Discussion

Significant records

Tornatellinops jacksonensis has only been recorded twice previously in Tasmania - from Preservation Island (Smith and Kershaw, 1981) and Deal Island (record advised by Peter Brown). The species is widespread on the NSW and Victorian coasts. This find extends the species' known Tasmanian range by 200 km. Achatinellids such as this species are likely to have frequently been inadvertently dispersed by indigeneous peoples (Cooke and Kondo, 1960), and this species was considered introduced to Tasmania by Kershaw (1991) without stated reason but presumably on this basis. This find of the species, close to Aboriginal middens and well away from all previous records, is consistent with this theory, but is also consistent with introduction after European settlement from some other area to which indigenous peoples had earlier introduced the species. (A rail track associated with coal mining had once existed through the area.) Specimens were found in leaf litter and under shrubs on a dry escarpment not far above the high-water mark. No live specimens were found. *T. jacksonensis* is one of two species suspected of having been introduced to Tasmania by Aboriginal peoples, the other being *Pupilla australis* (Angas, 1864) – see Bonham (2003).

The genus *Allocharopa* includes a radiation of at least nineteen predominantly undescribed Tasmanian species (most discussed in Bonham, 2003). The specimens collected from Schouten Island have an extremely wide umbilicus (shell diameter over umbilicus width [D/U] is around 2.2), a very flat shell (height/shell diameter ratio [H/D] is around 0.3), a relatively tight spire (1.8 mm wide at 4.5 whorls) and a rough sculpture resembling *A. kershawi* (Petterd, 1879). This combination of characters is not present in any Tasmanian *Allocharopa* form in known collections. However, in 2000, the author saw several similar specimens at a creek on the south side of Mt Mayson on the Freycinet Peninsula, but lost all material collected. A specimen recorded by Alastair Richardson as *A. kershawi* from Coles Bay in the late 1990s could also have been similar.

Pernagera sp. "Paradise" is a poorly known undescribed species with only nine previous records. It occurs in eastern Tasmania with a known linear range of about 110 km from St Patricks Head in the north to Wielangta and northern Maria Island in the south.

The record of *Thryasona diemenensis* was surprising as the nearest previous records were from Maria Island 30 km to the south, and the southern Douglas-Apsley 50 km to the north. This species, widespread and common over much of the state, is apparently absent from wet forests on the adjacent east coast mainland between the Douglas-Apsley and Wielangta.

Diversity and biogeography

The native land snail diversity on the island (nineteen or twenty species depending on whether *Tornatellinops jacksonensis* is included) is high by east coast standards. Indeed there is no 10x10 km grid square within 70 km of Schouten Island from which more species have been recorded, although some grid squares have been far more extensively searched. By comparison, 31 species have been recorded from Bruny Island and 21 from Maria, but both of these are much larger than Schouten and have also been far more thoroughly searched. Significantly larger well-surveyed Tasmanian islands with fewer species recorded include King (15 spp.), Flinders (15), Three Hummock (10), Hunter (7), and Robbins (9) (Bonham 1997, 2003). The presence of wet forest on the southern side of Milligans Hill made a significant contribution to the diversity recorded in this survey. For example, of nine species found at only one of the seven sites, six of these occurred at the wet forest site, Site 4. Most of these six species are wet forest specialists. During the same project, a similar survey of South Maria Island (which did not support large areas of very dense wet forest) yielded only twelve species, including no wet forest specialists.

The recorded snail fauna of Schouten Island is very similar to that of Maria Island overall. The two islands have 17 species in common. They differ in which species of *Tasmaphena* and *Allocharopa* are present (Maria has what appears to be *T. sinclairi* and a different undescribed *Allocharopa*), and Maria has two charopids not yet recorded from Schouten (*Planilaoma luckmanii* (Brazier, 1877) and an undescribed *Roblinella* known only from the summit of Bishop and Clerk). *Tornatellinops jacksonensis* has not yet been recorded from Maria Island.

Indeed, the fauna of Schouten is more similar to that of Maria Island, 30 km to the south, than to mainland areas a similar distance to the west on the opposite side of Great Oyster Bay. The presence of *Thryasona diemenensis* has been discussed above. There are also three common north-eastern species that are present on the western side of Great Oyster Bay but were not found in this survey. These are *Victaphanta lampra* (Reeve, 1854), *Dentherona subrugosa* (Legrand, 1871), and the slug *Cystopelta petterdi* (Tate, 1881). All of these species extend south to roughly level with Schouten Island and *D. subrugosa* extends to at least 30 km south of it. If any of these species were present on Schouten Island it is highly likely they would have been found during this survey.

The only other species common on the nearby mainland but not found in this survey was *Planilaoma luckmanii*. This species could be present and have been missed in this brief survey. On Maria Island it is rare.

Nine species not previously recorded from the Freycinet Peninsula were found in this survey. Sampling in the wet forests of the southern Freycinet Peninsula is desirable to determine whether the wet forest species documented here are also present on the Freycinet Peninsula. This is of special interest in the case of *Thryasona diemenensis* because of the curious east coast gap in this species' known range.

The southern portion of the Tasmanian east coast is a hotspot for undescribed local endemic snails, often associated with wet forests on dolerite screes (Bonham, 2003). On this basis, there is potential for further species to be added to the Schouten Island snail list if such habitats, especially on the southern side of Milligans Hill, are further targeted.

ACKNOWLEDGEMENTS

This study was funded by a grant from the Plomley Foundation. The late Dr Brian Smith (Queen Victoria Museum, Launceston) assisted extensively with project co-ordination. I also thank Abbey Throssell for the loan of a tent, Freycinet Sea Charters (Coles Bay) for transport to and from the island, and Stewart Dudgeon and others at the Parks and Wildlife Service, Coles Bay, for information about the island. Material collected was taken under permit TFA 05216.

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Lentinellus reconsidered

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Three years ago, we published a short article in this journal (Gates and Ratkowsky, 2003) on the fungal genus *Lentinellus* in Tasmania, identifying three species that occur widely in Tasmanian forests. We provided a key to the three species and descriptions of each of the species. The names that we gave to the species were based upon a review of the literature and an evaluation of the opinions of authors of previous papers. One of the species is usually found on soil, more rarely at the base of trees, and has a central or slightly eccentric stipe. We identified this one as *Lentinellus omphalodes* (Fr.) Karst. The other two species are always found on wood, are sessile or have a reduced, lateral stipe. From the literature, we decided that the species with a rather hairy pileus and very small spores was either *L. hepatotrichus* (Berk.) D.A. Reid or *L. ursinus* (Fr.) Kühner, and that the other species, with a more glabrous pileus and larger spores, was either *L. pulvinulus* (Berk.) Pegler or *L. flabelliformis* (Bolton: Fr.) Ito.

After publication, we sent a reprint of our paper to Prof. Ron Petersen of the University of Tennessee, and learned to our surprise that he and Karen Hughes, a molecular biologist, had just submitted a manuscript on the genus *Lentinellus* for publication. He suggested that some of the names we used in our article would have to be changed as a result of their study. Now that their work, a 270-page monograph comprising three separate papers, has appeared in print (Petersen and Hughes, 2004), we are able to note the following changes to the nomenclature of the Tasmanian species.

The species that we were calling *L. pulvinulus* does appear to be that species. Its known distribution is confined to the Southern Hemisphere, occurring in New Zealand and Argentina as well as in Tasmania. Phylogenetically, the species is closest to *L. perstrictifolius* (Speg.) Singer, also of Argentina, and suggests a Gondwanan origin (Petersen and Hughes, 2004). The second sessile or laterally stipitate species is *L. castoreus* (Fr.) Kühner & Maire, not *L. hepatotrichus*, which Petersen and Hughes (2004) consider to be a synonym of *L. pulvinulus*, nor *L. ursinus*, which is widespread in Europe, eastern Asia and North America, including temperate Mexico, but does not appear to extend south of the Equator. *Lentinellus castoreus*, on the other hand, is a very widespread species, whose worldwide distribution includes both temperate and tropical areas of both hemispheres. One feature that we had overlooked in our previous treatment of this taxon is the fact that the gills are much closer together than those of *L. pulvinulus*. Indeed, the crowded lamellae, in contrast to the rather distant gill spacing of *L. pulvinulus*, help make the two taxa easy to differentiate macroscopically. In terms of phylogeny, *L. castoreus* is closest to the *L. ursinus* clade (Petersen and Hughes, 2004). Both these broad species groups are noteworthy for their small spores.

The centrally stiptitate species that we had confidently called *L. omphalodes* is not that species, as that taxon is confined to the Northern Hemisphere. In any case, its name has been changed to *L. micheneri* (Berk. & M.A. Curtis) Pegler. Prof. Petersen (pers. comm.) suggested to us that our species might be *L. novae-zelandiae* (Berk.) R.H. Petersen or a new species, *L. tasmanica* R.H. Petersen, described in their monograph (Petersen and Hughes, 2004, pp. 128-131). *Lentinellus novae-zelandiae*, as the name suggests, was first described from New Zealand, but is also known from southern Argentina. This species has a lateral or absent stipe, however, in contrast to the well-developed, usually central, stipe of our Tasmanian collections, and perhaps more importantly, the pileus surface has pileicystidia, which our material lacks. Hence, the Tasmanian stipitate taxon is unlikely to be *L. novae-zelandiae*. On the other hand, our extensive collections of a soil-borne stipitate *Lentinellus* agree with Petersen's description of *L. tasmanica* in all important respects, including the absence of pileicystidia, with the exception of one very important character, viz. spore size. The protologue (Petersen and Hughes, 2004, p. 130) described the spore size as 3.6-5.2 x 3.2-4.0 µm, with a mean spore length of 4.60 µm. In another paper in the same monograph, devoted to type specimen studies, the spore size was given as slightly smaller, viz. 3.6-4.2 x 3.2-3.6 µm, and subglobose in shape. Our own Tasmanian material generally has spores in the range 5-6 x 3.5-4 µm, and is better described as elongate ellipsoidal rather than broadly ellipsoidal or subglobose. Are we to believe that there is a fourth widespread Tasmanian taxon of *Lentinellus*, or is it better to adopt a more conservative approach and conclude, for the moment at least, that the slightly larger spores of our collections do not suggest that the taxon is a different species from *L. tasmanica*? We opt for the latter alternative and conclude that our centrally stipitate species is *L. tasmanica*, despite the apparent discrepancy of spore size. A supporting macroscopic character is the observation by Petersen and Hughes (2004, p.130) that basidiomata of *L. tasmanica* "seem prone to poor drying, and in the process turn dark brown with tissues hardening". All our collections of the stipitate species exhibit this characteristic.

An amended key to the three Tasmanian species is given below.

KEY TO THE TASMANIAN SPECIES OF *LENTINELLUS*

1.a) Stipe well developed, central or slightly eccentric......*Lentinellus tasmanica*

1.b) Stipe absent or if present, short and lateral......................2

2.a) Pileus generally dark brown and densely hairy; lamellae crowded; spores small, 3-5 x 3-4 µm...*Lentinellus castoreus*

2.b) Pileus light-coloured and usually glabrous towards the margin; lamellae distant; spores larger than the above, 5-7 x 4-6 µm......*Lentinellus pulvinulus*

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Mushrooms of Maatsuyker Island

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Introduction

Maatsuyker Island (southern tip GDA 441000E, 5166000N) is a small, remote and isolated island 10 km off the south-west coast of Tasmania. It is the second largest island of the Maatsuyker Group, a group of six rocky islands in the Southern Ocean. Part of the South West Wilderness Area and World Heritage Area, Maatsuyker Island is wild and beautiful.

For the last 10 years or so, the Parks and Wildlife Service have been running the Caretaker Program. The program involves the placement of two volunteers on the island for four month periods to aid with the ongoing maintenance and management of the islands cultural and natural heritage. I was lucky enough to be a part of the program from February to June 2006 which gave me the opportunity to conduct the first macrofungal survey of the island.

Maatsuyker Island is roughly triangular in shape and approximately 180 hectares in size being 3 km long and 1.5 km at the widest point. The highest point on the island is located in the central east of the island and is 284m above sea level. The island has a temperate maritime climate and due to westerly winds known as the 'Roaring Forties' experiences high wind exposure and frequent gales.

Maatsuyker Island is geologically similar to adjacent areas of the Tasmanian mainland. Precambrian mica schists and quartz veins are abundant, along with phyllite and quartzite outcrops (Parks and Wildlife Service and Australian Maritime Authority, 1993). Highly erodible grey clay loam or light clay gradational soils are widespread over the island with sand deposits on the cliff tops of southeast slopes, the base of steep slopes and on the saddle above the haulage way (Pemberton, 1990; Parks and Wildlife Service and Australian Maritime Authority, 1993).

The vegetation of Maatsuyker Island is similar to the southwest coast of Tasmania with floristic composition and structure affected by high winds and salt spray (Moscal and Bratt 1977). The island supports a number of vegetation communities with some developing in response to the burrowing activities of seabirds (Pemberton, 1992).

The dominant species, *Leptospermum scoparium*, often grows in association with *Melaleuca squarrosa* and *Banksia marginata*. These species form a dense canopy up to six metres in height in sheltered locations with stunted wind-pruned forms in exposed sites (White, 1981). *Eucalyptus nitida*, growing to a height of ten metres, occurs in a two-hectare stand near the summit (Parks and Wildlife Service and Australian Maritime Authority, 1993). Understrorey species include *Acacia verticillata*, *Pittosporum bicolor*, *Billardiera longiflora*, *Pimelea drupacea*, *Monotoca glauca*, and *Tasmannia lanceolata* (White 1981). *Gahnia grandis* and various ferns grow in sheltered areas (White 1981). Dwarf forms of these species in association with *Carex impressa*, *Correa backhousia*, *Epacris impressa*, *Leucopogon parviflorus*, *Rhagodia baccata*, *Solanum vescum* and *Westringia brevifolia* occur in more exposed areas (White, 1981). A distinct vegetation type of *Poa poiformis* tussocks and creeping succulents such as *Carpobrotus rossii* and *Tetragonia impexicoma* occur on the steep slopes and sites used by seabirds for breeding.

Methods

The island was surveyed for macrofungi on 41 days during the period between February and May 2006. Survey effort was often increased after heavy rain and high humidity, conditions that often induce fungal fruiting.

Surveys consisted of walking along formed tracks on the island, foraging within 10 metres either side of the track and around other accessible parts of the island. Surveys were restricted to these locations to minimise disturbance to vegetation, soils and breeding seabirds.

Samples of fruiting bodies for the majority of species of macro fungi observed during the survey were collected. Specimens were described in detail before making a spore print and drying. Data recorded for each species consisted of location, habit, abundance, habitat, substrate, plant and fungi associations, description and measurements of fruiting body and photographs. This information was then used to assign a tentative identification while on the island. Identifications were later confirmed at the University of Tasmania.

Results

A total of 106 collections of macrofungal fruiting bodies was made, yielding 83 species of macrofungi (Table 1).

Table 1. Macrofungal species observed on Maatsuyker Island. Taxonomy is according to May *et al.* (2004). L-m: life-mode. Obs: number of observations. Life mode categories: S-saprotroph, M-mycorrhizal, L-lichen forming, P-parastic, U-unknown.

ASCOMYCETES	L-m	Obs
EUROTIALES		
Trichocomaceae		
Paecilomyces tenuipes (Peck) Samson Anamorphic *Byssochlamys* Westling	P	1
HELOTIALES		
Bulgariaceae		
Bulgaria sp. “green globular”	S	1
Geoglossaceae		
Trichoglossum hirsutum (Pers.) Boud.	S	1
Heliotiaceae		
Chlorociboria aeruginascens (Nyl.) Kanouse	S	1
Rustroemiaceae		
Lanzia lanaripes (Dennis) Spooner	S	1
XYLARIALES		
Xylariaceae		
Daldinia grandis Child	S	2
Unknown		
Ascomycete “buff cup”	S	1
Ascomycete “green cup”	S	1
BASIDIOMYCETES		
AGARICALES		
Agaricaceae		
Agaricus sp. “brown field”	S	1
Agaricus sp. “Maatsuyker field”	S	5
Agaricus sp. “scaly”	S	4
Amanitaceae		
Amanita aff. *punctata* (Cleland and Cheel) D.A.Reid	M	3
Amanita sp. “copper top”	M	2
Bolbitiaceae		
Descolea recedens (Cooke and Massee) Singer	S	1
Coprinaceae		
Coprinus sp. “umbrella ink cap”	S	2

Table 1. (contd.)	L-m	Obs
Paneolus sp. “little brown”	S	5
Psathyrella echinata (Cleland) Grgur.	S	5
Psathyrella sp. “scaly brown cap”	S	1
Entolomataceae		
Entoloma conferendum (Britzelm.) Noordel.	S	3
Entoloma sp. “conical black cap”	S	3
Hygrophoraceae		
Hygrocybe astatogala (R.Heim) Heinem.	S/M	3
Hygrocybe chromolimonea (G.Stev.) T.W.May and A.E.Wood	S/M	8
Hygrocybe firma (Berk. and Broome) Singer	S/M	1
Hygrocybe aff. *conica* (Schaeff. : Fr.) P.Kumm.	S/M	3
Hygrocybe sp. “rainbow”	S/M	1
Hygrophorus involutus G.Stev. var. *involutus*	S/M	1
Pluteaceae		
Pluteus atromarginatus (Konrad) Kühner	S	1
Strophariaceae		
Hypholoma fasiculare (Huds. : Fr.) P.Kumm.	S	1
Psilocybe subaeruginosa Cleland	S	2
Tricholomataceae		
Armillaria novaezelandiae (G.Stev.) Herink	S/P	1
Campanella olivaceonigra (E.Horak) T.W.May and A.E.Wood	S	2
Collybia eucalyptorum Cleland	S	2
Gymnopus sp. “hairy stem”	S	7
Laccaria sp. “pink”	M	4
Lepista sp. “velvety recurved cap”	S	1
Marasmius elegans (Cleland) Grgur.	S	2
Mycena interrupta (Berk.) Sacc.	S	1
Mycena sanguinolenta (Alb. and Schwein. : Fr.) P.Kumm.	S	8
Mycena vinacea Cleland	S	1
Mycena sp.”brown umbrella”	S	1
Mycena sp. “cream umbrella”	S	1
Mycena sp. “pale brown cap”	S	1
Mycena sp. “pink cap”	S	3
Mycena sp. “small white stem”	S	1

Table 1. (contd.)	L-m	Obs
Mycena sp. "tiny white cap"	S	1
Mycena sp. "yellow stipe"	S	1
Omphalina chromacea (Cleland) T.W.May and A.E.Wood	S/L	2
Panellus longinquus (Berk.) Singer	S	2
Unknown "white decurrent gills"	U	2
Loreleia marchantiae (Singer and Clémençon) Redhead, Moncalvo, Vilgalys and Lutzoni	S	2
CANTHARELLALES		
Clavariaceae		
Clavaria amoena Zoll. and Moritzi	S/M	3
Clavaria miniata Berk.	S/M	3
Ramariopsis sp. "orange branched"	S	1
Clavinulaceae		
Clavulina rugosa (Bull. : Fr.) J.Schröt.	S/M	2
CORTINARIALES		
Cortinariaceae		
Cortinarius phalarus Bougher and R.N. Hilton	M	1
Cortinarius sp. "purple cortina"	M	1
Galerina patagonica Singer	S	1
Galerina sp. "slimy striate cap"	S	2
Inocybe aff. *discissa* (Cleland) Grgur.	M	3
Setchelliogaster aff. *australiensis* G.W.Beaton, Pegler and T.W.K.Young	M	>10
Crepidotaceae		
Crepidotus applanatus (Pers.) P.Kumm.	S	4
Tubaria rufofulva (Cleland) D.A.Reid and E.Horak	S	2
DACRYMYCETALES		
Dacrymycetaceae		
Calocera guepinioides Berk.	S	3
HYMENOCHAETALES		
Hymenochaetaceae		
Phellinus sp. "brown ball'	S	>5
PORIALES		
Coriolaceae		
Postia dissecta (Lév.) Rajchenb.	S	1

Table 1. (contd.)	L-m	Obs
Postia pelliculosa (Berk.) Rajchenb.	S	1
Pycnoporus coccineus (Fr.) Bondartsev and Singer	S	1
Trametes versicolor (L. : Fr.) Lloyd	S/P	1
Polyporaceae		
Polyporus melanopus (Sw. : Fr.) Fr.	S	1
RUSSULALES		
Russulaceae		
Gymnomyces sp. “white earth ball”	M	2
Lactarius clarkeae Cleland	M	4
Lactarius eucalypti O.K.Mill. and R.N.Hilton	M	6
Russula persanguinea Cleland	M	5
Russula sp. “patchy yellow”	M	1
Russula sp. “purple cap”	M	1
Russula sp. “purple stipe”	M	1
STEREALES		
Meruliaceae		
Gloeoporus taxicola (Pers. : Fr.) Gilb. and Ryvarden	S	1
Stereaceae		
Stereum ostrea (Blume and Nees : Fr.) Fr.	S	4
TREMELLALES		
Exidiaceae		
Pseudohydnum gelatinosum (Scop. : Fr.) P.Karst.	S	2
Tremella mesenterica Retz. : Fr.	S	2
Tremella sp. “black jelly”	S	5
Unknown		
Unknown “meadow wax cap”	U	1
Unknown “white polypore” aff. *Trametes hirsuta* (Wulfen : Fr.) Lloyd	S	1

Of the species recorded, eight were Ascomycetes spread through six families, and 74 species were Basidiomycetes representing 20 families. Five species were not identified to genus: two ascomycetes (Unknown “buff cup” and “green cup”), two gilled mushrooms (Tricholomataceae “white decurrent gills” and Unknown “meadow wax cap”), and a polypore (Unknown “white polypore” aff. *Trametes hirsuta*). Of the remaining 78 species, 45 were identified to species level.

Saprotrophic, mycorrhizal and parasitic fungi were sampled. Saprotrophs made up the majority of the records, numbering 53 species. 14 obligate mycorrhizal species were observed (*Amanita* spp., *Cortinarius* spp., *Inocybe* aff. *discissa*, *Laccaria* sp. "pink", *Lactarius* spp., *Russula* spp., Russulaceae "white earth ball" and *Setchelliogaster* aff. *australiensis*). A further ten species were observed that can either act as saprotrophs or form symbioses. One of these species, *Omphalina chromacea*, forms a symbiotic partnership with algae as lichen, whereas the remaining species form mycorrhizas with higher plants. Two parasitic species were collected, *Armillaria novaezelandiae* and *Paecilomyces tenuipes*, and a third, *Trametes versicolor*, acting as either a saprotroph or parasite. The ecological roles of the two unknown gilled fungi were not determined.

Of the 83 species recorded, 43 species were observed more than once, in different locations while 40 species were observed only once during the survey. Of all species recorded, *Setchelliogaster* aff. *australiensis* was recorded the greatest number of times (>10 recordings) with only *Gymnopus* sp. "hairy stem", *Hygrocybe chromolimonea*, *Lactarius eucalypti*, *Phellinus* sp. "brown ball" and *Mycena sanguinolenta* recorded more than 5 times throughout the survey.

Discussion

With 83 species of fungi recorded from one season it would be reasonable to assume that Maatsuyker Island is diverse considering its small size. Seven of the 100 Fungimap target species (Fungimap, 2006) were recorded: *Marasmius elegans*, *Mycena interrupta*, *Omphalina chromacea*, *Pseudohydnum gelatinosum*, *Stereum ostrea*, *Tremella mesenterica* and *Tubaria rufofulva*. Approximately half of the species recorded were distributed widely over the island and observed on numerous occasions. There were equally as many species that were observed only once. This is not uncommon in fungal surveys with numerous authors reporting many rare species (Taylor, 2002). The number of sightings of a particular species is by no means a reflection of the true abundance or distribution over the island as much of the island was not surveyed.

It is also reasonable to assume that many more species of macrofungi occur on the island than were recorded, with new records of species added to the list to the very last day. Also despite best efforts, not all species observed were recorded due to practicality and time constraints. The production of fungal fruiting bodies is known to be variable from year to year and dependant on a number of unknown factors (Bougher and Tommerup, 1996). This is highlighted by Straatsma *et al.* (2001), who after 21 years of surveying fungal sporocarps in Switzerland, were still recording new species.

In terms of ecology, the fungi recorded were also diverse with saprotrophic, mycorrhizal, parastic and lichen forming fungi all represented. It was not surprising to record the 14 mycorrhizal species considering the dominance of Myrtaceous shrubs and trees on the island. *Setchelliogaster* aff. *australiensis* (Figure 1) was frequently encountered, and the most widespread species recorded, occurring all over the island. Interestingly, Bougher and Syme (1998) identify *Setchelliogaster* as a possible relict Gondwanan species that originally formed mycorrhizas with *Nothofagus* but has survived by switching to Myrtaceae. From the abundance of fruiting bodies, it would appear that this species would dominate the symbiotic relationship with *Leptospermum scoparium*, the dominant plant species. Despite the abundances of these species, only further study on the mycorrhizas would be able to confirm this. Many studies have found that the above and below ground mycorrhizal fungal community structure are vastly different (Peter *et al.*, 2001; Dahlberg *et al.*, 1997; Gardes and Bruns, 1996) and this may be the case with *Setchelliogaster* aff. *australiensis*. To consider mycorrhizal fungi further, both Epacridaceous shrubs and orchids occur on the island. Both families are known to form distinct mycorrhizas and thus their fungal partners would also occur on the island, albeit not macrofungi.

Figure 1. *Setchelliogaster* aff. *australiensis*. Photo: B. Horton.

One of the more interesting parasitic species encountered was *Paecilomyces tenuipes* (Figure 2), which is believed to be selectively parasitic on beetle larvae and noted as "uncommon" in Fuhrer (2005).

Figure 2. *Paecilomyces tenuipes*. Photo: B. Horton.

Another species of interest is *Cortinarius phalarus* (Figure 3). Unlike other *Cortinarius* species that have a cortina (partial veil covering the gills), this species has a distinct volva at the base of the stipe, which is unusual in this genus. *Cortinarius phalarus* may also be a Gondwanan fungus as it is thought to be closely related to a group of volvate cortinarii found in South America (Bougher and Syme, 1998).

Another interesting fungus was collected from Maatsuyker Island in 2005: the uncommon species *Hygrocybe stevensonii*, collected by Fiona Scott (27 May 2005).

Fungi are known to aid in soil structure, whereby hyphae act to bind sand and soil preventing erosion and providing stability (Forster, 1990; Tisdall, 1994). In such a climatically challenging environment as Maastuyker Island, which also has highly erodible soils, fungi may play an important role in soil processes and may act to minimise erosion, especially in seabird rookeries that are severely disturbed and eroded.

The macrofungal survey has increased our knowledge of the biodiversity and ecology of Maatsuyker Island. While it is possible that some of the fungi recorded are exotic to the island, having been introduced via the activities of the lighthouse keepers over the last 116 years, the island's location and inclusion in the South West World Heritage Area ensure that it currently receives only minimal disturbance and is managed in a way to conserve the cultural and natural heritage of the island, including its biodiversity. Further fungal studies on the island would certainly reveal more interesting species and provide an even greater understanding of their ecology and diversity.

Figure 3. *Cortinarius phalarus*. Photo: B. Horton.

ACKNOWLEDGEMENTS

I wish to thank the Tasmanian Parks and Wildlife Service for the opportunity to be a part of the Caretaker Program and for their permission to conduct a fungal survey of Maatsuyker Island. My gratitude extends to Genevieve Gates for aid with species identifications and David Ratkowsky for his input into the text. Many thanks to Nabil Abbas for assistance in the field.

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Sounds, scents and sensibilities in the Tasmanian bush

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Ahh, the smell that hits you as you first enter the forest. A blend of eucalypt oil, musk, sassafras, and an all-pervading sense of dampness. And just a hint of a certain *je-ne-sais-quoi* that really gives this place its unique identity. Except it's not quite *je-ne-sais-quoi* because I do know what it is, it's floor polish. *Floor polish?* Of course. It wafts in whenever someone opens the door. You know, the door that leads from the forestry dome to the offices beyond. This is what greets me every day as I arrive for work at Forestry Tasmania. It's like a little bit of the Southern Forests transported to the middle of Hobart – apart from the floor polish, that is.

We underestimate the role that scents play in our daily lives and our sense of place, but I'm not on a crusade for greater public awareness, unless it can be balanced by a greater sense of responsibility over the impacts of media control over our senses. In the current climate, I fear that if there were a groundswell of opinion that modern life was depriving us of olfactory opportunities, the pressure would really be on to develop smellivision. Would that be a bad thing? Most of us naturalists derive a great deal of pleasure from watching a good David Attenborough documentary; wouldn't it be so much better if we could smell the exotic location too? Well, quite apart from not particularly wanting to smell David's armpits as he descends on a rope from the rainforest canopy, my concern is that the producers would get it wrong, and we'd end up sniffing in some ersatz chemical cocktail of inappropriate aromas. It would be the TV equivalent of having to fight one's way through the perfume section of Myer in the week before Christmas.

Okay, so smellivision is fortunately a long way off - though I recently read in *New Scientist* of advances in 'aroma recording and playback' by a Japanese research group. But what I'm concerned about here is a more general phenomenon exemplified by our addiction to TV viewing – a sign of our times which could be called the macdonaldisation of our sense of place. It's all-pervasive and many of us probably don't even notice it's happening. Let me give you a couple of local examples. They both concern films that received widespread media acclaim.

Paul Scott's film, *The Oldest Living Tasmanian – The Huon Pine*, screened on the ABC in 2004. Make no mistake, this is a beautiful film, combining rare archival footage of piners at work, with top-notch wilderness photography from Tasmania's mountainous western rainforests. It could have been wonderfully evocative of place – except that someone dubbed the wilderness footage with birdcalls from the mainland. It's as though there exists in the producer's office a CD entitled 'Australian evocative bird sounds' – a one-size-fits-all source of sound suitable for any occasion when there's a need to evoke a sense of wildness. But whose wildness? Surely one of the things that's special about the west of Tasmania is that it doesn't resonate to the calls of whistling kites and pied currawongs? Would the smellivision version of this film also have assaulted us with the stench of dry kangaroo dung in the dusty outback, or wafts of resin from a stand of Bunya pines?

Then there's Katherine and Roger Scholes' *Last Port of Call*, a portrait of Flinders Island shack life, also screened on the ABC in 2004 as part of a *Reality Bites* series. Again, a real masterpiece, but for one thing. The soundtrack was peppered with non-Flindersian avifauna. For me, it evoked some rural corner of England, which I'll bet is where the bird recordings were made. Couldn't we have been treated to fairy wrens and thornbills instead? Is there a closet latter-day member of the Acclimatisation Society alive and well in the bowels of the ABC's post-production labs?

My only reason for singling out these productions is because they are Tasmanian, but the same fate befalls footage filmed around the world, whether it appears in natural history programs or Hollywood movies. The sad thing about it - for me - is not so much that it happens, but that so few people seem to care or even notice. Imagine the outcry if the Scholes had shot their footage in a hastily constructed mock shack in England and then tried to pass it off as Flinders Island by dubbing the soundtrack with fairy wrens and muttonbirds. Who would rate a film on the Huon pine if the wilderness shots featured expanses of semi-desert or subtropical vine forest, or if the footage purporting to be of piners on the lower Gordon river showed the old shipyards of Botany Bay in the background? No amount of black currawong calls would allay our sense of deception.

Smells do matter too. I recently returned to a beach at Lulworth in England that I had not visited for decades, but was instantly carried back to my first visit there (a camping trip when I was five) by the unique smell of the place – a product, I can only surmise, of beached seaweed putrefying in an unusual way through being suffused with fresh water emanating from a small stream flowing onto the beach. The stream itself may have imparted its particular contribution through having its origins in a spring in the chalk hills and having passed through dairy country and a duck pond on its way to the sea. There's probably a particular subliminal smell about my local Taroona beach too, which I hope my young sons will pick up on and be able to recall in decades to come. Though both beaches on different sides of the world share mounds of rotting kelp suffused with fresh water, they reek in completely different ways. They are very different places as a result.

Call me a grumpy old man, but few things annoy me more than having my sense of place rudely shattered by out-of-place olfactory sensations. As a naturalist, it's particularly galling when I'm rudely reminded of the city while out and about in the bush. It doesn't occur very often, but I get the feeling it's happening more and more in Tasmania. Maybe it's a further reflection of our increasing detachment from nature. I'm talking about 'perfumes', as in bottles of man-made chemicals applied to the human body, aimed at somehow bestowing on that person their own comforting sense of place, of sameness, wherever they go. If the perfume stayed on the person, I would feel sorry for the wearer but nothing more. But perfumes are designed to be detected by others, and to evoke responses. Flower scents are produced for a very similar reason – the plant doesn't make them because it likes the smell, it makes them because it hopes its pollinators will like the smell and will be conscripted into helping the plant to reproduce. My suggestion to perfume-wearers is to leave the perfume behind along with the city shoes when going bush. One's olfactory experiences will be the richer for doing so (and mine will be too should we pass within fifty metres of one other).

Humans are naturally a very visually-oriented species, far more so than most other mammals. The journal in which this article appears is a testament to that fact. Yet we implicitly recognise that sight is not the only important medium enabling us to engage with the world around us: we still talk darkly of the control exerted by 'the media' rather than 'the medium'. But the stimulus of vision is apparently over-riding, and in our modern world it is easy for us to be fooled into thinking that other stimuli just don't matter. Much as some travellers find it comforting to see the golden arches of Macdonalds wherever they go, so I fear we are being collectively comforted by being fed and brought up on anodyne soundscapes and homogenised smellscapes. Tasmania is awash with special places not just because of the way they look, it's also the way they sound and the way they smell.

I think it's time to restore a sense of balance in our senses. It's time we pricked up our ears to the full range of sensual possibilities available to us in our interaction with the world around us. And it's time we smelt a rat more often than we do when watching the telly.

Previously undescribed habitat of the Scottsdale burrowing crayfish *Engaeus spinicaudatus* (Decapoda: Parastacidae)

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Abstract

This paper reports on records of the Scottsdale burrowing crayfish *Engaeus spinicaudatus* from Ruby, China and Donnolly Creeks, minor tributaries of the Great Forester River, near Scottsdale, in northeastern Tasmania. These records expand the previously described habitat (buttongrass sedgeland) of this species to include scrub/forest along streams within dry sclerophyll forest. This riparian habitat is described in detail for several known localities of *E. spinicaudatus* along Ruby Creek.

Introduction

The Scottsdale burrowing crayfish *Engaeus spinicaudatus* (Decapoda: Parastacidae) is one of five burrowing crayfish listed on both the *Tasmanian Threatened Species Protection Act 1995* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. The species is listed as endangered under both Acts due to its restricted distribution and habitat disturbance (Doran, 2000).

Engaeus spinicaudatus is found near Scottsdale (Figure 1), northeast Tasmania, within an area of approximately 23 km^2 (Horwitz 1991; Gaffney and Horwitz 1992; Richards, 1997). Horwitz (1991) explored the extent of its distribution and it is unlikely that the species extends beyond this current known range (Doran, 2000). The range of *E. spinicaudatus* is closely bound by the distribution of other *Engaeus* species: *E. mairener*, *E. tayatea*, *E. leptorynchus* and *E. orramakunna* (Doran and Richards, 1996). *Engaeus spinicaudatus* is distinctive and can be distinguished from its neighbours by the presence of a terminal spine on the outer ramus of the uropod (Horwitz, 1990a), and it is unlikely that the species has been or will be confused with other species of *Engaeus* (Figure 2).

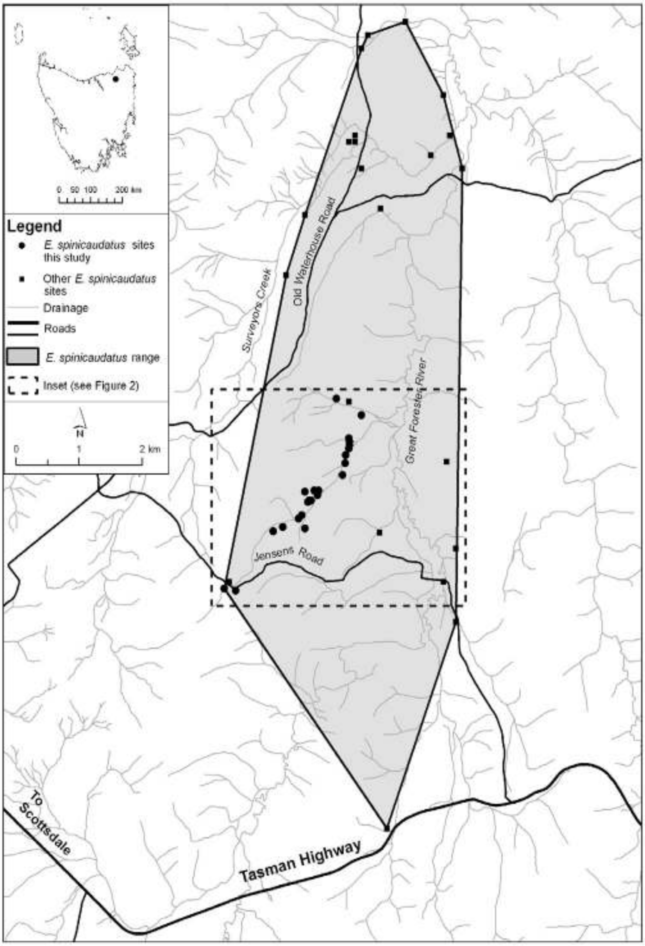

Figure 1. Distribution of *Engaeus spinicaudatus* near Scottsdale, northeast Tasmania.

Horwitz (1991) described the habitat of the species within its known range, and estimated that there was only about 3.9 km^2 of suitable habitat. During his study he found that *E. spinicaudatus* occurred predominantly in wet buttongrass (Figure 3) and heathy plains (particularly with peaty and saturated soils), the flood plains of creeks (often with scrubby or taller tea-tree vegetation), and wet areas converted to pasture from any of the preceding habitat types. These habitats have been well described, as has the life history of the species (Horwitz, 1990b).

Figure 2. *Engaeus spinicaudatus*. Inset shows terminal spine on the outer ramus of the uropod. Photo: Niall Doran.

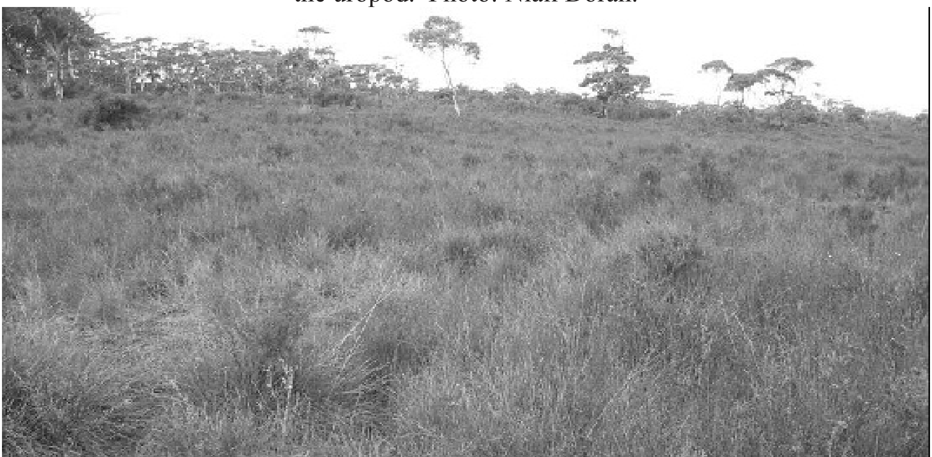

Figure 3. More typical buttongrass moorland habitat of *E. spinicaudatus*. Photo: Niall Doran.

This paper documents the results of a survey for *E. spinicaudatus* in dry eucalypt forest within the known range of the species. The survey was required as part of the threatened fauna management procedures under the forest practices system (Forest Practices Board, 2000; Munks and Taylor, 2000). The habitat of *E. spinicaudatus* within dry eucalypt forest is described.

Methods

Study area

Survey work was conducted along Ruby Creek and China Creek and associated tributaries (Scottsdale Tasmap 5444 549900mE 5446500mN). This paper is primarily concerned with the results from Ruby Creek, which is a north flowing tributary of the Great Forester River (Figure 1). Information on the habitat of the species along China Creek is not further reported because in that creek system the species occupies the more usual buttongrass vegetation. Ruby Creek originates at approximately 300 m a.s.l. within the Mt Stronach Forest Reserve to the south of Jensens Road and flows through State forest before joining China Creek to flow into the Great Forester River at approximately 50 m a.s.l. The geology of the area is Upper Devonian to Lower Carboniferous granite (Scottsdale Batholith). Current land use within the catchment is varied and includes some formal reserves, agricultural and private land, forestry activities and recreational use such as four wheel driving and horse riding. Historical use of the area included forestry and alluvial tin mining.

Animal survey

A survey of the occurrence of *E. spinicaudatus* within the study area was conducted during 1997. Excavations of crayfish burrows were made approximately every 150 m along Ruby Creek and associated tributaries, depending on burrow numbers and locations (25 sites). All tributaries, including minor seepages, were investigated for the presence of crayfish burrows. Burrows were visually inspected to determine the probability of occupation (e.g. evidence of fresh diggings) and those considered likely to be inhabited were excavated using spade, trowel and hand until either the crayfish was captured or the burrow deemed vacant (Figure 4). A burrow was defined as empty when the end of the tunnel system was reached without any crayfish detected. Specimens were identified on site and released at the excavated burrow site.

Additional surveys have been conducted by the authors as part of the establishment of long-term monitoring sites (to be reported elsewhere). Furthermore, a survey was conducted for the species in another tributary of the Great Forester

River (Donnolly Creek) in May 2005, located about 800 m east of Ruby Creek as part of the fauna management procedures under the forest practices system.

Figure 4. Typical burrows of *E. spinicaudatus* along Ruby Creek. Note the freshly dug soil around the burrow entrance. Photo: Niall Doran.

Results

Distribution of burrowing crayfish in the study area

The distribution of *Engaeus spinicaudatus* along Ruby Creek and other streams in its vicinity is illustrated in Figure 5. *Engaeus mairener* was also found along China Creek, the upper tributaries of Surveyors Creek and Ruby Creek. *Engaeus leptorynchus* was found along a minor tributary of Ruby Creek and *E. tayatea* was found along an upper tributary of Surveyors Creek. Over the length of Ruby Creek where *E. spinicaudatus* was found, the majority of the forest can be broadly classified as dry sclerophyll forest - more specifically as heathy coastal *Eucalyptus amygdalina* forest and shrubby siliceous *E. obliqua* forest (Duncan and Brown, 1985). On slopes adjacent to creeks, the vegetation is dominated by *E. amygdalina* with a sparse heathy/bracken understorey. Riparian areas are dominated by *E. obliqua* and locally by *E. ovata* with *Melaleuca squarrosa* forming locally dense stands with an understorey of ferns and graminoids. Frequent fires have modified the vegetation structure with many areas dominated by bracken or regenerating shrub species. Typical forested riparian habitat is shown in Figure 6.

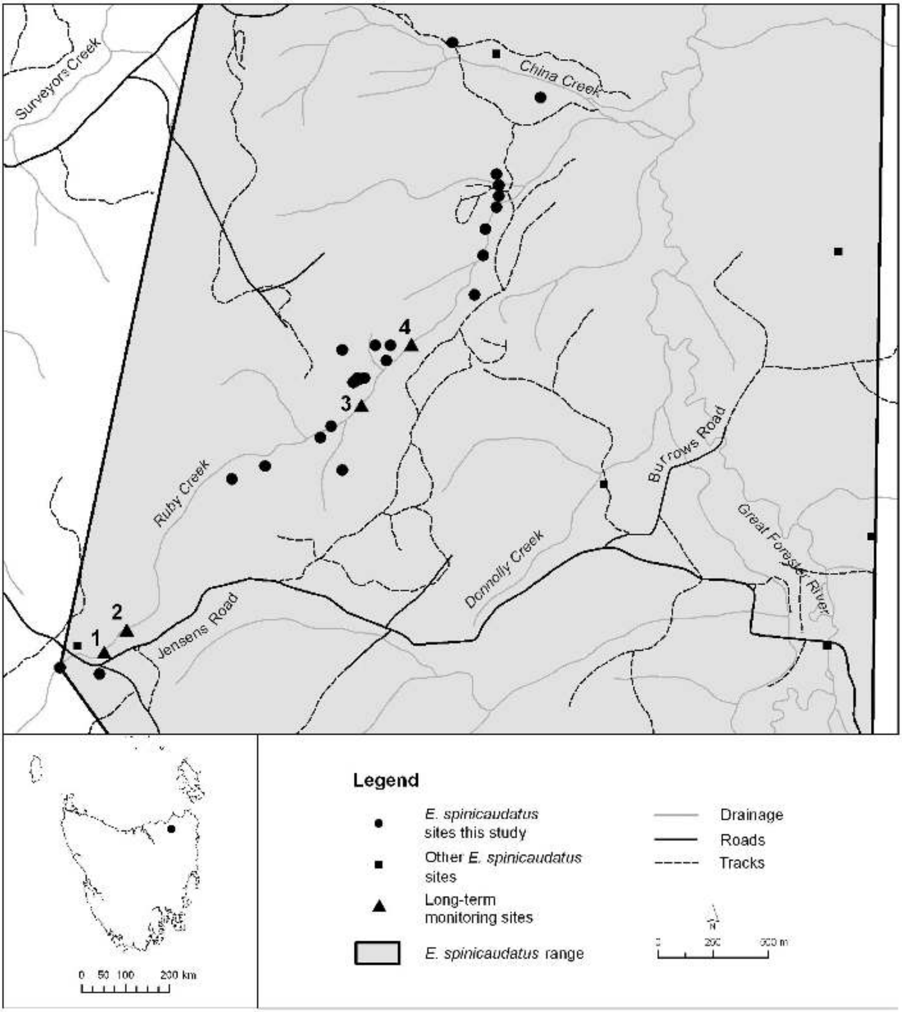

Figure 5. Location of Ruby Creek in northeast Tasmania, and the distribution of *Engaeus spinicaudatus* along Ruby Creek and surrounds. Location of long-term monitoring sites is shown (see Table 1 for site numbers).

Forest types and the occurrence of E. spinicaudatus

At a finer scale, the vegetation along Ruby Creek is variable. The four *E. spinicaudatus* sites that were later established as long-term monitoring sites (Figure 5) covered the variation in vegetation found along the length of the stream (Table 1), and were representative of sites for the species in China Creek and Donnolly Creek.

Figure 6. Forested riparian habitat of *E. spinicaudatus* along Ruby Creek. Note that this photo was taken about one month after the site had been heavily burnt, but the density and composition of the understorey and overstorey is still quite obvious. Photo: Niall Doran.

Relationship between burrow densities and habitat characteristics

Burrow sites where *E. spinicaudatus* were found in the initial survey (Richards, 1997) were within a few metres of creek banks. However, data collected during the establishment of the long-term monitoring sites found that the occurrence of burrow entrances can extend to at least 10 metres from the creek bank, depending on local site and seasonal conditions.

Burrow densities were variable depending on local conditions. In well-shaded, fern-rich areas adjacent to the creek with saturated soils, burrow density was high but in areas of predominantly dry heathy forest, burrow density is considerably lower. Burrows appeared absent from very rocky areas of stream bank.

Table 1. Description of vegetation of known localities of *Engaeus spinicaudatus* along Ruby Creek (site numbers refer to those on Figure 5).

Site 1

A sparse canopy of *Eucalyptus obliqua* and *Eucalyptus amygdalina* present over a lower canopy layer of *Acacia melanoxylon*. A dense understorey of *Melaleuca squarrosa* present over a very dense stand of *Todea barbara* (stems to 1 m high and up to 60 cm diameter). Other species present at the site include *Tasmannia lanceolata*, *Acacia verticillata*, *Pittosporum bicolor*, *Blechnum wattsii*, *Pteridium esculentum*, *Hypolepis rugosula*, *Gleichenia microphylla*, *Lepidosperma ensiforme*, *Gahnia* spp. and *Tmesipteris obliqua*. A power line easement is present to the immediate south of this site. This easement is periodically cleared of taller vegetation and was recently burnt (2001).

Site 2

A relatively dense canopy cover of *Eucalyptus obliqua* over *Acacia melanoxylon* present over a dense lower shrub layer comprising *Melaleuca squarrosa*, *Monotoca glauca*, *Acacia verticillata*, *Notelaea ligustrina*, *Pimelea drupacea*, *Leptospermum scoparium*, *Pultenaea juniperina*, *Coprosma quadrifida* and *Tasmannia lanceolata*. Ferns include *Pteridium esculentum*, *Blechnum nudum*, *Blechnum wattsii*, *Calochlaena dubia* and *Todea barbara*. Graminoids include *Gahnia sieberiana* and *Lepidosperma elatius*. This site was burnt in October 1998.

Site 3

A relatively sparse canopy of *Eucalyptus obliqua* present over a slightly denser lower canopy of *Allocasuarina littoralis*. A lower shrub layer of *Melaleuca squarrosa*, *Olearia lirata*, *Lomatia tinctoria*, *Acacia verticillata*, *Daviesia latifolia* and *Epacris impressa* combined with graminoids (*Carex appressa*, *Gahnia sieberiana*, *Lepidosperma elatius*) and ground ferns (*Blechnum wattsii*, *Blechnum nudum*, *Pteridium esculentum*, *Gleichenia microphylla* and *Todea barbara*) form a dense cover of vegetation. This site was burnt in October 1998 which reduced the canopy cover of shrub species markedly. The site is surrounded by heathy coastal *Eucalyptus amygdalina* forest with a mixed dominance of *Eucalyptus amygdalina* and *Eucalyptus obliqua* and a sparse heathy/bracken understorey.

Site 4

Eucalyptus obliqua and *Eucalyptus amygdalina* (with *Eucalyptus viminalis* and *Eucalyptus ovata*) form a sparse canopy over a dense lower shrub layer comprising *Melaleuca squarrosa*, *Lomatia tinctoria*, *Acacia verticillata* and *Olearia lirata*. A mixed fern/graminoid layer forms a dense cover of vegetation including *Blechnum wattsii*, *Blechnum nudum*, *Pteridium esculentum*, *Gleichenia microphylla*, *Sticherus tenera*, *Todea barbara*, *Carex appressa*, *Gahnia sieberiana*, *Lepidosperma elatius* and *Lepidosperma filiforme*. The vegetation along Ruby Creek comprises relatively dry eucalypt forest with a riparian zone of dense low shrubs, ferns and graminoids. This site is immediately upstream of an old alluvial tin mining dam that results in the water flow being very slow to still for much of the year, and the surrounding soils are often saturated.

Burrow density was highest where soils are most suitable for burrow formation. This included previously disturbed areas. Several sites along Ruby Creek represent mini flood plains created by historical tin-mining activities along the creek. Small dams created as part of mining caused the backing-up of water and accumulation of finer sediments. These dams have since burst but the flatter seasonally inundated areas upstream of the dams still exist and burrows were abundant in these areas.

DISCUSSION

The distribution of burrowing crayfish species in Tasmania has been relatively well studied (see Horwitz, 1991; Horwitz, 1990b; Doran and Richards, 1996) and the range of *Engaeus spinicaudatus* is well defined. However, within this defined range, it was previously thought that the species predominantly occupied habitats described by Horwitz (1991), namely, buttongrass and heathy plains.

In the present survey, *E. spinicaudatus* burrows were found in relatively dry forest within a riparian zone of dense low shrubs, ferns and sedges. This is substantially different from the vegetation in habitats previously reported for the species. However, site characteristics other than vegetation type alone may also indicate the presence of the species. Given the limited occurrence of *E. spinicaudatus* in this newly described riparian habitat, it is clear that the buttongrass habitat remains its stronghold. Several sections of Ruby Creek are flat and permanently saturated. Two of the long-term monitoring sites selected where burrow densities appear greatest were located immediately upstream of historical dam sites associated with alluvial tin mining. These areas have had an accumulation of silt over many years and are probably permanently saturated and hence are highly suitable for burrow formation. In areas of steeper gradient, Ruby Creek becomes more channelled, erosion is more prevalent, substrate alters and there are few, if any, flood plain areas. These areas of the creek appeared unfavourable to the species with few or no burrows observed. Where burrows were present in coarse gravel substrate, the burrow systems were shallow and took advantage of crevices and water flow between rocks.

The extension of *E. spinicaudatus* into the Ruby Creek catchment does not change the range of the species. However, it does expand the known area of occupancy within its known range. Richards (1997) estimated that the population of *E. spinicaudatus* along Ruby Creek might be in the vicinity of 1000 individuals. This was based on an estimate of 0.05 burrows per square metre (Horwitz, 1991) and a potential habitat area of 2 m either side of Ruby Creek available for occupancy (burrows may extend beyond 2 m but only in localised patches). Based on these estimates, the extension of the species to Ruby Creek expands the total area of potential habitat available for the species by 0.022 km^2. Although this is a small area in broader terms, it is extremely important for a species believed to be restricted to less than 4.0 km^2 of available habitat. It is also significant if other areas of this new habitat type are identified within the known range of the species in future.

The habitat along Ruby Creek is potentially threatened from a number of sources. Recreational activity in the area is likely to maintain the relatively frequent fire frequency (P. Bird pers. comm.). Forestry activities, including conversion of native forest to plantation, are currently occurring in the catchment and further harvesting is planned. Such activities are subject to the provisions of the *Forest Practices Code* (Forest Practices Board, 2000) and the *Tasmanian Threatened Species Protection Act 1995*. Potential impacts from such operations include increased siltation from roading and timber harvesting, alteration to drainage patterns and flow rates which in turn can impact on moisture levels in riparian areas. Increase in sedimentation from roads in the area (e.g. Jensens Road) may impact on habitat locally. Part of the population of *E. spinicaudatus* within the Ruby Creek catchment is captured within the Mt Stronach Forest Reserve to the south of Jensens Road. Of the c. 18 ha of the upper catchment of Ruby Creek within the reserve, most is unsuitable habitat (of the c. 800 m of stream in the reserve, only about 400 m is suitably moist, and only the first 1-2 m from the stream bank is suitable, equating to less than 0.16 ha of potential habitat).

Doran (2000) lists inappropriate forestry and agricultural activities as the main threats to *E. spinicaudatus* with secondary threats including downstream impacts of road construction, quarrying and the impacts of inappropriate fire management. A long-term monitoring project has been established to primarily monitor the impacts of forestry activities within the catchment of Ruby Creek on populations of the species. However, the long-term monitoring project is also likely to yield results on the impacts of other disturbances and also on the natural trends in burrow densities. The forested area surrounding these creeks is subject to substantial recreational activity such as four-wheel driving and firewood collecting. Consequently, there are frequent accidental and deliberate (arson) fires (as evidenced by the open heathy understorey dominated by bracken). Additionally, two of the sites are immediately downstream of a gravelled public road adjacent to a transmission line easement. This easement is periodically cleared of taller vegetation and had recently been burnt. The monitoring will continue and will be reported on elsewhere as part of a larger monitoring programme of other species of burrowing crayfish.

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Acknowledgements

The Forest Practices Authority (*née* FPB), Threatened Species Section (*née* TSU), Department of Primary Industries and Water (*née* DPIWE) and Forestry Tasmania (Bass District) provided funding for the survey of Ruby Creek. Peter Bird, Sean Blake and Paul Rosevear of Forestry Tasmania (Bass District) are thanked for providing access and information on the history of the site. Allison Woolley, Heath Blair, Rowena Fry and John Gooderham provided field assistance. Birgit Kruse produced the figures. The manuscript benefited from comments from the editor and an anonymous referee.

The fauna of buttongrass moorland

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Buttongrass moorland: a World Heritage ecosystem

The buttongrass moorland ecosystem is unique to Tasmania and has only recently been recognised as having World Heritage value. Three key features of this ecosystem contribute to its World Heritage status. Firstly, it comprises the only extensive vegetation type dominated by a hummock-forming tussock sedge known as buttongrass (*Gymnoschoenus sphaerocephalus*) (Balmer *et al.,* 2004). Secondly, the peats are primarily formed from sedges and shrubs (Hannan *et al.,* 1993), whereas the vast majority of the world's peatlands are formed from *Sphagnum* moss (Gore 1983a, b). Thirdly, the presence of burrowing crayfish living in the acidic peats is highly unusual world-wide (Pemberton *et al.*, 2005). Another important feature of the buttongrass moorland ecosystem is that much of it is largely undisturbed by the impacts associated with post-European settlement of Tasmania.

Buttongrass moorland vegetation

Buttongrass moorland vegetation covers more than half a million hectares, primarily in western Tasmania where it is a significant landscape feature. Buttongrass moorland is a treeless sedgey vegetation typically dominated by (but not always containing) buttongrass (Jarman *et al.,* 1988). Nearly two-thirds of all buttongrass moorland in Tasmania is protected within the Tasmanian Wilderness World Heritage Area (Balmer *et al.,* 2004). It is a variable vegetation type with 25 communities currently recognised (Jarman *et al.,* 1988). There are two main types, blanket moor and eastern moor. Blanket moor (Figure 1), as its name suggests, 'blankets' the landscape extending from flats onto slopes, ridges and plateaux, and occurs widely across western Tasmania. Blanket moor typically contains more shrubs than eastern moor and is associated with low fertility soil types. Eastern moor (Figure 2) is restricted to poorly drained flats and gentle slopes on more fertile soil types, and has its largest extent on the Central Plateau.

Buttongrass moorland habitat

As habitat, buttongrass moorland is a challenging place for animals to live.

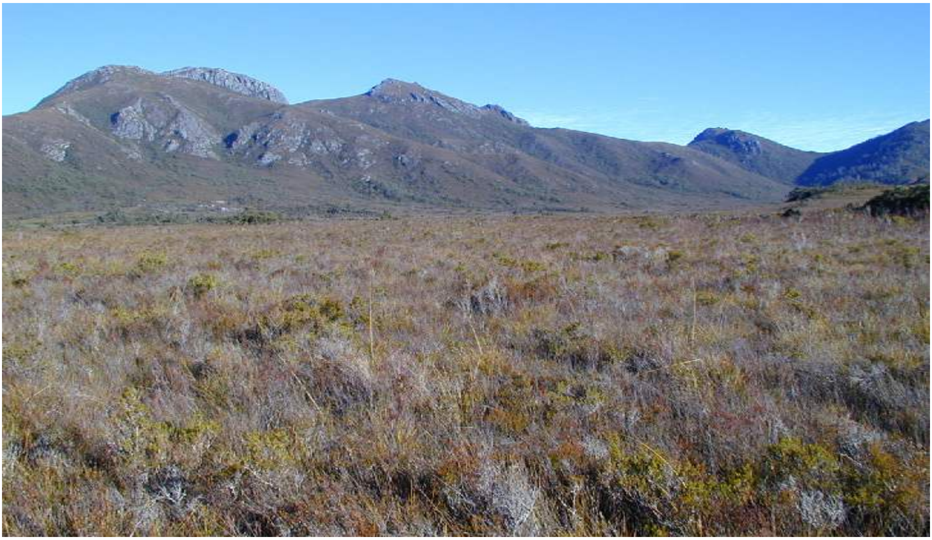

Figure 1. Blanket moor. Photo: M. Driessen.

Figure 2. Eastern moor. Photo: M. Driessen.

The peat is highly acidic (pH 3.5-4.5; Hannan *et al.,* 1993) and the soil surface may be dry cracked and hard in summer and inundated with water in winter. Hard-leafed plants that are low in nutrient value dominate the vegetation; indeed, buttongrass itself has the lowest recorded phosphorous levels in its foliage of any plant species (MacLean, 1978; Bowman *et al.,* 1986). Buttongrass moorland vegetation is highly flammable and may be the most flammable vegetation type in the world (Marsden-Smedley *et al.,* 1999) and was probably frequently burnt by Aborigines prior to European settlement (Marsden-Smedley, 1998). The lack of structural and floristic diversity of the vegetation further limits the habitat for fauna. As a result the diversity and abundance of fauna in this habitat is relatively low yet it has its own characteristic elements.

FAUNA

Vertebrate fauna

Few of Tasmania's vertebrate animals are known to spend their entire lifecycle within buttongrass moorland (Table 1) and most of these species also occur in other habitats. Buttongrass moorland is the primary habitat in Tasmania for four species of vertebrate, the broad-toothed mouse (*Mastacomys fuscus* - Figure 3), the ground parrot (*Pezoporus wallicus*), the striated fieldwren (*Calamanthus fuliginosus*) and the southern emu-wren (*Stipiturus malachurus*).

Figure 3. Broad-toothed mouse *Mastacomys fuscus*. Photo: M. Driessen.

Table 1. Native vertebrates of buttongrass moorlands. List excludes rarely occurring species that have limited association with buttongrass moorland. D = species occurrence in Tasmania is dependent or largely dependent on buttongrass moorland. L = species that spend their entire life-cycle in buttongrass moorland. M = migratory species. E = species endemic to Tasmania. Bird data modified from Brown *et al*. (1993) and with additions provided by T. Chaudhry, University of Tasmania (unpublished data).

Swamp antechinus	*Antechinus minimus*	L
Eastern quoll	*Dasyurus viverrinus*	E
Bennett's wallaby	*Macropus rufogriseus*	
Broad-toothed mouse	*Mastacomys fuscus*	D, L
Swamp rat	*Rattus lutreolus*	L
Tasmanian devil	*Sarcophilus harrisii*	E
Echidna	*Tachyglossus aculeatus*	
Wombat	*Vombatus ursinus*	
Tasmanian thornbill	*Acanthiza ewingii*	E
Richard's pipit	*Anthus novaeseelandiae*	
Sulphur-crested cockatoo	*Cacatua galerita*	
Striated field wren	*Calamanthus fuliginosus*	D, L
Marsh harrier	*Circus approximans*	M
Forest raven	*Corvus tasmanicus*	
Brown falcon	*Falco berigora*	
Latham's snipe	*Gallinago hardwickii*	M
Welcome swallow	*Hirundo neoxena*	M
Tree martin	*Hirundo nigricans*	M
Yellow-throated honeyeater	*Lichenostomus flavicollis*	E
Superb fairy-wren	*Malurus cyaneus*	
Dusky robin	*Melanodryas vittata*	E
Orange-bellied parrot	*Neophema chrysogaster*	D, M
Ground parrot	*Pezoporus wallicus*	D, L
New Holland honeyeater	*Phylidonyris novaehollandiae*	
Crescent honeyeater	*Phylidonyris pyrrhoptera*	
Beautiful firetail	*Stagonopleura bella*	
Southern emu-wren	*Stipiturus malachurus*	D, L
Black currawong	*Strepera fuliginosa*	E
She-oak skink	*Cyclodomorphus casuarinae*	L, E
White-lipped snake	*Drysdalia coronoides*	L
Metallic skink	*Niveoscincus metallicus*	L
Tiger snake	*Notechis scutatus*	L
Southern grass skink	*Pseudemoia entrecasteauxii*	L
Common froglet	*Crinia signifera*	L
Tasmanian froglet	*Crinia tasmaniensis*	L, E
Smooth froglet	*Geocrinia laevis*	L
Tasmanian tree frog	*Litoria burrowsae*	L, E
Brown tree frog	*Litoria ewingii*	L
Swamp galaxias	*Galaxias parvus*	D, L, E

In addition, the endangered, migratory orange-bellied parrot (*Neophema chrysogaster*) is dependent on buttongrass moorland for feeding during its breeding season and nests in adjacent forest vegetation (Brown and Wilson, 1984). The ground parrot is a particularly remarkable inhabitant of these moorlands, being one of only three ground-dwelling parrots in the world and buttongrass moorland is its stronghold in Australia (Bryant, 1991). The broad-toothed mouse is the only mammal species that is restricted to western Tasmania where it occurs primarily in buttongrass moorland from sea level to 1000 m (Driessen, 2002). Although the swamp antechinus (*Antechinus minimus*) occurs in other habitats in Tasmania, notably coastal heathland, buttongrass moorland is the stronghold for the species in Australia. Nearly half of Tasmania's frogs are also recorded. The brown tree frog (*Litoria ewingi*), Tasmanian froglet (*Crinia tasmaniensis*) and common froglet (*Crinia signifera*) are widely distributed in buttongrass moorland. The endemic Tasmanian tree frog (*Litoria burrowsae*) is restricted to western Tasmania and has its greatest population densities in buttongrass moorland.

Several mammal and bird species, such as wombat (*Vombatus ursinus*), Bennetts wallaby (*Macropus rufogriseus*), eastern quoll (*Dasyurus viverrinus*), echidna (*Tachyglossus aculeatus*), wedge-tailed eagle (*Aquila audax*), black currawong (*Strepera fuliginosa*) and New Holland honeyeater (*Phylidonyris novaehollandiae*), use buttongrass moorland habitat for feeding and typically shelter in other habitats. Copses growing on peat mounds and other dry vegetation copses within buttongrass moorlands may be particularly important for many of these species as they provide vegetation cover and/or dry soil for nesting and shelter within the habitat mosaic. Other vertebrate species, including southern brown bandicoot (*Isoodon obesulus*), brushtail possum (*Trichosurus vulpecula*), eastern pygmy possum (*Cercatetus nanus*), fan-tailed cuckoo (*Cacomantis flabelliformis*), masked lapwing (*Vanellus miles*) and white-breasted sea-eagle (*Haliaeetus leucogaster*) are rare users of, or visitors to, buttongrass moorland.

Invertebrate fauna

Until recently, there has been little systematic survey of invertebrate fauna in buttongrass moorland. Over the past seven years knowledge of the terrestrial invertebrate fauna has substantially improved (Greenslade and Smith, 1999; Driessen and Greenslade, 2004; Mallick and Driessen, 2005; M. Driessen, DPIW unpublished data). A monthly survey of invertebrates in buttongrass moorlands over 12-months resulted in a collection of nearly 60 000 invertebrates representing 27 major taxa (typically Order level), 233 families and over 1100 species/morphospecies (M. Driessen, DPIW unpublished data). Within the limits of the sampling methods used in this survey (pitfall traps and sweep nets), the terrestrial invertebrate fauna of buttongrass moorland is numerically dominated by springtails (Collembola: Katiannidae, Isotomidae, Bourletiellidae Katianninae), flies (Diptera: Chironomidae, Muscidae, Ceratopogonidae, Sciaridae), spiders (Araneae: Tetragnathidae, Araneidae, Thomisidae), mites (Acarina: Parakalummatidae, Uropodidae), crickets (Orthoptera: Gryllidae) and ants (Hymenoptera: Formicidae, subfamily Dolichoderinae). The most diverse groups recorded, in terms of number of families and morphospecies, are flies, wasps, spiders, mites, beetles, moths, bugs and springtails (Table 2).

Unlike many other habitats the diversity and abundance of beetles (98 species) and ants (11 species) is relatively low. Presumably the limited number and diversity of trees and shrubs and a poorly developed litter layer restricts their diversity. The acidic and poorly drained soils also limit nesting opportunities for ants, as well as other insects with a soil dwelling life-stage, however jack jumper (*Myrmecia* sp.) nests, raised above the water level, are a conspicuous feature in some areas of buttongrass moorland.

Table 2. An indication of family and morphospecies diversity of terrestrial invertebrate taxa most commonly recorded in sweep and pitfall samples taken from buttongrass moorland. Data based on 12 months of monthly samples from 40 pitfall samples and 8 sweep net samples (M. Driessen, DPIW, unpublished data).

Taxon	No. Families	No. Species/Morphospecies
Diptera (flies)	36	290
Acarina (mites)	35	68
Hymenoptera (wasps/ants)	31	266
Araneae (spiders)	29	290
Coleoptera (beetles)	25	98
Lepidoptera (moths/butterflies)	17	62
Hemiptera (bugs)	13	23
Collembola (springtails)	12	51

Only about 10-15% of the species/morphospecies summarised in Table 2 have been assigned formal species names. Although some of the morphospecies are certainly new to science (several of the sampled spiders and caddis-flies have been described as new species), it is not known what proportion are new species and what proportion simply could not be assigned to a named species by the specialists identifying the specimens.

Freshwater invertebrates of buttongrass moorland have probably received greater attention than their terrestrial counterparts with the burrowing crayfish rightly taking centre stage. Until recently one species of burrowing crayfish (*Parastacoides tasmanicus* - Figure 4) was considered to be widespread and typical of buttongrass moorland, but a taxonomic revision of this species has split this crayfish taxon into two genera and about twelve species (Hansen and Richardson, in press).

Figure 4. The burrowing crayfish *Parastacoides tasmanicus*. Photo: M. Driessen.

Burrowing crayfish have been recognised as keystone species in buttongrass moorland because of their fundamental role in this ecosystem (Brown *et al.,* 1993). Their burrowing activity has significant effects on the whole ecosystem through its influence on soil condition, and subsequently on plant growth and habitat formation for other animals. The large surface area of underground burrows represents an important avenue of gas exchange for plant roots in peat soils, which are often waterlogged and otherwise anaerobic (Brown *et al.,* 1993). The metabolism of the peat immediately surrounding the burrow is enhanced, though this effect dies away within a few centimetres of the tunnel (Richardson, 1983). The burrows also carry water from the subsoil to the surface, or occasionally the reverse (Brown *et al.,* 1993). In summer and early autumn, when water levels drop and surface waters disappear, crayfish burrows represent the only available water for aquatic species.

Crayfish burrows provide habitat for a discrete fauna, the pholeteros (Lake, 1977), which is numerically dominated by nematodes, oligochaetes, copepods, isopods and amphipods (Brown *et al.,* 1993). Two species of syncarid crustaceans, *Allanaspides hickmani* and *A. helonomus* that have a close association with crayfish burrows are of particular scientific interest because: they are very primitive among the higher crustaceans, they possess an unusual structure called the 'fenestra dorsalis', they have Gondwanic origins, and their present day distributions may help understand past hydrological features and processes in the region.

Pools in buttongrass moorland also provide habitat for the rare, endemic dragonfly *Synthemiopsis gomphomacromioides*. This species, which is the only member of its genus, is of scientific interest as it is the most primitive member of its family and because of its Gondwanic origins.

Rare or Threatened Species

Buttongrass moorland provides habitat (shelter, nesting, and/or food) for several species listed as rare or threatened under the Tasmanian Threatened Species Protection Act 1995: orange-bellied parrot, wedge-tailed eagle, Tasmanian devil (*Sarcophilus harrisii*), swamp galaxias (*Galaxias parvus*), *Allanaspides hickmani* and two species of caddis-fly (*Taskiria mccubbini*, *Taskiropsyche lacustris*). Of these species, only swamp galaxias, *Allanaspides hickmani* and the caddis-flies are restricted to buttongrass moorland and the orange-bellied parrot is dependent on this habitat for food during its breeding season. *Allanaspides hickmani* occurs only in pools in buttongrass moorland near Lake Pedder and Lake Gordon in southwest Tasmania and it has been estimated that 85-95% of its habitat was lost with the flooding of buttongrass moorland for hydro-electric power generation (Driessen *et al.,* in press). The total extant area of occupancy for *Allanaspides hickmani* is only 21 km^2. The two threatened caddis-flies were thought to be extinct following the flooding of the original Lake Pedder, but surveys in 1998 and 1999 found both species in buttongrass moorland adjacent to Lake Pedder (Jackson, 2000). The swamp galaxias is restricted to slow-flowing swampy streams and soft-bottom pools near Lake Pedder (Jackson, 2004). Like the *Allanaspides hickmani*, the caddis-flies and swamp galaxias have naturally restricted distributions and have lost significant areas of habitat through inundation. The orange-bellied parrot breeds only in southwest Tasmania during summer and migrates to the Australian mainland during winter. Since 1991 the size of the wild population has not exceeded 200 mature birds (Orange-belled Parrot Recovery Team, 1998). Threats include loss of critical winter habitat and food supply, and competition with and predation by introduced animals.

Endemism

It would appear that there are relatively few fauna species that are entirely restricted to buttongrass moorland. No vertebrate species is entirely restricted to buttongrass moorland, although few of Tasmania's vertebrate species are restricted to any one particular habitat, reflecting the State's small size, glacial history and relatively recent isolation from the Australian mainland. Similarly, few invertebrates are currently known to be restricted to buttongrass moorland; however, this may be due to taxonomic identification issues and limited systematic invertebrate surveys. But it is also possible that this is because the origins of this habitat are relatively recent or its extent was very restricted in the past. Little is known about the palaeo-origins and past extent of buttongrass moorland vegetation because fossil cyperaceous pollen has often not been identified beyond the family level. There is some evidence to suggest that a community similar in structure and ecology to modern buttongrass moorland occurred in the Oligocene-Miocene period (ca 38 mya) (Blackburn, 1985). The earliest pollen of buttongrass to have been identified from the fossil record was dated from the most recent glacial, in the Lake Ooze deposit (ca 18 kya) (Macphail and Colhoun, 1985), and 1.6 million year old leaf fragments of buttongrass have been found in Victoria (G. Jordan, University of Tasmania, pers. comm.).

MANAGEMENT

Buttongrass moorland is well reserved in Tasmania, with 66% in secure conservation reserves and much of its distribution within the Tasmanian Wilderness World Heritage Area (Balmer *et al.,* 2004). As a consequence there is only a limited number of management issues relating to buttongrass moorland, but these include fire, disease, and global warming.

Fire

Buttongrass moorland is very flammable and occurs adjacent to fire-sensitive vegetation (eg rainforest), and is underlain by peat that will also burn, and be lost, when soil moisture is low. Although buttongrass moorland may be the climax vegetation in some situations (Pemberton, 1989), its current extent appears to represent an anthropogenic disclimax with fire extending its distribution far beyond its natural edaphic limits (Jackson, 1968). There is substantial evidence that Aborigines must have regularly burned parts of western Tasmania for a considerable period of time (Thomas, 1993) to encourage game and to increase their ease of movement. It is argued that burning was probably performed during wetter seasons in moorland vegetation and that this frequent low intensity fire regime would have minimised the probability of broad-scale fire events and so avoided the burning of fire-sensitive vegetation (Marsden-Smedley, 1998; Marsden-Smedley and Kirkpatrick 2000). Since European settlement, there has been a reduction in fire frequency leading to increased biomass in buttongrass moorlands. Major regional-scale conflagrations in the 1890s and 1930s followed long periods without fire, resulting in very large areas of buttongrass being burnt at one time and the loss of fire sensitive vegetation (Marsden-Smedley and Kirkpatrick, 2000).

Several options for fire management in buttongrass moorland of western Tasmania have been summarised (King, 2004). The first option is to do nothing or 'benign neglect' (Brown, 1996) which allows the build up of fuels to high levels. This runs the risk of major 'hot' wildfires during summer (ignited either by lightning strikes or accidentally or illegally lit fires) which cannot be controlled, and which may lead to the loss of fire-sensitive vegetation and peat. A second option would be to contain all summer fires as soon as possible after they occur - an option not practical in the remote and inaccessible areas typical of most of western Tasmania. The third option would be to impose a regime of prescribed burning to minimise the risk to fire-sensitive vegetation, property and lives during wildfire events. Marsden-Smedley and Kirkpatrick (2000) proposed a combination of broad-scale ecosystem-management burning, with the intent of developing a mosaic of fire sizes and moorland vegetation ages, together with tactical hazard-reduction burning and wildfire suppression zones. This proposal provides a compromise between maintaining buttongrass moorland biodiversity extensively across most areas whilst simultaneously protecting fire sensitive vegetation. They suggest that broad-scale ecosystem-management burning on about a 20-year rotation has a high probability of maintaining ecological values in buttongrass moorlands, and would have strong similarities with what they understand to have been indigenous fire regimes.

Currently, limited areas of buttongrass moorland (estimated to be less than 2%) are subject to tactical hazard reduction burning and are strategically targeted to protect nearby fire-sensitive vegetation, life and property. The Parks and Wildlife Service is currently considering strategies for broad-scale management burning in buttongrass moorland, taking into account recent research on the effects of fire on plants, animals and soils (currently undertaken by the Department of Primary Industries and Water, the University of Tasmania and the University of Melbourne).

Phytophthora

Phytophthora cinnamomi belongs to a primitive group of fungus-like organisms called water moulds. It is a soil borne pathogen that causes death in a wide range of native plant species resulting in floristic and structural changes in susceptible plant communities. *Phytophthora* can be spread by water, wildlife and humans, as well as autonomously, and is widely distributed throughout most areas of Tasmania at altitudes below about 700 m (Rudman, 2004). Buttongrass moorland is recognised as a vegetation type that is highly susceptible to the pathogen and likely to have the largest diseased area of any vegetation type in Tasmania (Schahinger *et al.,* 2003). Plant species likely to be eliminated from infected areas are the shrubs banksia (*Banksia marginata*), white waratah (*Agastachys odorata*) and the lily Christmas bells (*Blandfordia punicea*) (Schahinger *et al.,* 2003). A number of other plant species have suffered a reduction in density rather than complete loss from a particular site, leading to the suggestion that, over the long term, plants will develop better genetic resistance to the pathogen (Tim Rudman, DPIW, pers. comm). Few management options are available to control *Phytophthora* and prevent further inevitable spread (Rudman, 2004). The focus of management is on the protection of significant values that are at risk (e.g, threatened species) and large areas of buttongrass moorland free of the pathogen that are known to occur in remote areas of the Tasmanian Wilderness World Heritage Area. Prescriptions aimed at minimising the chances of spread by people have been established to protect these areas (Schahinger *et al.,* 2003; Rudman, 2004).

Chytrid fungus

Chytrid fungus causes an infection in frogs called chytridiomycosis and is recognised as a major threatening process worldwide (DEH, 2006). It was probably introduced to Australia in the 1970s and was first recorded in Tasmania in 2004 by the Central North Field Naturalists (Obendorf, 2005). Surveys by the Central North Field Naturalists have shown that the disease is present in various locations in southern and northern Tasmania. Not all frog species are at risk from chytrid, however concern has been raised about the status of the Tasmanian tree frog, a species which is restricted to western Tasmania and is most common in limited areas of buttongrass moorland. Initial chytrid surveys in the World Heritage Area indicate that significant areas may be free of the disease (M. Pauza, DPIW, unpublished data). The challenge is to keep these areas free from chytrid; this may be difficult, as there are likely to be a number of agents involved in its spread. People can minimise the spread of the disease by not moving around water, tadpoles or frogs and ensuring all gear and equipment are clean (or simply dry, since the fungal spores cannot survive drying) before undertaking trips into the Tasmanian Wilderness World Heritage Area.

Introduced animals and weeds

Few introduced animals and very few weeds are known from buttongrass moorland, probably because of the difficult conditions under which buttongrass moorland occur and because much of the habitat has remained undisturbed. The only introduced animals regularly using buttongrass moorland are European wasps (*Vespula germanica*), bumblebees (*Bombus terrestris*) and honey bees (*Apis mellifera*). Other introduced animals recorded in moorland are cat (*Felis catus*), hedgehog slug (*Arion intermedius*), and a springtail (*Ceratophysella* sp.). The impacts of these introduced species on buttongrass moorland ecosystems are unknown. Weeds are rarely an issue in buttongrass moorland and only occur where disturbance has been a problem (Tim Rudman, DPIW, pers. comm). Some rehabilitation sites along the edges of the Gordon River Road have been invaded by *Erica lusitanica*, and European gorse (*Ulex europea*) has invaded disturbed moorland south of Zeehan, west coast Tasmania.

Climate change

The buttongrass moorland ecosystem of southwest Tasmania is at the climatic limit for peat formation due to the relatively dry and mild summers (Bridle *et al.,* 2003; Pemberton *et al.,* 2005). Climate change projections for southeast Australia indicate that average annual temperature will increase and rainfall will decrease during spring, summer and autumn (CSIRO, 2001). This scenario is likely to be detrimental to peat formation and the buttongrass moorland ecosystem, although it has been suggested that orographic effects may mediate the projected declines in rainfall for southwest Tasmania (Bridle *et al.,* 2003). Future changes in climate may have implications for fire, disease and exotic species management in buttongrass moorland.

ACKNOWLEDGEMENTS

Thanks to Jayne Balmer, Stephen Mallick and Alastair Richardson for their helpful discussions on buttongrass moorland and their comments on previous drafts. I thank Todd Chaudhry and Mark Holdsworth for their views on moorland bird fauna and in particular Todd who provided information from his draft PhD thesis. Finally thanks to Greg Jordan, Matthew Pauza and Tim Rudman for providing personal communications relating to their area of expertise or unpublished data.

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An endemic Tasmanian cowrie?

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Cowries are mainly tropical marine gastropod molluscs in the family Cypraeidae, and Tasmania is right at the edge of their range. It's no surprise, therefore, that Tasmania isn't a world centre of cowrie diversity, and a modest five species have been well known to collectors. One of these, the very large *Umbilia hesitata*, is usually a deep-water species and hence rarely washed ashore. The other four belong to the genus *Notocypraea*.

Notocypraea is a group of small (usually 15-35 mm) cowries that extends around the southern half of Australia from south-western WA to central NSW. There are at least seven species. The four well-known Tasmanian species (all also found elsewhere) are as follows:

N. angustata, the commonest, is usually plump and pale brown to purple (pale or beachworn specimens are yellow to orange), sometimes with two to four faint bands. The margins of the shell as viewed from above are densely covered with small very dark brown spots.

N. declivis has the same plump shape as *N. angustata* but rarely exceeds 25 mm long. Very good specimens are usually greyish and lightly covered with tiny pale brown flecks, but the flecks have worn off on most beach specimens. The darker spotting on the flanks is less extensive.

N. piperita is very small, slender and pale with four broken bands of brown or orange blotches. It is mainly found on the north coast and Bass Strait islands.

N. comptoni is an extremely variable species. The typical form is slender, reddish to purple, with four prominent bands. *N. comptoni mayi*, however, looks more like a more banded *N. angustata* with less prominent lateral spots, while *N. comptoni* var. *casta* is almost entirely white.

(If you're thinking I'm leaving one out, you may have come across the tiny "bean cowrie" *Ellatrivia merces*, which actually isn't a cowrie at all, but belongs to a related group, the Triviidae.)

In the early days of cowrie research, the confusing variations in these southern Australian cowries led to many varieties being named. Over time, many variety names were dismissed as meaningless, while others came to be used for specimens that looked odd in various ways, whether they matched the original description or not. A name in the latter group is *N. subcarnea*, described by Beddome (1896), and initially treated as a variety of *N. angustata*. The name *subcarnea* is often used mistakenly for what turn out to be *N. comptoni* var. *casta* or pale *N. angustata*, but Beddome's careful two-page description is of quite a different creature.

Notocypraea subcarnea (*sensu* Beddome, 1896) has a similar plumpish shape to *N. angustata*, but the spots around the margins are fewer, typically larger and much less distinct. On specimens in very good condition there may be a single indistinct dorsal band, but not the four weak bands of *N. angustata*. Southern specimens are shorter and more globular than *N. angustata*, and are quite strongly callused around the margins. Another difference is in the teeth underneath the shell. Hold the shell upside down with the more rounded end (the posterior) at the top. On an adult *N. angustata*, there will be a sharp toothless straight ridge a few millimetres long at the top end of the inner lip. On *N. subcarnea*, the teeth continue much closer to the end.

Beddome recorded *N. subcarnea* from "Blackman's Bay, Derwent River and Brown's River [Kingston-KB] beaches; Hobart, Harbour, Tasmania (dredged)". It is much more widespread than that, with recent records from Stanley, Douglas River and Marion Bay, but the exact distribution remains to be confirmed.

Suggestions that *N. subcarnea* might be more than a mere variety surfaced recently when leading cowrie expert Felix Lorenz began listing it as a full species on his website (www.cowries.info) on the basis of "consistent conchological features". Furthermore, genetic research reported by the Cowrie Genetic Database Project (http://www.flmnh.ufl.edu/cowries/) has suggested that *N. subcarnea* is actually the most genetically distinct of the Tasmanian *Notocypraea* and that its closest relative is *N. hartsmithi*, an extremely rare species that has been found from central NSW to southern Victoria. Lorenz has recently provided remarkable pictures of live-collected *N. subcarnea* on his website (http://www.cowries.info/travels/Abrotas06/index.html), and claims that it is rare and apparently endemic to Tasmania.

We shouldn't have to wait long for formal refereed papers confirming *N. subcarnea* as a full species (and hopefully shedding more light on its full distribution), but cowrie collectors are notorious for not waiting for the formal taxonomy once it becomes widely suspected that a named form is in fact a full species. We can expect increased international interest in Tasmania's modest cowrie fauna, but collectors should beware – most "*subcarnea*" stock offered by online shell dealers is in fact misidentified! (Besides, it's much more fun to walk the beaches and try finding your own, though this author's two recent attempts at Taroona Beach produced a feeble half a shell!)

Records wanted: I am interested in learning more about the full distribution of *N. subcarnea* in Tasmania based on verified specimens or photos. Please contact me if you have a suspect – I am happy to identify and return specimens or photos at no charge.

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Notes on the diet of feral cats in Tasmania

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Feral cats occur widely on the Tasmanian mainland, as well as on 59 of the state's offshore islands. Previous dietary studies in other parts of Australia have identified feral cats as being highly opportunistic predators. This means that dietary studies are valuable, yet limited to the region in which they are conducted. As such, whilst previous dietary studies on two Tasmanian offshore islands have been useful, accurate assessment of the effects of predation by feral cats across Tasmania required further investigation. This article summarises results of a dietary study of 91 feral cats captured from around Tasmania and euthanased as part of a routine feral animal control programme. The study was conducted for my honours project at the School of Zoology, University of Tasmania in 2005.

The analysis identified an extensive array of species that are predated upon by feral cats, including several species endemic to Tasmania. Organisms identified in this study included mammals, birds, reptiles, invertebrates and even plant materials. In many cases, it was difficult to identify material damaged by digestive processes,and therefore often not possible to identify material to species level.

Mammals - Several mammal species were identified, of which the majority were rabbits, rats and mice. It was not possible to determine whether the rats and mice were of native or feral species. A juvenile brushtail possum was also identified. Whilst an adult brushtail would be too large and aggressive to be killed by a cat, unattended juveniles may be predated upon. One stomach was found to contain the ear, fur and flesh of another cat. Cannibalism in cats is not unknown, particularly when resources are scarce; however, this cat may have been consumed as a result of scavenging rather than direct predation.

Passerine birds - Feral cats will climb trees after prey, so a wide range of bird species is susceptible to predation. Only two passerine species could be positively identified as prey from stomach contents: superb blue wren (*Malurus cyaneus*) and New Holland honeyeater (*Phylidonyris* *novaehollandiae*). Evidence of other passerines was noted, but digestive damage prevented identification.

Seabirds - Feral cats will predate on seabirds, particularly on islands. Several stomachs from cats caught on Bruny Island contained the remains of little penguins (*Eudyptula minor*). Anecdotal evidence suggests little penguins are preyed upon in several coastal colonies around Tasmania, as well as on offshore islands around the state.

Reptiles - Several skink species and one snake species were found in cat stomachs from around the state. One stomach was found to contain 27 pregnant female tussock skinks (*Pseudemoia pagenstecheri*). This particular species is currently listed as vulnerable due to habitat destruction, and this observation leads to particular concern regarding conservation of this species.

Invertebrates - Several types of invertebrates were identified as important dietary items among Tasmanian feral cats; however, most were only identified to family level due to digestive damage. Taxa recorded include moths, spiders, beetles and crickets. Several stomachs contained the pest moth species *Abantiades hyalinatus*.

Plant material - Plant material appeared frequently in stomach contents and included grass, sticks, leaves and seeds. It has been suggested in previous studies that vegetation may be consumed to assist with internal parasite control, or even as a source of moisture; however the amounts of plant material found by this study do not support this. Instead this study would suggest that many occurrences of plant material ingestion were as an indirect consequence of prey consumption, rather than direct consumption.

The study showed that the feeding habits of Tasmanian feral cats are as opportunistic as feral cats found on mainland Australia. There was no evidence found to suggest that cats have selective dietary tendencies, or that they do not scavenge. This type of diet ensures that feral cats have the potential to survive even the bleakest conditions as long as some food-source is still available, because a cat will simply switch prey when its preferred food-source is unavailable. This study has revealed several species not previously known to be predated by cats. However the study was conducted within a limited time frame; it is recommended that future studies are statewide, longer term and focus on the role of predation on threatened species.

Saltbushes and goosefoots

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The diverse and intriguing common names of saltbushes, bluebushes, crumble weeds, beetroot, quinoa and sugar beet provide motivation enough to explore the attributes of the 100 odd genera and 1500 species making up the goosefoot family. Characteristic of most family members are their goose-foot shaped leaves. This feature was the reasoning behind the family name of Chenopodiaceae, derived from the Greek words for goose and foot.

Many well-known saltbushes and bluebushes have superior drought and salt tolerance, such as the small, water-friendly, rambler called climbing saltbush *Einadia nutans* and the woolly short-leaf bluebush *Maireana brevifolia*. Unfortunately, however, the chenopod family contains many invasive weeds, including fat-hen *Chenopodium album*. On the positive side, sugar beet *Beta vulgaris altissima* is a key source of the world's sugar supplies, whilst beetroot *Beta vulgaris vulgaris*, English spinach *Spinacia oleracea* and quinoa *Chenopodium quinoa* are valued by various societies as traditional staple foods. The family also contributes to the flower-garden through the spectacular crimson-leaved ornamental bluebush *Kochia scoparia trichophylla*, whilst many medicinal and herbal remedies are extracted from the family's herbs, such as crested goosefoot *Chenopodium cristatum* (poultices heal skin infections) and pigweed *C. album* (leaves chewed for toothache).

Chenopods are a gardeners' ideal plant

Most of the 300 Australian herbaceous or shrubby species (15 Tasmanian species) are halophytes, flourishing in saline locations within saltmarshes or in arid plant communities. These tough survivors are some of the most drought-tolerant garden plants available and once established thrive on neglect. A word of warning however: their palatable leaves should be permanently protected from browsing rabbits, potoroos, wallabies etc, whilst their wind-borne pollen has a reputation as one of the main summer allergy inducers. Recent research indicates that the goosefoots, along with that of the non-chenopods plantain, ragwort, asthma weed and Paterson's curse, are the key pollen allergy culprits.

To survive their harsh environments, plants such as grey saltbush *Atriplex cinerea* are adorned with tiny moisture-laden hairs. These collapse, excreting their contents onto the leaves. This forms a satiny grey coating of salt crystals and waxy particles. Other species possess small succulent leaves, whilst still others have the leaves replaced by green bladder-like jointed stems. Typical examples of the latter are the saltmarsh plants shrubby glasswort *Sclerostegia arbuscula* and the sprawling mat-like wallaby saltbush *Threlkeldia diffusa*.

For the wildfire-susceptible rural fringe properties, chenopods can be grown with a range of succulents to form a natural fire-break. They retard fire with the aid of saline moisture accumulated in their fleshy foliage. Ground covers and scramblers such as coastal saltbush *Rhagodia candolleana* and climbing saltbush grown over an upright mesh can form a useful fire barrier. The latter species are also excellent for erosion control, but be aware that under certain conditions, for example in some coastal revegetation projects, they should be classed as 'over-successful natives'. To restrict their invasive potential they may need to be drastically pruned twice a year.

Glassworts form the saltmarsh's framework

Glassworts (sometimes called samphires), such as beaded glasswort *Sarcocornia quinqueflora* and thick-headed glasswort *S. blackiana*, function as 'framework' species within the much-undervalued saltmarshes. Harris and Kitchener (2005) describe Tasmanian saltmarshes in detail, while Kirkpatrick and Glasby (1981) provide information on the nature and whereabouts of these communities in Tasmania, which are typically located adjacent to the sporadically inundated high tide levels of intertidal mudflats. Glassworts have adapted to survive periods of inundation by concentrating the saline water into their bladder-like stems, turning them pink then red. When the red colouration deepens, their stems drop, relieving the plant of its salty burden.

Glassworts are also key plants in the saltmarsh food web. They sustain the diverse populations of arthropods and molluscs that are harvested by the long prying beaks of the many waders such as oystercatchers, red-necked stints and hooded plovers. For example, the Lauderdale saltmarsh (Ralph's Bay) and the Ramsar-listed Pittwater saltmarsh both have extensive glasswort communities supporting key migratory wader habitats. Many glasswort-dominated communities have been subjected to a long history of degradation through landfill, urban development and extensive grazing. However, their roles and values are now more appreciated, and many areas now receive formal reservation and/or recognition via Ramsar or other international agreements.

Mutual benefits for rare birds, moths and butterflies

Beaded and thick-headed glassworts and fleshy seablite *Suaeda australis* all provide a crucial food source for the endangered orange-bellied parrot *Neophema chrysogaster*. During winter the birds can be observed feasting on these fleshy leaves at sites on the central Victorian coast, while on migration to or from their southwestern Tasmanian breeding grounds they also utilise this habitat along the northwestern Tasmanian coast and on the western Bass Strait islands.

Saltmarsh looper moth *Dasybela achroa* is another saltmarsh rarity, and one that is entirely confined to Tasmania. Indeed, it has only ever been found around Lauderdale, giving the local saltmarshes there particular conservation significance. However, nobody has yet figured out what its larvae feed on, but a saltmarsh plant of some sort seems likely. In contrast, the local larval foodplant of the attractive and more widespread chequered blue butterfly *Theclinestes serpentata* is known to be coastal saltbush. Adults lay their flattened pale green eggs singly on the flower heads. On hatching, the larvae munch veraciously on the succulent leaves. By mimicking the leaf colour and texture, they remain protected from bird predation.

People's plants

Food - It is not surprising that the Aborigines and European colonists enjoyed a variety of bush tucker treats supplied by the local chenopods. After all, in the Andes during the Inca period vast armies were sustained on quinoa. Known to the Incas as the 'mothergrain', quinoa has proven nutritionally far superior to all cereals and milk. It contains up to 18% complete protein and has an ideal blend of poly- and mono-saturated fats. Although available today in health-food shops, users often forget to pre-rinse the bitter saponins out of the grain prior to cooking.

Once the early European colonists had realised that native plants eaten by Aboriginals were safe for them to try, chenopods became a very popular bush tucker. They require boiling to remove their saltiness before savouring as delicious greens. Commonly eaten were marsh saltbush *Atriplex paludosa* and climbing saltbush, whilst fleshy seablite gained a reputation as a pickle. Scurvy was avoided by early mariners by eating cooked bearded glassworts. Interestingly, recent irrigation trials in South Africa using saline water have opened up a potential green food supply, with excellent growth rates being achieved from bearded glasswort crops. A word of caution: as a green vegetable, these plants should be enjoyed in moderation. Like their spinach relative, they contain oxalates, which may cause digestive discomfort. However, the toxicity of oxalates is diminished by boiling and/or by serving them with foods rich in calcium. Delicious creamy sauces or spinach kirsches are ideal options. The seeds of grey saltbush, like many of the chenopods, were once valued for grinding into a meal for baking as flat bread.

Medicinal herbs - The glycoside saponin is an active ingredient in spinach and other chenopods and aids the digestion by improving the absorption of minerals such as calcium, thereby correcting nutrient deficiencies. Chenopods cooked as greens also have a mild laxative effect, whilst providing a good source of vitamins A and C. The crushed leaves of fat-hen have proven valuable in poultices applied to burns, swellings and wounds. They can also be chewed uncooked to relieve toothache, whilst medicinal teas have gained a reputation for healing mouth ulcers. Wormseed oil extracted from *C. ambrosioides* is considered one of the most toxic of all essential oils. It was used as an anthelmintic (intestinal worm killer), but its toxicity has limited this application.

Soaps - A 'lye' (alkaline substance) can be formed from the white ashes of burnt saltbush foliage. An excellent home-made soap was once produced in Tasmania by mixing the lye with mutton fat and perfuming this gelatinous mix with favourites from the colonist's cottage garden (lavender, roses), before allowing it to dry. Barilla Bay takes its name from the soap-producing saltbushes found there. According to John Whinray, quoted in Carr and Carr (1981), '*by 1819 people in Pitt Water were making soap of the best quality from cattle suet and marine ashes, probably from barilla in Barilla Bay*'. The word barilla itself is still used around the Mediterranean, where it refers to either the local saltworts (species of *Salsola* and *Halogeton*) or to the crude sodium carbonate ash obtained from burning these plants. Interestingly, the Incas paralleled the use of barilla by using the rinsings from quinoa preparation as a detergent for foaming water.

In conclusion

Goosefoots comprise a family with multiple benefits for humans, but these pale into insignificance compared to their important role in saltmarsh and arid zone ecosystems. We undervalue them at our peril!

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Finding a botanical Lazarus: tales of Tasmanian plant species 'risen from the dead'

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Introduction

'Extinct' is an emotive word. For many people it conjures up images of dodos and thylacines (but very rarely does the image of a cryptic shrub or herb pop into people's minds). As humans, we don't want any species to become extinct: witness the recent scientific and media interest in the Tasmanian devil being ravaged by the facial tumour disease. Unfortunately, every country in the world is 'home' to extinct plants and animals, and Tasmania is no different.

Currently there are around 30 species listed as 'presumed extinct' on the Tasmanian *Threatened Species Protection Act 1995*, including 4 birds, 1 mammal, 1 beetle, 2 caddisflies, 1 spider, 1 lichen, 15 dicotyledons, 4 monocotyledons and 1 fern. Unfortunately, we simply know that some of these are more than just 'presumed extinct' – there would be few scientists arguing that the King Island emu is still alive in some unsurveyed corner of the island. But other species are exactly that: '*presumed* extinct. For example, until recently (1996), the delightfully named southern hairy red snail (*Austrochloritis victoriae*) was listed as 'presumed extinct' (had not been collected since the 1920s). That was until Tasmanian terrestrial snail expert Kevin Bonham rediscovered the species on King Island (Bonham, 1997).

There would be few biologists who haven't camped in the Tasmanian bush, hoping for an elusive sighting of a thylacine, but how many have been hoping to also stumble across *Festuca archeri* (if indeed the species actually exists)?

If ever a sighting of a thylacine could be confirmed by the scientific community, it would almost certainly cause a media frenzy (and not just in Tasmania). There was not much fanfare about the re-emergence of the southern hairy red snail but the recent rediscovery of the beautiful Miena jewel beetle (*Castiarina insculpta*), caught on the back of someone's ute, got the media a little more interested.

Tasmania is (or was) home to several species of extinct plant, though these are less well known than some of their furred, feathered, shelled or winged friends. Fortunately, some of these plants have been rediscovered in recent years. The anecdotes below describe some of the recent discoveries.

THE STORIES

The stories are mostly written in the third person (by one of the authors) but some are in the first person and relate a personal tale. We're sure we've missed some interesting stories of rediscovery. However, like the plants themselves, some of these accounts are yet to be discovered, lost in the depths of herbarium specimens, dusty literature or in the dark recesses of someone's memory.

Argentipallium spiceri *(Asteraceae), 'spicers everlasting'*

For many years, this plant, under the name *Helichrysum spiceri*, was just an entry in *The Student's Flora of Tasmania* (Curtis, 1963) and no living plants were known. It was presumed to be extinct and was listed as such in the schedules of the *Threatened Species Protection Act*.

All that changed in 1997 when a single plant appeared in a bush garden, bordering *Eucalyptus obliqua* forest, near Longley in southeastern Tasmania. A specimen forwarded to the Tasmanian Herbarium confirmed the young shrub's identification and it became the prized exhibit in the Eberhard garden. It narrowly escaped another round of extinction when the family dog lay down on top of it (Rolan Eberhard, pers. comm.), but it sprang back unharmed and went on to produce flowers in the following summer (and it is now listed as endangered, although sleeping dogs are not listed as a threatening process).

This species was discovered by Augustus Simson in 1876 when he found a single individual growing on the roadside between Longley and the Sandfly coal seam. He returned the following summer and collected further material from the same plant (Simson, 1880). He showed the specimens to his friend, the Reverend William Spicer, and they determined that it was an unnamed species of *Helichrysum*. This was just in time for it to be included, as an addendum, in the Reverend Spicer's *Handbook of the Plants of Tasmania* (Spicer, 1878). At the same time, a specimen was forwarded to Ferdinand von Mueller, in Melbourne, who named it *Helichrysum spiceri* (Mueller, 1878).

Nothing further was heard about this plant in the wild until Leonard Rodway collected specimens at or near Huonville in January 1892. Rodway confused this species with another rare *Helichrysum* from the Furneaux Islands in northeastern Tasmania. He thought that *H. obtusifolium* and *H. spiceri* were the same species and in his *The Tasmanian Flora* (Rodway, 1903) he described the two together under the former name and extended its distribution to mainland Australia. This had the effect of consigning *H. spiceri* to obscurity for the next sixty years.

The plant appeared again in 1958 when Winifred Curtis collected material from the road bank at the edge of the Huon Highway, immediately south of its junction with the south end of Scotts Road, near Cairns Bay. Dr Curtis recognised this plant as distinct from *H. obtusifolium* and in Part 2 of *The Student's Flora of Tasmania* she (Curtis, 1963) described it as endemic to Tasmania and known only from the Huon district. This was the last time the plant was seen until its recent rediscovery by Jo Eberhard near Longley (Buchanan, 1998).

Towards the end of this saga, Australian taxonomists studying the southern hemisphere genera of the daisy family (Asteraceae) were becoming increasingly uncomfortable with the wide range of variation in the genus *Helichrysum*. As a part of the recent revision of the genus, three Tasmanian species (*H. dealbatum*, *H. obtusifolium* and *H. spiceri*) were transferred to the newly erected genus *Argentipallium* (Wilson, 1992).

One interesting fact stood out at three of the sites where *Argentipallium spiceri* had been collected: only one individual was seen (nothing is known about Rodway's collection on this point). Despite much searching in the vicinity of the Eberhard garden, no further plants were located (Alan Gray, pers. comm.). However, at this site and at the Cairns Bay site, *A. dealbatum* occurs close by. Furthermore, it was noticed that the seeds of *A. spiceri* were hollow and wrinkled and attempts to germinate the seed were unsuccessful. This lead to the realisation that *A. spiceri* was probably a hybrid. Thus, its successful propagation is only by cuttings or other vegetative means and its hybrid origin is now indicated by an 'X' before the specific name, *Argentipallium Xspiceri* (Buchanan, 2005).

Barbarea australis *(Brassicaceae), 'riverbed wintercress'*

Barbarea australis, an annual or short-lived perennial herb that occurs amongst river rocks in flood-prone rivers, is now known from about 10 river systems (chiefly the Derwent River system including the Shannon, Ouse, Clyde and Nive rivers, and also the St Patricks, Mersey, and Hellyer rivers), and is currently listed in the Tasmanian *Threatened Species Protection Act* as endangered. But until 1982, the species was only 'known' from much earlier collections (from the 1830s). Joseph Hooker described *B. australis* in 1852 (*The botany of the Antarctic voyage of H.M. Discovery ships Erebus and Terror. II. Flora No-*

vae-Zelandiae), citing the type material as having been collected by Colenso (a well known early New Zealand collector) from '*Northern Island*' (meaning the north island of New Zealand). However, Hooker stated that his description was '*made up chiefly from specimens from Tasmania*' and it is now known (Hewson, 1982) that the species is restricted to Tasmania (New Zealand material is the naturalised *B. intermedia* and mainland Australian material is the native *B. grayi*).

The Tasmanian Herbarium holds a Joseph Milligan specimen from around 1835, probably collected somewhere in the northwest (the specimen is labelled with a 'W', perhaps referring to the extensive 'Woolnorth' property). Hewson (1982) lectotypified the name *B. australis*, citing a Gunn collection held at Kew (collected February 1837 from the Hampshire Hills in the State's northwest). The Milligan specimen at the Tasmanian Herbarium was not recognised as the endemic native until Dennis Morris worked on the genus in 2003 – until that time, the specimen had been placed under the naturalised *B. intermedia*.

Coincident with Hewson (1982), people in Tasmania became a little more interested. It was Ken Harris who collected the first material of *B. australis* for 145 years. Handwritten notes on his specimens indicate that he suspected the specimen was *B. australis* – despite this, they were filed under *B. intermedia*.

So what happened to *B. australis* in Tasmania between the 1830s and the 1980s? Was *B. australis* ever extinct? Probably not. It may not even have officially achieved 'presumed extinct' status because essentially we never really knew it existed. Hooker tried to tell us in 1852, Leonard Rodway in *The Tasmanian Flora* (Rodway, 1903) failed to heed the species, Curtis included the species in the first edition of *The Student's Flora of Tasmania* (Curtis, 1956), noting '*recorded by J.D. Hooker from moist or marshy districts in the centre of the island and near Launceston*' but no-one collected specimens until 1982 (and even then they were filed under an assumed name).

Bossiaea obcordata *(Fabaceae), 'spiny bossia'*

Bossiaea obcordata is a semi-prostrate leguminous shrub with yellow and crimson (eggs and bacon) flowers. The heart-shaped leaves (that give the plant its specific epithet) are fairly sparse on its spiny branches. The species was probably described (as *Platylobium obcordatum*) by the French botanist Étienne Ventenat in 1803, apparently from plants grown in the garden of Empress Josephine, wife of Napoleon Bonaparte. Seeds of these plants would have been sourced from the struggling colony of New South Wales, though, unbeknownst to the British colonisers of Van Diemen's land, the same species was growing near the fledgling settlement of New Norfolk. Rodway (1903) referred to the species as *Bossiaea cinerea*, recognising the variety *rigida* for the Tasmanian material. The species was renamed *Bossiaea obcordata* in 1917 (by Druce). It also occurs in Victoria and southern Queensland.

The first Tasmanian record was in 1895, when Leonard Rodway collected *B. obcordata* from '*The Rocks near New Norfolk*' (which was taken to be Derbyshire Rocks) on the northern bank of the River Derwent to the east of the town. He repeated this performance in 1898. However, it was decades before the species resurfaced, in curious circumstances, after being collected by a Forestry Commission worker, Wolfgang (Wally) Pataczek, north of Fingal in 1971.

Wolfgang had inherited an interest in plants from his native Sudetenland, and established a herbarium at the Forestry Commission. While working in pine plantations near Tower Hill, he collected an unidentified floral object, from a strip of remnant *Eucalyptus sieberi* forest adjacent to a ridgetop spur road (Cox 10 Spur). The UFO was subsequently transferred to a Forestry Commission herbarium sheet, where it lay alone and unidentified for several years, until Wolfgang took the plant (and several other UFOs) to the Tasmanian Herbarium for an outing. Unfortunately it was not until some time later that Wolfgang's specimens resurfaced again, and it was at this stage that Alex Buchanan determined that Wolfgang's plant was not a *Bossiaea* nova - rather, the elusive *B. obcordata* had been fortuitously rediscovered. After revisiting Wolfgang's work diaries to remember where the plant had been found years earlier, Alex and he visited the site in the early 1980s, resulting in a file-full of correspondence flowing between the Forestry Commission and Parks and Wildlife Service about management of the species. This included the possibility of giving a fertiliser boost to the few plants struggling on the desperate mudstone soils of the Cox 10 ridgeline, and caging them to protect them from the equally desperate marsupials that were browsing them to ground-level in this nutrient-poor environment. Several plants were eventually caged with chicken wire, and produced branches, leaves, flowers and fruit in the traditional fashion. A topiary effect was created when these protruded through the wire and the animals yielded to temptation and resumed their pruning activities.

It is worth mentioning that Wolfgang also delivered to the Tasmanian Herbarium a distinctive wattle, which had been collected from Tower Hill by Max Gilbert. The wattle was named *Acacia pataczekii* (wallys wattle) by Dennis Morris, to the chagrin of Dr Gilbert.

In the last twenty years, many more populations of *Bossiaea obcordata* have been discovered, although searches at New Norfolk have failed to relocate Rodway's population. Most new sites lie north of the Fingal Valley. Mark Neyland and Jasmine Lynch have been the most prolific of the *Bossiaea* spotters, and several sites were found by Forestry Tasmania and Forest Practices Authority field workers. Some of the most vigorous plants are on steep roadside batters, possibly because they are too sheer for browsing marsupials. Most sites are on early Devonian - Silurian Mathinna quartzwacke turbidite sequences of interbedded sandstone, siltstone and mudstone (which is enough to induce withdrawal symptoms in any species), but *B. obcordata* has also been recorded from granite in the Rossarden area, dolerite south of Fingal and on mudstone near Tunnack. Jasmine Lynch compiled a detailed report (Lynch, 1993) on the distribution and ecology of *B. obcordata* and several other species of uncommon legumes, including *Acacia pataczekii*.

Bossiaea obcordata is listed as a Rare species (Schedule 5) on the *Tasmanian Threatened Species Protection Act*. It occurs in Castle Cary Forest Reserve and Sawpit Ridge Forest Reserve, and in several informal reserves established on State Forest to protect populations of the species.

Lycopus australis *(Lamiaceae), 'Australian gypsywort'*

Lycopus australis was presumed to be extinct, as it had not been recorded in Tasmania since 1943 (from around Cressy). It was rediscovered in January 2000 during plant surveys in the northeast (on the flood plains of the Lower Ringarooma River). Further populations were discovered in 2002 along the West Tamar in *Phragmites australis* wetlands and disturbed paperbark swamp forests, and in 2004 along a creek near Port Sorell.

So where has *L. australis* been hiding? Almost certainly much of its former potential habitat is long gone (drained and cultivated to create fertile grazing and cropping country). That the species has been found so close to Launceston indicates that perhaps it never disappeared, simply ducked underneath our radar for a few decades.

Could *L. australis* have been mistaken for a weed? When Rae Glazik reported her rediscovery of *L. australis*, she wrote '*…I came across what I thought was another weed, but was unsure of its identification…I presented the 'poxy weed' to Dennis Morris and he identified it as the extinct native gipsywort…*' (Glazik, 2000). Most keen botanists and naturalists would probably follow Rae Glazik's example, so it is unlikely that the species has gone unnoticed in too many more places.

The species also occurs in Victoria, New South Wales, South Australia and Queensland – such a widespread distribution might indicate a potentially wider distribution in Tasmania, although numerous wetland surveys (e.g. Kirkpatrick and Harwood, 1983a,b) would unfortunately suggest a more restricted distribution in this State (and it remains listed as an endangered species). The Tasmanian Herbarium holds a single record prior to the 2000–2004 collections. This record is from around Cressy from 1943. Oddly, Rodway, in *The Tasmanian Flora,* describes the habitat and distribution of *L. australis* in Tasmania as "moist, shady places in many parts".

Mentha australis *(Lamiaceae), 'river mint'*

While undertaking a routine botanical assessment of a proposed forestry coupe on private property near Lake Trevallyn, my (Mark Wapstra) roving botanical eye was distracted by what looked like more interesting lakeside vegetation. While munching a sandwich and peering out from the shelter of a copse of dogwood, my senses (sight and smell) were caught by a plant I did not immediately recognise.

Growing in a small patch along the water's edge was an erect, highly aromatic white-flowered herb. I took some specimens and keyed them out using *The Student's Flora of Tasmania* (Curtis, 1967), easily identifying them as *Mentha australis*. The Flora stated that its distribution was '*local in marshes in northern and central Tasmania*', an almost verbatim quote from Rodway's *The Tasmanian Flora* (Rodway, 1903). Specimens were taken to the Tasmanian Herbarium, where Dennis Morris and Alex Buchanan confirmed the identification (amusingly, we first used a field guide to the weeds of New Zealand to do this). The Tasmanian Herbarium holds very few records of the species, most with limited collection information.

At the time of the rediscovery of the plant, bureaucratic machinations were underway to officially list the taxon as 'presumed extinct' on the Tasmanian *Threatened Species Protection Act 1995*. The species is now listed as 'endangered' (although it did make it to the Act as 'presumed extinct' for a short period – impossible to stop the wheels of the bureaucratic machine once they are turning). It is only known from the Lake Trevallyn population (further searches have failed to turn up additional populations in the immediate area).

Mentha australis occurs elsewhere in Australia (Conn, 1999), often along rivers (hence its common name of river mint). It belongs to the family Lamiaceae, which includes many familiar garden herbs such as the mints. It is collected and grown as a culinary herb and apparently aborigines used it as a food flavouring and for treating colds. A population is now maintained at the Royal Tasmanian Botanical Gardens for anyone who might want to see this attractive plant. And anyone with a keen eye and nose should keep the senses alert while in the vicinity of slow-moving or still water bodies in 'northern and central districts'.

Myosurus australis *(Ranunculaceae), 'southern mousetail'*

This little member of the buttercup family belongs to a genus that occurs in the temperate regions of both hemispheres; one species is known from Australia. The species are not easily separable and our *Myosurus australis* has been, at various times, included with the European *M. minimus* and the South American *M. apetalus*. Currently, we follow Mueller's interpretation and recognise the Australian plant as a distinct species. This is based on variation in the shape of the little fruits (or achenes). *M. australis* has longer and more angular achenes than other species.

Myosurus australis was first discovered in Tasmania in 1970, by Dennis Morris, in a small rocky depression near Jericho. This was thought to be a remnant of a formerly more extensive population, now reduced by habitat modification (farmland). However, in later years, despite careful searching in the same location, no further plants have been found. This once-only occurrence, together with the location, near a farm dam in grazing country, raised the possibility that it might have been introduced from mainland Australia, where it is widespread but not common. By the 1990s no further populations had been discovered and, being an annual, new plants would have to become established regularly, probably each year, for the continuation of the species. Thus *M. australis* was considered to be extinct in Tasmania.

And then in 2005, Andrew North came across the species once again, near Penstock Lagoon in the Central Highlands. This time, it was found in cracks in a rocky dolerite pavement amongst an open forest of *Eucalyptus pauciflora* and *E. dalrympleana*, but also associated with grazing country, the site being used as a "sheep camp". In this highland environment the plants are small and inconspicuous, growing to only one or two centimetres tall. Perhaps it is more common than we realise, its diminutive stature and small greenish flowers making it easily overlooked.

When Andrew first found the specimens in January, they were no more than dry dead plants which he considered were of an unfamiliar introduced species. However on closer inspection he recalled their similarity to an illustration of *Myosurus minimus*. Suspecting the conservation significance and scientific interest of the plants, Andrew brought these rather poor specimens to the attention of Dennis Morris at the Tasmanian Herbarium. Dennis was able to immediately confirm their identification and noticing the presence of seeds suggested that Alan Gray could have a go at germinating them. One plant grew on quite happily on Alan's window sill, developing into a spectacular individual of *M. australis*, much to the excitement of many people. Given the association with sheep at both locations where it has been recorded in Tasmania and recognising the extensive movement of stock between Tasmania and mainland Australia, the question of whether *M. australis* is native or naturalised in Tasmania will probably remain a mystery until further sites are found. Certainly it can no longer be considered extinct.

Phebalium daviesii *(Rutaceae), 'davies waxflower'*

Generally, most plants that were first described from Tasmanian collections fall into three categories: those that were collected and described by voyaging visitors e.g. Labillardière and Brown; those that were collected by resident collectors and consigned in regular shipments to Kew Herbarium in London e.g. Gunn and Milligan collections; and those that were collected and described by Australian or Tasmanian botanists as in the modern era. *Phebalium daviesii* does not fit any of these categories, but falls somewhere between the last two.

Phebalium daviesii was discovered by Reverend Richard Henry Davies about 1855, near the site of present-day St Helens, probably on the banks of the George River near its mouth. He was a grazier and ran cattle on this land. Davies forwarded his collection to William Archer of 'Cheshunt' and eventually it reached Joseph Hooker at Kew. Hooker described the new shrub and named it after the discoverer (although the translation of Archer's handwritten notes resulted in R.H. becoming R.N. Davies); this was just in time for it to be included in the 'Additions etc' of his *Flora Tasmaniae* (Hooker, 1859).

The next collector to record the existence of this species was Augustus Simson. He made collections in three successive years, 1876, 1877 and 1878, during his regular visits to St Helens as agent for the tin miners of the area. He sent duplicate material to Mueller in Melbourne and his own specimens are now in the Tasmanian Herbarium.

The next collections were made in October 1892 and became part of Leonard Rodway's herbarium. It is not clear who collected this material but it may have been William Fitzgerald, because he made extensive collections from the Georges Bay area at this time. This suite of specimens is the first with a locality more precise than just Georges Bay. They were collected from Constable Creek and this probably represented a new site, about four kilometres southwest of the George River site. Constable Creek was the scene of intensive alluvial tin mining at that time and it is thought that the outwash of silt and gravel, deposited in the lower reaches of the valley, is the reason why this plant was never found there again.

Phebalium daviesii then became extinct, or so we thought. It eluded the eyes of field botanists, despite much searching, for almost a hundred years. Then in December 1990, a sharp-eyed pteridophile, Michael Garrett, rediscovered a small population on the banks of the George River. This was probably the same population that Davies found about 130 years earlier. Another small population has since been located a few kilometres upstream.

Australia celebrated its Centenary of Federation in 2001. As part of the celebrations, each State was asked to nominate a 'federation flower', a plant that would be ready for release as an ornamental – *P. daviesii* was Tasmania's choice. This attractive shrub has been propagated from the small wild population, and residents of St Helens and many other places are proud to display this threatened plant in their gardens (the species is listed as endangered). They will help assure its survival into the future.

Prasophyllum concinnum *(Orchidaceae), 'trim leek-orchid'*

In 1947, famous Tasmanian botanist Winifred Curtis collected the type specimen of *Prasophyllum concinnum* from Blackmans Bay, south of Hobart. However, it was not until 1992 that another collection of the species was made, oddly enough from at or near the type locality, by local orchid experts Hans and Annie Wapstra (Ziegeler, 1994). The area supporting the species, a beautiful patch of remnant heathland and woodland nestled among farmland and the ever-expanding suburbia of Blackmans Bay/Kingston, was under threat from a proposed major housing estate development. But after much work by locals and a committed and cooperative government of the day, the area was dedicated as a reserve in 1997 (Kirkpatrick, 1999). Now known as the Peter Murrell Nature Reserve, the area is host to many more interesting species and remains a hotspot for orchid enthusiasts (many probably trip unwittingly over the cryptic caterpillars of the threatened chaostola skipper butterfly, which also has been rediscovered in the reserve in recent years). Fortunately for *P. concinnum*, it has been found to be much more widespread and common than previously thought and has been removed entirely from the *Threatened Species Protection Act*.

Senecio campylocarpus *(Asteraceae) 'bulging fireweed'*

The genus *Senecio* has recently undergone significant revision (e.g. Thompson, 2004), which has resulted in several 'new' species for Tasmania. Until recently, one of these species, *S. campylocarpus*, was represented by two Tasmanian collections held at the Tasmanian Herbarium (although the species is widespread and common in Victoria). The two collections are from 1888 (near Launceston, collector unknown) and 1943 (by J.H. Wilson from a '*swamp near Cressy*').

Recently (April 2006), I (Mark Wapstra) located several small patches of a relatively short-statured entire-leaved *Senecio* along the grassy/weedy banks and margins of the Elizabeth River in the heart of Campbell Town (Figure 1) which turned out to be the long-lost *S. campylocarpus*. Why did I collect specimens? Well, I wasn't going to at first because I was on a week-long field trip, but the fact that a native-looking *Senecio* was growing in the middle of the gentle rapids made me stop and pick some plants.

Based on the fact that the species has persisted in a council park that is regularly mown, and that similar swampy habitat (e.g. on farms, along rivers and creeks) is still widespread in Tasmania, it is likely that the species is more widespread than indicated by the three records (although a search of several hundred metres of the Macquarie River near the Ross bridge in May 2006 failed to locate the species).

People should also watch out for *S. tasmanicus*, listed as extinct in the Census (Buchanan, 2005) but not yet on the *Threatened Species Protection Act 1995*. It too is likely to have simply been overlooked since 1888, when it was last collected, and probably occupies similar habitat to *S. campylocarpus*.

Figure 1. The Elizabeth River running through Campbell Town. *Senecio campylocarpus* was found growing between the open water and the well maintained lawn, in the boggy reeds/grass and also in the rocky rapids beneath the footbridge over the river.

Tetratheca gunnii *(Tremandraceae), 'shy pinkbells'*

Tetratheca gunnii is a spreading undershrub with attractive pale lilac to purple flowers towards the end of its branches. A single specimen was collected from the Asbestos Range by Ronald Gunn in 1843, and was named by Joseph Hooker after its discoverer. After this fleeting moment of fame, *Tetratheca gunnii* went to ground and remained incognito for the next 142 years. The species (or specimen!) was subsumed into the *Tetratheca pilosa* complex by Rodway (1903) and Curtis (1956), but was resurrected by Thompson (1976), who described distinctive floral features that separated *T. gunnii* from the more vigorous *T. pilosa*.

The 1980s was a period of exponential growth in knowledge about Tasmania's vegetation. Mick Brown of the Tasmanian National Parks and Wildlife Service was one of the most enthusiastic catalysts for flora research and conservation, with a strong focus on Tasmanian endemic species (e.g. Brown *et al.*, 1983). With support from the Forestry Commission and Australian NPandWS, Mick assembled a motley crew (Neil Gibson, Jamie Bayly-Stark, Fred Duncan and himself) to undertake a mission impossible - locate (but not destroy) the secretive *T. gunnii*. The *modus operandi* was to wander aimlessly for a day in the serpentine (ultramafic) country of the Asbestos Range - on the assumption that *T. gunnii*, like some other localised Tasmanian endemics known from this area (*Spyridium obcordatum*, *Epacris virgata*), would be confined to this substrate. On a fine morning in October 1985, after picking up vital supplies at Exeter Bakery, the *Tetratheca* hunters followed local custom by abandoning their vehicle along Tattersalls Road to the northwest of Beaconsfield. They then wandered aimlessly, as per instructions, into some nondescript *E. amygdalina* forest typical of the area.

About two minutes after leaving the road and the bakery products, the indefatigable Dr Brown tried to rally his flagging troops by declaring '*Well, here's* Tetratheca pilosa*!*' when he passed a clump of this robust species. I (Fred Duncan) had been trailing behind the others (a function of sleep deprivation induced by a five-month-old daughter) when I looked down at that instant and saw a solitary *Tetratheca* with more straggly appearance, and smaller in flowers and leaves, than my mental image of *T. pilosa*. So I announced to my sceptical companions '*…and here's* Tetratheca gunnii*!!!*' (complete with the three exclamation marks). We collected a sprig and returned to the car, where the plant matched perfectly Thompson's description of the long-lost *T. gunnii*. We searched several other sites in a remarkably successful day - finding three more small populations (of 1, 2 and 20 plants), the largest on a spoil heap downslope of an old mine shaft. The results of this expedition are described in Brown *et al*. (1986).

Since then, there have been many botanical studies in the serpentinite-based forests in the Beaconsfield area, including coordinated searches for *T. gunnii* by teams of botanists (totalling 40 person days during the flowering period in 1995). About ten populations of *T. gunnii* have come to light, varying in size from 1 to about 30 individuals. The populations tend to be unstable, with numbers often fluctuating over short periods. Some populations we found in 1985 have declined or vanished. Barker (1996a) notes that *T. gunnii* exhibits an unusual form of rarity: sparse in a sparse habitat. There have been detailed investigations into the ecology and management of the species (e.g. Barker, 1996a, b), one impetus being the susceptibility of *T. gunnii* to *Phytophthora cinnamomi*, the root-rot pathogen which has infected at least two of the populations. There have also been studies of the associated threatened endemics *Spyridium obcordatum* and *Epacris* aff. *virgata* (Gibson *et al.,* 1992; Coates, 1991; Keith, 1998).

The good news is that the reservation status of *T. gunnii* (and the other serpentine endemics) has improved tremendously, with most populations now being located in the Dans Hill Forest Reserve. This includes populations that occurred on private land that was acquired through the Private Forest Reserves Program and added to the Dans Hill reserve in 2003. Planning systems have flagged the potential for serpentine substrates to support important flora values, and procedures have been put in place to avoid spreading *Phytophthora* through mining, forestry or recreational activities.

For all that, *Tetratheca gunnii* remains one of Tasmania's most threatened plant species, and is listed as 'endangered' (Schedule 3) on the Tasmanian *Threatened Species Protection Act*. It is also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act*. However, they breed them tough in Beaconsfield, so hopefully it will prove as resilient as some other endangered locals that have had a higher profile in recent months.

Vittadinia australasica *var.* oricola *(Asteraceae), 'coast New-Holland-daisy'*

Vittadinia australasica is an annual or short-lived perennial herb, mostly 10–30 cm high, with inconspicuous mauve-coloured flowers that appear during November and December.

Nancy Burbidge described the species in a paper published posthumously in 1982 (Burbidge, 1982), its presence in Tasmania being based on a single specimen collected in the 19th century (held at the Melbourne Herbarium), with the less than expansive locality annotation of 'V.D.L.'. The taxon is also known from coastal areas of far southwestern Victoria, as well as South Australia and Western Australia. It was not until November 2000 that the species was found growing in Tasmania, to the south of Temma in the State's far northwest. The other species in the genus in Tasmania grow in grassy habitats in the Midlands and Derwent Valley; the Temma site is a further 200 km to the west, making it very much an outlier for the genus.

The discovery of *V. australasica* was two years in the making and, as tends to be the case, was not even in our thoughts back in 1999 when we first ventured into the Arthur-Pieman area. A group from the Nature Conservation Branch – Hans and Annie Wapstra, Karen Johnson and myself (Richard Schahinger) – were led to a grassy coastal dune area by a local Parks ranger, hoping to find the diminutive *Pterostylis rubenachii* (Arthur River greenhood). No such luck, but we did stumble across a spectacular display of *Euphrasia*, prompting an opportunistic revisit the following year (accompanied by Paul Black). And then slowly the significance of the area began to emerge, with confirmation of the species' identity by Neville Walsh of the Melbourne Herbarium, and the realisation that 'V.D.L.' almost certainly stood for Van Diemen's Land Company, a large agricultural firm granted land in northwestern Tasmania.

Several hundred *V. australasica* plants have now been recorded from the Temma site over an area of about 3 ha. Intensive searches of similar habitat between Woolnorth and the Pieman River in the years since have failed to turn up any new plants, highlighting the fortuitous nature of our initial discovery. The site in question has also proven to be home to several other elusive plants, including one that was about to be listed as extinct in Tasmania (*Euphrasia collina* subsp. *tetragona*), and another that had not been recorded previously on the mainland of Tasmania (*Scaevola albida*). The quest to find more populations of *V. australasica* ultimately led to the description of a grassland community unique to the near-coastal strip of northwestern Tasmania, a community that has all but disappeared since European settlement due to the impact of cattle and adverse fire regimes (Schahinger, 2002; Stockton, 1982). The species' hopes of survival in the wild remain tenuous (it is now listed as 'endangered'), with expanding dune blowouts triggered by off-road vehicles threatening to smother at least some plants. The Royal Tasmanian Botanical Gardens has successfully propagated the species from seed, however, providing at least some insurance against its return to 'extinction'.

DISCUSSION

In palaeontology, a 'Lazarus taxon' is one that disappears from one or more periods of the fossil record, only to appear again later. The term refers to the New

Testament story of Lazarus, whom Jesus miraculously raised from the dead. The Wollemi pine *Wollemia nobilis* is an example of a Lazarus taxon that has gained much notoriety in both the botanical and wider world after a relict stand of this fossil species was rediscovered in sandstone terrain northwest of Sydney (Jones *et al*., 1995). The term 'Lazarus taxon' has also found some acceptance in neontology, the study of extant organisms, as contrasted with palaeontology, as an organism that is rediscovered alive after having been widely considered extinct for years.

This article has presented several stories of Tasmanian Lazarus species. Hopefully it highlights that with a little knowledge, and a sense of alertness for the unusual, anyone with more than a passing interest in natural history can get in on the act of rediscovering our 'lost' plant species.

We know that some of our plants and animals are extinct forever (although some people still think the thylacine may be alive, or can be revived by the wonders of modern science). But others, especially the plants, may simply be 'lost to science', surviving on an isolated mountain top or in some uninviting marsh. Others are probably living closer to home (like *Mentha australis* that was found along the shores of the lake supplying Launceston with its drinking water and power).

In recent years, many species, not previously recorded from Tasmania, have been discovered in parts of the State that were settled early by Europeans and have been substantially modified by agriculture or the development of towns and cities. For example in the Midlands, several species fall into this category, including *Pterostylis commutata*, *Austrodanthonia popinensis* and *Leucopogon virgatu*s var. *brevifolius*. Most are species that have very localised extant distributions, but seem to occupy habitat that was probably much more widespread in the past. In fact, some were close to death's door when they were first discovered. Vegetative material of an unknown orchid was dug up from Ross Cemetery by Rod Fensham in 1985, during a survey of Tasmania's native grasslands (Kirkpatrick *et al*., 1988). It was grown on in an old milk container and blossomed into *Pterostylis commutata*, one of the State's most spectacular orchids. *Colobanthus curtisiae* was first found, in the same year, by Rod Fensham and Fred Duncan on native grassland adjacent to a Campbell Town cemetery. In more recent years, the delightfully named *Prasophyllum taphanyx* (graveside leek-orchid) has also been discovered in a Campbell Town cemetery. Hopefully these discoveries of plants in cemeteries are not some sort of bizarre premonition of future survival prospects!

Other recently described species have similarly restricted (albeit less morbid) habitats. For example, *Ozothamnus reflexifolius* has only been recorded from an insolated rock plate on Mount Direction on Hobart's eastern shore (Leeson and Rozefelds, 2003); and *Hibbertia basaltica* only from basalt outcrops in native grassland remnants near the historic town of Pontville (Buchanan and Schahinger, 2005).

At the same time, several species that were collected from environments which are now much modified have not been rediscovered, and are still presumed extinct. *Deyeuxia lawrencei* is known only from the type specimen collected by Robert Lawrence about 1831, possibly in the Launceston area (Curtis and Morris, 1994). *Banksia integrifolia* has not been recorded from King Island (possibly once its Tasmanian stronghold) since 1876, probably because it occupied a small part of the 70% of the island that has been cleared for agriculture; and the lone plant on Long Islet in the Hogan Group died in 1985.

Table 1 lists the plant species currently regarded as Presumed Extinct in Tasmania, with some comments on when they were last seen, what sort of habitats they were known to occur in and where people might want to look. But remember, you need a permit to collect threatened plants – be careful, use a digital camera or take someone back to your site (don't kill the last dodo!).

The recent discoveries of very small populations of some species (newly described endemics and mainland species not previously known from this state) suggest that many of our less common species have localised distributions, (i.e. they are not rare simply because of human-induced habitat loss). This, together with the almost certain extinction of some species which were collected in the past, provides circumstantial evidence that many species have been lost without face or trace, including species from groups (e.g. orchids) that have a high degree of endemism. The potential for extinction to have occurred (and for extinctions to continue to occur) is highest in regions such as the Bass Strait islands, north coast and hinterland and the Midlands, which have all suffered great modification to native vegetation (over 70% for some of these regions, and over 90% for some of their forest communities). However, all of these regions have some environmental affinity to parts of the southeastern Australian mainland, so some of Tasmania's 'unknown departed' may well be extant in Victoria, New South Wales or South Australia.

According to the 2005 census of Tasmania's vascular flora (Buchanan, 2005), Tasmania has about 1840 native taxa, with nearly 400 being Tasmanian endemics. About three species have been added to our native flora each year for the past ten years, partly by the discovery of new species and partly through taxonomic machinations. Tasmania's flora is very diverse for the size of the island and its temperate latitudes. It is sobering to think of how many species have been lost since European settlement, and even more sobering to think that some threatening processes - notably continued clearance of some vegetation types, disease (*Phytophthora cinnamomi*) and gradual attrition and degradation of habitat - will inevitably push more of our species towards the abyss of non-existence.

However, the message is not entirely pessimistic. As we have shown in this paper, some species which were presumed extinct have survived, sometimes against mighty odds and with their situation still tenuous. There is additional hope in the greater awareness in the Tasmanian and Australian community about the importance of our biodiversity, and this is reinforced by legislation to protect threatened species and communities, and an ever-increasing body of knowledge about the distribution, ecology and management of Tasmania's natural attributes, including its threatened flora.

Table 1. Flora *still* presumed extinct in Tasmania. Species formally listed as 'extinct' on the Tasmanian *Threatened Species Protection Act 1995* are marked (*); inclusion of other species is based on information held at the Tasmanian Herbarium (HO).

Name	**When and where last seen and by whom**
*Ballantinia antipoda** (Brassicaceae) - 'southern shepherds purse	Known from a single collection in Tasmania, collected by Mary Ballantine (after whom the genus is named) in 1842 from Macquarie Plains.
Banksia integrifolia var. *integrifolia** (Proteaceae) - 'coast banksia'	Excluding ornamental plantings in suburban gardens, the last official sighting of this species appears to be 1985. There are very few Tasmanian collections: one from King Island collected by the lighthouse keeper (Sprong) in 1876, and a series of records from Long islet in the Hogan Group from the outer Furneaux islands in eastern Bass Strait. These latter collections start with a collection by Scarlet in 1968, followed by collections by John Whinray in 1974 (Whinray, 1974) and Nigel Brothers in 1984 and 1985. Unfortunately, Brothers reported the single specimen to be dead in 1985.

Table 1. contd.

Name	**When and where last seen and by whom**
*Botrychium australe** (Ophioglossaceae) - 'parsley fern'	Garrett (1996) notes that "*a specimen collected by Gunn in 1847 from* 'Marlborough' *is annotated* 'very abundant all over the country about Marlborough'. *An intensive search by the author of the Bronte Park and Nive River locality failed to locate the species. A second Gunn collection is labelled '*Moriartys Plains*', possibly referring to the district about Dunorlan, southwest of Elizabeth Town (Garrett, 1996). Elsewhere in Australia,* Botrychium australe *is known from a wide range of habitats from lowland forest and scrubland to subalpine grassland. It requires adequate moisture and can be found in grassy woodland, well-drained plains, near streams in subalpine regions and in mossy soils (Duncan and Isaac, 1986)*".
*Caladenia cardiochila** (Orchidaceae) - 'heartlip spider-orchid'	Recorded from a single specimen by Biggs in 1947 from Flinders Island and has not definitely been seen since. However, there is a possible sighting (known from a drawing only) from the Akaroa area near St Helens in 1993, although despite several searches, no further specimens have come to light (Hans and Annie Wapstra, pers. comm.).
Cardamine tryssa (Brassicaceae) - 'delicate bittercress'	Known from a single record (no date on specimen but 1800s), collected by Spicer from near Pontville. The species was only described in 2003 (Thompson, 2003), so further collections might be needed before we can declare this species to be presumed extinct in Tasmania.
*Chenopodium erosum** (Chenopodiaceae) - 'papery goosefoot'	On the mainland this species occurs in Victoria, South Australia, Queensland and New South Wales. It is also known from New Zealand. It has been recorded once from Tasmania '*on sandy hills on an island of the Kent Group, Bass Strait*'. Robert Brown made this collection in 1804. No other material has been collected and the holotype is held in the United Kingdom (Schahinger, 2001).
Chionogentias cunninghamii subsp. *cunninghamii* (Gentianaceae) - 'Cunninghams snowgentian'	Known from Tasmania through one collection, possibly by Dr John Lhotsky, probably from around the Hobart or Port Arthur area, sometime around 1836-38 (Adams, 1995).

Table 1. contd.

Name	When and where last seen and by whom
*Coopernookia barbata** (Goodeniaceae) - 'purple native-primrose'	The original record from Tasmania by Paterson has never been confirmed, and may represent a mix-up in labelling because Paterson was in Sydney at about the same time as his collection of this specimen (the species is more widespread on the mainland and there is some doubt as to whether the species was ever present in Tasmania).
*Corunastylis nudiscapa** (Orchidaceae) - 'dense midge-orchid'	The occurrence of this species in Tasmania is based solely on the type specimen ('*hill E. of Mt Wellington*' collected in 1840), which is in good condition and the identity unmistakable. The nearest locality to the Tasmanian one is from the Otway Ranges in southern Victoria, and this species needs to be searched for more thoroughly in southern areas of Tasmania, especially the hills around Mt Wellington (Jones, 1998).
*Deyeuxia lawrencei** (Poaceae) - 'Lawrences bentgrass'	Known only from the type specimen collected (in poor condition) by R.W. Lawrence c. 1831, without location, but possibly in the Launceston area (Curtis and Morris, 1994).
Festuca archeri (Poaceae) - 'Archers fescue'	Known only from the type specimen collected by Archer, locality unknown, which consists of the upper part of a single culm and its inflorescence (Curtis and Morris, 1994).
Goodenia pinnatifida (Goodeniaceae) - 'cutleaf native-primrose'	As was the case for *Coopernookia barbata*, this species was collected by Paterson from the Port Dalrymple area but there are no specimens in Australian herbaria of Tasmanian material; the species is common on the mainland and there is some doubt as to whether the species was ever present in Tasmania.
*Hibbertia rufa** (Dilleniaceae) - 'brown guineaflower'	Only known from a single collection by Fitzgerald from the Georges Bay area, St Helens in 1892.
Hovea magnibractea (Fabaceae) - 'sheath purplepea'	First described in 2001, this species occurs in Victoria and Tasmania but is only known from old specimens with imprecise information. The only locality information available is a collection by Dr Story on the banks of the Swan River at The Grange (Thompson, 2001).

Table 1. contd.

Name	When and where last seen and by whom
Hutchinsia tasmanica (Brassicaceae) - 'highland purse'	There is a single Tasmanian collection from '*hut at Bacons Run*' near Arthurs Lake from 1848. The specimens held at HO are very young and cannot be assigned to genus with certainty, and may even represent specimens of *Capsella bursa-pastoris*, a weed species.
*Lepilaena australis** (Zannichelliaceae)	Known only from a single incomplete specimen collected by Leonard Rodway at Campbell Town in 1893.
*Levenhookia dubia** (Stylidiaceae) - 'hairy stylewort'	The single collection at HO is of dubious provenance collected by Archer, and it is possible that this species never occurred in Tasmania.
*Myriophyllum glomeratum** (Haloragaceae) - 'clustered watermilfoil'	On the mainland this species occurs in Victoria, New South Wales and South Australia. In Tasmania, it has been apparently recorded only once (in the Cressy region in 1842) from damp places and in stagnant water in the north of the State (Hughes and Davis, 1989), although there are not currently any collections at HO.
*Ozothamnus selaginoides** (Asteraceae) - 'Table Mountain everlastingbush'	There is a single record, apparently from Table Mountain west of Bothwell, collected by Stuart in the 1800s. However, despite quite extensive searching of the Table Mountain area, no further specimens have been located, and it is odd that there are no other Stuart collections for the area for the same period, as he usually collected several species from places he visited.
*Podotheca angustifolia** (Asteraceae) - 'sticky longheads'	Represented by a single collection from the northwest coast of dubious status (location, date of collection and collector unknown).
*Prostanthera cuneata** (Lamiaceae) - 'alpine mintbush'	Two collections from Tasmania only, one by Stuart from the South Esk River in 1851 and the other by Simson from the Perth area in 1890. Apparent flood debris in the specimens might be indicative of potential habitat in flood-prone river systems in northern Tasmania.

Table 1. contd.

Name	When and where last seen and by whom
Punctelia subflava (Parmeliaceae) - a lichen	Not recorded in Tasmanian since the collection of the type specimen by an unknown collector from an unspecified location. In mainland Australia, this species can be found in coastal habitats such as mangroves, and it is possible that in Tasmania it once occurred in swampy *Melaleuca*-dominated, coastal forests that have since been extensively cleared (Kantvilas *et al*., 2002).
*Senecio macrocarpus** (Asteraceae) - 'largefruit fireweed'	There are only old records from northern Tasmania, with imprecise collection details. In south-eastern mainland Australia the species occurs in low-lying areas on basalt-derived soils in grassland, sedgeland and woodland (Thompson, 2004).
Senecio psilocarpus (Asteraceae) - 'swamp fireweed'	Known from only two records in Tasmania, from Flinders Island and a swamp near Cressy, the latter record from 1943. The species grows in swamps (Thompson, 2004).
Senecio tasmanicus (Asteraceae) - 'Tasmanian fireweed'	Known from two collections, one by Archer (date and precise locality unknown) and the other by Gunn from '*Formosa*' near Cressy (date also unknown). This species was described by Thompson (2004) and has probably been overlooked, although its apparent habitat of lowland plains near swamps has been extensively cleared.
Taraxacum cygnorum (Asteraceae) - 'coast dandelion'	This coastal species occurs in Western Australia, Victoria and Tasmania. In Tasmania, it has only been recorded from the Bass Strait islands (Prime Seal Island in 1845, 1945 and 1947; Flinders Island in 1947; and King Island in 1887). Despite numerous surveys of the islands (e.g. Harris *et al*., 2001), the species appears to be extinct. In Victoria, the species occurs on coastal limestone, a rock type also present on some of the Bass Strait islands. It should be noted that the taxonomy of *Taraxacum* is under review and this might result in better information on this species.
*Thesium australe** (Santalaceae) - 'southern toadflax'	There is a single Tasmanian spcimen collected by Robert Brown in the Derwent River catchment, but it has not been seen since 1803, despite some quite extensive searching in potentially suitable habitat.

Table 1. contd.

Name	When and where last seen and by whom
*Veronica notabilis** (Scrophulariaceae) - 'forest speedwell'	This species has an uncertain status in Tasmania with one possible collection by Gunn in the 1830s or 1840s from the St Patricks River area.
*Vittadinia megacephala** (Asteraceae) - 'giant New-Holland-daisy'	No specimens are held at HO, and the most recent information suggests that the species is considered to have been recorded in error from the State (Gray and Rozefelds, 2005).
Wurmbea latifolia (Liliaceae) - 'broadleaf early nancy'	Known only from a single collection from '*sea sand near Woolnorth*' by R.C. Gunn between 1836 and 1838.

ACKNOWLEDGEMENTS

Ian Thompson confirmed the identity of *Senecio campylocarpus* for Mark Wapstra. Lorilee Yeates made useful comments on the draft manuscript, as did Hans and Annie Wapstra, who also provided information on orchid species presumed to be extinct. Andrew North kindly provided comments on the tale of *Myosurus australis*.

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What lives under large logs in Tasmanian eucalypt forest?

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Introduction

Almost wherever you walk in Tasmania's forests, you encounter logs. They come in a range of lengths, diameters and stages of decay, and can dominate the ground layer. There must be few amongst us who can honestly say that they have never felt the inclination, even if only in childhood, to explore them, to find out what they're made of and to try and figure out what lives in or under them. Even a cursory look hints at the wealth of nature that makes use of logs - slaters, scorpions, spiders, beetles, fungi, mosses, lichens, skinks, snakes and quolls to name but a few. Many of the logs we encounter are too large to move, which can cause consternation since we suspect these large logs are harbouring the most interesting creatures. If only there were a way we could find out what lives under those logs! If only we could borrow one of those big forestry excavators for a few days and take a peep into that secret world!

As luck would have it, we were given exactly this opportunity early in 2006, as part of a study into the habitat preferences and conservation requirements of the broad-toothed stag-beetle *Lissotes latidens* in Wielangta Forest. This beetle is listed as endangered under the *Tasmanian Threatened Species Protection Act 1995* and under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. Through the work reported in Meggs and Munks (2003) it was already known to live under small logs in wet eucalypt forest (the sort of logs that people can roll over unaided by machinery), but it seemed nobody could say whether it also occurred under larger logs in either wet or dry forest. A project was devised to try and find out. This paper is primarily derived from the internal research report arising from this work (Grove, 2006). That report focused on beetles, particularly on *L. latidens*. In this paper we shift the focus away from this species to cover all the beetle species recorded as well as other 'incidental' species records.

What did we do?

The study was conducted in Wielangta State Forest, south of Orford in the hinterland of Marion Bay. We located six unharvested forestry coupes within the range of *L.latidens* in Wielangta that in combination gave us equality of sampling effort between wet and dry forest types and which had sufficient roading for ease of access and to avoid unnecessary damage by the excavator. Details of these study sites are given in Grove (2006). *Lissotes latidens* is thought to live at the soil-log interface (Meggs and Munks, 2003); hence the survey procedure was tailored to optimally sample this habitat. It involved two methods: live pitfall-trapping around large logs; and rolling of large logs using an excavator. These methods were applied to different areas of the chosen coupes, to avoid any interference of one survey method with the other while keeping the findings comparable at the coupe-scale. In the event, pitfall-trapping was conducted in five of the six coupes used for log-rolling. Live beetles encountered (other than field-identified *L.latidens*) were collected into alcohol, and added to the Tasmanian Forest Insect Collection maintained by Forestry Tasmania.

Fifty-five person-days were spent on fieldwork overall. Survey work was conducted under an amendment to DPIWE Permit no. TFA 05232.

Live pitfall-trapping

Pitfall traps, of a standard design widely used in work of this nature, were installed at a spacing of about 3 m or so along the length of each of the 54 large logs selected for this sampling approach (34 in dry forest and 20 in wet forest), and in close proximity to the log in question (162 traps in total). If the ground immediately adjacent to the log was too stony to dig in a pit, it was dug in a little further away from the log, and a short section of rigid corrugated plastic ('Corflute') inserted between the log margin and the trap (running at right angles to the log), as a barrier to channel any insects towards the trap (Figure 1). Only sections of log apparently in contact with the soil were considered suitable for sampling. A small amount of leaf-litter was placed in each trap to provide cover for any animals caught. Small holes were also made in the base of the plastic cups to prevent drowning in the event of rain. Trapping was conducted over a four-week period in January and early February 2006, and traps were checked every few days. Logs in wet forest were generally longer than those in dry forest, so on average each log in wet forest was able to support more pitfall traps. This explains the difference in the total sampling effort in wet versus dry forest, which amounted to 2242 trap-days in wet forest and1624 in dry forest. At completion of the study period, the traps and flagging tape were removed and the pits refilled with soil.

Log-rolling

A total of 121 logs were selected for sampling, with a combined length of 1114

m. Logs were selected on the basis of minimising habitat disturbance and on excavator accessibility. Many logs were considered unsuitable because they were found to have minimal soil contact due to the stony substrate. After recording key features of the log (see Grove, 2006), the excavator was guided to each marked log whereupon the operator used the machinery to lift or roll the log, putting it down close by before retreating (Figure 2). Where possible, the log was moved in one piece, but logs in a more advanced state of decay generally disintegrated and had to be moved in sections. Often, only a portion of the log ended up being rolled. Thus the actual combined length of logs rolled (896 m) was less than the combined length of logs initially selected for rolling. Of this rolled length, the proportion found to be in contact with soil averaged 32% in wet forest and 24% in dry forest. The newly exposed ground that was beneath the log was searched for beetles and other arthropods, including by raking over the top centimetre or so of soil surface. Adults (but not larvae) encountered, whether live or as dead fragments, were identified on site wherever possible. The excavator was then used to replace the sampled log back as close to its original position as possible.

Figure 1. Pitfall trap design (left) and typical location (right). Photos: Simon Grove.

Figure 2. Four stages in log-rolling using the excavator and subsequent inspection for beetles in Wielangta forest. Photos: Karen Richards.

WHAT DID WE FIND?

Table 1 shows the beetle species found during this study. We have not presented separate data here for each study site. Site-by-site beetle data, derived from both live-caught and dead specimens, are presented in Grove (2006). We have also chosen not to separate dry and wet forest data, since few clear patterns were evident, perhaps because of the low numbers of any one species caught. Even *L.latidens* was found in both forest types - see Grove (2006) for a fuller discussion on this.

Table 1. Beetles recorded live during the study in Wielangta forest, January – February 2006.

Family	Species	Pitfall-trapping	Log-rolling
Lucanidae	*Lissotes cancroides*		1
	Lissotes curvicornis		4
	Lissotes latidens		2
	Lissotes obtusatus	3	16
	Syndesus cornutus		2
Carabidae	*Chylnus ater*	7	1
	Notonomus politulus	2	4
	Percosoma carenoides	11	3
	Promecoderus brunnicornis	12	5
	Rhabdotus reflexus	29	
	Simodontus australis		2
	Trechimorphus diemenensis		2
Scarabaeidae	*Telura vitticollis*		1
	Sericesthis nigrolineata	2	1
Tenebrionidae	*Adelium abbreviatum*	1	4
	Brycopia picta		1
	Coripera deplanata	2	10
	Diemenoma commoda		1
	Diemenoma tasmanica		5
	Isopteron triviale		3
	Homotrysis luctuosa		3
Ulodidae	*Ganyme sapphira*		1
Prostomidae	*Prostomis atkinsoni*		26
Curculionidae	*Decilaus striatus*		1
	Dryophthorus ECZ sp 02		4
	Merimnetes simplicipennis		2
	Poropterus TFIC sp 04		1

Pitfall-trapping produced 69 live beetles, comprising nine species. Log-rolling produced a total of 106 live beetles, comprising 26 species. Together these included a respectable five species of stag-beetles (lucanids) and seven species of ground-beetles (carabids). A sixth stag-beetle species, *Ceratognathus niger*, was also found under a log, but only as fragments of a long-dead specimen. Fragments of three dead *L. latidens* were also found in similar condition.

Few non-beetle species were found in pitfall traps, but bull ants *Myrmecia esuriens* were often present in dry forest traps, as were scorpions *Cercophonius squama*. Log-rolling also produced relatively few other species, but amongst the invertebrates the snails *Caryodes dufresnii* and *Helicarion cuvieri*, and millipedes of the genera *Lissodesmus* and *Tasmanodesmus*, were frequently noted. Ants were plentiful and occupied both the logs and the soil beneath. Most abundant were *Iridomyrmex* spp, while *Amblypone australis* was also common. Bull ants *Myrmecia forficata* and *M. esuriens* were often encountered, as were jackjumpers *M. pilosula*.

No vertebrate species were noted during pitfall-trapping. During log-rolling, metallic skink *Niveoscincus metallicus* and tree skink *N. pretiosus* were often encountered under logs, while only a single specimen of Whites skink *Egernia whitei* was found. Two frog species were recorded under logs in very low numbers: brown tree frog *Littoria ewingii* and common brown froglet *Crinia signifera*.

Of most interest were the accumulations of scats of echidna *Tachyglossus aculeatus* which were found under several rolled logs at several of the study sites. The scats appeared to have accumulated over a long period, as some occurred on the ground surface, while others were completely buried beneath soil and debris. All accumulations were beneath logs and were confined to discrete areas of less than 0.5 m^2 rather than being randomly deposited over the total available area. The amount of material varied between sites; however just four of the sites together yielded 2.5 kg of scats, which have been collected for later dietary analysis by one of us (CS).

ARE LARGE LOGS REALLY AS INTERESTING AS THEY LOOK?

The combined beetle catch from log-rolling and pitfall-trapping was rather meagre - 175 live individuals from 27 species in total. We had expected to find many more individuals and species living under large logs than proved to be the case. Pitfall-trapping produced fewer species than log-rolling, and all but two of these - the stag-beetle *Lissotes cancroides* and the ground-beetle *Rhabdotus reflexus* - were also found by log-rolling. It is possible to argue that pitfall-trapping adjacent to large logs did not adequately sample the under-log habitat, but this argument does not explain the low numbers found through excavator log-rolling. To only find 105 individual beetles from a total log length of 1114 m of log length, 896 m of which was rolled (i.e. one beetle per 8.5 m of log rolled), implies that living under large logs is not a particularly 'desirable' thing for beetles to do. Of course this study has its own biases - for instance, nearly all the beetle species recorded are relatively large (body length over 1 cm), and individuals of small species may have been missed during hand-searching. This study doesn't allow us to directly compare the occupancy rate with that of smaller logs, but our own experience suggests that the occupancy rate under smaller logs would be higher than this. Nevertheless, most of the species that we encountered do have a genuine association with logs. Besides the ground-beetles and one of the weevils (*Merimnetes simplicipennis*), we consider all the beetle species encountered to be saproxylic (i.e. associated with dead wood - in this case because they probably feed on it). The ground-beetles are all predators and most may have no particular association with logs, although all would benefit from the shelter that logs provide and one, *Chylnus ater*, is thought to be primarily a log-dweller.

Interestingly, in both wet and dry forest the percentage of rolled log length found to be in contact with soil was much lower than that estimated from external examination of the whole logs prior to the excavator arriving. In other words, most sections of most logs were found to be perched on rocks or stones rather than resting on the soil. This is clearly evident in the case of the log shown in Figure 2, and may partly explain the cause of our disappointment. Another possible explanation would be that large logs are simply so heavy that, where they are in contact with the soil, there tends to be little airspace left and the soil is heavily compressed. With the benefit of hindsight, we perhaps should not have expected the ground beneath large logs to host large numbers of beetles since neither the 'perched' condition nor the 'compressed' condition would appear to be particularly good beetle habitat.

None of this implies that large logs don't have other important beetle values. Our study did not look inside large logs, only beneath them. Had we spent our energies (and those of the excavator) breaking open logs we might have had more success. Compare our 27 beetle species to the several hundreds recorded from only 18 large eucalypt logs in a long-term study at Warra (Grove and Bashford, 2003 and subsequent unpublished data) and it is clear that some large log habitat is extremely rich in beetle species.

Though this study was focused on beetles, it does shed some light on the extent to which other animals make use of large logs. Large logs are clearly used by the local reptiles and amphibians, but whether they depend on them is not clear. A more significant finding from this study was the regularity with which we encountered accumulations of echidna scats, which suggests that large logs have a role in providing sheltering or latrine areas for local echidnas, and may enable them to more clearly define their home ranges. Interestingly, CS noted another instance of apparent 'latrine' behaviour at Old Hastings Road in the south of Tasmania in August 2006 while searching for stag-beetles. Several echidna scats were found inside a hollow log. The log had an internal cavity of 35 cm diameter, and was 1.5 m in length and closed at one end. This 'latrine' behaviour is well known in other mammal species and is accepted as being a means of communication between individuals. Platypus *Ornithorhynchus anatinus*, the only close relative of the echidna, has also been found to deposit scats in selected sites in its home range (CS unpublished data).

Acknowledgements

Besides the authors of this report, field sampling and technical assistance also involved Mick Miller, Frank Bishop, Nick Hall, Aaron Jacobson, Tim Wardlaw and Dick Bashford (all from Forestry Tasmania), and their contribution to this study is gratefully acknowledged. Excavator and operator hire was obtained from a local contractor operating out of Triabunna. We also thank Sue Baker for her helpful comments on an earlier draft of this paper.

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A note from the retiring Editor

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This is the last volume of *The Tasmanian Naturalist* to appear before I hand over Editor's duties to the highly capable Mark Wapstra. I hope that the last few volumes have proven of interest to our readership, and trust that Mark will be assured a steady stream of manuscripts for future volumes. The Tasmanian Field Naturalists Club would welcome feedback on the general content of *The Tasmanian Naturalist* so that we can endeavour to continue to provide the readership with a broad coverage of Tasmanian natural history topics of lasting value. And please keep the manuscripts rolling in - the 'natural history' of field naturalists clubs is testimony to the fact that you don't need to be a research scientist to have interesting things to say about Tasmania's fascinating natural history.

I would like to take this opportunity to extend my thanks to David Ratkowsky for his voluntary proof-reading of pre-publication versions of this and some previous volumes of *The Tasmanian Naturalist* which I have edited. While i's get dotted and t's get crossed automatically these days, no desktop publishing package yet has the wit to check that in-text citations and reference lists match up; that figures and tables are numbered in the order in which they are quoted; that font sizes are consistent; and that brackets are paired (to name but a few of the many potential editorial 'spoilers' that David has diligently brought to my attention).

ADVICE TO CONTRIBUTORS

The Tasmanian Naturalist publishes papers and articles on all aspects of natural history and the conservation, management and sustainable use of natural resources, with a focus on Tasmania and Tasmanian naturalists. They need not be written in a formal scientific format unless appropriate for the content. A wide range of types of articles is accepted, including poems and stand-alone illustrations. The journal will publish papers and articles that: summarise or review relevant scientific studies, in language that can be appreciated by field naturalists; stimulate interest in, or facilitate in identifying, studying or recording particular taxa or habitats; record interesting observations of behaviour, phenology, natural variation or biogeography; stimulate thinking and discussion on points of interest or contention to naturalists; put the study of natural history today into context through comparisons with past writings, archives, etc.; or review recent publications that are relevant to the study of Tasmanian natural history.

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Manuscripts should be sent to the editor (from 2007: Mark Wapstra), preferably electronically (email: mark@ecotas.com.au) as Word documents. Alternatively they can be mailed to Mark at 28 Suncrest Avenue, Lenah Valley, Tasmania 7008. Graphs, illustrations or maps should also be provided electronically by preference, generally in TIFF or EMF format (i.e. not embedded in the Word document).

Articles should follow the style of similar ones in recent issues of *The Tasmanian Naturalist*. References cited in the text should be listed at the end of the paper in the following format:

Ratkowsky, A.V. and Ratkowsky, D.A., 1976. The birds of the Mt. Wellington Range, Tasmania. *Emu* **77:** 19-22.

Watts, D., 1993. *Tasmanian Mammals. A Field Guide.* Peregrine Press, Kettering.

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Bryant, S.L., 1991. *The Ground Parrot* Pezoporus wallicus *in Tasmania: Distribution, Density and Conservation Status.* Scientific Report 1/91. Department of Parks, Wildlife and Heritage, Hobart.

Formal papers are normally sent to at least one independent referee for comment. This is undertaken to try to ensure accuracy of information and to improve the quality of presentation. Additionally, the editor is willing to assist any prospective authors who have little experience in this style of writing.

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Founded 1904

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