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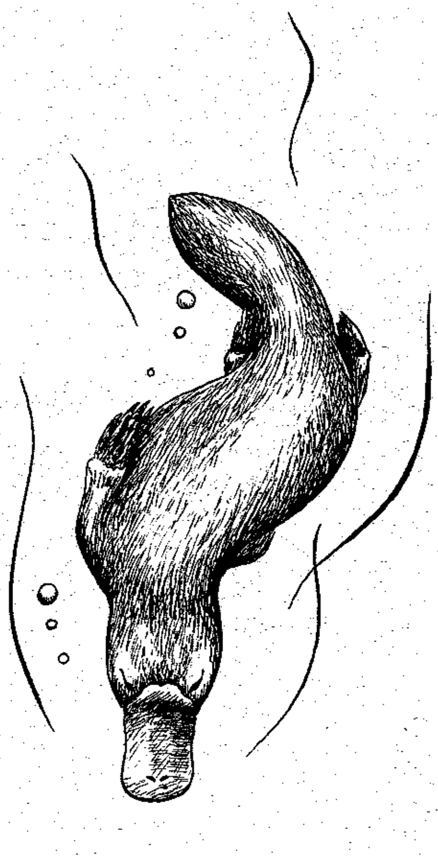

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THE TASMANIAN NATURALIST

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CONTENTS

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A bright light on the dark forest floor: observations on fairy lanterns *Thismia rodwayi* F.Muell. (Burmanniaceae) in Tasmanian forests

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Introduction

Thismia rodwayi is one of Tasmania's most cryptic flowering plants. It is our only virtually subterranean species (Curtis and Morris, 1994) and until 2002 had seldom been recorded since European settlement.

The common name ascribed to *T. rodwayi* is 'fairy lanterns'. This name aptly describes the appearance of the small orange and red fleshy flowers that barely emerge from the soil surface and are typically covered by leaf-litter. These brightly coloured flowers are about 10-22 mm in length and have an obovate longitudinally striped floral tube (the 'lantern'), surmounted by six perianth lobes - the inner three arching inward and cohering at the top, and the outer lobes spreading (Figure 1, Figure 2). The vegetative part of the plant is white and entirely subterranean. The roots are about 1-1.5 mm thick and spread 4-15 cm. They give rise to erect flower stems (0.5-3 cm), which bear about six colourless bracts (these are the 'leaves'), which increase in size toward the terminal flower. The plant lacks chlorophyll and is therefore incapable of photosynthesis. It is considered a saprophyte, although this term is slightly misleading as it derives its energy from a fungus, the fungus being the true saprophyte.

T. rodwayi was first recorded in Tasmania (near Hobart) in 1890 and at that time caused quite a stir amongst botanists around the world (von Mueller, 1890a,b) because it was one of the first species in the family to be found in temperate climates (most species are tropical and subtropical). Since that first collection, the species had until recently only been found on five other occasions: from the Mt Field area, the Little Denison River area, somewhere in the northeast and a further site on the lower slopes of Mt Wellington.

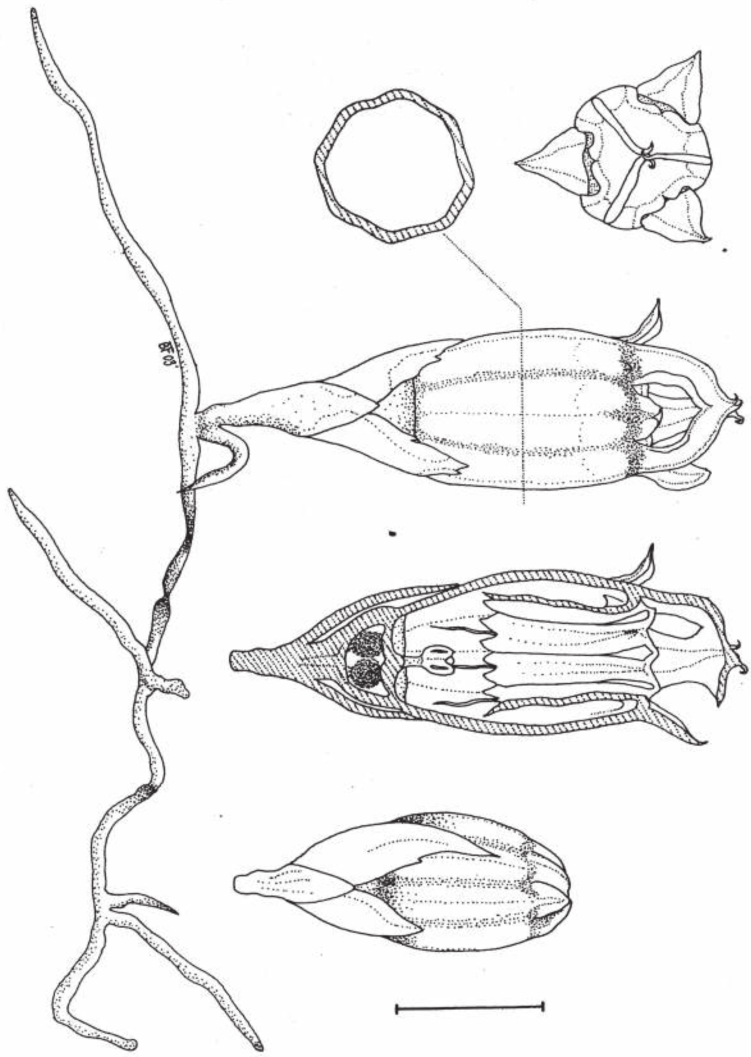

Figure 1. Line drawing of *Thismia rodwayi* drawn from dissected fresh specimens. Drawing by Brian French. Scale bar indicates 1 cm.

Figure 2. *Thismia rodwayi* in situ, showing growth habit (note: leaf litter has been removed). Photo: H & A Wapstra

But in 2002, the profile of this diminutive species changed: it was discovered on the lower slopes of Mount Wellington by Sapphire McMullen-Fisher (as part of fungus surveys) and in the same year in the Meander area by Sandy Tiffen and Nick Fitzgerald (in a proposed forestry coupe). These discoveries, combined with the conservation status of the species (listed as rare on the Tasmanian *Threatened Species Protection Act, 1995*) and the imminent forestry activities near the new site at Archers Sugarloaf, prompted research and further surveys by the Forest Practices Authority (then Board), the results of which were presented in Roberts *et al.* (2003a,b) and Wapstra *et al.* (2004).

This work indicated that the species occurs in wet and damp sclerophyll forest in seven disjunct areas of Tasmania (1. Ben Lomond region: 1 site, exact location unknown, 1980s; 2. Mt Wellington area: 3 sites, 1890, 1980s, 2002; 3. Mt Field area: 1 site, 1923; 4. Little Denison River area: 1 site, 1968; 5. Meander area: 18 sites from 5 locations separated by c. 5 km, 2002-2004; 6. Cluan Tier: 1 site, 2004; 7. Black Sugarloaf: 1 site, 2004).

The specific aims of this paper are to present:

1. Information on new sites for *Thismia rodwayi* in northern Tasmania, including the results of annual monitoring of populations of the species since 2002.
2. A systematic surveying and sampling method.
3. Information on the biology and morphology of the species.
4. Results of a preliminary analysis of the volatile chemical compounds associated with flowers of the species (during the course of sampling, a distinct pungent odour was noticed from flowers wrapped in moist paper stored in plastic containers for storage prior to curation, indicating a potential connection to pollination and/or dispersal vectors).
5. Results of bioclimatic modelling based on known sites for the species in Tasmania.

The broader objective of this paper is to improve the profile of *Thismia rodwayi* in the scientific and naturalist community with the intention of heightening interest in the species, hopefully leading to the discovery of further sites. The paper concludes with some suggested research priorities for the species with the intention of attracting post-graduate student interest.

Methods

Survey sites

Many of the known sites recorded in December 2002 and reported in Roberts *et al.* (2003b) were resurveyed in 2003 and 2004, using the sampling method described above. Most previously recorded flowers have been pegged using a metal stake with a label indicating the date of the survey, how many flowers were present, the stage of anthesis (e.g. bud, mature flower, decaying flower) and whether specimens were taken (usually only taken if flowers broke off during sampling). The pegged site was used as the centre point for the plot.

Additional surveys were conducted in the vicinity of previously recorded sites in apparently suitable habitat (i.e. wet sclerophyll forest dominated by *Eucalyptus obliqua*, *E. delegatensis*, *E. viminalis*, *E. globulus* or *E. regnans* with an understorey with one or more of *Bedfordia salicina*, *Pomaderris apetala* and *Olearia argophylla*). Three new sites have been reported (all in 2004) from the Black Sugarloaf area (S. Lloyd, pers. comm.), the Meander area near Sales Rivulet (M. Wapstra and A. Chuter, pers. obs.) and the Cluan Tiers (R. Barnes, pers. comm.).

Sampling method

Since 2002, a standard survey method has been used for both long-term monitoring of known sites and surveying of potential habitat. At each site, several 1 m^2 quadrats (a metre ruler or other metre measure is used to define the search area) are searched by hand. Coarse debris such as logs and rocks are first carefully lifted from the leaf litter. The top layer of leaf litter is then manually shifted to expose the lower leaf litter / soil surface interface. At this point, careful manual shifting of the remaining leaf litter and loosening of the top few centimetres of soil is undertaken. When at full anthesis, flowers of *T. rodwayi* are obvious because of their colour but do break easily from the underground stem, so care is needed (gloves or digging implements have been found to be too coarse in most cases). Buds and decaying flowers are less obvious but, with experience, are rarely missed. If specimens are found, leaf litter is carefully replaced over the sample site to prevent desiccation. Approximately 5 minutes is needed to search each quadrat and usually about 30 minutes is spent at each site (depending on the number of observers). This method allows a crude comparison of relative density among sites to be made. If specimens are located, it is often prudent to search carefully the immediately surrounding leaf litter because flowers are often clustered within less than 2 metres of each other. Following a "line" such as a decayed log can also prove fruitful.

Description

Specimens were dissected under a binocular microscope to produce transverse and longitudinal sections of the flower. Digital images of each part of the plant including roots, corolla and reproductive organs were taken. A line drawing representing the plant was produced.

An approximate 10 x 10 x 10 cm cube of soil, associated with two flowers growing close to each other that had almost perished, was excavated to determine the extent of the vermiform root system associated with each flower.

Chemical analysis of plant

Two mature flowers (that broke off during survey) were collected from the Meander area from a site supporting c. 25 flowers in a c. 3 x 3 m area. These were placed in separate 5 ml headspace glass vials, capped and stored on ice for transport to the laboratory. Flower volatiles were analysed by combined Gas Chromatography – Mass Spectrometry (GC-MS) on a Varian CP-3800 GC coupled to a Varian 1200 GC. In one protocol 0.5 mL of headspace air was injected in split mode onto a 30 m Varian VF–5 MS capillary column running an oven temperature program from 15°C to 170°C at 10 degrees per minute. In the second protocol a Solid Phase Micro Extraction (SPME) needle was used to collect flower volatiles for 10 minutes, before desorbing these in the GC-MS injection port.

Potential distribution

Based on the distribution of *T. rodwayi* records and its apparent preference for certain forest types, it is possible to estimate the extent of potential habitat in Tasmania. Using recognised vegetation mapping units known or likely to support the species, the area potentially occupied by the species was calculated. The mapping units used for this analysis were the RFA (Regional Forest Agreement) vegetation units: tall *E. obliqua* forest (OT), tall *E. delegatensis* forest (DT), *E. viminalis* wet forest (VW), *E. regnans* forest (R) and the damp sclerophyll complex DSC. In using these vegetation types, it should be noted that *T. rodwayi* tends to occur in the wet sclerophyll phase of the communities rather than the mixed forest (in the case of the first four communities) or the dry sclerophyll phase of the damp sclerophyll forest. However, more detailed mapping is not available and it is argued that the values used are indicative of the proportion of potential habitat in reserves.

CORTEX was used to map the potential range of *T. rodwayi*. This modelling tool is described in Peters and Thackway (1998). It is derived from BIOCLIM, a climate-based modelling approach inspired by Henry Nix of the Australian National University (Nix, 1986), and GARP, a rule-based genetic algorithm devised by David Stockwell (Stockwell and Peters, 1999).

The models are based on the concept of species-environmental envelopes (which are implemented as preconditions of rules). The model works at discovering the envelope that “contains” most (or all) of the observations in the smallest possible area. Environments are expressed as conjunctions of environmental variable ranges or categories (e.g. dolerite with slopes between 7% and 18% elevations between 100 and 900 m).

RESULTS AND DISCUSSION

Plant description (growth habit)

Figure 1 presents a detailed line drawing of dissected specimens of *T. rodwayi* and Figure 2 shows the growth habit of the species. In both graphics, the vermiform root system is clearly discernable. Approximately 75 cm of roots were extracted from a 10 x 10 x 10 cm clod of soil that supported two flowers of *T. rodwayi* (about 5 cm apart at the soil surface). There was no evidence that the flowers arose from the same root system. However, the 75 cm of root excavated was made up of numerous small sections (most c. 5 cm long) with tapered ends: whether this observation indicates the species is perennial arising from the same root stock each season or whether it simply indicates that the fragile roots are broken by soil perturbations (e.g. by worms) is not known.

Flowering habit and abundance

In Tasmania, mature (i.e. fully-formed) flowers of *T. rodwayi* have been recorded from as early as 12 October to as late as 19 December, indicating a flowering period of at least 3 months. Often, flowers are present in various stages of anthesis from early buds (appearing just above the soil surface) to fully mature flowers and often even "drying" flowers in a state of decay.

Long-term monitoring of known sites indicates that flowers are consistently present at most sites, although the abundance of flowers varies from year to year. This latter observation is more likely the result of incomplete sampling of all leaf litter at a site (which is near impossible) and the sampling of slightly different areas in each year. For example, at a site in the Meander area that supported 3 flowers in 2002 (from 12 m^2) and no flowers in 2003 (from 20 m^2), 25 flowers were observed in 2004 (from 5 m^2). In 2004, the original plot locations of 2002 were resampled (with flowers at one of three plots only) but additional searching only about 50 m downslope revealed a small densely clustered patch in an area of about 3 x 2 metres.

Chemical analysis

Using the first protocol (headspace air injected directly onto the column) two dominant volatiles were detected: 1-heptene and a-heptadiene (Figure 3). Protocol two (SPME) detected additional volatiles: 3-octanone, 3-octanol, myrtenal and myrtanol. Other volatiles were also detected by these two methods; however, they remain unidentified. It is unknown at this stage whether the identified volatiles contribute to the pungent odour of the flowers.

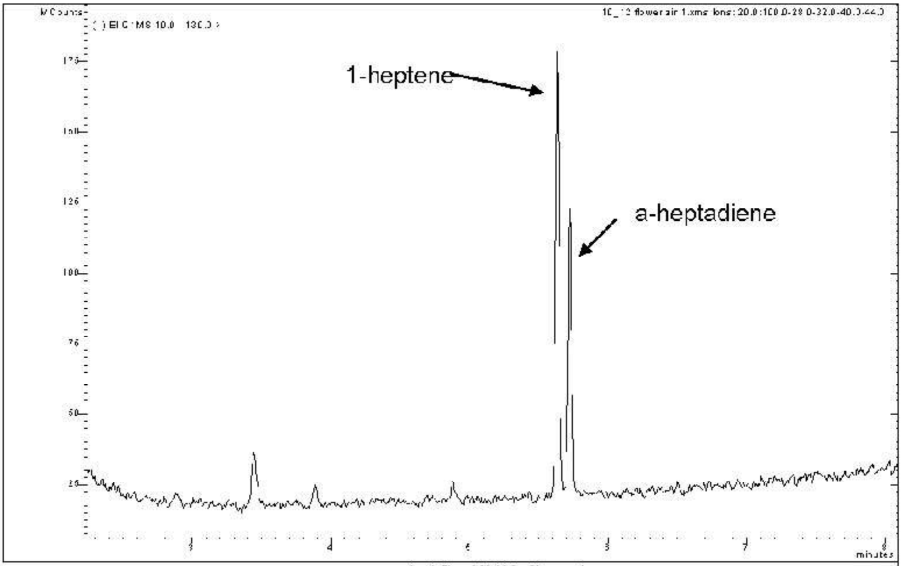

Figure 3. Chromatogram of GCMS analysis of flower volatiles. For the purposes of this paper, the small text can be ignored; the main point to note is the presence of two peaks in detection corresponding to the labelled volatiles 1-heptene and a-heptadiene.

Distribution

Thismia rodwayi is known from about 26 sites from 7 disparate locations around Tasmania. This widespread distribution appears to be reflective of the distribution of potentially suitable forest types (Figure 4) and probably indicates that with additional intensive survey the species might be discovered in other locations. Lending support to this postulation is that since the work of Roberts *et al.* (2003b), two additional sites have been located several kilometres from the previously recorded locations. The recent record from Cluan Tiers extended the range in the central north of Tasmania by 12 km to the northeast of the previously recorded sites in the Meander area.

The record from the Black Sugarloaf area north of Westbury extended the range by 34 km to the north-northeast of the Meander sites. Interestingly, both these sites, while in extensive areas of native forest, are separated from the previous sites by relatively large areas of cleared land. Having said that, several searches in apparently suitable habitat close to known sites proved fruitless (e.g. the species was not recorded from 80 1 m^2 plots over about 10 ha in the Jackeys Creek area about 1 km from several "reliable" sites). The environmental envelope suggested by the CORTEX model for *T. rodwayi* is defined by topography, rainfall and geology (Figure 5).

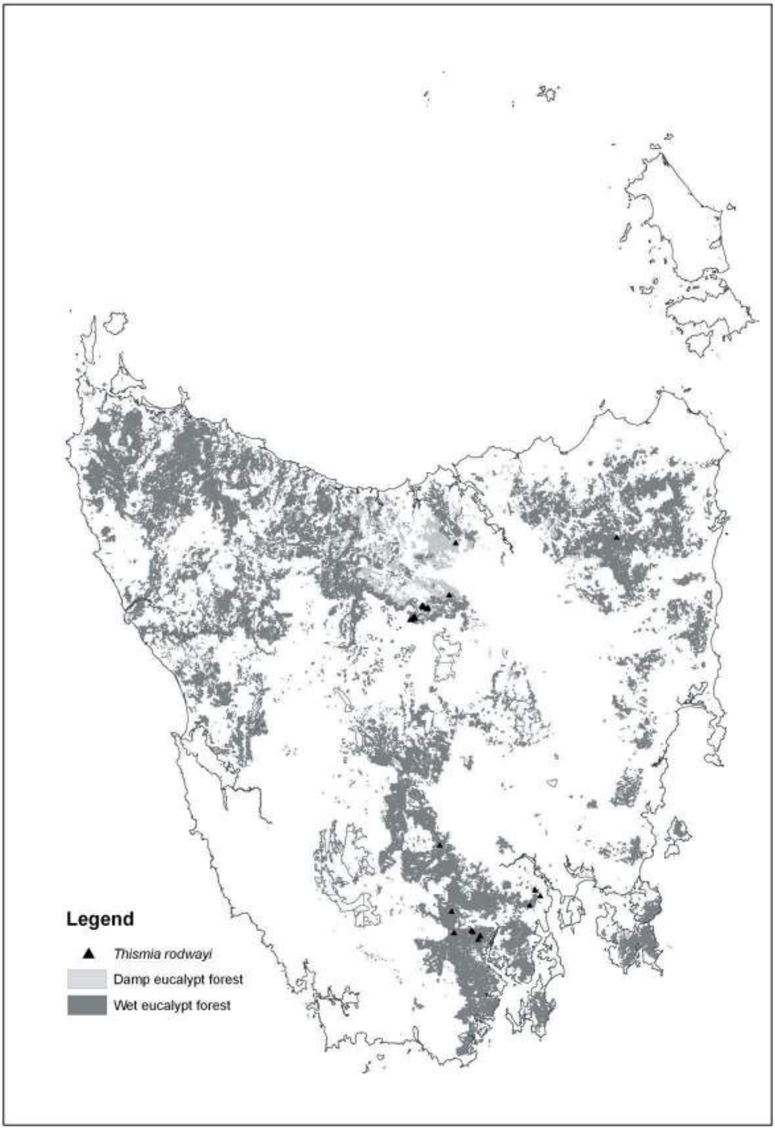

Figure 4. Map of Tasmania showing *Thismia rodwayi* records (black triangles) in relation to the distribution of wet and damp eucalypt forest (grey shading). Base data supplied by DPIWE; vegetation mapping based on TASVEG.

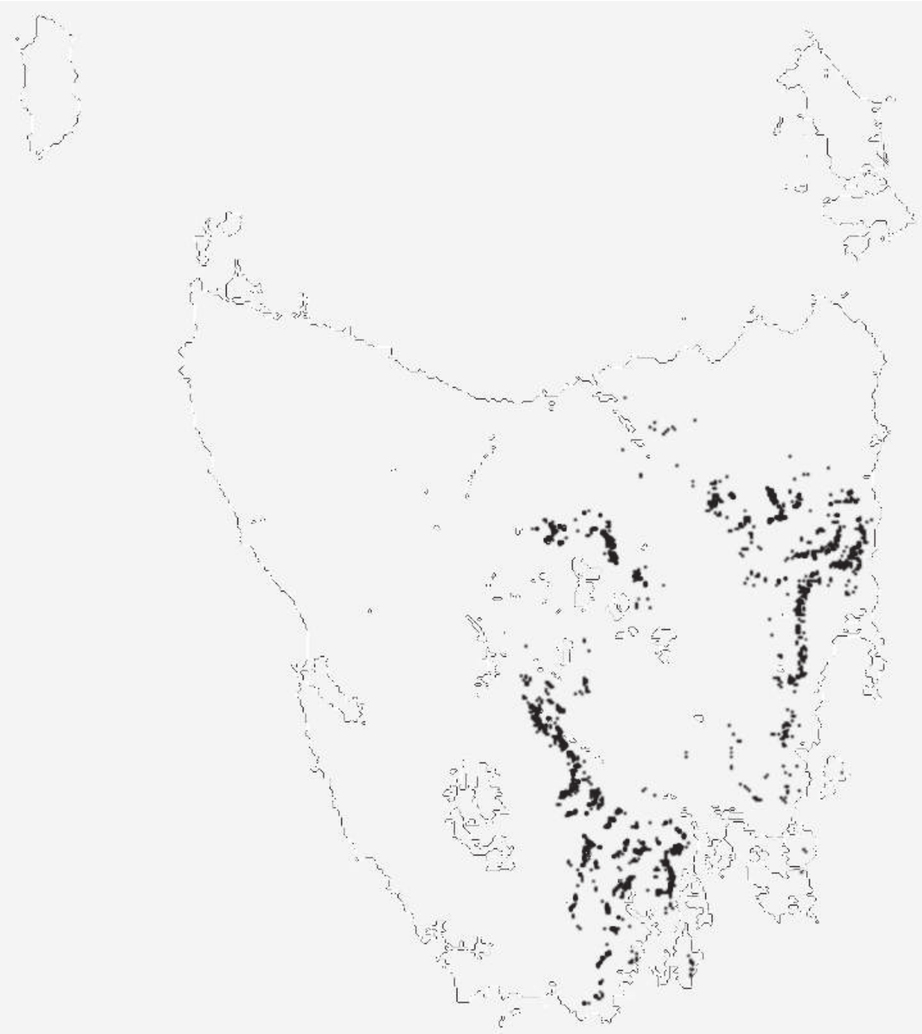

Figure 5. CORTEX model of predicted range of *Thismia rodwayi* in Tasmania.

Slopes are moderate to steep, curvature both down slope and across slope is concave and relief is moderate to high. Rainfall is low to moderate (approx. 320-820 mm/annum) and there is a marked preference for soils derived from Parmeneer sediments especially glacio-marine sediments. Note that these values refer in this case to those that characterise the 1000 m grid square.

The CORTEX model indicates that *T. rodwayi* may occur around much of the northern base of the Western Tiers, the Wellington Range extending west through to the Florentine Valley, parts of the Southern Forests and the wetter parts of the east coast including the Wielangta area and the hinterlands behind the Swansea-St Helens area. The fact that *T. rodwayi* has not been recorded from some of these areas probably indicates a lack of intensive survey (although some relatively intensive leaf-litter invertebrate surveys have been conducted in many parts of this predicted range).

A comparison of the broad vegetation map and the CORTEX model map indicates some overlap of areas potentially suitable for *T. rodwayi*. Of note, however, is that the CORTEX model does not predict extensive areas of potential habitat in the northeast, on the Tasman and Forestier Peninsulas, Maria Island, southern Bruny Island or the northwest wet eucalypt forests. These areas support very similar forest types at similar altitudes and on similar substrates to the known sites and so should not be discounted from further surveys. The CORTEX model excluded a record from northeast Tasmania because of a very low degree of precision: that a specimen has been found somewhere in the northeast is almost certain because it is apparently from this specimen that the line drawing in Curtis and Morris (1994) is based (A. Buchanan, pers. comm.), confirming the predictions of the model for this part of the State.

This bioclimatic model map may be useful for focussing further targeted searches for *T. rodwayi* in Tasmania, particularly when combined with the broad vegetation map. One note of caution is that although several of the records of *T. rodwayi* are in forests mapped as damp sclerophyll forest, all of these sites actually occur in the wet sclerophyll facies of this broad community: the site in Cluan Tiers is actually *Eucalyptus ovata* wet sclerophyll forest and the sites at Black Sugarloaf and Archers Sugarloaf are *E. obliqua* wet sclerophyll forest. Evidence from the Archers Sugarloaf area suggests that *T. rodwayi* is not present in the drier facies of damp sclerophyll forest (Roberts *et al.* 2003b).

Table 1 shows the extent and level of reservation at a Statewide level of five forest types associated with *T. rodwayi*. It is clear that while these vegetation types are targeted for clearing (for conversion to plantation) and other intensive forest management practices (such as clearfelling followed by high intensity regeneration burns), extensive areas of both the regrowth and oldgrowth phases of the communities are protected in formal reserves throughout the State. To date, *T. rodwayi* has been located in several formal reserves throughout its range and other known sites in wood production forests are being managed by prescription during harvesting operations (generally exclusion of the known site with a buffer of undisturbed native forest).

Table 1. Current Statewide extent and reservation levels of the five main forest types with which *Thismia rodwayi* is associated[1.] Bracketed values indicate extent and reservation levels of oldgrowth component of the community; data on new reserves to be created under the Supplementary Regional Forest Agreement of 13 May 2005 have not been included.

Community[2]	Current Extent (ha)	Reservation (ha)	% Reservation
E. viminalis wet forest[3]	6983	1326	19%
	(300)	(157)	(52%)
E. regnans forest	76587	18212	24%
	(12614)	(5960)	(47%)
Tall *E. obliqua* forest	450856	118018	26%
	(89791)	(51080)	(57%)
Tall *E. delegatensis* forest	294399	115335	39%
	(108389)	(67821)	(63%)
Damp sclerophyll complex[4]	43963	11264	26%
	(2198)	(1549)	(70%)

[1]Values are derived from TASVEG mapping and taken from those used by CARSAG (the scientific advisory group to the Private Forest Reserves Program, Department of Primary Industries, Water and Environment, used with permission.
[2]Community names as used in the Regional Forest Agreement
[3]Community is protected from further clearing on public and private land by State/ Commonwealth policy
[4]Oldgrowth areas of this community protected on public land under the Regional Forest Agreement

Postulations on pollination and seed dispersal

How *T. rodwayi* is pollinated is a mystery. Some members of the family Burmanniaceae are self-pollinating, which is facilitated by the close proximity of anthers and stigma (Maas-van de Kamer 1998). However, some observers have postulated that several species of *Thismia* may be pollinated by small flies (Diptera) attracted by scent and falling into the urceolate flowers (Stone 1980; Vogel 1962 cited in Maas-van de Kamer 1998). Vogel 1978 (cited in Maas-van de Kamer 1998) suggested that *Thismia fungiformis* may be pollinated by fungus gnats tricked into laying eggs in the fungus-mimicking flower. Fungus gnats are responsible for pollination is some Orchidaceae (e.g. the greenhoods, *Pterostylis* species), which has a superficially similar trap-like structure to the perianth. Comparison to other subterranean or near-subterranean flowering plants such as *Rhizanthella* (in the Orchidaceae) may provide some answers: ants are implicated in the pollination of this genus that has a superficially similar growth habit to species of *Thismia*.

What do our own observations suggest? Two observations made over the last 4 years of research on the species may provide a clue. The first is that specimens of *T. rodwayi* stored in moist conditions in a closed container (to prevent drying out during transport) begin to give off a detectable odour after only a few hours. This odour (to some people) is of rotten fish, which immediately brings to mind the fly-attracting tropical species of flowering plants such as the giant *Rafflesia* of southeast Asia. Blume (1849, cited in Coleman, 1936) also reported a smell of decaying fish about the root of *Sarcosiphon* (now *Thismia*) *clandestinus*. In species of *Rafflesia*, both olfactory and visual clues are important in attracting flies to flowers: pollination is by deception with the pollinators receiving no reward but an apparent offering of food and a possible brood place (Beaman *et al.* 1988) – a similar syndrome might occur in species of *Thismia*. Stone (1980) postulated that myophily (pollination by flys) occurred in species of *Thismia* because of the mitriform (cap-like) perianth apex of *T. clavigera*, although he noted no noticeable odour associated with this species. The second observation is that mature flowers of *T. rodwayi* are often "holed" in the wall of the flower and the flower itself often contains small particles of soil or faecal matter, presumably from small insects (M. Wapstra and B. French pers. obs.; A. Buchanan and Sarah Lloyd pers. obs.). Rübsamen (cited in Maas-van de Kamer 1998) twice found an egg or larva inside the nectaries of a *Gymnosiphon* flower (similar to *Thismia* in flower structure and growth habit).

The results of our preliminary chemical analysis did not indicate volatile chemical compounds usually associated with a fishy odour. Interestingly, the compounds 3-octanone, 3-octanol, 1-heptene, mrytenal and myrtanol were detected and these have been implicated in various behavioural responses in ants (Cammaerts and Mori, 1987), termites (Reinhard *et al.*, 2003), nematodes (Matsumori *et al.*, 1989), beetles (Pierce *et al.*, 1991), wasps (Rains *et al.* 2004), springtails (Bengtsson *et al.*, 1991) and flies (Birkett *et al.*, 2004). Clearly a more detailed chemical analysis of the volatile component of flowers of *T. rodwayi* would be needed to further elucidate the role of different chemicals in the life cycle of the plant.

We have not personally observed the seeds of *T. rodwayi*; however, the seeds of other species of *Thismia* are numerous, minute and well-adapted for dispersal by air or water (Maas-van de Kamer 1998). Wind dispersal of seeds of *T. rodwayi* seems unlikely because the flowers usually mature at the interface of the soil and dense layer of leaf litter, where air movement would be slight. A possible dispersal mechanism may be water, either flow over ground and through the layer of leaf litter and upper soil surface, or by rain splash out of the fruit cup. This latter mechanism was postulated by Stone (1980) for *T. clavigera* but both mechanisms are possible in the moderate rainfall habitat of *T. rodwayi* in Tasmania.

Flowers of *T. rodwayi* are also distinctively bright orange-red. While the flowers are rarely exposed above the leaf litter, digging by native animals such as potoroos and wombats would occasionally expose flowers, which might be attractive to birds or mammals, especially those that forage for fungi (such as potoroos). Whether the seeds of *T. rodwayi* can survive digestion by animals is not known. Beccari (1890 cited in Maas-van de Kamer 1998) supposed that the seeds of Burmanniaceae might also be dispersed by birds that have eaten earthworms that had ingested seeds.

It is interesting to note that flowers of *T. rodwayi* are usually found very close together, often clustered in small "colonies", which might support the notion of dispersal by raindrop splash or mechanical action of foraging animals. At one site, we observed flowers of *T. rodwayi* in a "line" perpendicular to the slope, which might support the notion of dispersal by over-ground water. Clustering of flowers has also been observed in *T. clavarioides* from Queensland (Thiele and Jordan, 2002): whether such clustering is related to the genetics of the plant (e.g. do the plants in a single patch comprise a single clone) or the method of pollination/dispersal is not known.

RESEARCH DIRECTIONS

For many of our rare plants, we know very little about their biology, ecology, distribution and habitat characteristics. With cryptic and ephemeral species such as *T. rodwayi*, we know even less because our ability to improve our knowledge is hampered by the logistics of finding enough material to work on. However, observations over the last 4 years have confirmed that several of the known populations of *T. rodwayi* in both the north and the south of the State "flower" consistently each year. Furthermore, several sites supporting 10+ flowers (with up to 25 flowers at one site) have been recorded, meaning that sampling need not "destroy" whole populations. The majority of the surveys reported in Roberts *et al.* (2003b) and this present paper are best regarded as cursory because at most sites only about 20 m^2 of leaf litter was excavated, indicating that perhaps the species is more widespread (but not necessarily abundant).

With this in mind, the following research directions are suggested with the intention of attracting post-graduate student interest in some or all of these aspects of the species:

- More detailed examination of the macro-habitat (e.g. forest type, geology, slope, aspect, altitude, etc.) and micro-habitat (e.g. leaf-litter depth and composition, soil type, moisture levels, associated vascular species, etc.) variables associated with the species through statistical modelling.
- Field-testing of the bioclimatic model presented in this current paper, examining the range of altitudes, geologies and forest types potentially supporting the species around Tasmania: suggested areas for focus include the Florentine Valley, further areas in the Southern Forests, parts of the east coast (including southern Bruny Island, northern Maria Island, the Wielangta forests and parts of the Eastern Tiers), the northeast forests and further sites around the northern base of the Western Tiers.
- Estimates of population numbers at each site with a more stratified random sampling method and assessment of the characteristics of the flowers (e.g. "life span" of individual flowers, how many buds mature, etc.).
- On-going long-term monitoring of known populations to examine how often the species flowers, whether it flowers in the same site every year and what factors might influence flowering (such as climate factors like rainfall, soil and air temperature, etc.).
- Examination of the pollination and dispersal mechanisms of the species through a combined field experiment assessing possible pollinating organisms (through insect trapping methods and possibly time-delay photography) and a more detailed analysis of the chemical compounds present in the flowers at different stages of maturity.
- Genetic relationships among populations within Tasmania and a comparison with specimens from Victoria and New Zealand (specimens of *T. rodwayi* from northern and southern Tasmania were provided in 2003 to Vincent Merckx and Peter Schols from the Laboratory of Systematics at the Institute of Botany and Microbiology (Belgium) to conduct DNA phylogenetic research on members of the Burmanniaceae family).

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Hermit crab

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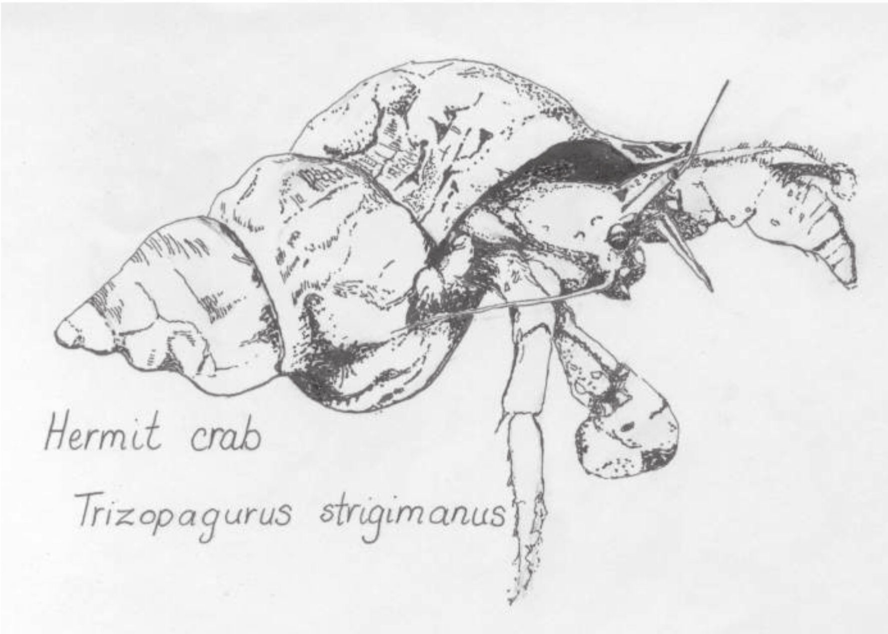
The Tasmanian Field Naturalists Club's February 2005 excursion to Marion Bay followed storm activity which resulted in numerous debris, including large numbers of molluscs and crabs, being washed up on the shore. The gulls were enjoying the offerings. Quite a few hermit crabs were found. The one that I have drawn below (*Trizopagurus strigimanus*) is shown trying to upright and manoeuvre itself - fascinating to watch. According to Graham Edgar, the species in question is unusual in having a ridged, sound-producing organ on the palm of both claws. It is in the family Diogenidae, members of which have an asymmetrical soft abdomen partly coiled to fit the empty gastropod shell that they inhabit; and a left claw equal in size to, or larger than, the right claw. Their colouring is striking, being bright red in the body with blue eyes. This shell appears to be from a great whelk *Penion maxima*, a species which normally resides in deep waters but enters comparatively shallow waters in southern Tasmania, where *Trizopagurus strigimanus* resides.



Mammal records from *The Tasmanian Naturalist*

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Summary

In this report, I examine records of native and introduced Tasmanian mammals contained in the volumes of *The Tasmanian Naturalist*. Eighty-eight papers were identified with mammalian records, and these highlight the important work of naturalists in contributing to knowledge of species occurrence and ecology. This work provides an index of mammal records published in this journal through the years, and may be useful for researchers who are seeking primary source observations on Tasmanian mammals.

Methods

All volumes of *The Tasmanian Naturalist* were searched for records of mammal species, including the old series: Vol. 1, no. 1 (April 1907) to Vol. 2, no. 4 (April 1911), a subsequent 'new series' published as Vol. 1, no. 1 (October 1924) to Vol. 2, no. 4 (June 1928), and the contemporary series: no. 1 (1965) to no. 126 (2004) (also see Fenton 2004: 143). Records were collated separately for each terrestrial non-flying mammal species and a short description of the records for these species was assembled. Records for bats, seals, dolphins and whales were grouped and tabulated. The review of records was confined to mammal species occurring in Tasmania, and does not include the mammal records for New Zealand which have been published in this journal (i.e. Bryant 1995) or the fossil records (i.e. Scott and Harrisson 1911). Common names used follow Strahan (1995).

Results

Mammal records from *The Tasmanian Naturalist* were found in 88 articles published between 1926 and 2004. Only 3 articles (3 %) from <1960 contained mammal records, whereas 13 (15 %) were from 1961 to 1969, 10 (11 %) from 1970-1979, 26 (30 %) from 1980-1989, 24 (27 %) from 1990-1999, and 12 (14 %) were from 2000 to 2005. There is mention of all Tasmanian species of non-flying terrestrial mammals, with records appearing in ≥10 articles for platypus, Tasmanian devil, southern brown bandicoot, eastern barred bandicoot, common brushtail possum, common ringtail possum, red-necked wallaby, rufous-bellied pademelon, house mouse, swamp rat, and European rabbit (Table 1).

The table indicates that, over the years ,there has been a preponderance of records towards the larger ubiquitous mammals and the introduced species such as the rabbit. Records of inconspicuous small mammals such as the dusky antechinus, swamp antechinus, white-footed dunnart, eastern pygmy-possum, New Holland mouse, long-tailed mouse, brown rat, and brown hare occur in fewer than five articles each.

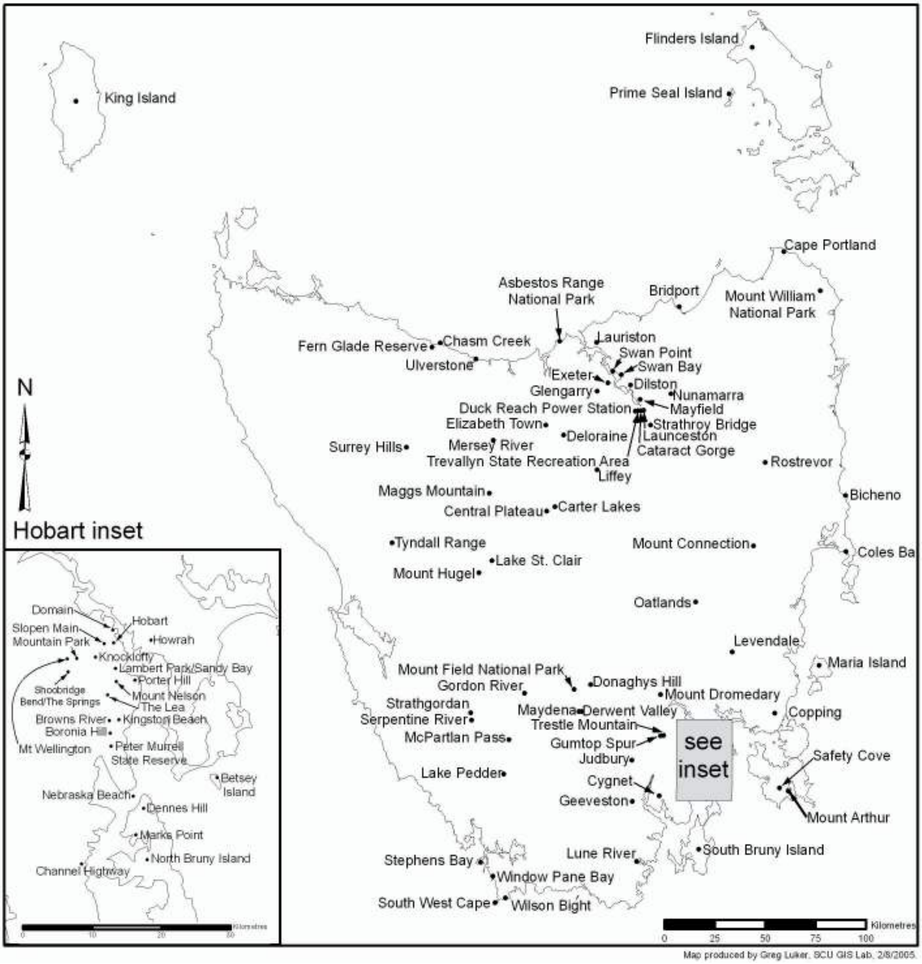

Figure 1: Localities mentioned in the text. Co-ordinates were sourced from the Geoscience Australia online place-name search. Locations are accurate to approximately one minute of latitude/longitude, which is approximately 1.8 km.

Table 1. Number of papers with mammal species records in *The Tasmanian Naturalist*.

Common Name	**No. of papers**	**Sources (see page following table)**
Short-beaked Echidna *Tachyglossus aculeatus*	9	1-10
Platypus *Ornithorhynchus anatinus*	12	4, 6, 7, 11-19
Thylacine *Thylacinus cyanocephalus*	4	20-23
Tasmanian Devil *Sarcophilus harrisii*	10	6, 7, 9, 14, 22, 24-28
Quoll spp. *Dasyurus spp.*	3	11, 29, 30
Spotted-tailed Quoll *Dasyurus maculatus*	3	9, 26, 31
Eastern Quoll *Dasyurus viverrinus*	9	6, 7, 9, 14, 27, 28, 32-34
Antechinus spp *Antechinus spp.*	2	26, 35
Dusky Antechinus *Antechinus swainsonii*	2	6, 14
Swamp Antechinus *Antechinus minimus*	5	36-40
White-footed Dunnart *Sminthopsis leucopus*	1	41
Southern Brown Bandicoot *Isoodon obesulus*	11	1, 5, 6, 7, 9, 18, 35, 40, 42-45
Eastern Barred Bandicoot *Perameles gunnii*	11	1, 5, 6, 7, 18, 27, 35, 43-47
Common Wombat *Vombatus ursinus*	8	1, 5, 7, 9, 27, 30, 31, 48
Common Brushtail possum *Trichosurus vulpecula*	18	1, 5, 6, 7, 9, 11, 18, 20, 27, 28, 31, 35, 37, 46, 49-52
Pygmy-Possum spp. *Cercartetus spp.*	2	18, 29
Little Pygmy-Possum *Cercartetus lepidus*	8	1, 5, 7, 9, 26, 41, 53, 54
Eastern Pygmy-Possum *Cercartetus nanus*	5	5, 26, 40, 53, 55
Sugar Glider *Petaurus breviceps*	6	5, 7, 20, 33, 42, 56
Common Ringtail Possum *Pseudocheirus peregrinus*	16	1, 5, 6, 7, 9, 11, 18, 20, 26, 31, 35, 41, 46, 57-59
Southern Bettong *Bettongia gaimardi*	9	1, 5, 6, 7, 9, 18, 30, 32, 60
Long-nosed Potoroo *Potorous tridactylus*	9	1, 5, 6, 7, 9, 18, 27, 35, 46

Table 1 contd.

Common Name	**No. of papers**	**Sources (see page following table)**
Eastern Grey Kangaroo *Macropus giganteus*	1	61
Red-necked Wallaby *Macropus rufogriseus*	10	1, 2, 5, 7, 9, 11, 20, 27, 28, 49
Rufous-bellied Pademelon	10	2, 5, 7, 9, 20, 27, 28, 31, 37, 62
Bat spp.	13	5, 6, 7, 9, 11, 26, 28, 55, 63-67
Unidentified rodent spp.	2	30, 55, 68
Water Rat *Hydromys chrysogaster*	9	1, 7, 9, 17, 18, 37, 42, 69, 70
House Mouse *Mus musculus*	14	6, 18, 28, 35, 37, 41, 42, 46, 54, 55, 68, 69, 71, 72
New Holland Mouse *Pseudomys novaehollandiae*	2	31, 47
Long-tailed Mouse *Pseudomys higginsi*	5	5, 26, 39, 40, 41
Broad-toothed Rat *Mastacomys fuscus*	6	5, 29, 39, 40, 69, 73
Swamp Rat *Rattus lutreolus*	10	5, 18, 26, 31, 39, 40, 41, 42, 46, 69
Black Rat *Rattus rattus*	7	7, 18, 28, 31, 42, 69, 71
Brown Rat *Rattus norvegicus*	5	6, 7, 18, 35, 69
Fox *Vulpes vulpes*	2	34, 88
House Cat *Felis catus*	9	1, 5, 7, 23, 37, 43, 46, 68, 71
European Rabbit *Oryctolagus cuniculus*	18	5, 6, 7, 18, 23, 35, 42, 43, 46, 54, 68, 71, 73-78
Brown Hare *Lepus capensis*	4	6, 35, 43, 72
Goat *Capra hircus*	2	5, 73
Fallow Deer *Dama dama*	1	61
Seals	10	30, 34, 68, 74, 76, 79-83
Dolphins	3	34, 84, 85
Whales	5	30, 34, 85-87

Sources for Table 1: 1 Briggs 1965; 2 Milledge 1969; 3 Ziegeler 1971; 4 Hird 1993; 5 Taylor and McQuillan 1994; 6 Hird 1995; 7 Taylor *et al.* 1997; 8 Wapstra *et al.* 2000; 9 Hird 2000; 10 Wall 1979; 11 Wall and Wall 1972; 12 Tyson 1980; 13 Taylor *et al.* 1991; 14 Taylor and McQuillan 1994; 15 Hird and Paterson 1995; 16 Otley and le Mar 1998; 17 Rakick *et al.* 2001; 18 Driessen 2003; 19 Munks *et al.* 2004; 20 Crowther 1926; 21 Anon 1966a; 22 Sharland 1975; 23 Bryant and Harris 1994; 24 Anon 1966c; 25 Sharland 1967; 26 Mumbray 1992; 27 Hird and Hammer 1995; 28 Brereton *et al.* 1996; 29 Wallis *et al.* 1977; 30 Ziegeler 2004; 31 Green and Scarborough 1990; 32 Anon 1982; 33 Klettenheimer and Salamon 1997; 34 Grove 2004; 35 Ziegeler 1970; 36 Andrews 1967; 37 Whinray 1971; 38 Scarborough and Green 1989; 39 Driessen and Comfort 1991; 40 Driessen *et al.* 2002; 41 Linton 1928; 42 Green and Rainbird 1985; 43 Green 1965; 44 Anon 1966b; 45 David 1982; 46 Green 1982; 47 Brown *et al.* 1999; 48 Hird 1986; 49 Thomas and Wall 1966; 50 Murray 1977; 51 Neyland 1999; 52 Duncan 2000; 53 Wall 1985; 54 Green *et al.* 1988; 55 Green *et al.* 1986; 56 Wall 1994; 57 Munks 1999; 58 Munks 2000; 59 Munks and Taylor 2000;60 Driessen and Hocking 1990; 61 Duncan 1992; 62 Barker 1983; 63 Green 1966; 64 Tyson 1981; 65 Woinarski 1986; 66 Rounsevell 1980; 67 Green and Rainbird 1984; 68 Jones 1984; 69 Green 1967; 70 Dartnall 1969; 71 Pye 1984; 72 Spencer 2004; 73 Bryant 1992; 74 Sharland 1966; 75 Shepherd 1975; 76 Rounsevell 1984a; 77 Skira 1984; 78 Fearn 1988; 79 Ingham 1984; 80 Fletcher and Shaughnessy 1984; 81 Rounsevell 1984b; 82 Dartnall 1971; 83 Burton 1986; 84 Green and Scott 1985; 85 Wapstra 1991; 86 Wall 1981; 87 Lord 1924; 88 Bryant 1995..

SUPPLEMENTARY INFORMATION FOR TERRESTRIAL NON-FLYING MAMMALS

Note: Localities mentioned in the text are shown in Figure 1.

SHORT-BEAKED ECHIDNA (*TACHYGLOSSUS ACULEATUS*)

Records of the echidna from *The Tasmanian Naturalist* include mention of its occurrence on Flinders Island (Milledge 1969), North Bruny Island (Ziegeler 1971; Hird 2000) and Mount Wellington (Taylor and McQuillan 1994). According to Briggs (1965), the echidna is ‘common’ at Safety Cove and ‘seem very numerous’ at ‘Slopen Main’. Wall (1979) reported on an echidna unconcerned at the smell of humans. Hird (1993) reported that an echidna which had almost drowned was rescued from part of an estuary at an undisclosed location in south-eastern Tasmania. They are ‘regularly sighted’ in the Mount Nelson area (Hird 1995) and have been reported from Cataract Gorge Reserve (Taylor *et al.* 1997). The most recent record is provided by Wapstra *et al.* (2000), who reported observations of echidnas using tree hollows.

Platypus (*Ornithorhynchus anatinus*)

Platypuses can be seen at Lake St. Clair occasionally, and one has been seen at Shadow Lake near Mount Hugel (Wall and Wall 1972). Road-killed platypuses have been found near Nunamarra, Strathroy Bridge near Launceston, near Glengarry and near Exeter (Tyson 1980). Taylor *et al.* (1991) provide 22 records and observations of the platypus from various localities including Plenty River in the Derwent Valley, Mount Field, and Carter Lakes on the Central Plateau. These records included a roadkill specimen from the Deloraine bypass, and a dead platypus which had apparently been fed upon by wedgetailed eagle *Aquila audax*. They are also known from Mount Wellington (Taylor and McQuillan 1994), Sandy Bay (Hird 1995), King Island (Hird and Paterson 1995), near Duck Reach Power Station (Taylor *et al.* 1997), Surrey Hills area (Otley and le Mar 1998), Chasm Creek, northeast of Burnie (Rakick *et al.* 2001) and in Browns River 'near the Lea' (Driessen 2003). Hird (1993) reported observations of platypus utilising estuarine habitats, and Munks *et al.* (2004) report on the structure of platypus nests found in a cave.

Thylacine (*Thylacinus cyanocephalus*)

Anon (1966a) reported that 'from the back country reports continue to filter in about the supposed occurrence' of the thylacine. It was stated that recent reports from the West Coast had been 'accepted by game authorities as indicating that in this wild region the thylacine is still living'. Sharland (1975) made some remarks on the old Battery Point zoo in Hobart which apparently had 'a number of thylacines' in the 1920s. The most recent mention of the thylacine was by Bryant and Harris (1994), who attributed its demise to the 'persecution and hunting pressure from settlers'.

Tasmanian Devil (*Sarcophilus harrisii*)

Sharland (1967) discusses how the devil got it name, and Sharland (1975) made some remarks on the old Battery Point zoo in Hobart (circa 1925-1933) which apparently was the first to successfully breed the Tasmanian devil in captivity. Anon (1966c) states that the Tasmanian devil 'is common among wooded ranges, in parts of lowland scrub, and about the fringe of farms'. At Mount Wellington, devils 'appear to be rare' (Taylor and McQuillan 1994) and found only in 'small numbers' at Gumtop Spur, northwest of Wellington Park (Hird 1995; Hird and Hammer 1995). They have also been recorded at Howrah Hills (Brereton *et al.* 1996), Cataract Gorge Reserve (Taylor *et al.* 1997) and Bruny Island (Hird 2000).

Spotted-tailed Quoll (*Dasyurus maculatus*)

Green and Scarborough (1990) provided a detailed review of the literature on spotted-tailed quoll, and made an appraisal of the specimens in the Queen Victoria Museum. They presented a distribution map, which was based on their tabulation of 104 previously unpublished records. This valuable work also detailed many observations on spotted-tailed quoll life history. 'Its most favoured habitat' was reported to be 'sclerophyll forest and the edges of rainforest', but populations are also known from 'dry coastal heathlands of the north-east'. Hird (2000) cited that a resident of North Bruny Island 'had trapped a spotted-tail quoll near Dennes Hill in a possum cage', while noting that other evidence for the species on Bruny Island is lacking. It is also noted that Wallis *et al.* (1977) found quoll scats on Strathgordon Road, although whether they were spotted-tailed quoll or its congener the eastern quoll was not ascertained.

Eastern Quoll (*Dasyurus viverrinus*)

Eastern quolls have been found at Pandani Hut at Mount Field National Park (Anon 1982), Porter Hill (Hird 1995), Howrah Hills (Brereton *et al.* 1996), and North Bruny Island (Hird (2000). Klettenheimer and Salamon (1997) caught eastern quolls at Mount Dromedary near Hobart, and observed them 'climbing trees up to six metres high quite effortlessly'. Taylor *et al.* (1997) stated that eastern quoll scats 'were abundant on the southern side' of Cataract Gorge Reserve. Taylor and McQuillan (1994) reported that eastern quolls are known from Mount Wellington, although this record has since been acknowledged as erroneous (Hird and Hammer 1995). However, at Gumtop Spur, 20 eastern quolls were caught in April 1995. Recent member observations include one (roadkill) found 3km SE of Copping on Tasman Highway (3 May 2004); and another roadkill quoll (presumably *eastern quoll*) 1.5km S of Copping on Arthur Highway (17 May 2004) (see Grove 2004).

Dusky Antechinus (*Antechinus swainsonii*)

Dusky Antechinus are known from Mount Wellington (Taylor and McQuillan 1994) and from Porter Hill (Hird 1995). The loss of this species 'in bushland in near-urban areas appears to be the norm in southern Tasmania over a range of lowland habitats' (Tas. Field Nats. unpubl. data; cited by Hird 1995), although the species occurs near disturbed habitats in the Cygnet district' (Hird 1995). It has also been suggested that 'predation by feral and ranging domestic cats, and possibly competition from introduced rodents' are the most likely explanation for such losses (Hird 1995).

Swamp Antechinus (*Antechinus minimus*)

A significant record of swamp antechinus is provided by Andrews (1967) who captured an albino individual in the vicinity of the junction of the Gordon and Serpentine Rivers, in the south west of the State. Whinray (1971) detailed an old record from Prime Seal Island which was lodged with the British Museum (Natural History) in 1858. Scarborough and Green (1989) extended knowledge of swamp antechinus distribution and habitat preference, and provided records from Bridport, Swan Bay, Dilston, Bruny Island, King Island, Maggs Mountain, Mount Arthur and Elizabeth Town. More recently, this species has been captured at McPartlan Pass in southwest Tasmania (Driessen and Comfort 1991) and at Tyndall Range (Driessen *et al.* 2002).

White-footed Dunnart (*Sminthopsis leucopus*)

Early portrayals of white-footed dunnart were made by Linton (1928) but there have been no records in the volumes of *The Tasmanian Naturalist* of captures or observation of the species since then.

Southern Brown Bandicoot (*Isoodon obesulus*)

Green (1965) described fluctuating populations of southern brown bandicoots (and other mammalian species), following changes in predator abundance. Anon (1966b) credits this species as a predator of grass-eating insects (Corbie: *Oncopera* sp.). Anon (1966b) also comments that 'the greatest number of bandicoots seen by the average observer are dead ones, killed on the roads. Others are killed by dogs and cats and birds of prey'. Records of southern brown bandicoots are from Safety Cove (Briggs 1965), Knocklofty, West Hobart (Ziegeler 1970), Swan Point (Davis 1982), Mount Wellington (Taylor and McQuillan 1994), Mount Nelson (Hird 1995), Cataract Gorge Reserve and adjoining areas of Trevallyn State Recreation Area (Taylor *et al.* 1997), South Bruny Island (Hird 2000), Tyndall Range (Driessen *et al.* 2002), Kingston Beach and at Browns River (Driessen 2003). This species is also recorded from masked owl *Tyto novaehollandiae* pellets (Green and Rainbird 1985).

Eastern Barred Bandicoot (*Perameles gunnii*)

Like the southern brown bandicoot (and other mammals), populations of eastern barred bandicoot are impacted upon by predator abundance

(Green 1965), praised for limiting grass-eating insects (Anon 1966b), and recorded from the pellets of the Masked Owl (Green 1982). Similarly there are records of eastern barred bandicoots from Knocklofty, West Hobart (Ziegeler 1970), Swan Point (Davis 1982), Mount Wellington (Taylor and McQuillan 1994), Mount Nelson (Hird 1995), north of Cataract Gorge Reserve (Taylor *et al.* 1997), and Kingston Beach (Driessen 2003). Hird and Hammer (1995) caught one barred bandicoot on Gumtop Spur, and reported that this species is 'regularly observed killed on Boyer Road' in that area. They also reported two further records of this species from Mountain Park on Mount Wellington, one in *Eucalyptus obliqua* forest 200 m below Shoobridge Bend and the other in *E. johnstonii* forest 1.8 km above The Springs. This species is considered 'nationally vulnerable' and, in Tasmania, 'distributed mainly in the north-west, south-east and localised pockets in the north-east, but is largely absent from the midlands' (Brown *et al.* 1999).

COMMON WOMBAT (*VOMBATUS URSINUS*)

The common wombat is reported from Safety Cove (Briggs 1965), Asbestos Range National Park (Hird 1986), Mount Wellington (Taylor and McQuillan 1994), Gumtop Spur (Hird and Hammer 1995), Cataract Gorge Reserve (Taylor *et al.* 1997), North Bruny Island (Hird 2000), South West Cape, Window Pane Bay, and Stephens Bay in the far south-west (Ziegeler 2004). This species is reportedly scavenged upon by spotted-tailed quoll (Green and Scarborough 1990).

COMMON BRUSHTAIL POSSUM (*TRICHOSURUS VULPECULA*)

Crowther (1926) reported that in the years 1923-25 there were 71,576 common brushtail possum skins processed for the fur trade. However, populations survived and in 1965 it was reported that they were 'common' at Safety Cove (Briggs 1965). Furthermore, at Lake St. Clair, Wall and Wall (1972) record a population size increase between 1952 and 1972 (Wall and Wall 1972). Other brushtail records are from Lune River (Thomas and Wall 1966), Knocklofty (Ziegeler 1970), Prime Seal Island and Flinders Island (Whinray 1971), Levendale (Duncan 2000), Mount Wellington (Taylor and McQuillan 1994), Mount Nelson area (Hird 1995), Gumtop Spur (Hird and Hammer 1995), the Domain in Hobart (Brereton *et al.* 1996), Cataract Gorge Reserve (Taylor *et al.* 1997), Oatlands (Neyland 1999), North Bruny Island (Hird 2000), and Browns River (Driessen 2003). A remarkable observation of the brushtail's predatory behaviour on a blowfly was described by Murray (1977). This species is scavenged upon by spotted-tailed quoll (Green and Scarborough 1990) and preyed upon by masked owl (Green 1982).

LITTLE PYGMY-POSSUM (*CERCARTETUS LEPIDUS*)

Linton (1928) states that the 'Little Dormouse Phalanger' occurs 'lower down the slopes, where a water course nourishes fuller vegetation'. She also describes nesting and torpor of the species. Briggs (1965) states this species is 'found occasionally' at Safety Cove, and 'are numerous now that the fires are properly controlled'. Wall (1985) observed four little pygmy-possums about 2 m above ground on a snow gum *Eucalyptus coccifera* whilst on a excursion to Mount Connection on 16 December 1983, also in the Lower Gordon River in 1977, and on 9 March 1984 in a small plant of *Richea dracophylla* on Trestle Mountain. He stated that this species generally occurs in dry forests and heathland. Little Pygmy-Possums are known from Mount Wellington (Taylor and McQuillan 1994). Taylor *et al.* (1997) stated that this species 'will almost certainly occur' at Cataract Gorge Reserve, despite the failure to capture or detect the species during their survey. Similarly, Driessen (2003) did not find pygmy-possums at Kingston Beach, but stated that 'they may also occur in the area but specialised techniques are required to confirm their presence'. Green *et al.* (1988) found this species in the stomach contents of a laughing kookaburra *Dacelo novaeguineae* and they have been found in dasyurid scats (either Tasmanian devil or spotted-tailed quoll) at Donaghys Hill (Mumbray 1992).

EASTERN PYGMY-POSSUM (*CERCARTETUS NANUS*)

Wall (1985) states that the eastern pygmy-possum is found in 'rainforest country' in Tasmania and Green *et al.* (1986) notes the recording of eastern pygmy-possum in the preserved gut of a southern boobook owl *Ninox novaehollandiae*. This species reportedly occurs on Mount Wellington (Taylor and McQuillan 1994). Driessen *et al.* (2002) noted that this species has been trapped in buttongrass moorlands. Wallis *et al.* (1977) found fur of pygmy-possum species in quoll scats, but whether it was the eastern or little pygmy-possum was not determined.

SUGAR GLIDER (*PETAURUS BREVICEPS*)

Wall (1994) reported remains of a sugar glider from Pinnacle Road, Mount Wellington, and in an accompanying editors note it was added that it was highly likely that the masked owl was responsible. Green and Rainbird (1985) also record this species from masked owl pellets. Taylor and McQuillan (1994) stated that sugar gliders are known from Fern Glade, Mount Wellington. Klettenheimer and Salamon (1997) released 31 sugar gliders, 2/3 bred in captivity, in an area close to Mount Dromedary, and subsequently caught several of these released gliders and also six resident gliders during a monitoring program.

COMMON RINGTAIL POSSUM (*PSEUDOCHEIRUS PEREGRINUS*)

Crowther (1926) stated that 'the Ring-tailed Opossum is being wiped out. In the old days of the 'possum dog and moonlight shooting it had some chance; now with the deadly spot light it is a systematic massacre'. In 1923-25 there were 1,457,125 ringtail skins processed, and Crowther (1926) anticipated that 'over 250,000' would go through in 1926. In 1949 the ringtail was believed to be 'fairly common' at Lake St. Clair, although there may have been a 'drastic reduction in the population' in that area during the subsequent 20 years (Wall and Wall 1972). However, it has been reported as 'plentiful' at Safety Cove (Briggs 1965) and there are records from Mount Wellington (Taylor and McQuillan 1994), Mount Nelson (Hird 1995) and Cataract Gorge Reserve (Taylor *et al.* 1997). Dead specimens have been reported from Knocklofty (Ziegeler 1970), and from 'Victoria Street, Kingston Beach' and 'the Channel Highway' (Driessen 2003). It has also been recorded as prey of the masked owl (Green 1982) and spotted-tailed quoll (Green and Scarborough 1990). This species has been found in dasyurid scats (either Tasmanian devil or spotted-tailed quoll) at Donaghys Hill (Mumbray 1992). Island records are for North Bruny (Hird 2000) and Flinders (Munks 1999; 2000; Munks and Taylor 2000), the latter representing a series of detailed ecological studies.

SOUTHERN BETTONG (*BETTONGIA GAIMARDI*)

Driessen and Hocking (1990) reviewed information on distribution, habitat and status of bettongs in Tasmania including consideration of the impact of land management practices on populations. They reported that it occurs as far west as the Mersey River in the north, Derwent Bridge in the Central Highlands and National Park, Judbury and Geeveston in the south. Records of this species from *The Tasmanian Naturalist* are for Pawlenna (Anon 1982); Mount Wellington Range (Taylor and McQuillan 1994; Hird and Hammer 1995); Mount Nelson (Hird 1995); Cataract

Gorge Reserve (Taylor *et al.* (1997), Bruny Island (Hird 2000); Browns River (Driessen 2003); Wilson Bight, Stephens Bay and Window Pane Bay (Ziegeler 2004).

Long-nosed Potoroo (*Potorous tridactylus*)

The long-nosed potoroo is 'widespread and common in areas of forest, woodland and heath in Tasmania' (Hird and Hammer 1995). However, Briggs (1965) found it to be 'uncommon' at Safety Cove, and Ziegeler (1970) states that he recorded this species only once in a small gully at Knocklofty, commenting also that it was 'probably wiped out by the [1967] fires' in that area. Green (1982) recorded this species in masked owl pellets, and Taylor and McQuillan (1994) state that they are known from Mount Wellington. Hird (1995) found that long-nosed potoroos were 'common and widespread' at Mount Nelson, and Hird and Hammer (1995) caught a potoroo at Gumtop Spur. Taylor *et al.* (1997) stated that 'this species was trapped in grassy forest on the northern side' of Cataract Gorge Reserve, and that 'it prefers areas with a dense ground cover'. Hird (2000) captured 13 potoroos at Dennes Hill on North Bruny Island, and provided three further records: a male found killed on the road, another seen on a road, and a sighting at Marks Point. Driessen (2003) caught three long-nosed potoroos at Kingston Beach, and one at Browns River. He stated that they appear 'to be relatively common' in the Kingston area as he has had 'high captures rates at Boronia Hill Reserve and at the Peter Murrell Reserve'. He also remarked that 'the public does not often see this species, as it prefers to forage and live where there is good ground cover, rarely venturing out into the open'.

Eastern Grey Kangaroo (*Macropus giganteus*)

Duncan (1992) studied the diet of eastern grey kangaroos in the midlands through faecal analysis and found that grasses such as *Holcus lanatus*, *Vulpia* spp., *Danthonia* spp. and *Poa* spp. made up a major component of the diet.

Red-necked Wallaby (*Macropus rufogriseus*)

Crowther (1926) reported that in 1923-25 there were 281, 663 red-necked wallaby skins processed for the fur trade. 'Huge populations' have been reported for Flinders Island (Milledge 1969), although it is apparently 'very rare' on Mount Wellington 'despite suitable habitat and its presence being recorded in the early days of settlement' (Taylor and McQuillan

1994). Red-necked wallaby are also known from Gumtop Spur (Hird and Hammer 1995), Howrah Hills (Brereton *et al.* 1996), Cataract Gorge Reserve (Taylor *et al.* 1997) and Dennes Hill (Hird 2000).

Rufous-bellied Pademelon (*Thylogale billardierii*)

The rufous-bellied pademelon was first recorded for Prime Seal Island as early as 1828, and Whinray (1971) reported they were plentiful there during his visits to this island in 1965 and 1966. He further states that he was 'given the heads of 22 pademelons shot during one of the 1966 visits' and these were deposited with the Monash University Zoology Department and Museum Victoria. This species has also been reported at Flinders Island (Milledge 1969), Dennes Hill, North Bruny Island, and South Bruny (Hird 2000), Cape Portland (Barker 1983), Mount Wellington Range (Taylor and McQuillan 1994; Hird and Hammer 1995), Howrah Hills (Brereton *et al.* 1996) and Cataract Gorge Reserve (Taylor *et al.* 1997). This species is recorded as prey of spotted-tailed quoll (Green and Scarborough 1990) and forest raven *Corvus tasmanicus* (Barker 1983).

Water Rat (*Hydromys chrysogaster*)

The first specimens of the water rat known to science are reported to have been collected from Bruny and Maria Islands (Dartnall 1969). This species was present on Prime Seal Island in the 1920s and 1930s, and Whinray (1971) believed that it should still occur there. Briggs (1965) stated that water rats were 'plentiful' at Safety Cove, and Taylor *et al.* (1997) stated that they are 'reported to occasionally occur' near the Duck Reach Power Station. Hird (2000) found footprints of the water rat on the coast near 'Lauriston' on North Bruny Island, and also reported that this species raided poultry at 'Nebraska'. Driessen (2003) believed that water rats may be present in the Browns River 'as they are known to occur throughout the Derwent estuary'. Other records of water rats in *The Tasmanian Naturalist* include a record from masked owl pellets (Green and Rainbird 1985) and an observation of a water rat being chased by a platypus (Rakick *et al.* 2001).

House Mouse (*Mus musculus*)

Records of the house mouse are from Knocklofty (Ziegeler 1970), Prime Seal Island (Whinray 1971), Macquarie Island (Pye 1984; Jones 1984), Porter Hill (Hird 1995), Domain, in Hobart (Brereton *et al.* 1996), Kingston Beach area (Driessen 2003), Mayfield and Rostrevor (Green *et al.* 1986). Records of predation on the house mouse include those by masked owl (Green 1982; Green and Rainbird 1985), feral cat (Jones 1984), southern boobook owl (Green *et al.* 1986), laughing kookaburra (Green *et al.* 1988), spotted-tailed quoll (Green and Scarborough 1990), and bluetongue lizard *Tiliqua nigrolutea* (Spencer 2004).

NEW HOLLAND MOUSE (*PSEUDOMYS NOVAEHOLLANDIAE*)

The only mention of new Holland mouse in *The Tasmanian Naturalist* is by Brown *et al.* (1999). They stated that this species is 'rare' and is 'restricted to coastal areas in pockets from Asbestos Range National Park to Cape Portland, and also occurs in Mount William National Park, Bicheno and Coles Bay.

LONG-TAILED MOUSE (*PSEUDOMYS HIGGINSI*)

Green (1967) states that this species is 'an endemic Tasmanian animal and occurs only in the rain-forests and near similar habitat'. Taylor and McQuillan (1994) reported that it 'is widely distributed across a range of habitats', but the highest densities are reached in 'mountain and alpine regions, particularly where boulder screes and rocky ground are present' (citing Stoddart and Challis 1993). The rocky high altitude areas of Mount Wellington were thus identified as providing optimal habitat for long-tailed mouse. This species has also been captured at McPartlan Pass in southwest Tasmania (Driessen and Comfort 1991), and it was noted by Driessen *et al.* (2002) that long-tailed mice have been trapped in buttongrass moorlands. Mumbray (1992) records this species in dasyurid scats at Donaghys Hill.

BROAD-TOOTHED RAT (*MASTACOMYS FUSCUS*)

This species has as its main stronghold 'the buttongrass areas of the western half' of Tasmania (Green 1967; Driessen *et al.* 2002), and heathland copses in the World Heritage Area (Bryant 1992). Records of this species include Shoobridge Bend in 1968 (Taylor and McQuillan 1994) and McPartlan Pass (Driessen and Comfort 1991). Wallis *et al.* (1977) reported that they found a jaw bone of broad-toothed rat in quoll scats by the Strathgordon road, near the start of the old Lake Pedder walking track.

SWAMP RAT (*RATTUS LUTREOLUS*)

The swamp rat (or velvet rat) occurs 'in a wide range of habitat including coastal heath, swamp land, subalpine rain-forest and sedgeland' (Green 1967). A number of authors have commented on its occurrence at

Mountain Park, Mount Wellington and near-urban areas such as Porter Hill and Lambert Park (Taylor and McQuillan 1994; Hird 1995; Hird and Hammer 1995). It has also been found at Donaghys Hill (Mumbray 1992), in sedgeland at McPartlan Pass (Driessen and Comfort 1991), in buttongrass moorlands at Tyndall Range (Driessen *et al.* 2002) and at Kingston Beach (Driessen 2003). Swamp rats have also been recorded as prey of masked owl (Green 1982; Green and Rainbird 1985) and spotted-tailed quoll (Green and Scarborough 1990).

Black Rat (*Rattus rattus*)

Records of the introduced black rat in *The Tasmanian Naturalist* are from Macquarie Island (Pye 1984), from spotted-tailed quoll and masked owl prey remains (Green and Rainbird 1985; Green and Scarborough 1990), the Domain (Brereton *et al.* 1996) and Cataract Gorge Reserve (Taylor *et al.* 1997). More recent records are provided by Driessen (2003), who made three captures at Kingston Beach and two at Browns River. He stated that they ‘typically occur where there is disturbance to native habitat or in areas close to human dwellings’. An unidentified *Rattus* sp. was found in the pellets of boobook owl by Green *et al.* (1986) at Mayfield, which may have been this species.

Brown Rat (*Rattus norvegicus*)

Records of the brown rat include Knocklofty (Ziegeler 1970), Trevallyn State Recreation Area (Taylor *et al.* 1997), Porter Hill (Hird 1995) and the Kingston Beach area (Driessen 2003).

House Cat (*Felis catus*)

Briggs (1965) records a cat chasing a southern brown bandicoot, and Green (1965) described fluctuating populations of this species, following changes in prey abundance. Other records of feral cats are for Prime Seal Islands (Whinray 1971), Macquarie Island (Jones 1984; Pye 1984; Bryant and Harris 1994), and also Patenna (Green 1982) and from Trevallyn State Recreation Area (Taylor *et al.* 1997).

European Rabbit (*Oryctolagus cuniculus*)

Green (1965) describes the drastic reduction of the rabbit in the Tasmanian midlands in 1953, following the introduction of myxomatosis. Sharland (1966) states that the rabbit is ‘well established’ on Macquarie Island, and blames it for ‘eating out natural vegetation’ (also see Jones 1984; Pye 1984; Skira 1984; Bryant and Harris 1994). It has been reported as ‘fairly common’ at Knocklofty (Ziegeler 1970), present on Betsey Island (Shepherd (1975), 'extremely common' in the Liffey Valley (Fearn 1988), present at Mount Nelson (Hird 1995) and Cataract Gorge Reserve (Taylor *et al.* 1997), and 'very common' throughout the Kingston Beach area (Driessen 2003). Bryant (1992) made mention of a rabbit eradication program undertaken in the Strathgordon / Maydena area in 1993. Taylor and McQuillan (1994) noted that 'grazing by rabbits in the alpine areas can cause loss of plant cover, degrade uncommon cushion plants and result in erosion'. Rabbit has also been identified from pellets of masked owl (Green 1982; Green and Rainbird 1985) and southern boobook (Green *et al.* 1986), from the stomach of a tiger snake *Notechis ater humphreysi* (Fearn 1988), and from scats of carnivorous mammals (Taylor *et al.* 1997)

Brown Hare (*Lepus capensis*)

Green (1965) described fluctuating populations of brown hare, following changes in predator abundance. It 'occurs in small numbers' at Knocklofty, West Hobart (Ziegeler 1970) and has been captured at Mount Nelson (Hird 1995). Spencer (2004) noted a rather large bluetongue lizard *Tiliqua nigrolutea* feeding on a juvenile brown hare.

Goat (*Capra hircus*)

Bryant (1992) stated that feral goats 'are causing widespread damage through browsing, soil erosion and spread of disease in a number of regions, particularly the Central Plateau Conservation Area', and also mentioned a control program underway at that time. Taylor and McQuillan (1994) identify that the goat was having serious impact on Mount Wellington and could 'dramatically alter the composition of plant communities'.

Fallow Deer (*Dama dama*)

Duncan (1992) studied the diet of this species in the midlands and found that dicotyledons (e.g. low-fibre herbs such as *Trifolium* spp., *Viola* spp. and *Geranium* spp. and high fibre browse species such as *Acacia* spp., *Banksia* spp. and *Leucopogon* sp.) occurred consistently in their faeces.

Fox (*Vulpes vulpes*)

Bryant (1995) commented that 'As a state we live in constant fear of the introduction of the fox, one species which could potentially cause massive decline of all our small mammals'. Unfortunately this fear might well be realised since one fox was recently seen trotting across farmland at West Gawler Creek, south of Ulverstone (Grove 2004).

CONCLUSION

This review highlights the wealth of information on mammalian species in *The Tasmanian Naturalist* and illustrates the significance of the work of naturalists. It also provides an index of records published in the journal, and should prove to be a useful starting point for researchers seeking information on Tasmanian mammals in the future. However, this review should not be taken as a summary of the state of knowledge concerning Tasmanian mammals, since much important work has been published in many other journals as well as books and published and unpublished reports. For instance, Rounsevell *et al.* (1991) presented comprehensive distribution maps for 34 terrestrial mammal species native to Tasmania. Significant papers dealing with Tasmanian mammals can also be found in the volumes of the *Records of the Queen Victoria Museum* and *Papers and Proceedings of the Royal Society of Tasmania*, and also in the references cited in Watts' (1993) *Tasmanian Mammals* and Strahan's (1995) *Mammals of Australia*.

The desirability of further community-based mammal distribution research in Tasmania modelled on the highly successful Mammal Survey Groups in Victoria has been canvassed by Hird (1996). While some of the publications cited here have been based on that model, further mammal research activity in Tasmania has been limited by lack of access to basic survey equipment that in other states (such as Victoria) would be provided by wildlife agencies. This is despite the obvious ongoing, but poorly documented, impact on many mammal species of habitat loss brought about by land clearing and forestry practices.

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Cecilioides acicula (Muller, 1774) (Pulmonata: Ferrussaciidae), a burrowing land snail introduced to Tasmania

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Abstract

This paper gives the first definite Australian record for the blind awlsnail *Cecilioides acicula* (Muller, 1774), the first ferrussaciid recorded from Tasmania.

Identification

Cecilioides acicula has a small, very thin needle-shaped shell of 5.5-6 whorls, 4-5 mm high and 1-1.3 mm wide. The shell is glossy, pale yellow to off-white, with a sculpture of irregular low radial corrugations. The body whorl accounts for around half the shell height and the aperture is elongate, around 1.5 mm high by 0.5 mm wide. *Cecilioides acicula* cannot easily be mistaken for any other Tasmanian land snail, native or introduced. There is some resemblance in size and shape to the truncatellids present in saltmarshes in the north of the state but these have much less pointy spires, more rounded apertures and are operculate. The species is known by a variety of common names including blind snail, European blind snail, blind awlsnail, blind pin snail and blind white snail.

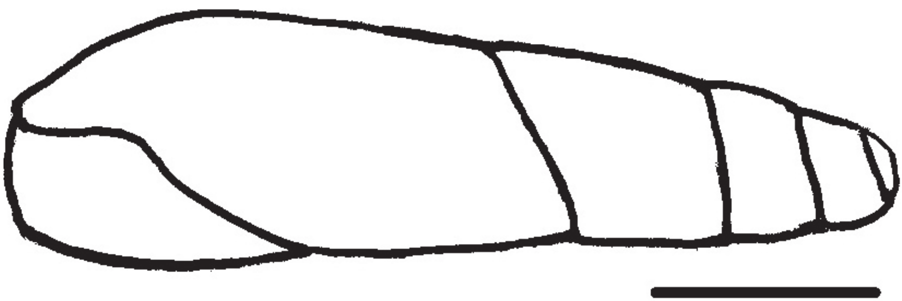

Figure 1. *Cecilioides acicula*. Horizontal line represents 1 mm. Line drawing by the author.

Cecilioides acicula in Tasmania

The house where I live, at 410 Macquarie Street, South Hobart, was built in the 1850s and has an excavated backyard courtyard bounded by a rock wall approximately 1.4 metres high and constructed of loose boulders with gaps between them. Behind the rock wall is a bank of deep soil covered by lawn. Seepage from this earthen bank into the rock wall, sometimes causing parts of the wall to collapse, occurs in times of heavy rain or as a result of hosing. The soil is calcium-rich and includes mammal bones from nineteenth-century farms.

On 15 Feb 2003 I collected a single dead specimen of *C. acicula* from a ledge on the rock wall approximately 60 cm below the soil surface. On 30 June 2003, I collected a second dead specimen in debris washed out from behind the wall following a partial collapse, and on 26 Oct 2003 I collected a broken shell from mud in a gap in the rock wall approximately 40 cm below the soil surface. No further specimens have yet been seen (perhaps because more of the wall is now covered in vegetation, or because water flow through the yard from the adjacent Adult Education Centre car park has been greatly reduced) and limited attempts to find the snail in similar environments elsewhere in Hobart have failed. All three specimens collected are worn and were presumably dead for some time prior to collection, so the finds do not guarantee an extant population, although there is no particular reason to doubt that one exists.

Discussion

This species, widespread as a native in Europe, is a burrowing snail that lives underground typically 40-70 cm below the soil surface. Dead shells are most commonly exposed in ant or mammal diggings or in soil washed away in small floods (Grego, pers. comm). The species may have been present in Hobart for a long time. Its discovery was serendipitous and the population could easily have gone undetected for much longer.

Cecilioides acicula has been recorded from New Zealand (Barker, 1999). There is no previous known confirmed record from Australian territory. Varman (1998) illustrates a snail that looks identical to *C. acicula* from Norfolk Island but writes: “Another mystery but these have been found in archaeological contexts dating from the 1790s but also in fossiliferous deposits, so has to be indigenous.” As noted by Evans (1972), *C. acicula* is very capable of burrowing into fossil deposits; therefore the Norfolk Island specimens are not necessarily native and could well be this species.

Because *C. acicula* is subterranean and hence easily overlooked, it is likely to be some time before sufficient records are available to give a useful picture of how widespread and common it is (or has been) in the Hobart area, or to comment on any environmental impact it might have. I would appreciate any further records or suspected records of the species. In particular, archaeologists excavating historic sites, including grave sites, may encounter this snail.

This is the second species from this family to be recorded from Australia. The other species, *Ferrussacia folliculus* (Ferussac, 1819), has been recorded from suburban gardens in Adelaide, South Australia (Venmans, 1957).

ACKNOWLEDGEMENTS

I wish to thank Josef Grego (Slovakia) for comments about the species and reference specimens, and my landlord Chris Gurney for information about the history of the property.

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MOUNT WELLINGTON HUTS – AN INTRODUCTION

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Mount Wellington, on the western fringes of Hobart, offers the local natural historian all sorts of delights and frequently features in the pages of *The Tasmanian Naturalist*. However, one aspect that has received relatively little attention is its huts - or, in most cases, its hut remains. This article introduces the reader to the fascinating story of the Mountain's huts.

Early Hobart was heavily dependent on local timber for heating, cooking, building, and for export income. Knocklofty (formerly known as Woodcutters Hill) was soon denuded; some early drawings show a hill scarred with the tracks made by wood harvesters and stone gatherers. Attention then turned to the tall timber on the lower slopes of the Mountain. Trees were energetically cut until about 1855, when the supply of profitable timber was exhausted. The water-powered mills belonging to Stace and Degraves, which were situated on the upper Hobart Rivulet, had the lion's share of the timber, and from these mills an extensive network of timber tracks and timber haulage-ways radiated up the lower slopes, to about the altitude of the Sphinx Rock. The Lower Sawmill Track (which was reopened in 1985) is in fact a timber haulage track.

These timber routes, which were consequently abandoned and not yet completely overgrown, were used by Hobartians for access to secluded sites in the many small steepish valleys in the mountain foothills. It is a rare hut site on Mount Wellington that is not close to an old timber route and its accompanying group of sawpits. Some of the timber trails had the advantage of being dead-end tracks, with the added benefit to hut builders of privacy and security from vandalism. The timber trails were vital to the hut builders, who had to carry all of their hardware, supplies and tools to their site in the short time available to them at weekends.

It is possible that the craze of mountain hut building was in part a reaction to the long hours and somewhat miserable industrial working conditions at the close of the 19th century. Some photos show men posing with axes in "macho" style, perhaps trying to recapture the pioneer spirit of the early settlers

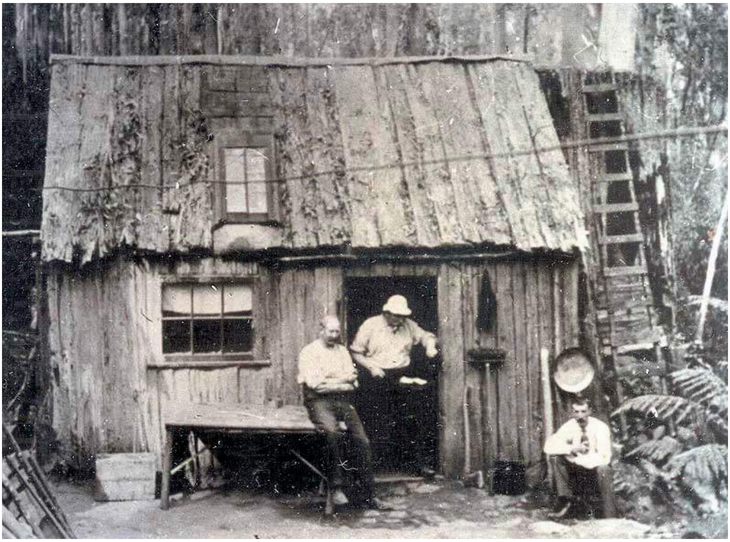

Figure 1. The Ellis and Sansom hut - whose design exemplifies late 19th Century utilitarianism.

Figure 2. The bridge at the Clematis and Falls hut exemplifies a certain elegance in late 19th Century design.

The design of these recreational huts ranged from the plain utilitarianism of the Ellis and Sansom hut (Figure 1) to the elegant Disneyesque complex at the Clematis and Falls Hut site, with its impossibly ornate decoration, fairy-tale high level bridges (Figure 2) and cleared landscaped areas near the water.

The employees of the Cascade Brewery were also hut builders; around the 1880's they built huts within easy range of the brewery which have now been either built over, or covered by the ever-growing McRobies tip. To date, no Cascade Company employee hut site has been identified, probably due to site disruption in the area, and the increased fire frequency on the lower slopes of the mountain. Interestingly there have been no written accounts yet discovered of visits to these particular huts; perhaps these huts were not attractive enough to inspire eloquence.

The Mountain has quite a history of exploitation since the Collins settlement was established on the Hobart Rivulet. Apart from the timber industry, immense quantities of building-quality sandstone were mined, and dozens of stone quarries can be discovered, many in the Waterworks Reserve. A slate-like stone was quarried near the Breakneck Track. The Cascade Prospecting Company operated a gold mine near Gentle Annie spur. Water was gathered from springs and mountain streams into pipes and aqueducts. Trappers and charcoal burners also operated on the lower slopes. Convicts were housed in a stockade above Ferntree to work at road building, and, of course, the bushranger Rocky Whelan rampaged in the area. Huts were also built for science and for surveying purposes at the summit (Thark hut and Wragge's observatory).

An examination of early hut photographs reveals the prevalence of the tree fern *Dicksonia antarctica* growing luxuriantly around most of the huts; however, site visits reveal that they have been much reduced in number since then. For example, Fern Tree hut (not near Ferntree) now has no tree ferns growing in the vicinity at all. It is possible that the water table on the lower slopes has lowered somewhat, perhaps as a result of more vigorous - and thirsty - regrowth forest arising from the ashes of the 1967 bushfires. Another pointer to a drier environment is the present day lack of water at some of the hut sites; Wattle Grove 2 and Webber and Teague huts, built on tributaries of the Guy Fawkes and McRobies Gully streams, now have no visible water available at all. The reduced water flow has been restricted to a trickle underneath the moss covered dolerite boulders in the stream bed.

There is happily at least one example of the original fern cover at the Falls/Clematis complex. The streamside promenade area has some impressive tree fern remnants, although the three central ferns have been burnt out.

There is so much still to be discovered regarding the history of our mountain. For example, where is Surveyor Hutchinson's hut on Snake Plains? The mountain reluctantly gives up its secrets. Almost any venture off-track reveals signs of past human activity. The ephemeral nature of these sites is quite evident, with, for example, plant growth dislodging rock foundations at the Wattle Grove Two hut site. A set of stone steps near the Sandy Bay Rivulet above the reservoirs seems to have disappeared in recent flooding, and the remains of Stace's watermill dam and sluice gate in the Hobart Rivulet have suffered much flood damage also.

Many of the abandoned recreational hut sites are very pleasant places to visit, and to spend a little time where so many people now long gone once had so much enjoyment. For example, the large beehive-type rock chimney at Musk Hut (Figure 3) is still in good condition, and is quite a sight to behold. The large hut platform at Wattle Grove 2 has enough room for the largest picnic party, and, of course, the three huts Sama, Retreat and Kara still stand, hidden from view at the end of obscure trails, hopefully safe for many years to come.

Figure 3. Musk hut, in its late 19th Century prime. Today, the rock chimney remains as the main evidence of its former glory.

Editor's note: readers might care to view John and Maria Grist's web site (www.users.bigpond.net.au/jandmgrist/index.htm) for further information on Mount Wellington's huts.

SIGNIFICANT RANGE EXTENSION FOR THE FRESHWATER MUSSEL *HYRIDELLA (HYRIDELLA) NARRACANENSIS* IN TASMANIA.

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ABSTRACT

Specimens of the freshwater mussel, *Hyridella (Hyridella) narracanensis* (Cotton & Gabriel, 1932), were recently found in the Boobyalla River in North East Tasmania. This is a significant range extension as, until this discovery, the species was only known from the South Esk catchment in Tasmania. Some possible implications of this record are discussed.

INTRODUCTION

A prominent component of the invertebrate fauna of many of the major rivers in Australia are large, black or brown freshwater mussels belonging to the family Hyriidae. Eighteen species are recognised for Australia as a whole with two of these being known from Tasmania (Smith, 1992). Until now, both the Tasmanian species were thought to be confined to the South Esk catchment (Smith & Kershaw, 1979). The larger of the two species, *Velesunio moretonicus* (Sowerby, 1865), is known from many parts of the catchment and is endemic to Tasmania. It has a heavy, black shell and can reach over 120 mm in length. The smaller one is *Hyridella (Hyridella) narracanensis* (Cotton & Gabriel, 1932) which has a thin brown shell and reaches about 60 mm in length. *Hyridella narracanensis* was originally described from the Narracan River, South Gippsland, Victoria and was recognised as the species found in the northern part of the South Esk in the major revision of the family published by McMichael & Hiscock (1958).

Hyriids have a complex life-cycle (Walker, 1981). After fertilisation, the developing larvae are held in a modified gill pouch (or marsupium) of the female until they form into shelled larvae called glochidia.. These are liberated and become parasitic on the gills of freshwater fish (or more rarely tadpoles or invertebrates), where they can stay for several weeks. They then detach and fall to the bottom and develop into juvenile mussels. This parasitic stage appears to be necessary to further the development of the larva, which can be transported great distances by the fish in that time. A definitive list of the possible host species for the two Tasmanian species of mussels is not available, but it is known that several species of galaxiids are used, together with other native fish species (Walker, 1981; Playford, 2004).

The adult mussels are filter-feeders, living in shallow, fairly swiftly flowing streams, usually in a sandy gravel substrate. They burrow using their strong muscular foot and then lie buried with only the posterior shell margins exposed, through which their short siphons extend into the stream flow. Water is drawn over the gills by ciliary action and food particles strained from the water. The species favours flowing water with little silt load.

Before the present study, Tasmanian records of *H. narracanensis* were from the Liffey River at Bishopsbourne, the South Esk River below Ben Lomond and the Cataract Gorge, Launceston (McMichael & Hiscock, 1958).

OBSERVATIONS

In May 2004, a dead valve of a small freshwater mussel was found by Sean Blake on the banks of the Boobyalla River, close to the junction with the Little Boobyalla River (Grid Ref. 572100 5468600). About a year later, on 17th May 2005, I went back to that site with Sean to look in the same area for further signs of the species. After a search of the area, a second single valve of the same species was found. Several stretches of the river were examined, but there was severe degradation of the riverine habitat with high silt loads in the water and disturbance of the banks and bed of the stream due to cattle trampling.

Figure 1. *Hyridella (Hyridella) narracanensis*. Left: Inside the valve of specimen no. QVM:9:22333, showing the arrangement of hinge teeth. Right:a live specimen (QVM:9:22335) showing the large muscular foot and the two mantle siphons protruding from the posterior end of the animal (on the right). Photos: Tammy Gordon.

A little further upstream a small section of the stream surrounded by dense scrub was found where cattle had been fenced out (Grid Ref. 571500 5468200). Here the water was clear and running over a bed of clean sandy gravel. The stream was flowing fairly rapidly and the water was only about 25 – 30 cm deep. Sieving through the surface of the gravel with a coarse net eventually yielded 2 live specimens of the small mussel. These were transferred to a container of clean water where they were observed to open the gap and extend their siphons. They also extended their white, muscular foot and attempted to move over the bottom of the container.

The 4 specimens (2 dead valves and 2 live collected animals) have been registered into the reference collections of the Queen Victoria Museum & Art Gallery. The measurements of these specimens are given in Table 1. The specimens (see Figure 1) were identified as *Hyridella narracanensis* as they were consistent with the description given in McMichael & Hiscock (1958) and with other Tasmanian and Victoria reference specimens held in the Museum's collections. The ratio of shell height (H) to length (L) for this species is 55 - 65%

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Table 1. Measurement of the shells of the specimens found

Specimen	State	Height (H) mm	Length (L) mm	Ratio H/L %
QVM:9:22333	dead	29	50	58
QVM:9:22334	dead	28	52	54
QVM:9:22335	live	20	31	64
QVM:9:22336	live	24	40	60

Discussion

Before this study the two species of hyriid mussels were only known in Tasmania from the South Esk catchment. This is still true of *Velesunio moretonicus*, but the finding of a population of *Hyridella narracanensis* living outside that catchment is significant and throws into doubt several of the assumptions about the species. The identification of populations of the same species of freshwater mussel on both sides of Bass Strait has always been a matter of some speculation. Have they been isolated since the last time a land bridge occurred between Tasmania and Victoria and if this is true are they tending towards becoming separate species? Work on a sister species, *Hyridella glenelgensis*, with reference to this species, was recently reported on by Playford (2004). He compared the biology and conservation status of these two small mussels in southern Victoria and some of his conclusions may be applicable to *Hyridella narracanensis* in Tasmania.

Another question that arises is – have these mussels always lived in other coastal rivers outside the South Esk system, or is this somehow a new occurrence? These two questions could be related when one remembers that these mussels go through a parasitic stage on the gills of fish. Some of the fish species that are known to carry mussels also occur in coastal streams on both sides of Bass Strait and they are also known to have a marine stage as part of their life history. Could it be that some fish migrate from a freshwater environment in Victoria, cross Bass Strait, and enter the fresh water of a coastal river in northern Tasmania? If this were to happen, then it might be that some of these fish could be carrying the glochidia larvae of a freshwater mussel on this migration. If this could happen, then are there populations of these mussels established in any other coastal rivers along the north coast of Tasmania? Why haven't such populations been found before? Is this another indicator of global warming and a changing climate?

Consequently, this find stimulates a whole series of questions to be asked. Are there any other populations of this mussel to be found in other north-flowing rivers along the Bass Strait coast of Tasmania? Which fish carry the glochidia larvae and is there any evidence that they can carry the larvae while at sea? Do we know if fish from a freshwater habitat in Victoria migrate to a freshwater habitat in Tasmania (or *vice versa*)? It might even be that this population, in a coastal river of North East Tasmania, has been established via a fish host from the known populations in the South Esk system. This may have occurred naturally through a short marine migration along the coast from the Tamar, or artificially by direct human agency. I feel that this latter possibility is the least likely as these are not fish species of interest to anglers and the locality is not near any angling locality. The river is small and shallow and mainly runs through agricultural land. Of even smaller possibility is the direct human translocation of the mussels themselves. It is hard to envisage any reason for such an act. To further this study, I would be very interested in seeing any other specimens of freshwater mussels from anywhere in the State.

ACKNOWLEDGEMENTS

I would like to thank Sean Blake and Peter Duckworth for bringing the initial specimen to my attention and to Sean for guiding me to the locality and assisting with the collection of the specimens. Thanks are also due to Tony Seymour the owner and Thomas Purcell the Manager of Boobyalla Vale property for permission to search for the animals. I would also like to thank Tammy Gordon of the Queen Victoria Museum and Art Gallery for taking the photographs and Professor Keith Walker of the University of Adelaide and Tarmo Raadik of the Arthur Rylah Institute for Environmental Research in Victoria for helpful suggestions.

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Groundsels and Fireweeds

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With over 1500 species worldwide, the herbaceous groundsels and fireweeds of the genus *Senecio* make up a significant portion of the daisy (Asteraceae) family. This genus has many interesting features and relationships, including two intriguing stories. The first explores how the hardy South African sticky groundsel (*Senecio viscosus*) imposed grief and extensive heartache up on the 'Imperial Bushmen Contingent' troops during the Boer War and the second describes the strange but painful exploding trousers problem arising from efforts to control the rampant Ragwort weed (*S. jacobaea*).

Groundsels exhibit attractive floral displays

Before exploring further the above two stories, let's highlight some of the fascinating attributes of the numerous groundsels and fireweeds species. Many species are horticultural gems appreciated for their contributions towards colourful garden displays. Well known are the reliable winter flowering, shade loving 'florists cineraria', *S. cruenta* and the old fashioned grey-leaved 'dusty miller', *S. cineraria*. Others include the garden gem, California geranium *S. petasitis* with its distinctive lobed foliage enveloping delightful yellow panicles and the bold bright yellow flowering trusses of the big-leaf groundsel *S. grandiflorus*.

Alpine and woodland groundsels abound

Tasmania is privileged to have 23 indigenous species including a suite of alpine Groundsels such as the single flowering yellow and cream forms of *S. pectinatus*, the floriferous *S. leptocarpus* and the showy *S. primulaefolius*. Common woodland species include the shrubby and common fireweeds, *S.minimus* and *S. linearifolius* and the differing forms of the variable groundsel *S. lautus*. These grow prolifically with their characteristic yellow daisy flowers, often dominating any bare soil. The more drought-tolerant natives, such as the silvery cotton fireweed, *S. quadridentatus*, hill fireweed, *S. hispidulus* and the annual fireweed *S. glomeratus* (with its distinctive covering of soft cobweb-like hairs), carry out a scab-like protective role particularly after bush fires and vegetation clearing. By temporarily protecting the soil from water erosion, they contribute significantly towards re-establishing the original woodland community and its delicately balanced interrelationships.

Butterfly-attracting flowers produce fluffy grey bearded seed heads

Most species develop a characteristic fluffy grey or white parachute-like seed heads (pappus). Since these resembled an old man's beard this feature resulted in the botanical name *Senecio*, derived from the Latin for old man '*Senex*'. Their common name, groundsel, came from '*grundeswyle*', Old German for 'Earth glutton'. It reflects upon the ability of its wind-blown seed to germinate freely, enabling them to act as pioneering colonisers. Close examination of their yellow flower heads, reveals many tiny ray and disc shaped florets, packed tightly together to resemble a single flower. This flower form evolved to provide a wonderfully simple way for nectar seeking insects to easily pollinate many flowers during only one visit. Hence it is not uncommon to observe them enveloped in a cloud of insect pollinators such as beetles, hoverflies, moths, native bees, flies, flower spiders and lady birds. The chaostola and donnysa Skippers along with the white grass dart and yellow banded dart butterflies take advantage of this feature, collecting nectar in exchange for their pollination services. Under protection of darkness their larva browses on native grasses or sedges and finally pupates by forming cylindrical cells, out of the leaves that they tie and roll together.

These butterflies are very territorial towards their groundsels, displaying aggression against other males or insects with buffeting and spiralling flight patterns. Their orange, brown and black colourations send a clear message to potential predators that they contain a highly toxic alkaloid (pyrrolizidine). In fact they have absorbed substantial amounts whilst feeding on the groundsel's pollens and flower parts. This same alkaloid has been linked to irreversible liver damage and death of stock. Flour (grain crops), milk (grazing cows) or honey (foraging bees) contaminated by groundsel are constant concerns to primary producers.

Sticky groundsel and ragwort caused disastrous impacts

Unfortunately, the *Senecio* genus contains a number of environmental weeds including the highly toxic ragwort *S. jacobaea* and the pretty purple groundsel *S. elegans*. Ragwort, being a prolific weed confronting pastoralists both in Australia and New Zealand was the focus of a major control program in the 1930's, using the unstable but effective potassium chlorate. However, the dust from this chemical trapped itself within the cotton fibres of horsemen's trousers. Once heated by riding friction it dramatically exploded causing severe burns and major loss of dignity to many devastated horsemen. It was soon replaced by another safer herbicide by the late 1930's.

Sticky groundsel is the most toxic of all groundsel weeds and this fact brings us back to our Boer War story. The trouper's horses making up the ranks of the Light-Horse Regiment were decimated by this toxic little South Africa native. This situation was described vividly in a quote by Adamson in the book *The Private Capital*. "*Horse sickness, a disease particular to South Africa, is doing its work: a horse starts out perfectly well and is dead by noon*". No wonder its war record had an enormous impact on the moral of the Aussie Light Horsemen, whose horses had accompanied them all the way from home. Beyond this strong bonding, their survival was a tribute to their trusty steeds.

As an aside, its succulent leaves have enabled to flourish, as a weed on gravel bedding along railway lines in the USA. Its fine roots clamber over the stone surfaces, scavenging moisture that condenses in the cool of the night between the stones. With its ability to kill most leaf-feeding insects, its insecticidal qualities are attracting research dollars.

Parrot's favourite treat

On a happier note, the common groundsel *S. vulgaris* often revives memories of those by-gone days when one's pet parrot, canary or finch was given a fresh sprig as a treat. Many of our feathered friends also enjoy without ill effects, pecking the developing seed heads from our native groundsels. These birds include the introduced European goldfinch, the greenfinch, the beautiful firetail (Tassie's only native finch) along with our colourful blue-winged parrot, Eastern and green rosellas and musk lorikeets. As gardeners feeding the birds is one of the many great reasons for growing a selection of hardy but cheery groundsels and fireweeds!

Winkles, whelks and warreners: a year of shelling at Taroona

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Figure 1. A view along Taroona Beach from its southern end. Sandy patches amongst the rocks in the foreground (where in this photo a group of marine naturalists are searching for shells) have yielded the highest proportion of seashell species on the Taroona foreshore list to date. Photo: Simon Grove.

Taroona is the northernmost suburb in Kingborough, on the western shore of the Derwent estuary, between Sandy Bay and Kingston. If one were to travel southwards down the estuary towards the ocean, one would travel along a gradient of increasing salinity, increasing tidal amplitude, decreasing exposure to river-borne pollutants and increasing exposure to oceanic influences. Taroona is situated at a point along this continuum where lower-energy estuarine influences give way to higher-energy conditions typical of the open coastline. Depending on the aspect, the bedrock and the distance from the River Derwent, one can find along Taroona's foreshore exposed wave-cut platforms (Alum Cliffs), semi-exposed sandy beaches (Taroona and Hinsby Beaches), semi-exposed boulder shorelines (Crayfish Point, Cartwright Point) and sheltered sandy-muddy beaches (School Beach).

I moved to Taroona four years ago, and was soon struck by the diversity of marine life that could be seen along the foreshore. The suburb's name is thought to be derived from an aboriginal word for chiton (a group of 8-plated molluscs, for which local rocky shores host many species). One of my favourite spots is at the southern end of Taroona Beach (Figure 1), where the shoreline topography and aspect combine to deliver fresh drifts of small shells with almost every tide. Last year I began systematically recording the seashells that I encountered on my frequent walks along various sections of this shoreline. For a full year (from 22nd May 2004 to 11th July 2005 – 39 visits) I databased every record of every species that I saw on a particular visit. Thereafter, I have chiefly kept a record of species for which I have retained specimens in my ever-expanding collection of Tasmanian seashells. This article summarises my findings to date. It is not intended as a guide to the natural history of local marine molluscs or their habitats: Graham Edgar's two volumes on marine habitats (Edgar 2001) and marine life (Edgar 2000) amply fulfill this role.

Winkles, whelks and warreners (or turban shells) are amongst the better-known of Tasmanian seashells – hence the title of this paper. Taroona hosts all the typical species that fit this description. But it turns out that these are just the tip of the iceberg. Almost every additional visit I make reveals further species that I had not previously recorded in Taroona. Indeed, for reasons which I will expand on later, the rate of discovery shows every sign of increasing (Figure 2), and at the time of writing had reached 215 species (Appendix 1). As is often the case with biological inventory data, the species list is dominated by species that were individually rarely recorded. For instance, during my fourteen months of intensive recording, there were thirty species that I only ever encountered once, with a further fifteen species recorded just twice each (Figure 3). This does not necessarily mean that they are genuinely rare. For many, it is just as likely that Taroona is not optimal habitat. For instance, the bivalves *Paphies erycinaea*, *Anapella cycladea* and *Spisula trigonella*, and the mud-snail *Nassarius pauperatus* are more typical of lower-energy shorelines: they are more common at Sandy Bay.

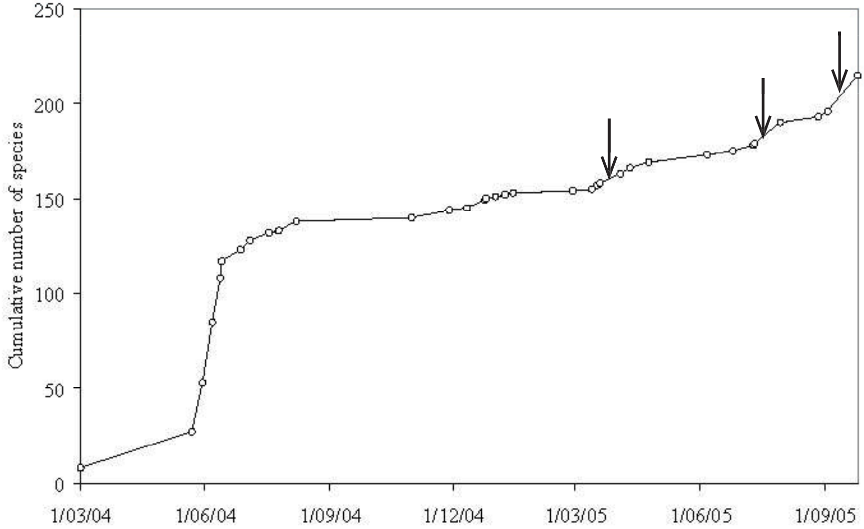

Figure 2. Species accumulation curve for marine molluscs, based on my recent visits to the Taroona foreshore. The recent upturns in the rate of accumulation, indicated by the three arrows, can be attributed to my starting to sample shell-grit.

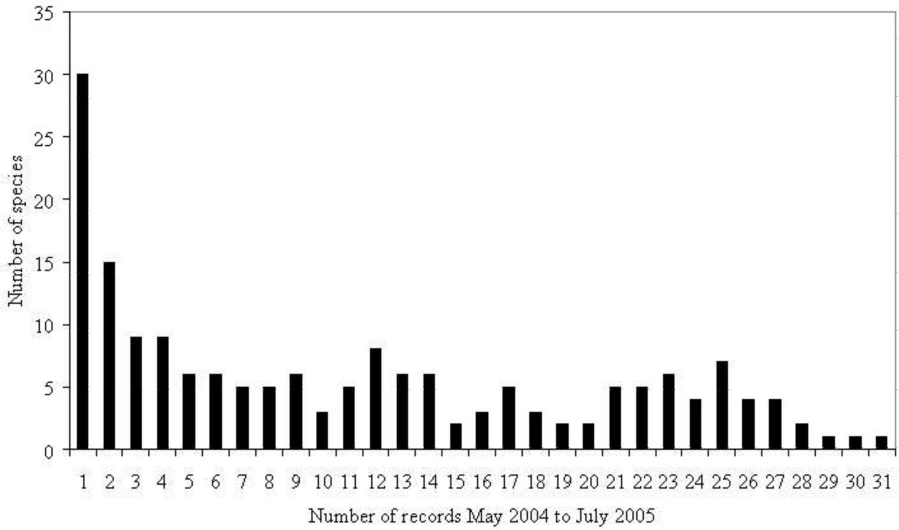

Figure 3. The frequency with which I have recorded seashell species along the Taroona foreshore over 39 visits between May 2004 and July 2005.

By contrast, the necklace-shell *Polinices tasmanica*, the file-shell *Limatula strangei*, the white rock-shell *Cleidothaerus albidus* and the murex *Agnewia tritoniformis* are typical of more oceanic conditions and are commoner south of Taroona. Other species may be common in deeper waters in the mouth of the Derwent, but rarely beached. These would include the large volutes *Livonia mammilla* and *Ericusa sowerbyi* and the whelk *Penion maximus*.

Yet other species on the list are so small that their apparent rarity may merely reflect the difficulty of actually spotting them. The tiny bivalve *Lasaea australis* is one such species that I had only encountered in small numbers until recently, and had been pleased to do so because of its attractive purple colouration. I knew it wasn't rare – it lives intertidally amongst the byssus threads of mussels or wedged into empty barnacle shells. But what really brought home to me the scale of its abundance was examining under a microscope several dried scoops of shell grit from various spots along the foreshore. Instantly, a whole new world of micromolluscs was revealed. What had seemed likely to contain only broken bits of limpets and topshells in fact contained dozens of species of seashells each no bigger than a grain of rice – and many of them considerably smaller. *Lasaea australis* is actually one of the more abundant and larger species in this mix (Figure 4).

Figure 4. A typical sample of micromolluscs from Taroona. These specimens were extracted from a handful of shell grit from the School Beach. The white arrow is about 5 mm long and points to a valve of the bivalve *Lasaea australis*.

Identifying the smaller species is no easy task. For the larger species Margaret Richmond's two volumes (Richmond 1992; 1997) generally suffice, as would the field guide by the Tasmanian Marine Naturalists Association (TMNA 2003). However, for the smaller species the standard work on Tasmanian molluscs (May & Macpherson, 1958) is both difficult to obtain and difficult to use - and many of the scientific names are outdated. My prospects of identifying the smaller species have been boosted enormously by being granted occasional access by the Tasmanian Museum to their new Collections and Research Facility at Rosny. The Facility hosts important collections of molluscs from around Tasmania, including many type specimens. Under Liz Turner's guidance, I have thus been able to put names to most of what I have found so far, but doubtless many further species await local discovery.

Figure 5 demonstrates that as my quest for novelty in the Taroona seashell fauna continues, so the average size of the additional species encountered decreases. Whereas for the first few months of this survey I could expect to find additional species in the 10-100 mm size-range, in the last few months this had dropped to the 1-10 mm range - although there are still much larger additional species turning up occasionally.

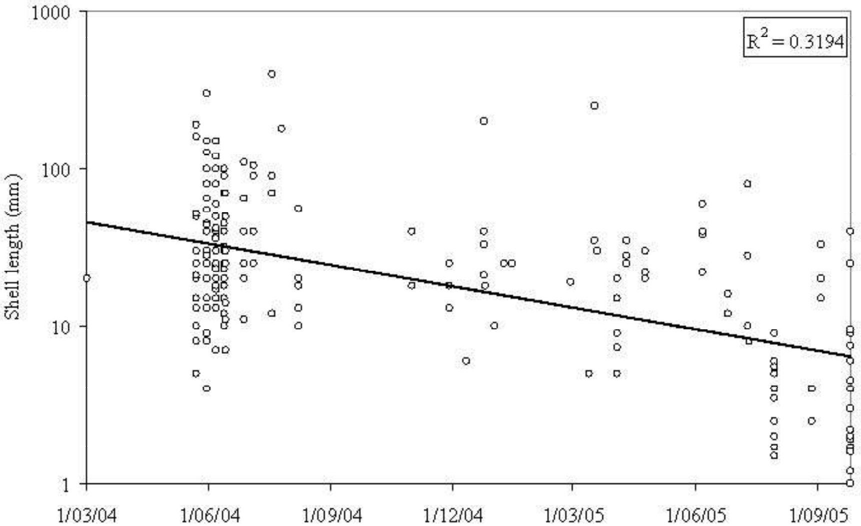

Figure 5. Relationship between date of first record and typical shell length for the species in question, for all 215 species of shells that I have recorded to date on the Taroona foreshore. Note that a logarithmic scale is used for the y-axis.

At the other end of the abundance scale are species that I found almost every time I went down to the beach – but they are few in number. The three most consistently recorded species are the kelp-snail *Phasianotrochus irisodontes*, the false-cockle *Venericardia bimaculata* and the margin-shell *Mesoginella pygmaeoides*. Because of their small size (4-12 mm), none of these species would be apparent to the casual visitor to the beach, but are there to be seen for those willing to get down on hands and knees and explore the drifts of shells that accumulate along the strandline or in the lee of intertidal rocks adjacent to Taroona's sandy beaches.

It is encouraging that nearly all the species on the list are native. The chief exceptions are the Pacific oyster *Crassostrea gigas*, the New Zealand clam *Venerupis largillierti*, the green chiton *Chiton glaucus* and the New Zealand screw shell *Maoricolpus roseus*. The first is a native of the temperate North Pacific, while the other three come from New Zealand and may have inadvertently been transplanted from there with stock of oysters imported for on-growing. All are now fairly common at Taroona, and one must wonder whether they have ousted native species. For instance, I have only ever found extremely worn (and presumably old) specimens of the native screw shell *Gazameda gunnii*, while the vast majority of beached native mud oyster *Ostrea angasi* shells are also old and worn.

For a small proportion of species, I remain unsure as to whether the presence of empty shells on the beach implies the presence of living animals in the vicinity, or whether they have been washed in from afar. However, major and consistent declines in shell abundance and richness over recent decades have been recorded from sediment cores taken at a range of locations in the Derwent estuary and the D'Entrecasteaux Channel (Edgar and Samson, 2004). It seems that continued urbanisation and concomitant pollution issues due to stormwater runoff, sewage discharge and factory discharge, coupled with shellfish trawling and overfishing, mean that the health of the local marine environment is far worse than its pre-European condition (Edgar *et al*. 2005). That being the case, one can only marvel at the resilience of the species that are still present at Taroona, and wonder at what additional species one might have encountered a century or two ago. I hope that this article will at least find use as a baseline against which to compare any future changes to our foreshores and to the outstanding marine life that exists beyond the breaking waves.

I am also unsure of the current local status of the large whelk *Penion mandarinus*. All specimens that I have noted have borne large holes in the main body whorl, and at least one of these was found on the strand-line in the vicinity of a recognised aboriginal midden site near the Taroona High School. Maybe they represent the ancient remains of an aboriginal meal - though I doubt that whelks would have been as favoured as the more abundant warreners and oysters. On the other hand, I can see no clear reason why the species should not still occur here.

Two further species deserve a mention – though I have not included them in Appendix 1. One is a venerid clam *Antigona* sp, probably *A. clathrata*. This is a tropical Indo-Pacific species, which in Australia is confined to the Great Barrier Reef and vicinity. Yet in September 2005 I found a single very worn specimen near the boat-ramp on Taroona Beach. At this stage I assume it was jettisoned from a child's bucket. An alternative possibility is that it is an old specimen of a species that once occurred here hundreds or thousands of years ago. Examples of warmer-water species (such as the bivalves *Anadara trapezia*) may occasionally get washed up on beaches in southeast Tasmania from offshore deposits near Clifton and Seven Mile Beach, dating from a period in southeast Tasmania's history when water temperatures were higher. However, to my knowledge not even these deposits contain tropical species (*Anadara trapezia* is cold-tolerant enought to still live in Victoria), and in any event I have no other evidence of shells from these deposits being washed up at Taroona. The second species of dubious origin is the greenlip abalone *Haliotis laevigata*. Though common on the north coast of Tasmania it is generally absent from the cooler waters further south, and I believe the source of the single large shell that I found on Taroona Beach is once again more likely to have been a child's bucket.

Acknowledgements

I would not have been able to figure out the identity of many of the shells listed here had Graham Edgar not lent me his comprehensive collection of shell identification books, and had Liz Turner not given freely of her time and malacological expertise in her position at the Tasmanian Museum's Rosny Collections and Research Facility. Between them, they have set me on a path that intrigues and fascinates me more by the day. My wife Chris and sons James and Ben have frequently accompanied me on shelling forays, and even when they haven't they have (usually) accepted my passion for shelling with grace and good humour.

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Appendix 1. Taxonomic listing of seashells that I have recorded along the Taroona Foreshore. Taxonomy is based on my ongoing review of the recent literature. Numbers refer to the number of visits on which I have recorded the species, and serve as a guide to their relative frequency of occurrence at Taroona. However, as explained in the text, I only recorded species systematically for just over a year (39 visits) while the numbers in this list also include records made over about a dozen subsequent visits in which only retained shells were recorded.

Species	**No. of records**
CHITONIDAE	
Chiton glaucus Gray, 1828	1
Sypharochiton pelliserpentis (Quoy & Gaimard, 1836)	9
NUCULANIDAE	
Nuculana (Scaeoleda) crassa (Hinds, 1843)	13
MYTILIDAE	
Brachidontes (Brachidontes) rostratus (Dunker, 1857)	17
Musculus impactus (Hermann, 1782)	10
Mytilus (Mytilus) galloprovincialis Lamarck, 1819	28
Trichomusculus barbatus (Reeve, 1858)	1
Xenostrobus inconstans (Dunker, 1856)?	1
Xenostrobus pulex (Lamarck, 1819)	30
GLYCYMERIDAE	
Glycymeris (Glycymeris) striatularis (Lamarck, 1819)	24
PTERIIDAE	
Electroma (Electroma) georgiana (Quoy & Gaimard, 1834)	9
LIMIDAE	
Limatula strangei (Sowerby, 1872)	3

Species	No. of records
OSTREIDAE	
Crassostrea gigas Thunberg, 1793	19
Ostrea (Eostrea) angasi Sowerby, 1871	25
PECTINIDAE	
Equichlamys bifrons (Lamarck, 1819)	11
Mimachlamys asperrima (Lamarck, 1819)	14
Pecten fumatus Reeve, 1852	23
TRIGONIIDAE	
Neotrigonia margaritacea (Lamarck, 1804)	3
LUCINIDAE	
Divalucina cumingi (A. Adams & Angas, 1863)	12
Epicodakia tatei (Angas, 1879)	2
Wallucina assimilis (Angas, 1868)	8
UNGULINIDAE	
Fellaniella (Zemysia) globularis (Lamarck, 1818)	5
GALEOMMATIDAE	
Lasaea australis (Lamarck, 1818)	28
Myllita (Myllita) tasmanica Tenison Woods, 1875	1
Mysella lactea Hedley, 1902?	1
CYAMIIDAE	
Cyamiomactra mactroides Tate & May, 1900	1
GAIMARDIIDAE	
Gaimardia (Neogaimardia) tasmanica (Beddome, 1882)	4
CARDITIDAE	
Cardiocardita (Bathycardita) raouli (Angas, 1872)	1
Cardita excavata Deshayes, 1854	8
Hamacuna hamata (Hedley & May, 1908)	1
Venericardia bimaculata (Deshayes, 1854)	33
CONDYLOCARDIIDAE	
Condylocardia limaeformis Cotton, 1930	1
Condylocardia pectinata (Tate & May, 1900)	3
Condylocardia rectangularis Cotton, 1930	1
Cuna concentrica Hedley, 1902	1
Cuna delta (Tate & May, 1900)	1
Ovacuna atkinsoni (Tenison Woods, 1877)	1
CARDIIDAE	
Fulvia tenuicostata (Lamarck, 1819)	22
Nemocardium (Pratulum) thetidis (Hedley, 1902)	5
MACTRIDAE	
Mactra (Austromactra) rufescens Lamarck, 1819	6
Mactra (Electomactra) antecedens Iredale, 1930	14
Spisula (Notospisula) trigonella (Lamarck, 1818)	2

Species	No. of records
MESODESMATIDAE	
Anapella cycladea (Lamarck, 1818)	1
Paphies (Amesodesma) elongata (Reeve, 1854)	15
Paphies (Atactodea) erycinaea (Lamarck, 1819)	1
TELLINIDAE	
Pseudarcopagia botanica Hedley, 1918	9
Tellinella albinella (Lamarck, 1818)	1
PSAMMOBIIDAE	
Gari (Psammobia) livida (Lamarck, 1818)	10
Soletellina (Soletellina) biradiata (Wood, 1815)	12
VENERIDAE	
Bassina (Callanaitis) disjecta (Perry, 1811)	8
Callista (Notocallista) diemenensis (Hanley, 1844)	18
Dosinia caerulea Reeve, 1850	11
Eumarcia fumigata (Sowerby, 1853)	1
Irus (Irus) carditoides (Lamarck, 1818)	7
Irus (Notopaphia) griseus (Lamarck, 1818)	24
Katelysia scalarina (Lamarck, 1818)	1
Placamen placidum (Philippi, 1844)	22
Tawera gallinula (Lamarck, 1818)	14
Tawera lagopus (Lamack, 1818)	1
Timoclea (Chioneryx) cardioides (Lamarck, 1818)	10
Venerupis (Paphirus) largillierti (Philippi, 1849)	14
Venerupis (Venerupis) anomala (Lamarck, 1818)	22
PETRICOLIDAE	
Petricola (Velargilla) rubiginosa (A. Adams & Angas, 1864)	4
HIATELLIDAE	
Hiatella australis (Lamarck, 1818)	27
PHOLADIDAE	
Barnea (Anchomasa) obturamentum Hedley, 1893	9
Pholas (Monothyra) australasiae Sowerby, 1849	4
MYOCHAMIDAE	
Myadora brevis Sowerby, 1829	1
CLEIDOTHAERIDAE	
Cleidothaerus albidus (Lamarck, 1819)	3
SEPIIDAE	
Sepia (Mesembrisepia) novaehollandiae Hoyle, 1909	1
PATELLIDAE	
Patella (Scutellastra) peronii Blainville, 1825	20
NACELLIDAE	
Cellana solida (Blainville, 1825)	24
LOTTIIDAE	
Notoacmea corrodenda (May, 1920)	12

Species	**No. of records**
LOTTIIDAE	
Notoacmea flammea (Quoy & Gaimard, 1834)	24
Notoacmea mayi (May, 1923)	3
Notoacmea petterdi (Tenison Woods, 1876)	8
Patelloida alticostata (Angas, 1865)	22
LOTTIIDAE	
Patelloida insignis (Menke, 1843)	21
Patelloida latistrigata (Angas, 1865)	21
Patelloida profunda (Crosse & Fischer, 1864)	27
Patelloida victoriana (Singleton, 1937)	9
SCISSURELLIDAE	
Sinezona pulchra (Petterd, 1884)	1
HALIOTIDAE	
Haliotis (Notohaliotis) ruber Leech, 1814	19
FISSURELLIDAE	
Amblychilepas javanicensis (Lamarck, 1822)	2
Amblychilepas nigrita (Sowerby, 1834)	2
Emarginula (Emarginula) candida (A. Adams, 1851)	9
Hemitoma (Montfortia) subemarginata (Blainville, 1819)	5
Macroschisma tasmaniae Sowerby, 1866	15
Montfortula rugosa (Quoy & Gaimard, 1834)	27
Scutus (Scutus) antipodes Montfort, 1810	8
TURBINIDAE	
Astralium aureum (Jonas, 1844)	13
Phasianella australis (Gmelin, 1791)	17
Turbo (Subninella) undulatus Lightfoot, 1786	22
TROCHIDAE	
Austrocochlea brevis Parsons & Ward, 1994	3
Austrocochlea concamerata (Wood, 1828)	10
Austrocochlea constricta (Lamarck, 1822)	21
Austrocochlea odontis (Wood, 1828)	28
Bankivia fasciata (Menke, 1830)	18
Cantharidella tiberiana (Crosse, 1863)	1
Clanculus aloysii Tenison Woods, 1876	15
Clanculus flagellatus (Philippi, 1848)	1
Clanculus limbatus (Quoy & Gaimard, 1834)	15
Clanculus plebejus (Philippi, 1851)	28
TROCHIDAE	
Clanculus undatus (Lamarck, 1816)	2
Fossarina (Fossarina) petterdi Crosse, 1870	6
Fossarina (Minopa) legrandi Petterd, 1879	8
Gibbula (Hisseyagibbula) hisseyana (Tenison Woods, 1876)	1
Phasianotrochus eximius (Perry, 1811)	16

Species	No. of records
TROCHIDAE	
Phasianotrochus irisodontes (Quoy & Gaimard, 1834)	31
Phasianotrochus rutilis (A. Adams, 1853)	10
SKENEIDAE	
Cirsonella weldii (Tenison Woods, 1876)?	1
TROCHACLIDIDAE	
Acremodontina translucida (May, 1915)	2
CERITHIIDAE	
Cacozeliana granarium Kiener, 1842	26
DIALIDAE	
Diala suturalis (A. Adams, 1853)	4
LITIOPIDAE	
Alaba monile (A. Adams, 1862)	18
TURRITELLIDAE	
Gazameda gunnii (Reeve, 1848)	6
Maoricolpus roseus (Quoy & Gaimard, 1834)	26
SILIQUARIIDAE	
Stephopoma nucleocostata May, 1915	1
PLESIOTROCHIDAE	
Plesiotrochus monachus (Crosse & Fischer, 1864)	26
LITTORINIDAE	
Afrolittorina praetermissa (May, 1909)	26
Austrolittorina unifasciata (Gray, 1826)	27
Bembicium melanostomum (Gmelin, 1791)	17
Bembicium nanum (Lamarck, 1822)	16
Risellopsis mutabilis May, 1909	3
Rufolacuna bruniensis (Beddome, 1883)	1
EATONIELLIDAE	
Crassitoniella erratica (May, 1912)	1
Eatoniella (Eatoniella) melanochroma (Tate, 1899)	3
ANABATHRONIDAE	
*Anabathron (Scrobs) luteofuscu*s May, 1919	3
Badepigrus badia (Petterd, 1884)	3
RISSOIDAE	
Alvania (Alvania) fasciata (Tenison Woods, 1876)	1
Lironoba australis (Tenison Woods, 1877)	3
Merelina gracilis (Angas, 1871)	1
Rissoina (Rissoina) fasciata (A. Adams, 1853)	1
Rissoina (Rissoina) rhyllensis Gatliff & Gabriel, 1908	1
HYDROBIIDAE	
Tatea rufilabris (A. Adams, 1862)	4
HIPPONICIDAE	
Antisabia foliacea (Quoy & Gaimard, 1835)	1

Species	No. of records
HIPPONICIDAE	
Sabia australis Lamarck, 1819	13
CALYPTRAEIDAE	
Calyptraea calyptraeformis Lamarck, 1822	17
Zeacrypta immersa (Angas, 1865)	1
CYPRAEIDAE	
Cypraea (Notocypraea) angustata Gmelin, 1791	15
Cypraea (Notocypraea) comptoni Gray, 1847	1
Cypraea (Notocypraea) declivis Sowerby, 1870	2
TRIVIIDAE	
Trivia (Ellatrivia) merces (Iredale, 1924)	2
NATICIDAE	
Eunaticina umbilicata (Quoy & Gaimard, 1833)	3
Friginatica beddomei (Johnston 1884)	6
Polinices (Conuber) conicus (Lamarck, 1822)	25
Polinices (Conuber) tasmanica (Tenison Woods, 1876)	2
Sinum zonale (Quoy & Gaimard, 1833)	1
CASSIDAE	
Semicassis (Antephalium) semigranosum (Lamarck, 1822)	17
Semicassis (Semicassis) pyrum (Lamarck, 1822)	2
RANELLIDAE	
Argobuccinum pustulosum (Lightfoot, 1786)	10
Cabestana spengleri Perry, 1811	21
Cabestana tabulata (Menke, 1843)	5
Ranella australasia (Perry, 1811)	1
Sassia (Cymatiella) eburnea (Reeve, 1844)	7
Sassia (Cymatiella) verrucosa (Reeve, 1844)	21
TRIPHORIDAE	
Hedleytriphora scitula (A. Adams, 1851)	1
CERITHIOPSIDAE	
Ataxocerithium serotinum (A. Adams, 1855)	1
EPITONIIDAE	1
Epitonium (Hyaloscala) jukesianum (Forbes, 1852)	10
Epitonium (Hyaloscala) tacitum (Iredale, 1936)?	1
Opalia (Granuliscala) granosa (Quoy & Gaimard, 1834)	1
Opalia (Opalia) australis (Lamarck, 1822)	13
ACLIDIDAE	
Austrorissopsis brevis (May, 1919)	1
EULIMIDAE	
Melanella inflata (Tate & May, 1900)?	1
MURICIDAE	
Agnewia tritoniformis (Blainville, 1832)	3
Bedeva paivae (Crosse, 1864)	13

Species	**No. of records**
MURICIDAE	
Lepsiella (Lepsiella) vinosa (Lamarck, 1822)	13
Litozamia brazieri (Tenison Woods, 1876)	11
Litozamia petterdi (Crosse, 1870)	5
Phycothais reticulata (Blainville, 1832)	15
Prototyphis angasi (Crosse, 1863)	4
Thais (Dicathais) orbita (Gmelin, 1791)	23
BUCCINIDAE	
Cominella (Cominella) lineolata (Lamarck, 1809)	22
Penion mandarinus (Duclos, 1831)	2
Penion maximus (Tryon, 1881)	1
Tasmeuthria clarkei (Tenison Woods, 1876)	13
COLUMBELLIDAE	
Anachis atkinsoni Tenison Woods, 1875	3
Mitrella (Dentimitrella) legrandi (Tenison Woods, 1876)	2
Mitrella (Dentimitrella) pulla Gaskoin, 1852	1
Mitrella (Dentimitrella) semiconvexa (Lamarck, 1822)	13
Mitrella (Dentimitrella) tayloriana (Reeve, 1859)	29
Mitrella (Dentimitrella) vincta (Tate, 1893)	17
Pseudamycla dermestoidea (Lamarck, 1822)	27
NASSARIIDAE	
Nassarius (Niotha) nigellus (Reeve, 1854)	28
Nassarius (Niotha) pauperatus (Lamarck, 1822)	1
FASCIOLARIIDAE	
Fusinus (Fusinus) novaehollandiae (Reeve, 1847)	24
Pleuroploca australasia (Perry, 1811)	17
VOLUTIDAE	
Amoria undulata (Lamarck, 1804)	8
Ericusa sowerbyi (Kiener, 1839)	1
Livonia mammilla (Sowerby, 1844)	1
OLIVIDAE	
Alocospira marginata (Lamarck, 1811)	4
Belloliva leucozona (A. Adams & Angas, 1864)	5
MARGINELLIDAE	
Austroginella formicula (Lamarck, 1822)	14
Mesoginella pygmaeoides (Singleton, 1937)	32
Mesoginella turbinata (Sowerby, 1846)	6
MITRIDAE	
Mitra (Mitra) carbonaria Swainson, 1822	3
VOLUTOMITRIDAE	
Waimatea obscura (Hutton, 1873)	6
COSTELLARIIDAE	
Austromitra analogica (Reeve, 1845)	13

Species	No. of records
COSTELLARIIDAE	
Austromitra tasmanica (Tenison Woods, 1876)	1
Cancellaria (Sydaphera) lactea Deshayes, 1830	5
TURRIDAE	
Epidirona quoyi (Desmoulins, 1842)	1
Etrema bicolor (Angas, 1871)	1
TURRIDAE	
Guraleus (Euguraleus) tasmanicus (Tenison Woods, 1876)	2
Guraleus (Guraleus) pictus (A. Adams & Angas, 1864)	1
Guraleus (Mitraguraleus) mitralis (A. Adams & Angas, 1863)	2
TEREBRIDAE	
Duplicaria ustulata (Deshayes, 1857)	1
Terebra tristis Deshayes, 1859	1
CONIDAE	
Conus anemone Lamarck, 1810	4
PYRAMIDELLIDAE	
Odostomia deplexa Tate & May, 1900	3
Syrnola bifasciata Tenison Woods, 1875	1
Turbonilla (Chemnitzia) fusca (A. Adams, 1855)	3
Turbonilla (Turbonilla) mariae Tenison Woods, 1876	6
SIPHONARIIDAE	
Siphonaria (Pachysiphonaria) tasmanica Tenison Woods, 1876	5
Siphonaria (Siphonaria) diemenensis Quoy & Gaimard, 1833	26
Siphonaria (Siphonaria) funiculata Reeve, 1856	25
ELLOBIIDAE	
Marinula xanthostoma A. Adams & H. Adams, 1855	6

Floristic composition of a six-year-old clearfelled coupe in the Weld/Huon valley

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Summary

The floristic composition of a 160 ha coupe, Warra 011B, was surveyed six years after it was clearfelled, burnt and sown (CBS) and compared with a pre-harvest survey to determine the change in species composition due to the silvicultural treatment. The comparison is limited because the pre-harvest survey was based on a planned walk that sampled a range of environments and maximised species richness information whereas the post-harvest survey was based on 9 randomly located 100 m^2 plots plus a reconnaissance walk across the coupe. Additional uncertainty resulted from different botanical skill levels in pre-harvest and post-harvest surveyors.

The pre-harvest survey recorded 54 species. Of these, 31 species (57%) were also recorded in the regeneration at age 6. Fifty-seven native vascular plant species were present in the regeneration, which included 26 species that had not been recorded in the coupe before harvest. Twenty-three species that had been recorded before logging were not found in the regeneration. Eleven of these were epiphytic ferns, which may re-establish as moist microhabitats develop within the growing forest. Although the CBS treatment has changed species assemblages, the regeneration includes a diverse flora with a high representation of early successional species.

A weak negative relationship was found between distance from the mature forest edge and the richness of rainforest species, which suggests that retained mature forest edges facilitate the recolonisation of rainforest species. There was no significant relationship between edge distance and the richness of non-rainforest species, which suggests that the distribution of propagules for these species was more even.

The results will be used to inform guided visitors to the coupe, which currently number about 300 people annually. An ongoing study at the nearby Warra Silvicultural Systems Trial, based on multiple measurements of

permanent plots established prior to harvesting, should more precisely determine the long-term effects of clearfell, burn and sow, and alternative silvicultural practices, on the floristic composition of wet eucalypt forests.

Introduction

Warra 011B (GDA 476000E 5232500N) is a 160 ha coupe (Figure 1) with an altitudinal range of more than 200 m. It is accessed via Warra Road and is often used visited on guided tours to the Warra Long Term Ecological Research Site (www.warra.com). About 300 people are guided through the Site annually. An informal lookout above a quarry at Warra 011B provides excellent views of the Weld Valley, Snowy Range, Barn Back and, in the distance, Mt Wellington.

Figure 1. Aerial view of Warra 011B in 1998. Note Weld Ridge in the background and Warra 012E (clearfelled, burnt and sown in 1989) to the right. The informal lookout is located above a quarry near the centre of the coupe.

A pre-harvest botanical survey (Williams 1986) resulted in a list of communities and vascular plant species for the coupe. Harvesting of special timbers commenced in 1985 and clearfelling was carried out over the period from 1991 through to 1996. The coupe was enlarged due to the lengthy delay in approval of annual woodchip licences for new coupes while the Australian and Tasmanian Governments negotiated arrangements for the Comprehensive Regional Assessment process that led to the 1997 Regional Forest Agreement. The coupe was burnt and sown in March 1998 with a mixture of *Eucalyp-*

tus obliqua and *E. delegatensis* (sowing mix 38% and 62% respectively).

A short study was undertaken in December 2004 to record vascular species richness and abundance in the six-year-old regeneration and compare it with the species recorded from the pre-harvesting survey. The main purpose was to provide information for mooted interpretation development at the informal lookout. A secondary aim was to compare the local floristic changes after clearfelling at Warra 011B with broader studies conducted elsewhere, e.g. Hickey (1994). It was also of some interest to compare findings at Warra 011B with a report (Green *et al.* 2004) of another regenerated coupe in the Weld Valley (Warra 15H) where the authors reported only 12 vascular species in the regeneration.

Methods

Pre-harvest survey

A pre-harvest botanical survey was carried out over Warra 012A and 011A (Williams 1986). Warra 011A was since integrated into the larger 011B coupe. Species found in 012A but not in 011A were excluded from the comparison. Williams undertook a planned walk that encompassed a range of environments to maximise species richness information. The lower elevations of 011B, with tall *E. obliqua* mixed forest were not included in the sampling area. Some 54 vascular species were recorded within Warra 011B, including 44 classified as rainforest species (after Jarman *et al.* 1991).

Three forest communities were recorded by Williams (1986):

- Tall *E. delegatensis* over *Nothofagus cunninghamii*, *Phyllocladus aspleniifolius*, *Eucryphia lucida* and *Atherosperma moschatum* thamnic rainforest.
- Tall *E. delegatensis* forest over *Atherosperma moschatum*, *Eucryphia lucida* and *Nothofagus cunninghamii* with a predominant *Dicksonia antarctica* understorey.
- Tall *E. nitida* forest over *Phyllocladus aspleniifolius* implicate rainforest.

Post harvest survey:

Species frequency and abundance was determined from nine 10 m by 10 m plots previously established for a study of *E. obliqua*–*E. delegatensis* seedling dominance (Neyland and Dingle 2000) which stratified the coupe into three altitude zones:

- High (approx 520-450 m)
- Middle (approx 450-380 m)
- Low (approx 380-300 m)

Three plots within each altitude zone were randomly selected using a random number table. The plots were sampled in December 2004 for landform, drainage, slope, aspect, rock cover and floristics. All vascular species present at each plot were noted and recorded using the Braun-Blanquet scale (Mueller-Dombois and Ellenberg 1974).

A reconnaissance walk through the coupe, covering all three altitudinal zones, was carried out in January 2005 to identify species that may have been present in the coupe but absent from the nine sample plots due to their low frequency in occurrence.

Data analysis

The data were used to compile a list of species present before and after logging, species present before logging and absent after, and previously unrecorded species that had colonised the disturbed area. Species richness was considered within life-form classes: trees, tall shrubs, low shrubs, ground ferns, epiphytic ferns, herbs and sedges and climbers, based on the dominant form of the mature plant.

Mean frequency (the number of plots with a particular species as a percentage of the total number of plots) and mean percent cover was calculated for each species. In order to establish mean percent cover, the Braun-Blanquet classes were transformed to their midpoints as follows: <1= 0.5%, 2=3%, 3=15%, 4=37.5%, 5=62.5%, 6=87.5% and then meaned across the nine sample plots.

Edge effects on floristics were determined by categorising plots into two classes, up to 100 m from the mature forest edge (3 plots) and those beyond 100 m from the forest edge (6 plots). Rainforest species, non-rainforest species and total vascular species richness all were compared between classes using t tests. The effect of edges on the life-form of species present was also considered, using the divisions of <100 m and >100 m from the mature forest edge. Herbs and sedges, ground ferns and climbers were not analysed due to very low species counts.

Results

Total vascular species richness increased slightly from 54 species prior to treatment to 57 species at six years post-harvest (Table 1).

Table 1. Species richness prior to (Oldgrowth), and six years after (Regeneration), at a clearfell, burn and sow treatment at Warra 011B.

Life-form	**Mean Species Richness**	
	Old growth	**Regeneration**
Trees	8	13
Tall Shrubs	13	19
Low shrubs	9	16
Herbs & sedges	5	3
Epiphytic ferns	11	0
Ground ferns	6	5
Climbers	2	1
Total	**54**	**57**

Twenty-three of the 54 species recorded at the site in 1986 were not found in regeneration at WR011B. The number of tree species, tall shrubs and low shrubs increased, while the number of herbs and sedges, ground ferns, epiphytic ferns and climbers decreased. No species of epiphytic fern persisted in any of the areas surveyed, accounting for 48% of all species that failed to be detected.

Table 2 shows species recorded at either the pre-harvest, post-harvest or both surveys. Some 43% (23 species) of species identified in the pre-harvest survey were not recorded in the regeneration. Conversely, 46% (26 species) of species identified in the regeneration had not been recorded in the pre-harvest survey. Several *Acacia* and *Leptospermum* tree species were recorded in the regeneration but not in the oldgrowth forest. The absence of *Eucryphia milliganii* in the regeneration may reflect a localised occurrence in the oldgrowth forest, because its congeneric, *Eucryphia lucida* was found at both surveys. The apparent absence of *Eucalyptus obliqua* in the oldgrowth forest is an obvious anomaly and reflects the fact that the pre-harvest survey did not sample the lower elevations of the coupe. The sclerophyllous tall shrubs *Banksia*, *Cassinia*, *Notelaea*, *Prostanthera* and *Zieria* were found in the regeneration, but not recorded in the oldgrowth forest. The sclerophyllous low shrubs *Bauera*, *Correa* and *Lomatia* were recorded in the regeneration but not in the oldgrowth. Although *Coprosma nitida* appears to be absent from the regeneration this may be a result of some confusion with the similar species *Coprosma quadrifida*, which was recorded after logging.

Table 2. Species list, grouped by life-form and survey. # indicates found only on reconnaissance walk, not on plots.

Species	Survey	Species	Survey
Trees		**Low Shrubs**	
Acacia dealbata	Post	*Aristotelia peduncularis*	Both
Acacia melanoxylon	Post	*Bauera rubioides*	Post
Acacia riceana	Both	*Coprosma nitida*	Pre
Acacia verticillata	Post	*Coprosma quadrifida*	Post
Atherosperma moschatum	Both	*Correa lawrenceana*	Post
Eucalyptus delegatensis	Both	*Cyathodes glauca*	Both
Eucalyptus nitida	Both	*Gaultheria hispida*	Post#
Eucalyptus obliqua	Post	*Leptecophylla juniperina*	Both
Eucryphia lucida	Both	*Lomatia tinctoria*	Post
Eucryphia milliganii	Pre	*Monotoca submutica*	Both#
Leptospermum lanigerum	Post	*Olearia persoonioides*	Both#
Leptospermum scoparium	Post	*Oxylobium arborescens*	Post#
Nothofagus cunninghamii	Both#	*Pimelea cinerea*	Post
Phyllocladus aspleniifolius	Both	*Pimelea drupacea*	Post
Tall Shrubs		*Senecio* spp	Post
Agastachys odorata	Both#	*Telopea truncata*	Pre
Anodopetalum biglandulosum	Both#	*Trochocarpa cunninghamii*	Both#
Anopterus glandulosus	Both	*Trochocarpa gunnii*	Both
Banksia marginata	Post	*Zieria arborescens*	Post
Cassinia aculeata	Post	**Herbs and sedges**	
Cenarrhenes nitida	Both	*Acianthus viridis*	Pre
Hakea lissosperma	Post#	*Calorophus elongatus*	Pre
Leptospermum glaucescens	Both#	*Drymophila cyanocarpa*	Both
Leptospermum nitidum	Both#	*Gahnia grandis*	Both
Monotoca glauca	Both	*Gnaphalium collinum*	Post
Notelaea ligustrina	Post	*Uncinia tenella*	Pre
Olearia argophylla	Both#	**Epiphytic ferns**	
Orites diversifolia	Pre	*Asplenium bulbiferum*	Pre
Persoonia spp	Both#	*Asplenium flaccidum*	Pre
Nematolepis squamea	Both	*Grammitis billardierei*	Pre
Pittosporum bicolour	Both	*Hymenophyllum australe*	Pre
Pomaderris apetala	Both	*Hymenophyllum flabellatum*	Pre
Prostanthera lasianthos	Post	*Hymenophyllum peltatum*	Pre
Tasmannia lanceolata	Both#	*Hymenophyllum rarum*	Pre

Table 2 contd.

Epiphytic ferns (contd.)		**Ground ferns (contd.)**	
Microsorum pustulatum	Pre	*Blechnum wattsii*	Both
Polyphlebium venosum	Pre	*Sticherus tener*	Pre
Rumohra adiantiformis	Pre	*Hypolepis rugosula*	Both#
Tmesipteris obliqua	Pre	*Gleichenia microphylla*	Post#
Ground ferns		**Climbers**	
Dicksonia antarctica	Pre	*Clematis aristata*	Pre
Pteridium esculentum	Post	*Billardiera longiflora*	Post
Polystichum proliferum	Pre	*Prionotes cerinthoides*	Pre
Histiopteris incisa	Both		

Three species of herbs and sedges, *Acianthus*, *Calorophus* and *Uncinia*, appeared to be absent at the post-harvest survey, but this may be attributable to localised occurrences or the relevant inexperience of the post-harvest survey team, compared to the pre-harvest surveyor. Of the ground ferns, *Blechnum wattsii*, *Histiopteris incisa* and *Hypolepis rugosula* persisted within the coupe. Three species of ground fern were not recorded in the post-harvest survey, including *Dicksonia antarctica*, which is an important substrate for epiphytic species. None of the 11 epiphytic fern species recorded in the oldgrowth forest were found in the regeneration. Of the climbers, *Prionotes* and *Clematis* were not found in the regeneration whereas *Billardiera* appeared to be an early colonising species.

Mean frequency and percent cover is presented in Table 3 for the post-harvest survey. Four species, *Eucalyptus delegatensis*, *Eucalyptus obliqua*, *Nematolepis squamea* and *Gahnia grandis* were found on all plots. Only ten species (four trees, three tall shrubs, two low shrubs and one sedge) had a percent cover of greater than 1%.

Edge Effects on Floristics

Vascular species richness was found to be significantly greater up to 100 m from a mature forest edge, compared to beyond 100 m (t test: t = 4.23, df = 7, P = <0.01). The rainforest species richness was significantly different between the two distances, up to 100 m had a mean rainforest species richness of 11.3, compared with 6.2 for distances greater than 100 m from an edge (t test; t = 3.54, df = 7, P = <0.01).

A line was fitted to the data to model a linear relationship between distance from edge and rainforest species richness (Figure 2). Other models may have provided a better fit but a simple approach was adopted because of the small data set. The regression coefficient R^2 was determined to be 0.39

(P = 0.07), indicating a weak negative relationship between edge distance and rainforest species richness. Figure 2 indicates an outlying point 130 m from the mature forest boundary. When this particular point is removed from the analysis, R^2 increases to 0.58. It is suggested that the point is an unusual observation and a larger sampling may have resulted in a stronger negative correlation between edge distance and rainforest species richness.

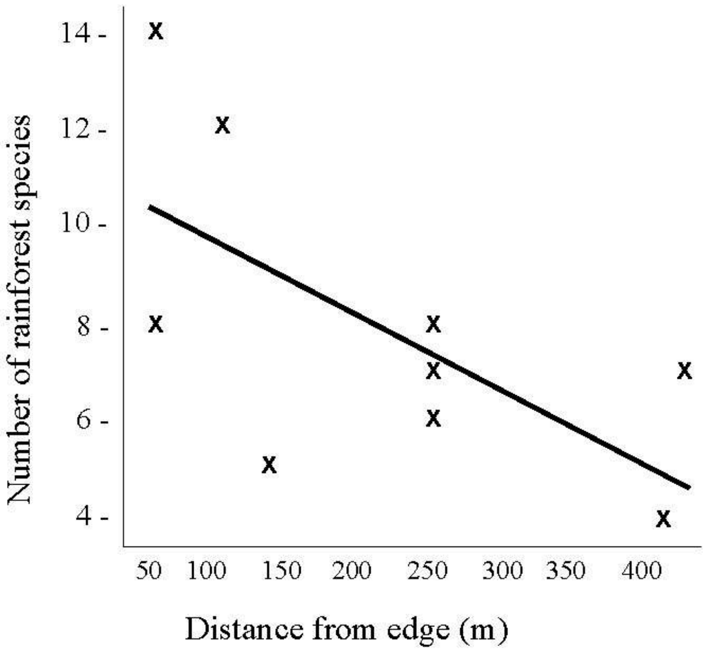

Figure 2. Relationship between edge distance and rainforest species richness

The species richness for non-rainforest species (including those species classified as unlikely rainforest species by Jarman *et al.* 1991) was not significantly related to distance from the forest edge (t test: t = 2, df = 7, P>0.05). Furthermore, only low shrubs showed a significant difference in the number of species present up to 100 m of the forest edge in comparison with the count found beyond 100 m, with a greater number of shrubs occurring up to 100 m from the boundary.

Table 3. Mean frequency and percent cover for vascular species at Warra 011B
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Species	**Freq**	**Cover**	**Species**	**Freq**	**Cover**
Trees		**%**	**Low shrubs**		**%**
Acacia dealbata	0.1	0.3	*Aristotelia peduncularis*	0.2	0.1
Acacia melanoxylon	0.4	0.2	*Bauera rubioides*	0.1	1.7
Acacia riceana	0.6	3.5	*Coprosma quadrifida*	0.2	0.1
Acacia verticillata	0.2	2	*Correa lawrenceana*	0.1	<0.01
Atherosperma moschatum	0.2	0.1	*Cyathodes glauca*	0.8	1.2
Eucryphia lucida	0.3	0.2	*Leptecophylla juniperina*	1	4.6
Eucalyptus delegatensis	1	47.8	*Lomatia tinctoria*	0.1	1.7
Eucalyptus nitida	0.1	<0.01	*Pimelea cinerea*	0.1	<0.01
Eucalyptus obliqua	1	25.8	*Pimelea drupacea*	0.3	0.2
Leptospermum lanigerum	0.3	0.17	*Senecio* spp	0.7	0.3
Leptospermum scoparium	0.4	0.5	*Trochocarpa gunnii*	0.7	0.3
Phyllocladus aspleniifolius	0.7	0.3	**Herbs and sedges**		
Tall shrubs			*Drymophila cyanocarpa*	0.1	<0.01
Anopterus glandulosus	0.3	0.17	*Gahnia grandis*	1	18.2
Banksia marginata	0.2	0.1	*Gnaphalium collinum*	0.1	0.06
Cassinia aculeata	0.2	0.1	**Ground ferns**		
Cenarrhenes nitida	0.2	0.1	*Blechnum wattsii*	0.7	0.3
Monotoca glauca	0.9	15.4	*Histiopteris incisa*	0.4	0.2
Notelaea ligustrina	0.1	<0.01	*Pteridium esculentum*	0.1	0.3
Nematolepis squamea	1	5.9	**Climbers**		
Pittosporum bicolour	0.3	0.2	*Billardiera longiflora*	0.6	0.3
Pomaderris apetala	0.4	8.7			
Prostanthera lasianthos	0.1	<0.01			
Zieria arborescens	0.2	0.1			

Discussion

Species richness was found to have marginally increased at Warra 011B following the CBS treatment. This finding accords with many studies that reported an increase in species richness after logging in dry eucalypt forest (e.g. Dickinson and Kirkpatrick 1987), wet sclerophyll forest (eg. Wapstra *et al.* 2003) and mixed forest (eg. Hickey 1994). Green *et al.* (2004) implied a reduction in species diversity and reported only 12 vascular species in regeneration in a nearby clearfelled coupe in the Weld Valley. However they provide few details of their sampling methodology.

An increase in vascular species richness immediately following the logging period is often due to the increased abundance and frequency of species able to colonise disturbed environments (Wapstra *et al.* 2003). If Warra 011B had been surveyed at an earlier stage after harvesting, a greater increase in species richness may have been observed. Harris (2004) showed the early increase in vascular plant richness after logging in the Victorian Otway ranges was due to an influx of herbaceous species. Most of these species had their maximum occurrence two or three years after treatment. Many were not recorded after 5 years post harvest, leading to an overall decline in floristic diversity after three years. Six years after the regeneration burn at Warra, herbaceous species that may have been initially present would have declined due to reduced light intensity as the cover of woody species increased. Species richness therefore may have been even higher immediately following the burn and sow, stabilising at six years at a level that is similar to pre-harvest records.

The mean number of rainforest species fell from 44 pre-harvest to 30, six years after the regeneration burn. This accounted for the majority of species that were not recorded in the regeneration. The most significant loss was that of the epiphytic ferns. All 11 species recorded prior to treatment had failed to regenerate in any of the sample areas. Such a finding is consistent with numerous studies (Hickey 1994, Ough 2001, Wapstra *et al.* 2003, Harris 2004) that have found that the single most significant loss after clearfelling is that of epiphytic fern species.

Three ground fern species including *Dicksonia antarctica* failed to be detected both within the sample plots and along the reconnaissance walk across the coupe. Tree ferns can rapidly resprout from protected growing points on the top of their trunks after fire. However extensive mechanical disturbance from logging may have removed mature stems so that recolonisation would largely depend on spores from offsite sources. Moist stable conditions conducive to spore regeneration may not develop for decades after logging has occurred (Smith *et al.* 2004).

However, usually some *Dicksonia* individuals resprout after a regeneration burn and it has been suggested that Warra 011B had few mature tree ferns prior to the CBS treatment. This may account for the failure to locate surviving individuals.

The lack of *Dicksonia* in the regeneration has implications for the recovery of epiphytic ferns, because tree fern trunks provide ideal substrates for colonisation by epiphytes. Peacock and Duncan (1994) showed that some vascular epiphytes may take 50 years to recolonise regrowth after clearfelling. The availability of suitable micro-habitats and substrates within Warra 011B will play a pivotal role in determining the rate at which epiphytic ferns will be able to recolonise the area.

Twenty-six additional species colonised Warra 011B after logging, including three *Acacia* species (*A. melanoxylon*, *A. dealbata*, *A. verticillata*). Howard (1974) reported acacias germinating from viable ground stored seed in rainforest stands where they had been absent previously. Many of the species now occupying Warra 011B regenerate profusely from ground-stored seed and protected root-stocks following disturbance. However excessive disturbance by machinery or intense fire can kill ground-stored propagules. Where the humus has been destroyed, regeneration frequencies are generally smaller (Duncan 1985). This effect was evident in some parts of Warra 011B, particularly on snig tracks which are now largely colonised by the hardy sedge *Gahnia grandis*, which has bird-dispersed and ground-stored seed.

Low frequencies were observed for three of the four major rainforest trees (*Atherosperma moschatum*, *Nothofagus cunninghamii* and *Eucryphia lucida*). The other, *Phyllocladus aspleniifolius*, is capable of regeneration from ground-stored and bird-dispersed seed and was the most commonly occurring rainforest tree, at a frequency of 0.7. *Nothofagus cunninghamii*, which regenerates mainly from seed from adjacent mature trees, was absent from the sampled plots. A small individual was found persisting on a road side verge during the reconnaissance walk. *Nothofagus cunninghamii* may be slow to re-establish on large clearfelled areas due to limited dispersal capabilities (Hickey *et al.* 1982, Lindenmayer *et al.* 2000). Therefore distances from viable seed sources and dispersion capabilities are crucial factors in ensuring successful rainforest regeneration after logging. Leatherwood (*Eucryphia lucida*), which regenerates from wind-blown seed and by coppicing, was only found up to 100 m of a mature forest edge. These results are consistent with those of Tabor (2004), who investigated edge effects on the regeneration of the four major rainforest trees. He concluded that by 200 m from a suitable seed source, the frequency of *Nothofagus cunninghamii*, *Eucryphia lucida*, and *Atherosperma* *moschatum* was much reduced. The ability of *Phyllocladus aspleniifolius* to regenerate from ground-stored seed allowed it to persist throughout coupes.

Distances from the edge of the surrounding mature forest were found to have a significant impact on the number of rainforest species able to regenerate within the coupe. Non-rainforest species with long-lived ground stored seed such as *Acacia dealbata* and *Nematolepis squamea* were advantaged by the burning treatment and regenerated in large numbers. There was no significant difference in the number of non-rainforest species and distance from forest edge, indicating a fairly even distribution of propagules, i.e. seed or rootstocks. In a clearfelled coupe, the majority of species regenerate by seed rather than by vegetative reproduction (Murphy and Ough 1997).

The presence of weeds was confined to an internal quarry and on road verges. Although no weeds were found on the sample plots, *Erica lusitanica*, *Hypochoeris radicata* and *Centaurium erythraea* were all noted during the coupe walk. Weed species were not included on the species list, so as to avoid giving a false impression of the species richness of the coupe. They were not seen to be a major concern within Warra 11B, as they only persisted in isolated areas along roadside cuttings.

Several limitations of this study must be acknowledged. The sample plots constituted 900 m^2 of area whereas the pre-harvest survey was carried out over a planned transect, designed to incorporate several smaller sub-environments within the coupe such as riparian zones, to maximise species richness. This issue was partly addressed by the post-harvest reconnaissance walk through the coupe after sampling the plots, to integrate such areas and locate species that had lower frequencies within the coupe. This increased the post-harvest species list by some 36 percent, which highlights the difficulty of comparing pre- and post harvest species richness that are based on different sampling techniques. Also arising is the question of accurate identification of species, especially where pre- and post surveys are undertaken by different observers and with varying botanical expertise. For example, *Coprosma nitida* was recorded pre-harvest, yet *Coprosma quadrifida* was identified later. It must be questioned whether this is a true representation of ecological processes within the coupe, or is it more likely to be due to differences in observers. These difficulties can be partly overcome through the acquisition of voucher specimens that can be referenced by subsequent surveyors.

The species list from this study is by no means absolute. It is a compilation of the minimum number of species persisting at Warra 011B and a larger sampling may have yielded several other species. It is clear however, that the

CBS treatment has changed species assemblages and resulted in a diverse flora with a high representation of early successional species. Further study on the impact of silvicultural practices on Tasmanian tall eucalypt forests (Hickey *et al.* 2001) and based on precisely located permanent plots established prior to harvesting (Neyland 2001) should help determine the long-term effects of clearfell, burn and sow practices on understorey floristic composition.

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March Federation weekend 4-6th March 2005, held at Kaloma Scout Camp, Wynyard

Compiled by Genevieve Gates

Introduction *by Deb Hill, Central North Field Naturalists Club (with additional comments by Margaret Kinsey, Burnie Field Naturalists Club)*

"Discovering Wynyard" was the theme for the weekend and we began with a walk along the Inglis River where there were sightings of an azure kingfisher, a platypus and a water rat. More abundant were the white-faced herons, grey fantails and scarlet robins. The range of saltmarsh plants at the mouth of the small tidal creeks running into the Inglis River was also of special interest. *Blechnum minus* and *Blechnum nudum* were identified in many wet areas along the track. The unusually large size of these ferns made us wonder at their age.

We also visited Fossil Bluff at Wynyard to view the amazing geological features. The different climatic conditions that occurred during the Oligocene period (about 38 million years ago) when the bluff was beneath the sea are indicated by the layers of sandstone some of which are rich in fossils. Exposed beds of tillite lie beneath the sandstone. The tillite originated about 275 million years ago from glacial deposits. There are many rock types contained in the tillite including quartzite, jasper and agate.

Richard Donaghey gave an after dinner lecture on birds and how they can be indicators of the health of the bush in agricultural areas in North-West Tasmania. Richard is about to release the book he has written on this subject and it will be available at the North West Environment Centre. It will be attractively priced and contain important information on species.

The weekend concluded with a walk on Table Cape from the lookout to the lighthouse where a sea eagle was spotted. Tasmanian devil scats were quite abundant along the track as we continued towards the lighthouse, and we noted the extensive stands of *Melaleuca ericifolia* near the lighthouse. A steep scramble down the side of Table Cape (we missed the track) was rewarded with a cuppa at Mary Kille's home.

Table 1. Fungus list, compiled by Genevieve Gates and David Ratkowsky, Tasmanian Field Naturalists Club. I: Inglis River Walk, Wynyard (including York Street Reserve), 5 March 2005. T: Table Cape, 6 March 2005. *Dictyopanus pusillus* was the only Fungimap target species recorded.

Bolbitius sp. (T)	*Dictyopanus pusillus* (I, T)	*Marasmiellus affixus* (I)
Boletus sp. with yellow trama (I)	*Fomes hemitephrus* (I)	*Marasmiellus* sp. "cream" (I)
Calocera guepinioides (I)	*Ganoderma applanatum* (I)	*Melanotus hepatochrous* (I)
Corticioid species-grey (I)	*Heterotextus peziziformis* (I)	*Tricholomopsis rutilans* (I)

Table 2. Vascular plant list for Fossil Bluff, 5 March 2005, compiled by Margaret Kinsey, Burnie Field Naturalists Club.

AIZOACEAE	EPACRIDACEAE	MYRTACEAE
Carpobrotus rossii?	*Leucopogon australis*	*Melaleuca ericifolia*
APIACEAE	MIMOSACEAE	PITTOSPORACEAE
Apium prostratum	*Acacia melanoxylon*	*Bursaria spinosa*
ASTERACEAE	*Acacia sophorae*	PRIMULACEAE
Senecio lautus	MYOPORACEAE	*Samolus repens*
Senecio linearifolius	*Myoporum insulare*	ROSACEAE
CAMPANULACEAE		*Rubus parvifolius*
Lobelia anceps		

Table 3. Vascular plant list for Table Cape, 6 March 2005, compiled by Margaret Kinsey, Burnie Field Naturalists Club.

AIZOACEAE	CARYOPHYLLACEAE	RHAMNACEAE
Tetragonia expansa	*Stellaria pungens?*	*Pomaderris apetala*
APIACEAE	EPACRIDACEAE	SAPINDACEAE
Hydrocotyle sp.	*Leucopogon parviflorus?*	*Dodonaea viscosa*
ASTERACEAE	MIMOSACEAE	MONOCOTS
Cassinia aculeata	*Acacia melanoxylon*	*Lomandra longifolia*
Olearia lirata	*Acacia verticillata*	*Poa* sp.
Senecio lautus	MYRTACEAE	FERNS
Senecio linearifolius	*Eucalyptus ovata*	*Dicksonia antarctica*
CAPRIFOLIACEAE	*Eucalyptus viminalis*	*Hypolepis* sp.
Sambucus gaudichaudiana	*Melaleuca ericifolia*	*Pteridium esculentum*

Table 4. Vascular plant list for Inglis River, 5 March 2005, compiled by Margaret Kinsey, Burnie Field Naturalists Club.

ASTERACEAE
Cassinia aculeata
Cotula sp.
Olearia argophylla
Olearia lirata
Senecio linearifolius
Senecio odoratus?
CAMPANULACEAE
Lobelia anceps
CASUARINACEAE
Allocasuarina monilifera
DILLENIACEAE
Hibbertia procumbens
DROSERACEAE
Drosera peltata ssp auriculata
Drosera pygmaea
EPACRIDACEAE
Astroloma humifusum
Epacris impressa
Leucopogon australis
Leucopogon ericoides
Leucopogon parviflorus
Leucopogon virgatus
Monotoca glauca
EUPHORBIACEAE
Amperea xiphoclada
Phyllanthus gunnii
FABACEAE
Aotus ericoides
Daviesia ulicifolia
Dillwynia sp.
Pultenaea daphnoides
Pultenaea juniperina
HALORAGACEAE
Gonocarpus sp
LAURACEAE
Cassytha sp.
MALVACEAE
Gynatrix pulchella
MIMOSACEAE
Acacia dealbata
Acacia melanoxylon
Acacia myrtifolia
Acacia stricta
Acacia verniciflua
Acacia verticillata
MYRTACEAE
Eucalyptus amygdalina
Eucalyptus obliqua
Eucalyptus ovata
Eucalyptus viminalis
Euromyrtus ramosissima
Leptospermum glaucescens
Leptospermum scoparium
Melaleuca ericifolia
Melaleuca squarrosa
PITTOSPORACEAE
Billardiera longiflora
Bursaria spinosa
Pittosporum bicolor
POLYGONACEAE
Comesperma volubile
PRIMULACEAE
Samolus repens
PROTEACEAE
Banksia marginata
Lomatia tinctoria
Persoonia juniperina
RANUNCULACEAE
Clematis aristata
RHAMNACEAE
Pomaderris apetala
ROSACEAE
Acaena novaezelandiae
RUBIACEAE
Coprosma quadrifida
RUTACEAE
Zieria arborescens
SANTALACEAE
Leptomeria drupacea
SOLANACEAE
Solanum laciniatum
THYMELAEACEAE
Pimelea drupacea
Pimelea linifolia
MONOCOTS
Cheiloglottis gunnii (leaves)
Dianella tasmanica
Diplarrena moraea
Gahnia sp.
Lepidosperma sp.
Lomandra longifolia
Poa sp.
FERNS
Blechnum minus
Blechnum nudum
Blechnum wattsii
Dicksonia antarctica
Histiopteris incisa
Hypolepis sp.
Pellaea falcata
Polystichum proliferum
Pteridium esculentum

Table 5. Taxonomic list of seashells from Fossil Bluff (F) and/or Johnson's Beach (J), 5-6 March 2005, collected by Genevieve Gates and identified by Simon Grove, August 2005. An asterisk denotes species that are of interest to 'southerners' because of their rarity in Tasmania beyond the North coast.

Species	Common name	Loc
MYTILIDAE		
Xenostrobus pulex (Lamarck, 1819)	Little black horse-mussel	F, J
ARCIDAE		
Barbatia pistachia (Lamarck, 1819)	Hairy ark	F, J
MACTRIDAE		
Mactra rufescens Lamarck, 1819	Reddish trough-shell	J
TELLINIDAE		
Pseudarcopagia botanica (Hedley, 1918)	Decussated tellin	F, J
VENERIDAE		
Irus carditoides (Lamarck, 1818)	Cardita-like boring-venus	F
Placamen placidum (Philippi, 1844)	Placid venus	F
NACELLIDAE		
Cellana solida (Blainville, 1825)	Orange-edged limpet	J
LOTTIIDAE		
Patelloida alticostata (Angas, 1865)	Tall-ribbed limpet	F, J
Patelloida insignis (Menke, 1843)	Maltese-cross limpet	F, J
HALIOTIDAE		
**Haliotis emmae* Reeve, 1846	Emma's abalone	F, J
FISSURELLIDAE		
Scutus antipodes Montfort, 1810	Elephant snail	J
TURBINIDAE		
Astralium aureum (Jonas, 1844)	Golden star-shell	F, J
**Phasianella ventricosa* Swainson, 1822	Swollen pheasant-shell	F, J
Turbo undulatus Lightfoot, 1786	Wavy turban-shell	F, J
TROCHIDAE		
Austrocochlea adelaidae (Philippi, 1849)	Adelaide top-shell	F
Austrocochlea concamerata (Wood, 1828)	Wavy top-shell	F, J
Austrocochlea constricta (Lamarck, 1822)	Ribbed top-shell	F, J
**Herpetopoma aspersa* (Philippi, 1846)	Pearled top-shell	F
Phasianotrochus eximius (Perry, 1811)	Choice kelp-shell	F
Phasianotrochus irisodontes (Quoy & Gaimard, 1834)	Rainbow kelp-shell	F
NERITIDAE		
Nerita atramentosa Reeve, 1855	Black nerite	J
LITTORINIDAE		
Bembicium nanum (Lamarck, 1822)	Striped-mouth conniwink	J
Austrolittorina unifasciata (Gray, 1826)	Banded australwink	F
HIPPONICIDAE		
Antisabia foliacea (Quoy & Gaimard, 1835)	Foliaceous bonnet-limpet	F, J
Hipponix australis (Lamarck, 1819)	Southern bonnet-limpet	J

Table 5 contd.

Species	**Common name**	**Loc**
CYPRAEIDAE		
Cypraea comptoni Gray, 1847	Compton's cowrie	F
**Cypraea piperita* Gray, 1825	Peppered cowrie	F
NATICIDAE		
Polinices conicus (Lamarck, 1822)	Conical sand-snail	J
RANELLIDAE		
Sassia eburnea (Reeve, 1844)	Common sand-whelk	F
**Sassia subdistorta* (Lamarck, 1822)	Distorted sand-whelk	F
Sassia verrucosa (Reeve, 1844)	Warted sand-whelk	F
EPITONIIDAE		
Opalia australis (Lamarck, 1822)	Southern wentletrap	F, J
Opalia granosa (Quoy & Gaimard, 1834)	Granulated wentletrap	F, J
MURICIDAE		
Lepsiella vinosa (Lamarck, 1822)	Wine-mouthed rock-snail	F
**Muricopsis umbilicatus* (Tenison Woods, 1876)	Umbilicated murex	J
Thais orbita (Gmelin, 1791)	Cartrut shell	F, J
BUCCINIDAE		
Cominella lineolata (Lamarck, 1809)	Lineated whelk	F, J
*#*Cominella tasmanica* (Tenison Woods, 1878)	Tasmanian whelk	J
Tasmeuthria clarkei (Tenison Woods, 1876)	Clarke's whelk	F
COLUMBELLIDAE		
Mitrella semiconvexa (Lamarck, 1822)	Semiconvex dove-shell	F
NASSARIIDAE		
Nassarius nigellus (Reeve, 1854)	Little mud-snail	F
Nassarius pauperatus (Lamarck, 1822)	Impoverished mud-snail	F
FASCIOLARIIDAE		
**Fusinus undulatus* (Perry, 1811)	Wavy spindle-shell	F
Pleuroploca australasia (Perry, 1811)	Australian tulip-shell	F, J
OLIVIDAE		
Alocospira marginata (Lamarck, 1811)	Margined olive	F
MITRIDAE		
Mitra glabra Swainson, 1821	Smooth mitre	F
VOLUTOMITRIDAE		
Waimatea obscura (Hutton, 1873)	Magpie volute-mitre	F
TURRIDAE		
**Marita compta* (A. Adams & Angas, 1864)	Margin-like turrid	F
CONIDAE		
Conus anemone Lamarck, 1810	Anemone cone-shell	F, J
SIPHONARIIDAE		
Siphonaria diemenensis Quoy & Gaimard, 1833	Van Diemen's Land siphon-shell	F, J

#Provisional identification only: very worn specimen.

Book Reviews: A plethora of books on fungi?

Reviewed by David Ratkowsky

A Field Guide to Australian Fungi, by Bruce Fuhrer. Published by Bloomings Books, Melbourne, 2005. 360 pages. ISBN 1 876473 51 7.

Fungi Down Under: the Fungimap Guide to Australian Fungi, by Pat Grey and Ed Grey. Published by Fungimap, c/- Royal Botanic Gardens, Melbourne, 2005. 146 pages. ISBN 0 646 44674 6.

A Field Guide to the Fungi of Australia, by A.M. Young. Published by the University of New South Wales Press, Sydney, 2005. 240 pages. ISBN 0 86840 742 9.

Never before have Australian naturalists with an interest in fungi had such a choice of guide books, with three new field guides published in 2005 at about the same time. The books are different in range and scope but all will be welcomed by those who aspire to put a name to a fungus that they may have seen in the bush or suburban garden.

Probably the most extensive and comprehensive of the three books that were launched this year is the one by Bruce Fuhrer, which covers ca. 500 species, all beautifully photographed with the care and attention to detail that we have come to expect from this author. Bruce's renown extends well beyond people with an interest in fungi, as he is the author and/or photographer of a diverse range of biological groups, such as Banksias, bryophytes and the marine life at seashores. The present book goes far beyond the content of his previous books on fungi (Fuhrer and Robinson 1992; Fuhrer 2001), whose text rarely contained more than a single sentence describing each species. The new book, which re-uses some of the same photographs in his *Field Companion*, contains more detail to help the reader identify the species, almost always providing information on spore print colour, spore size, shape and surface ornamentation, if any. The other engaging feature was the author's willingness to include large numbers of the more unfamiliar, less commonly photographed species, even if some could not always be named to species level. Thus, the Fuhrer book covers representatives of all the various kinds of fungi, i.e. gilled fungi, fleshy and woody pore fungi, coral- and club-fungi, puffballs, spine fungi, shelf fungi, jelly fungi, disc- and cup-fungi, with a few slime moulds thrown in to round off the work. It is a highly successful effort and is likely to be the one work that the field mycologist will want to consult most frequently in search of a name. No book is error-free, and the publisher has probably not served the author well by allowing a production editor to misname the beautiful cover photograph of *Mycena nargan*, a purplish black species, as *Mycena nivalis*, which is a species with a snow-white cap. Cystidia is also misspelled in the inside front and back covers, and the photograph of *Coprinus comatus* facing p. 1 is misidentified as *Coprinus atramentarius.* Publishers must learn that authors need to be given the whole book to proof-read, not just the text material from p. 1 onwards.

The scope of *Fungi Down Under* is entirely different, being confined only to the 100 target species of the Fungimap project. This special project was initiated jointly in 1995 by the Royal Botanic Gardens Melbourne and the Field Naturalists Club of Victoria as a means of providing Australia-wide distribution maps for this continent's larger fungi. As the majority of Australian macrofungi are yet to be named and described, the project had to be confined to a fixed number of target species, chosen for their ease of identification in the field, without recourse to microscopic examination. Volunteers throughout Australia, mainly amateurs, were encouraged to send in records of these target species, and many thousands of records were received. For the production of the book, and for a CD-ROM that preceded it, people were asked to contribute photographs, habitat information and the precise location where the specimen was found. This provided Pat and Ed Grey with a lot of choice of photographs to select, and they skilfully compiled the text and species descriptions at their disposal. Leon Costermans, who designed and edited the book, digitally prepared the photographs and artwork for printing, resulting in an attractive layout, with each of the 100 target species assigned a whole page of the book. Often, each species is allotted more than one photo, and each has a distribution map of Australia with red dots indicating the localities at which the species was recorded. The book is informative, pleasant to look at and to read, and thoroughly achieves its objective, and should inspire naturalists who have not as yet become involved in Fungimap to do so in the future.

The third book under review, the field guide by A.M. (Tony) Young, is a thoroughly revised version of his previous book, *Common Australian Fungi*, the last revision of which appeared in 2000. This is a substantially different effort, and much more successful than that one, bringing the nomenclature up-to-date so that the species names now conform largely to those that appear in the other two books under review and to the names that are generally found in the mycological literature. For this book, Tony collaborated with Kay Smith, who painted 23 watercolours and prepared more than 260 line drawings. While these paintings and drawings certainly help contribute to species identification, those of us who believe that a good photograph is hard to beat would like to have seen more than the 36 colour photos that were included in this work and confined to a section in the centre of the book. Generally, the treatment of each species ends with a distribution giving the Australian States in which the species are known to appear. It is lamentable to see Tasmania "left off the map" as frequently as it is in this book. While the author may be forgiven for overlooking two papers on the fungi of Mt. Wellington that appeared in the *Papers & Proceedings of the Royal Society of Tasmania* in 2002 and 2004, there is less excuse for his not obtaining access to the extensive Fungimap records prior to publication, which would have showed that the target species *Amanita xanthocephala*, *Fistulina hepatica*, *Hericium coralloides*, *Marasmius elegans*, *Mycena viscidocruenta*, *Plectania campylospora*, *Tremella fuciformis*, *T. mesenterica* and *Xerula radicata* have been frequently reported from this island. Hopefully, these and other omissions can be corrected in the next revision of the book

Together with Ian McCann's field guide and the little "Bush Book" of Richard Robinson, both published in 2003, the Australian fungus enthusiast now has a big choice of recent books to choose from. Is there a plethora of choice, i.e. a surfeit, an excess of these books? For those of us for whom fungi are the main subject of interest in the natural environment, the choice is extremely welcome, especially when compared to the situation a decade ago. The three books on offer here may appeal to different markets, at least to some extent. Bruce Fuhrer's book is certainly the most comprehensive, but is focussed on the regions of Australia that experience high autumn and winter rainfall. Tony Young's book will be relevant to residents of Queensland and northern New South Wales, as it includes many species that are found mainly or exclusively in that part of Australia. *Fungi Down Under* will be sought after by those who wish to be part of the Fungimap project, but whose interest in fungi doesn't extend beyond that project. Surely it is a welcome situation to have such a choice.

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Fuhrer, B.A. (2001). *A Field Companion to Australian Fungi.* Revised Edition, Bloomings Books, Hawthorn, Victoria. 162 pp.

Fuhrer, B.A. and Robinson, R. (1992). *Rainforest Fungi of Tasmania and South-East Australia*. CSIRO, Australia and the Forestry Commission, Tasmania. 95 pp.

McCann, I.R. (2003). *Australian Fungi Illustrated*. Macdown Productions, Vermont, Victoria. 128 pp.

Robinson, R. (2003). *Fungi of the South-West Forests*. Department of Conservation and Land Management, Kensington, Western Australia. 72 pp.

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.

Submission of manuscripts

Manuscripts should be sent to the editor, Simon Grove, preferably electronically (email: groveherd@bigpond.com) as Word documents. Alternatively they can be mailed to 25 Taroona Crescent, Taroona, Tasmania 7053. 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.

Ponder, W.F. (1993). Endemism in invertebrates in streams and rivers as demonstrated by hydrobiid snails. In: *Tasmanian Wilderness: World Heritage Values.* Eds. S. Smith and M. Banks. Royal Society of Tasmania, Hobart.

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.

Tasmanian Field Naturalists Club

G.P.O. Box 68, Hobart, Tas. 7001

Founded 1904

OBJECTIVES

The Tasmanian Field Naturalists Club aims to encourage the study of all aspects of natural history and to advocate the conservation of our natural heritage. The club is comprised of both amateurs and professionals who share a common interest in the natural world.

ACTIVITIES

Members meet on the first Thursday of each month in Life Sciences Lecture Theatre 1 at the University of Tasmania at Sandy Bay. These meetings include a guest speaker who provides an illustrated talk. An excursion is usually held on the following weekend to a suitable site to allow field observations of the subject of that week's talk. The Club's committee coordinates input from members of the Club into natural area management plans and other issues of interest to members.

THE TASMANIAN NATURALIST

The Club publishes the journal *The Tasmanian Naturalist*. This annual journal provides a forum for the presentation of observations on natural history, and views on the management of natural values,in both formal and informal styles.

MEMBERSHIP

Membership of the Tasmanian Field Naturalists Club is open to any person interested in natural history. Members receive *The Tasmanian Naturalist* annually, plus a quarterly bulletin with information covering forthcoming activities; the Club's library is also available for use. Prospective members should either write to he Secretary at the above address, phone Janet Fenton on (03) 6239 6443, or visit our web site at http://www.tasfieldnats.org.au/tasonline/tasfield/tasfield.htm.

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