

The Victorian Naturalist



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From the Editors

It has been observed often that the pursuit of natural history encompasses a wide range of areas. This diversity is nowhere more apparent than in this issue of *The Victorian Naturalist*. Here we have papers on grasslands, the behaviour of birds and mammals in wooded areas, the dietary preferences of one reptilian species, as well as observations on another, and comments on small mammals. This is biodiversity, indeed.

This issue also demonstrates another long-running feature of the FNCV's journal. *The Victorian Naturalist* has long provided an avenue to publish natural history research that either includes historical aspects of the subject matter, or takes history as the major focus. The Editors are always pleased to include articles that explain how the state of play in any natural science area was reached. That is not to say that we turn away from what is the main thrust of the journal – the publication of research in natural history – but, rather that we recognise that intellectual disciplines are constantly changing, and some account of these changes also should be recognised.

In this issue we offer two papers that bear out this point. There is a paper that considers a major change that has taken place in natural history studies. In addition, the paper on native grasslands on the Mornington Peninsula is an excellent example of the use of history as an element within a good natural history study.

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The Victorian Naturalist

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Front cover: Striped Legless Lizard *Delma impar*. Photo by Sid Larwill.

Back cover: Emu *Dromaius novaehollandiae*. Photo by Mr Taylor. Both the front and back cover photos are from the FNCV collection.

Native grassland at Safety Beach, Mornington Peninsula, Victoria

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Abstract

Small patches of remnant vegetation at Safety Beach, on the Mornington Peninsula, are described. Floristic and historical evidence are examined, in an attempt to reconstruct the vegetation of this area before colonisation. There is strong evidence that the plains between the slopes of Mt Martha and Arthurs Seat once supported patches of seasonally 'boggy' natural grassland sparsely timbered with Blackwood *Acacia melanoxyloides*. The plain also supported patches of Swamp Paperbark *Melaleuca ericifolia* scrub, and numerous wetlands. Previous mapping exercises have not identified grasslands on the Mornington Peninsula. The observations presented here add to a growing awareness that patches of grassland were once scattered through low-lying areas of South Gippsland. The ecology of these areas is discussed, along with the prospects for their conservation on the Mornington Peninsula. This paper records the presence of several significant plant taxa, including Golden Cowslips *Diuris behrii* (vulnerable in Victoria) and Purple Blown-grass *Lachnagrostis punicea* subsp. *punicea* (rare in Victoria). (*The Victorian Naturalist* 124 (3), 2007, 132-149)

Introduction

Safety Beach occupies the coastal flat between the prominent granitic hills of Arthurs Seat and Mt Martha, on the Mornington Peninsula (Gippsland Plain Bioregion). The low, near-coastal land surface is composed largely of heavy, dark-coloured clays, derived from Quaternary swamp and stream deposits. In places, low prominences of sand and gravel occur. The plain extends eastward over a kilometre inland, before the land surface gently rises at the commencement of the 'Baxter sandstone', which extends across much of the northern half of the Mornington Peninsula (Geological Survey of Victoria, 1967a,b).

Safety Beach has been largely urbanised for many years; however, on several 'vacant' blocks, remnant native vegetation has survived. This vegetation is increasingly under threat of destruction. Some was destroyed in ~2004 with the construction of the new Mt Martha Marina, while other patches were developed for housing between 2000 and 2007.

During a recent project undertaken for the Mornington Peninsula Shire (Sinclair *et al.*, 2006) it was necessary to map all native vegetation on the Mornington Peninsula at a scale which captured these remnant patches (1:10,000). It was evident that previous studies had not adequately considered the vegetation of Safety Beach,

neither as it appears today, nor how it was before urbanisation. Calder (1972, 1974, 1975), in her studies of vegetation across the Mornington Peninsula, makes little mention of the area, but suggests that the low-lying flat was once a large scrub of Swamp Paperbark *Melaleuca ericifolia*. The available broad-scale (1:100 000) representation of the deduced pre-1750 vegetation (Department of Sustainability and Environment (DSE) 2001a) did not make specific allowance for this heavy-soil flat. Instead, the area is represented as a transitional zone between Coast Banksia Woodland (Ecological Vegetation Class (EVC) 2, see Table 1) and Grassy Woodland (EVC 175, which occurs on the Baxter Sandstone and the granitic areas; see Table 1). Even cursory examination confirms that the remnant vegetation present at Safety Beach is markedly different from either of these vegetation types. The most recent mapping of current vegetation did not capture these remnant areas at all, due to the broader scale of this mapping (1:25,000) (DSE 2001b; Oates and Taranto, 2001).

Detailed investigation of the flora of Safety Beach was thought warranted now, since future opportunities for understanding the natural vegetation of this area will become increasingly limited as urban

development proceeds. This project used information from historical survey maps and old aerial photographs along with detailed field investigations in an attempt to reconstruct former natural vegetation patterns. This approach has been very useful in other studies aimed at reconstructing native vegetation in long-modified areas of lowland southern Victoria (e.g. Lunt 1997; Cook and Yugovic 2003; Yugovic and Mitchell 2006).

Methods

Historical Information and GIS work

Historical survey plans (drawn between 1803 and 1857, Results and Reference sections) of Safety Beach were viewed on microfilm at the State Library of Victoria. Aerial photographs taken before urbanisation were also consulted (State Rivers and Water Supply Commission, State Aerial Survey of Victoria. Photographs prepared by Department of Lands and Survey from photographs taken on 12 January 1957. Sheets: Westport A1, A3; Sorrento B4). These historical sources were examined alongside modern GIS (geographical information system, Arcview 3.2.) data, provided by DSE, including hydrological, topographic and cadastral features; and soil maps (Geological Survey of Victoria, 1967a,b). Where necessary, aerial photographs and images of the historic plans were scanned and introduced into a GIS environment using 'ImageWarp' to geo-reference the images.

Field examinations

The remnant vegetation at Safety Beach is often treeless, and not easily detected on aerial photographs. Every street in Safety Beach was travelled, and all 'vacant' house blocks were briefly examined from the road. Over 50 were found to contain some native vegetation. Most of these areas were on private land. These were examined closely where it was clear that public entry was frequent and/or unhindered, while those blocks which were fenced were not examined. Most blocks contained few native species in low abundance, and were not investigated in detail. Twenty-seven accessible sites were identified that were considered to be informative in reconstructing the pre-settlement flora. At ten of

these sites, quadrats were taken. These data are held in DSE's Flora Information System (FIS) (quadrats E03403-E03412).

Vegetation description

Victoria's DSE currently uses EVCs to describe native vegetation. This typology is employed in this report. All EVCs mentioned in the text are summarised in Table 1. For clarity, however, the specific vegetation patterns of Safety Beach are generally described here in as much detail as possible without reliance on the EVC typology.

Results

Historical information

Due to its position on the coast of Port Phillip, Safety Beach is well represented on early Victorian survey maps. The earliest maps of the area that make reference to its vegetation were drawn well before extensive settlement of the area, although they provide few annotations of ecological interest. Charles Grimes, who explored Port Phillip in 1802, simply labels the area between Arthurs Seat and Mt Martha as 'Swamp' (Grimes, 1803). Tuckey (1804) provides a slightly more detailed rendering of the vegetation, and delineates a crescent-shaped area extending along the coast and about a kilometre inland, and labels it 'extensive swamp'. Further inland, at the base of Mt Martha, Tuckey draws a 'large lagoon'. Cross (1827), shows three small creeks, and again labels the area as 'swampy'.

The first detailed survey of the area was made in 1841 by Thomas Nutt, for the squatter Hugh Jamieson, who took up one of the first runs on the Peninsula. The boundary of Nutt's survey was marked with blazed trees, and these boundaries are faithfully retained in today's property and infrastructure layout. The certainty with which these bounds can be recognised today, along with the sketched courses of some creeks, allow the annotations on vegetation to be accurately positioned in discrete portions of the landscape. Along the coast, Nutt (1841) shows a narrow 'Sandy Beach', with a 'swampy flat' immediately inland, marked with small dots and sketches of tussocks. This area is drained by three small creeks, one of which (Brokil Ck (or Tassel Ck)) is labelled 'salt water'. Further inland, he records a 'Fine Flat',

Table 1. Summary descriptions of EVCs mentioned in this report. Further information can be found, as indicated, in the following sources: 1: Oates and Taranto (2001), 2: Yugo vic (unpubl.), 3: Frood (unpubl.), 4: Frood (1991).

EVC	Environment/ soil	Prominent Species locally (examples only)	Structure	Ref.
2 Coast Banksia Woodland	Deep sands near coast, often sheltered from wind and fire	<i>Banksia integrifolia</i> , <i>Leucopogon virgatus</i> , <i>Tetragona implexicoma</i> , <i>Rhagodia cantoliteana</i> , <i>Pteridium esculentum</i> , <i>Lepidosperma gladiatum</i>	Woodland to 20m	1,2
3 Damp-sands Herb-rich Woodland	Undulating sandy country, usually relatively fertile	<i>Eucalyptus viminalis</i> , <i>Eucalyptus radiata</i> , <i>Acacia mearnsii</i> , <i>Acacia melanoxylon</i> , <i>Leptospermum continentale</i> , <i>Bosstea cinerea</i> , <i>Amperea xiphoclada</i> , <i>Lomandra longifolia</i> , <i>Pteridium esculentum</i>	Woodland or forest to 20m	1,2
9 Coastal Saltmarsh	Soils waterlogged and periodically inundated by saline water	<i>Sarcocornia quinqueflora</i> , <i>Suaeda australis</i> , <i>Samolus repens</i> , <i>Juncus kraussii</i> , <i>Gahnia filum</i> , <i>Distichlis distichophylla</i>	Herbland or shrubland to 1.5m	1,2,3
10 Estuarine Wetland	Soils waterlogged and almost permanently inundated by saline water	<i>Juncus kraussii</i>	Sedgeland or herbland to 1.5m	3
13 Brackish Sedgeland	Various soils waterlogged by saline water	<i>Gahnia trifida</i> , <i>Gahnia filum</i> (unknown - virtually extinct locally?)	Sedgeland to 2m	3
53 61 Swamp Scrub (Freshwater)	Damp, relatively fertile flats, occasionally flooded or waterlogged	<i>Melaleuca ericifolia</i> , <i>Acacia verticillata</i> , <i>Senecio minimus</i> , <i>Acacia novae-zelandiae</i> , <i>Poa</i> spp., <i>Microlaena stipoides</i> , <i>Juncus</i> spp., <i>Gahnia</i> spp., <i>Carex appressa</i> .	scrub to 5m	1,2,3
53 62 Swamp Scrub (Estuarine)	Damp, sheltered margins of estuaries and saltmarshes	<i>Melaleuca ericifolia</i> , <i>Poa labillardierei</i> , <i>Suaeda australis</i> , <i>Gahnia filum</i>	Scrub to 5m	1,3
83 Swampy Riparian Woodland	Streambanks on flats and in low gradient gullies	<i>Eucalyptus ovata</i> , <i>Acacia melanoxylon</i> , <i>Melaleuca ericifolia</i> , <i>Lomandra longifolia</i> , <i>Goodenia ovata</i> , <i>Phragmites australis</i>	Woodland to 20m	1,3

Table 1. Cont.

125 Plains Grassy Wetland	Shallow (often closed) depressions on heavy soils, seasonally inundated by shallow standing freshwater	<i>Poa labillardierei</i> , <i>Amphibromus</i> spp., <i>Lachnagrostis</i> spp., <i>Notodanthonia semianularis</i> , <i>Epilobium billardierianum</i> , <i>Eleocharis acuta</i> , <i>Eryngium vestitulosum</i>	Grassland or herbland to 1m	1,2,3
132_06 Plains Grassland (South Gippsland)	Heavy-soil flats, seasonally waterlogged	See main text	Grassland to 1m	2,3,4
175 Grassy Woodland	Various. Relatively fertile soils, often with freely-draining material overlying clay	<i>Eucalyptus viminalis</i> , <i>Eucalyptus ovata</i> , <i>Eucalyptus pauciflora</i> , <i>Eucalyptus radiata</i> , <i>Allocasuarina</i> spp., <i>Banksia marginata</i> (tree-form), <i>Exocarpos cupressiformis</i> , <i>Leptospermum continentale</i> , <i>Gahnia radula</i> , numerous herbs and grass-like plants	Woodland to 20m	1,2
710 Damp Heathland	Poorly drained, infertile sites, often with underlying clays impeding winter drainage	<i>Leptospermum continentale</i> , <i>Allocasuarina paludosa</i> , <i>Banksia marginata</i> (shrub form), <i>Gahnia radula</i>	Heathland to 2m	1,2
793 Damp Heathy Woodland	Poorly drained, infertile sites, often with underlying clays impeding winter drainage	<i>Eucalyptus cephalocarpa</i> , <i>Eucalyptus ovata</i> , understorey as above (710)	Sparse woodland to 1.5m	1,2
914 Estuarine Flats Grassland	Heavy-soil flats, usually associated with estuaries, often waterlogged by saline and/or fresh water	<i>Poa labillardierei</i> , <i>Poa poliformis</i> , <i>Juncus kraussii</i> , <i>Phragmites australis</i> , <i>Distichlis distichophylla</i> , <i>Samolus repens</i> , <i>Acaena novae-zelandiae</i>	Grassland to 1m	1,2,3
934 Brackish Grassland	Heavy-soil flats, occasionally waterlogged, some saline influence	<i>Poa labillardierei</i> , <i>Poa poliformis</i> , <i>Catolophthalmis lacteus</i>	Grassland to 1m	1,2,3
937 Swampy Woodland	Seasonally waterlogged flats	<i>Eucalyptus ovata</i> , <i>Acacia melanoxylon</i> , <i>Melaleuca ericifolia</i> , <i>Goodenia ovata</i> , <i>Carex appressa</i> , <i>Poa labillardierei</i> , <i>Poa tenera</i> , <i>Gahnia</i> spp., <i>Cenella cordifolia</i> and other inundation tolerant herbs and grasses	Woodland to 20m	1,2,3



Fig. 3. Grassland at Safety Beach. The grass sward at one relatively high-quality site (FIS Quadrat E03403) is shown. The letter (d) shows the most conspicuous example in the photograph of a gilgai depression, supporting Coast Tussock-grass and Prickfoot, and the lower letter (r) shows a raised area, supporting Kangaroo Grass, as discussed in the text.

with areas of 'Tea Tree Scrub' flanking it to the north and south. This 'Fine Flat' is located coast-ward of the present-day Moorooduc Hwy. Further inland, Nutt records various areas of 'Swampy' land, forests and woodlands.

The Crown Lands Office produced another detailed map in 1857 (Anon. 1857). This map shows the boundary of Nutt's previous survey, and represents the infrastructure then present. The near-coastal flat is again labelled 'swampy flat' and marked with lines of dots. The inland side of this flat is flanked by an area labelled 'Tea tree scrub'. It is bounded to the north on the lower slopes of Mt Martha by a 'fine flat moderately timbered with Honeysuckle [probably tree form *Banksia marginata*]' and to the south near Arthurs Seat by a 'sandy rise' and an area 'thickly wooded' with 'Oak [*Allocasuarina* spp.] and Honeysuckle'. Near the coast, at the junction of Nepean Hwy and Dromana Pde, an un-annotated area (now urbanised)

is densely stippled, and possibly represents a wetland or scrub.

The most informative early map is an undated map drawn by George Smythe (Fig. 1). It shows the boundary of Nutt's pre-existing survey (1841), but shows less developed infrastructure than in 1857, suggesting that it was surveyed between 1841 and 1857. On this map, comments on the vegetation relate to clearly defined areas. Patches of 'Tea Tree Scrub' and 'Marshy Plains' are shown with detailed boundaries. Given the great precision with which the courses of all the creeks are plotted across the Peninsula, as seen when Smythe's plan is aligned to modern GIS layers, these boundaries are likely to be reliable.

All the maps agree in the basic layout of the vegetation at Safety Beach, allowing the information to be brought together into a coherent whole. Behind the narrow sandy coastal strand, on the heavy clay soils, extending about a kilometre inland and covering several hundred hectares, was a 'flat', variously represented as being 'swampy', 'fine' or 'grassy', and clearly distinct from areas of 'tea tree scrub'. Smythe describes this area as being 'rich black soil timbered with lightwood' (discussed below), while no other reference is made to trees or shrubs on this area. Three or four small creeks entered Port Phillip from this flat, at least one of which (Brokil Creek) was brackish. All around this flat were areas of 'tea tree scrub' along drainage lines, and further areas of 'marsh'. Further inland (roughly beyond the Mornington Peninsula Freeway, north of Bruce Rd and south of Nepean Hwy, see Figs 1 and 2) vegetation descriptions mostly relate to woodlands and scrubs, remnants of which persist in various condition states across the Peninsula, while most of the 'flat' has been cleared. The focus of this paper is the original vegetation of the 'flat' (Figs 1 and 2), which remains undocumented.

Given these descriptions and its position in the landscape, the 'flat' probably supported vegetation referable to Plains Grassland (South Gippsland) (EVC 132_62) and/or Brackish Grassland (EVC 934) along with Plains Grassy Wetland (EVC 125, in the broad sense) (Frood, 1991; Oates and Taranto, 2001). Such grassland communi-

ties have not been previously mapped on the Mornington Peninsula, and will be the focus of this paper.

Vegetation of the coastal flat at Safety Beach – past and present

Among the 22 sites examined in detail, areas representative of several distinct vegetation types were found, corresponding closely to the vegetation described in the historical record. As described below, each of these is generally assignable to one or more EVCs. Table 2 presents species lists for the these mapped ‘zones’. These lists are each derived from several sites examined within each zone, shown on Fig. 2.

Grassland

Fourteen sites support native grasslands, on heavy soils with an undulating or ‘gilgai’ surface that tends to be waterlogged in winter and deeply cracking in summer. Across most of the sites investigated (FIS quadrats E03403-E03408), the native graminoid layer is dominated by a combination of Coast Tussock-grass *Poa poiformis* (discussed below), Wetland Wallaby-grass *Notodanthonia semiannularis*, and Kangaroo Grass *Themeda triandra*. Even in the small remaining patches, the floristic composition varies notably at a fine spatial scale (several metres). This variation seems to be determined largely by surface microtopography. Fig. 3 shows the grass swart at the largest remaining site at Safety Beach. The labels show a raised area (gilgai ‘puff’) and a slight gilgai depression. On the raised area, Kangaroo Grass dominates strongly, and is accompanied by other species usually found in drier habitats, including Creeping Bossiaea *Bossiaea prostrata* and Cranberry Heath *Astroloma humifusum*. In the depression, Coast Tussock-grass and Wetland Wallaby-grass dominate, along with several herbs tolerant of seasonal waterlogging, such as Prickfoot *Eryngium vesiculosum* and Pennywort *Centella cordifolia*. As discussed below, some of these low-lying areas approach wetlands in their ecology and composition.

Despite weed invasion, many native species in addition to those noted are relatively common throughout these grassland patches, including Mat Grass *Hemarthria uncinata* Common Bog-rush *Scheonua*

apogon, and the herbs Slender Speedwell *Veronica gracilis*, Milky Beauty-heads *Calocephalus lacteus*, Wiry Buttons *Leptorhynchus tenuifolius*, Varied Raspwort *Haloragis heterophylla*, Small Loosestrife *Lythrum hyssopifolia*, Wood-sorrel *Oxalis* sp aff. *exilis* (glabrescent), and Tall Sundew *Drosera peltata* subsp. *peltata*. Shrubs are rare, the most common being Hop Goodenia *Goodenia ovata* and Swamp Paperbark *Melaleuca ericifolia*.

According to the present EVC typology, these areas are accommodated largely within the broad conception of Plains Grassland (South Gippsland) (EVC 132_62) (Frood, 1991; Oates and Taranto, 2001; Cook and Yugovic, 2003).

Some grassland areas dominated by Coast-tussock grass also include species characteristic of (sub-)saline areas, such as Shiny Swamp-mat *Selliera radicans* and Australian Salt-grass *Distichlis distichophylla*. Some of these areas are probably best described as Brackish Grassland (EVC 934). In the more pronounced depressions, the vegetation is probably best described as wetland, as discussed below.

Swamp Scrub

The survey plans all show areas of ‘Tea Tree Scrub’. This vegetation is unequivocally identifiable as Swamp Scrub (EVC 53) (Oates and Taranto, 2001). Two large areas (7.3 ha and 1 ha) of mature Swamp Paper-bark remain in Safety Beach, and clearly correspond to areas delineated as ‘Tea tree Scrub’ by Smythe (undated). Only one of these areas was able to be visited, and was found to be highly modified by weeds. Two of the smaller ‘house’ blocks surveyed in detail also support remnants of Swamp Scrub (FIS quadrats E03409 and E03410). They contain species typical of Swamp Scrub (such as Swamp Paperbark, Prickly Moses *Acacia verticillata* and Slender Tussock-grass *Poa tenera*), but also a few species more typical of open, grassy wetlands, notably Common Blown Grass *Lachnagrostis filiformis*. This is readily explicable, given that much of the Swamp Paperbark cover has been removed and suppressed by mowing, leaving these swampy areas open to invasion by open wetland species, and

Table 2. Plant Species found at Safety Beach in 2005-6. All names are used according to Ross and Walsh (2003). 'r' indicates taxa rare in Victoria, 'v' vulnerable in Victoria. The lack of a check mark for any species against a given vegetation type show ONLY that the species was not recorded in that type on this survey, NOT that the species would never have occurred there.

Species	Common Name	Grassland	Marsh	Swamp Scrub	Sandy rises
FERNS					
Dennstaedtiaceae					
<i>Pteridium esculentum</i>	Austral Bracken				o
MONOCOTYLEDONS					
Cyperaceae					
<i>Baumea articulata</i>	Jointed Twig-sedge	o	o		
<i>Carex appressa</i>	Tall Sedge	o	o	o	
<i>Carex breviculmis</i>	Common Grass-sedge	o	o		
<i>Eleocharis acuta</i>	Common Spike-sedge	o	o		
<i>Ficinia nodosa</i>	Knobby Club-sedge				o
<i>Gahnia filum</i>	Chaffy Saw-sedge	o	o		
<i>Isolepis cernua</i> var. <i>platycarpa</i>	Broad-fruit Club-sedge		o		
<i>Isolepis inundata</i>	Swamp Club-sedge		o		
<i>Isolepis marginata</i>	Little Club-sedge	o	o	o	
<i>Lepidosperma laterale</i> var. <i>majus</i>	Variable Sword-sedge			o	
<i>Lepidosperma ?gunnii</i>	Sword Sedge	o			
<i>Schoenus apogon</i>	Common Bog-sedge	o	o	o	
<i>Schoenus tesquorum</i>	Soft Bog-sedge	o	o		
Juncaceae					
<i>Juncus amabilis</i>	Hollow Rush	o		o	
<i>Juncus holoschoenus</i>	Joint-leaf Rush	o		o	
<i>Juncus pallidus</i>	Pale Rush	o		o	
<i>Luzula meridionalis</i> var. <i>densiflora</i>	Common Wood-rush	o			
Juncaginaceae					
<i>Triglochin striata</i>	Streaked Arrow-grass		o		
Liliaceae					
<i>Caesia calliantha</i>	Blue Grass-lily	o			
<i>Caesia parvifolia</i> var. <i>parvifolia</i>	Pale Grass-lily				o
<i>Dianella brevicaulis</i>	Small-flower Flax-lily	o		o	
<i>Dianella laevis</i>	Smooth Flax-lily			o	o
<i>Dianella revoluta</i> subsp. <i>revoluta</i> s.l.	Black-anther Flax-lily	o			
<i>Hypoxis hygrometrica</i>	Golden Weather-glass	o			
<i>Hypoxis vaginata</i> var. <i>vaginata</i>	Yellow Star	o			
<i>Tricoryne elatior</i>	Yellow Rush-lily	o			
Orchidaceae					
v <i>Diuris behrii</i>	Golden Cowslips	o			
<i>Microtis arenaria</i>	Notched Onion-orchid	o			
<i>Microtis parviflora</i>	Slender Onion-orchid	o			
<i>Microtis unifolia</i>	Common Onion-orchid	o	o	o	
<i>Thelymitra antennifera</i>	Rabbit Ears	o			
<i>Thelymitra pauciflora</i> s.l.	Slender Sun-orchid	o			

Table 2 (cont.)

Species	Common Name	Grassland	Marsh	Swamp Scrub	Sandy rises
Poaceae					
<i>Austrodanthonia caespitosa</i>	Common-Wallaby-grass	o			
<i>Austrodanthonia geniculata</i>	Kneed Wallaby-grass				o
<i>Austrodanthonia laevis</i>	Smooth Wallaby-grass	o			
<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	Slender Wallaby-grass	o		o	
<i>Austrodanthonia setacea</i> var. <i>setacea</i>	Bristly Wallaby-grass				o
<i>Austrostipa flavescens</i>	Coast Spear-grass				o
<i>Austrostipa pubinodis</i>	Tall Spear-grass	o			
<i>Austrostipa semibarbata</i>	Fibrous Spear-grass	o			
<i>Distichlis distichophylla</i>	Australian Salt-grass	o			
<i>Elymus scaber</i>	Common Wheat-grass	o			
<i>Eragrostis brownii</i>	Common love-grass	o			
<i>Hemarthria uncinata</i>	Matt Grass	o			
<i>Lachnagrostis filiformis</i> var. 1	Common Blown-grass		o	o	
r <i>Lachnagrostis punicea</i> subsp. <i>punicea</i>	Purple Blown-grass	o			
<i>Microlaena stipoides</i>	Weeping Grass	o		o	
<i>Notodanthonia semiannularis</i>	Wetland Wallaby-grass	o		o	
<i>Phragmites australis</i>	Common reed		o		
<i>Poa labillardierei</i>	Common Tussock-grass	o		o	
<i>Poa 'poiformis'</i>	Coast Tussock-grass	o	o		
<i>Poa tenera</i>	Slender Tussock-grass			o	
<i>Pentapogon quadrifidus</i>	Five-awned Spear-grass	o			
<i>Themeda triandra</i>	Kangaroo Grass	o			
Xanthorroaceae					
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	o		o	o
DICOTYLEDONS					
Aizoaceae					
<i>Carpobrotus</i> sp.	Pigface	o			
Apiaceae					
<i>Centella cordifolia</i>	Pennywort	o			
<i>Eryngium vesiculosum</i>	Prickfoot	o	o		
Asteraceae					
<i>Brachyscome graminea</i>	Grass Brachyscome	o			
<i>Calocephalus lacteus</i>	Milky Beauty-heads	o			
<i>Cassinia aculeata</i>	Common Cassinia	o			
<i>Cassinia longifolia</i>	Shiny Cassinia	o			
<i>Euchiton involucratus</i> s.s.	Star Cudweed	o			
<i>Ozothamnus ferrugineus</i>	Tree Everlasting	o		o	
<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed	o			
<i>Leptorhynchus tenuifolius</i>	Wiry Buttons	o			
<i>Senecio glomeratus</i>	Annual Fireweed	o			
<i>Solenogyne dominii</i>	Smooth Solenogyne	o			
Convolvulaceae					
<i>Dichondra repens</i>	Kidney Weed	o		o	
Droseraceae					
<i>Drosera peltata</i> subsp. <i>peltata</i>	Pale Sundew	o			
Epacridaceae					
<i>Astroloma humifusum</i>	Cranberry Heath	o			

Table 2 (cont.)

Species	Common Name	Grassland	Marsh	Swamp Scrub	Sandy rises
Euphorbiaceae					
<i>Amperea xiphioclada</i>	Broom Spurge				0
Fabaceae					
<i>Bossiaea cinerea</i>	Showy Bossiaea				0
<i>Bossiaea prostrata</i>	Creeping Bossiaea	0			
<i>Kennedia prostrata</i>	Running Postman				0
<i>Viminaria juncea</i>	Golden Spray	0			
Geraniaceae					
<i>Geranium retrorsum</i> s.l.	Grassland Cranesbill	0			
<i>Geranium</i> sp. 2	Variable Cranesbill	0		0	
Goodeniaceae					
<i>Goodenia ovata</i>	Hop Goodenia	0		0	
<i>Selliera radicans</i>	Shiny Swamp-mat	0	0		
Haloragaceae					
<i>Haloragis heterophylla</i>	Varied Raspwort	0	0		
Lythraceae					
<i>Lythrum hyssopifolia</i>	Small Loosestrife	0	0	0	
Mimoscaeeae					
<i>Acacia melanoxylon</i>	Blackwood	0		0	
<i>Acacia verticillata</i>	Prickly Moses			0	
Myrtaceae					
<i>Eucalyptus ovata</i>	Swamp Gum				0
<i>Eucalyptus viminalis</i>	Manna Gum				0
<i>Leptospermum laevigatum</i>	Coast Tea-tree	0			0
<i>Leptospermum continentale</i>	Prickly Tea-tree	0			
<i>Melaleuca ericifolia</i>	Swamp Paperbark	0		0	
Onagraceae					
<i>Epilobium billiardierium</i> subsp. <i>intermedium</i>	Variable Willow-herb			0	
Oxalidaceae					
<i>Oxalis</i> sp. aff. <i>exilis</i> (glabrescent)	Shady Woodsorrel	0		0	
Proteaceae					
<i>Banksia integrifolia</i>	Coast Banksia				0
Ranunculaceae					
<i>Clematis microphylla</i>	Small-leaved Clematis			0	
Rosaceae					
<i>Acaena ovina</i> var. <i>velutina</i>	Australian Sheep's Burr	0			
<i>Acaena novae-zelandiae</i>	Bidgee-widgee	0		0	
Rubiaceae					
<i>Asperula conferta</i>	Common Woodruff	0	0		
<i>Opercularia ovata</i>	Broad-leaf Stinkweed	0			
<i>Opercularia varia</i>	Variable Stinkweed				0
Santalaceae					
<i>Exocarpos strictus</i>	Pale-fruit Ballart			0	
Scrophulariaceae					
<i>Gratiola peruviana</i>	Austral Brooklime			0	
<i>Veronica gracilis</i>	Slender Speedwell	0	0	0	
Solanaceae					
<i>Solanum laciniatum</i>	Large Kangaroo Apple				0
ALGAE (incomplete)					
<i>Chara</i> sp.	Stonewort		0		

numerous weeds. Most of the Swamp Scrub is attributable to Swamp Scrub (Freshwater) (EVC 53_61), although some areas of Swamp Scrub (Estuarine) (EVC 53_62) may have occurred near the creek mouths.

Marshes

The survey plans (Nutt, 1841; Anon 1857; Smythe, undated) show areas of treeless wetland, labelled by terms such as 'marshy plain' and 'swampy flat'. Unfortunately, no open wetlands are now preserved in the area. However, numerous wetland plant species occur in several of the deeper depressions within the grassland, and on the road verge of Nepean Hwy (between Marine Drive and Mornington Peninsula Freeway; see Fig. 2). Although the soils and hydrology have been altered greatly since settlement by earthworks, this roadside preserves several flora species which may show something of the character of the wetland vegetation that was once present locally. It is dominated by sedges and rushes (Common Spike-sedge *Elaeochaeris acuta*, Jointed Twig-sedge *Baumea articulata*, Streaked Arrow-grass *Triglochin striata*, Common Bog-rush *Schoenus apogon*, Tall Sedge *Carex appressa* and Club Sedges *Isolepis* spp.) and some grass and herb species, including Prickfoot. In standing water, algae of the genus *Chara* are prominent.

Under DSE's current typology (Frood unpublished.), several wetland EVCs probably once occurred in the Safety Beach area. Judging from the known characteristics of the landscape and the little remaining physical evidence, the most common EVC was probably Plains Grassy Wetland (EVC 125). This is a broadly defined EVC with several floristic communities, including Herb-rich Plains Grassy Wetland, which is characterised by many of the herb species still found at Safety Beach (SAC, 1996). This community occurs on the margins of the former Carrum Swamp, which occurred in a landscape very similar to Safety Beach.

Woodlands on sandy rises

Several raised, sandy areas are present at Safety Beach (see Fig. 2), some of which still support a few indigenous plants, including the trees Narrow-leaved Peppermint *Eucalyptus radiata* and Coast

Banksia Banksia integrifolia, along with Austral Bracken *Pteridium esculentum* and several shrubs, herbs and grasses including Coast Spear-grass *Austrostipa flavescens*, Broom Spurge *Amperea xiphocladia* and Showy Bossiaea *Bossiaea cinerea*. These areas are clearly remnants of either Damp-sands Herb-rich Woodland (EVC 3) or Coast Banksia Woodland (EVC 2) (Oates and Taranto, 2001), two EVCs which both occur on near-coastal sandy flats. These vegetation types were probably scattered along the beach and throughout the Safety Beach area, on small patches of sand (FIS Quadrat E03411). The aerial photographs from 1957 clearly show wooded sandy rises scattered across the otherwise almost treeless plain (Fig. 4).

Eucalypt 'woodlands' on heavier soil

In addition to the sites supporting trees on sandy rises, one other treed site occurs on heavier soil (FIS Quadrat E03412). It shares many of the species of the sites described above, but also supports a mix of species characteristic of woodlands across the wider Mornington Peninsula. For example, the lower layer includes Prickly Tea-tree *Leptospermum continentale*, Grey Parrot Pea *Dillwynia cinerascens* and Hedge Wattle *Acacia paradoxa*. The tree layer includes Swamp Gum *Eucalyptus ovata* and Black Wattle *Acacia mearnsii*. This small, isolated site is difficult to assign confidently to an EVC under the current typology, but it clearly supports floristic elements of Grassy Woodland (EVC 175), Swampy Woodland (EVC 937) and Swampy Riparian Woodland (EVC 83). The presence of trees and shrubs at this site, in contrast to the other sites on heavier soils, is possibly due to this site experiencing less severe drought stress in summer. The site is directly adjacent to one of the major drainage channels, giving larger trees direct access to permanent water. Furthermore, the site sits on a slightly raised natural levee, composed of slightly coarser material than the surrounding heavy-soil plain, ameliorating the severity of soil cracking in summer, which otherwise disadvantages the establishment of woody species. The aerial photographs taken in 1957 show other trees clustered along the stream channels (Fig. 5). The

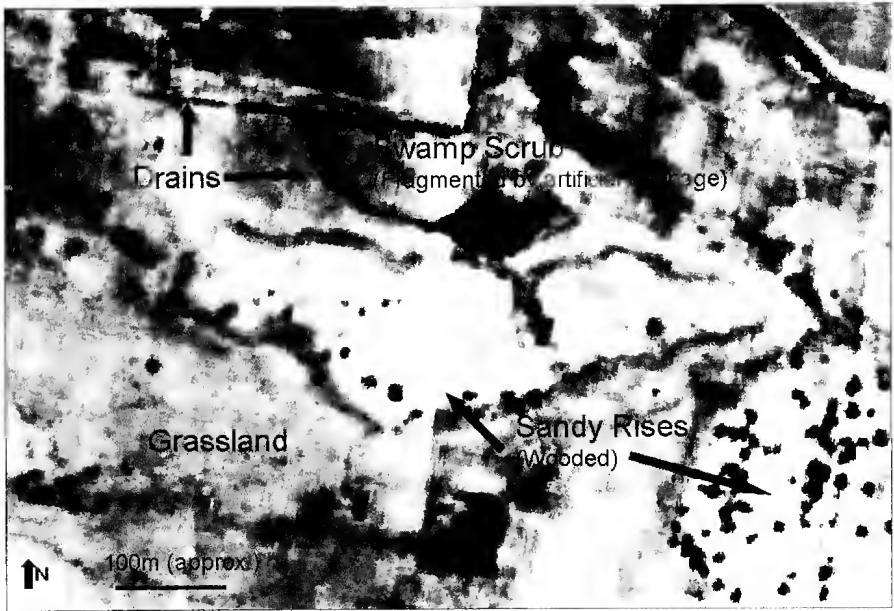


Fig. 4. Grassland interrupted by Sandy Rises and Swamp Scrub, 1957. The area shown is covered by the vegetation map (The lower rectangle on Fig. 2). The area at the top of the photograph is clearly delineated by Smythe (undated) as Swamp Scrub. By 1957, this area had been largely drained.

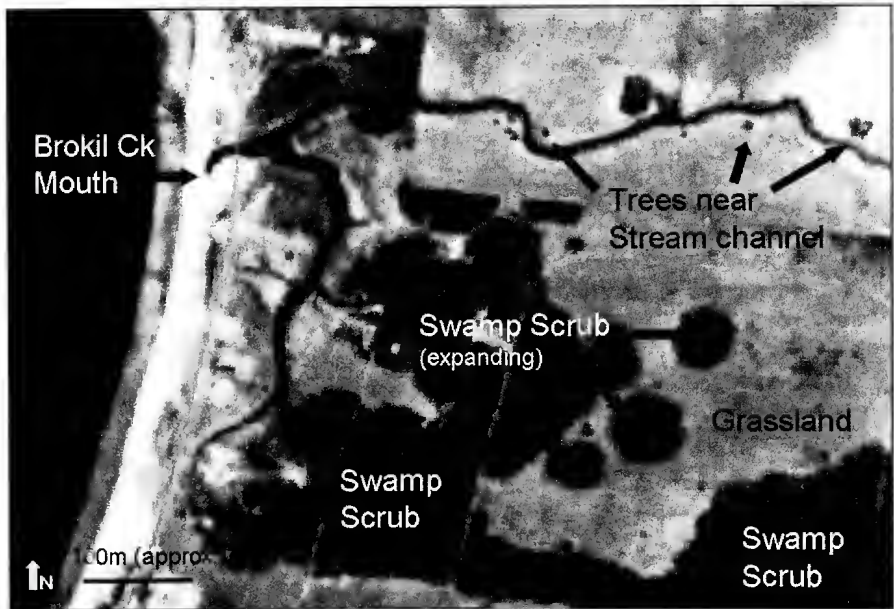


Fig. 5. The mouth of Brokil Creek with associated stream channels, scrub and grassland, 1957. The area shown is covered by the vegetation map (the upper rectangle on Fig. 2). Several patches of Swamp Scrub are apparently expanding. Their circular shape probably results from the radial suckering of the dominant Swamp Paperbark.

additional species recorded at this site have not been recorded in Table 2, since the site is transitional, and includes elements more characteristic of Grassy Woodland (EVC 175), which has not otherwise been investigated in any detail here.

Mapping the past patterns of vegetation at Safety Beach

Fig. 2 presents an attempt to map the former patterns of native vegetation at Safety Beach. The map was created using both current and historical data, and is necessarily 'coarse'. Several 'zones' are represented on the map, each corresponding to the vegetation types already discussed.

Grassland: Most areas mapped as 'grassland' are (almost) treeless on the 1957 photographs, on heavy soils, and in areas marked as 'swampy', 'grassy', 'fine', or 'open' (and distant from any comments mentioning scrub or trees) on Smythe's map. While these areas can be delineated readily in some areas, in others the precise boundaries of the 'grassland' are difficult to determine. These are often areas where the soil boundaries are now obscure, and Smythe provides no boundary line on his map. These areas only tentatively assigned to 'grassland' are marked with question marks (?) on Fig. 2. The area of 'grassland' was locally between ~300 and 560 hectares.

Swamp Scrub: Areas of Swamp Scrub have been traced directly from Smythe's (undated) map, which clearly delineates this EVC. Some boundaries have been modified slightly with reference to the 1957 aerial photographs.

Marshes: These areas have been traced directly from Smythe's map, with some minor alterations with reference to the 1957 aerial photographs.

Woodlands on Sandy Rises: These areas are not apparent on Smythe's map, presumably because they are relatively small. However, they are clearly visible on the 1957 aerial photographs (Fig. 4), and are often evident today, even in the urban environment.

Eucalypt Woodland on Heavy Soils: This vegetation, discussed above, is NOT MAPPED on Fig. 2, since it was probably

of minor extent, along stream channels and associated with Swamp Scrub.

Terrestrial vegetation- various: On the map, this unit is used to account for the vegetation not discussed in this paper. It includes areas labelled by Smythe or Nutt (1841) as 'heathy plain', 'stringybark', or 'thickly wooded oak, scrubby and rushy land'. These areas still support patches of Damp Heathy Woodland (EVC 793), Grassy Woodland (EVC 175) and Damp Heathland (EVC 710) (Sinclair *et al.*, 2005).

Discussion

Safety Beach in context – Grasslands in south-eastern Victoria

When Victoria was colonised, a large part of the state's lowlands was covered by Plains Grassland (EVC 132). This vegetation is best documented for the basalt plains of Western Victoria, where detailed botanical and ecological studies have been undertaken over a number of decades (e.g. Sutton 1916-1917; Patton, 1935; Willis 1964; Stuwe and Parsons, 1977; Lunt 1990; Morgan and Rollason, 1995). Large areas of grassland also occurred in northern Victoria (Carter *et al.*, 2003; Kirkpatrick *et al.*, 1995). These grasslands were important in the history of Victorian agriculture and settlement, and have long been well known (Howitt, 1855; Powell, 1970).

The smaller grasslands of lowland eastern Victoria, in contrast, are less well known, with relatively few studies into their floristic composition, distribution or ecology (Lunt 1997; Cook and Yugovic, 2003; Yugovic and Mitchell, 2006). The historical evidence for their existence is fragmentary, and very little physical evidence of them remains. For example, Cook and Yugovic's recent work (2003) on the former Clyde-Tooradin grassland was partially concerned with simply demonstrating its existence, after all memory or evidence was apparently lost.

Grasslands occur under conditions favouring grasses, but precluding the establishment or survival of shrubs and trees. The combination of factors creating these conditions differ from area to area, and are sometimes difficult to interpret. In western and northern Victoria, it has long

been recognised that the formation of grasslands is promoted by heavy clay soils in combination with relatively low rainfall, which make water stress too severe for the establishment of trees. In winter, the heavy soil swells, while in summer it opens into deep cracks that cause severe drought-stress (Sutton, 1916-17; Patton, 1930, 1935, Willis 1964). Lunt (1997) also suggested a role for drought-stress in preventing tree growth on the (now-extinct) grasslands around Sale, most of which occurred in a rain-shadow area. In their discussion of the Clyde-Tooradin grassland, which exists in an area of relatively higher rainfall, Cook and Yugovic (2003) suggested that burning by aboriginal people was necessary to maintain this area as an open grassland, to prevent the encroachment of the adjacent Swamp Paperbark. They also suggested that other low-lying, swampy places in southern Victoria were also regularly burnt before colonisation, leading to the maintenance of a number of small grasslands in lowland Gippsland, including Brokil Ck at Safety Beach. These comments of Cook and Yugovic (2003) encouraged on-ground investigation at Safety Beach.

Timber on the grasslands

The 'good grass country' on the flat shown by Smythe (undated) is described as being 'timbered with lightwood'. Lightwood *Acacia implexa* generally occurs in dry sites with shallow or rocky soils (Costermans 1983, Entwisle *et al.*, 1996) and does not usually occur in seasonally waterlogged soils like those at Safety Beach. Smythe's reference to it in this environment requires explanation. No Lightwoods were observed in Safety Beach during field-work for this paper, and there are no records of Lightwood from this area (when all databases available on the FIS, including herbarium data, are searched). Other woody species (including Coast Banksia *Banksia integrifolia* and Blackwood *Acacia melanoxylon*) remain in suburban Safety Beach, so that if Lightwood ever occurred here, it has been entirely and preferentially removed. Together, these observations suggest that Lightwood may never have occurred at Safety Beach, and that Smythe's usage of

this name differs from the present usage. It is probable that Smythe was instead referring to the very similar Blackwood, which still occurs scattered in Safety Beach, and which tolerates inundation and drought. This alternate usage of the name 'Lightwood' also appears in other reports of the 1800s, according to Yugovic and Mitchell (2006).

Smythe's use of the word 'timbered' is also worth discussing. Was this area a treeless plain, or a woodland? The historic plans and the floristic evidence suggests that the trees were present but sparse (and may have occurred 'in mosaic' with treeless areas, depending on subtle soil changes, see below). Certain species (such as Milky Beauty-heads and Prickfoot) are grassland/grassy-wetland-specific and rarely occur on sites with an appreciable canopy (pers. obs.). Their presence strongly suggests that these sites have long supported very open, grassy vegetation. The Blackwoods noted probably occurred with several other species of small tree and shrub, possibly including Drooping sheoak *Allocasuarina verticillata*, Black Wattle *Acacia mearnsii*, and Golden Spray *Viminaria juncea* (the latter species only around depressions and wetlands), all of which are today present in Safety Beach, probably as remnant populations. It is worth noting that the term 'Plains Grassland' is regularly applied to partially treed areas across Victoria.

Factors influencing vegetation patterning at Safety Beach

Cook and Yugovic (2003) suggested that fire was important in maintaining the boundary between open plains and patches of suckering Swamp Paperbark at Clyde-Tooradin. A similar explanation has been offered to explain the maintenance of other grasslands in South Gippsland (Yugovic and Mitchell, 2006). This was based on the observation that the grassland occurred under the same conditions as the adjacent wet Swamp Scrub, making water-stress an apparently untenable argument for the treelessness of such grassland. A few patches of Swamp Scrub at Safety Beach apparently expanded between the 19th century (Smythe, undated) and 1957 (Fig. 5), supporting the idea that fire management once

played a role in maintaining some grassland boundaries. Cook and Yugovic (2003) also noted the obvious benefit for the indigenous people in keeping the area open and free from scrub. At Safety Beach, the benefit to be gained by Aboriginal people from keeping the area open would have been similarly great. Plant and animal foods would be accessed more easily (and may have been more plentiful), and an open plain would have allowed easy access to the beach, which is otherwise difficult locally because of the steep cliffs of Mt Martha and Arthurs Seat. Unfortunately, there is no reliable record of Aboriginal burning practices detailed enough to confirm these ideas.

Several lines of evidence also suggest that fire was not necessarily the only (or even the major) factor maintaining the open grassy vegetation at Safety Beach. Firstly, the former presence of Blackwood suggests that fire intensity was probably lower than that needed to suppress vigorous, suckering Swamp Paperbark. Secondly, most patches of Swamp Scrub at Safety Beach corresponded to drainage lines and depressions (unlike Clyde-Tooradin or Koo-Wee-Rup), and some patches have maintained essentially the same boundaries for about 150 years (as deduced from Smythe (undated), the old aerial photographs (1957) and current observations), suggesting that Swamp Scrub was often restricted by relief, not predominantly by fire (although relief may influence fire behaviour).

Small changes in local relief and soil-type were probably of key importance in determining patterns of treelessness at Safety Beach, through their interactions with water availability. Drainage lines were presumably best able to support Swamp Paperbark and Swamp Gum because they remained moist most of the year, while the slightly higher plains would have been moist in winter, but probably dry enough in summer to crack and disadvantage woody plants, as on the western and northern plains (Sutton, 1916-17; Patton, 1930, 1935, Willis 1964). In these areas today, large, deep soil cracks several centimetres wide can be observed in summer; although these must be interpreted with caution, since the hydrology has probably changed markedly since settlement. It

is important to note that soil type and fire history are not mutually exclusive explanations for patterns of treelessness, and that these factors may interact (for example, drier areas of relatively heavy soil may be less rapidly colonised by Swamp Paperbark, and these areas would be the most naturally promising areas to maintain as open plains via burning). While the historic vegetation boundaries reflect physical differences in soil texture and hydrology they may have been further accentuated through the judicious human use of fire.

Small depressions in the grassland would have supported pools in winter. These probably suffered minor or severe drought stress in summer, depending on their depth and soil structure. These areas presumably contained various types of open 'marshes' now referred to as Plains Grassy Wetlands. Small sandy rises provided growing conditions that are different again, the sandy substrate being well-drained and non-cracking. As noted above, these areas supported Damp-sands Herb-rich Woodland (EVC 3) and Coast Banksia Woodland (EVC 2).

Salinity is also undoubtedly a factor influencing vegetation patterns at Safety Beach, both through salt spray and through the influence of saline ground-water and (in isolated areas) tidal inundation. Again, relief plays a major role in determining whether plants are exposed to salinity. Depressions in areas with saline ground-water, or the banks of the salty creeks, expose plants to salt stress, and would have carried vegetation referable to Brackish Grassland (EVC 934). In this way, the coastal flat at Safety Beach resembles an estuary, where patterns of saltmarsh, wetland and grassland are intricately patterned according to elevation. It is possible that small patches of typically estuarine vegetation (such as Coastal Saltmarsh (EVC 9), Estuarine Wetland (EVC 10), Estuarine Flats Grassland (EVC 914), Swamp Scrub (Estuarine) (EVC 53_62) and Brackish Sedgeland (EVC 13), Oates and Taranto, 2001; Frood unpubl.) occurred at the mouths of the small salty creeks, although there is no physical evidence of any such communities now. Port Phillip has lost many of its small 'estuarine' creek mouths since settlement, with few (e.g. Balcombe Creek.) surviving.

A note on plant identification

The dominant Tussock-grass was identified here as Coast Tussock-grass *Poa poiformis*. In his description of Plains Grassland (South Gippsland) Frood (1991) notes

The form of *Poa labillardierei* is of comparable morphology (viz. Compact tussock with bluish inrolled foliage which is sometimes quite prickly, and superficially resembling *P. poiformis*) to the form which occurs on black soils of the western volcanics (e.g.

Merri Creek grasslands and Skipton area).

Several quadrats taken by others at Carrum in open, grassy vegetation resembling the moist grasslands of Safety Beach record the dominant grass as *Poa labillardierei* var. (Basalt Plains) (FIS quadrats N02206-N02209). This informal varietal name includes several entities with stiff, bluish, prickly leaves (N. Walsh, pers. comm.). Given the ecological similarities between all these sites, it is tempting to conclude that essentially identical plants dominate at all sites, but are difficult to determine using the current taxonomy, and which are treated differently by different observers. Such difficulty in placing plants into described taxa is not unusual or unexpected in *Poa*, which has long been recognised as a genus with much variation that is difficult to deal with taxonomically (Vickery, 1970).

Biological significance and prospects for conservation

The vegetation communities at Safety Beach are highly significant, in terms of their Bioregional Conservation Status (www.dse.vic.gov.au). Plains Grassland (South Gippsland) is endangered throughout its range, and is also listed as endangered under the *Flora and Fauna Guarantee Act* 1988 (SAC, 1994). Brackish Grassland has not been mapped anywhere else in the Port Philip area. However, it is understood that it once occurred near the mouth of the Yarra and possibly at Phillip Island (Oates and Taranto, 2001). It is considered rare in the Gippsland Plain Bioregion. Swamp Scrub, while still relatively abundant in some areas of the Mornington Peninsula, is considered endangered in the Gippsland Plain Bioregion. Several plant taxa are also considered worthy of note, given their conservation status (Ross and Walsh, 2003).

Golden Cowslips *Diuris behrii* is considered vulnerable in Victoria. This orchid has not previously been recorded on the Mornington Peninsula. At Safety Beach, only three plants were noted (FIS quadrat E03404).

Purple Blown-grass *Lachnagrostis punicea* subsp. *punicea* is considered rare in Victoria and Australia. A single previous record of this species exists on the Mornington Peninsula, from Pt Leo (1996, FIS T17503). It remains on many of the remnant patches at Safety Beach.

Several other species should be considered regionally or locally significant, being relatively rarely encountered on the Mornington Peninsula (pers. obs.), including Grass Brachyscome *Brachyscome graminea*, Milky Beauty-heads *Calocephalus lacteus*, Prickfoot, Varied Raspwort *Haloragis heterophylla*, Rabbit Ears *Thelymitra antennifera*, and Common Woodruff *Asperula conferta*.

Despite these significant biological features, the prospects for conserving grassland at Safety Beach are poor. All of the sites described here are on unreserved urban blocks that will probably be developed in accordance with their current residential zoning. One site was destroyed during the preparation of this report. Due to the small size of the properties (<0.4 ha), Victorian laws regulating removal and off-setting of native vegetation do not apply. Since the sites do not typically contain woody vegetation, council laws relating to removal or lopping of trees do not apply.

Aside from clearing, the major threat to the remaining native vegetation at Safety Beach is weed invasion. Most sites are already severely invaded by numerous weeds. The most serious weeds are the grasses Sweet Vernal-grass *Anthoxanthum odoratum*, Paspalum *Paspalum dilatatum*, Kikuyu *Pennisetum clandestinum*, Yorkshire Fog *Holcus lanatus*, Tall Fescue *Festuca arundinacea*, Rat-tail Grass *Sporobolus africanus*, Canary Grass *Phalaris* spp. and Buffalo Grass *Stenotaphrum secundatum*. As the focus of this paper was the former vegetation of this area, weed species are not listed in Table 2; however, weeds are fully recorded in the quadrat data held by the author and on the FIS.

Several very small areas of land managed by local government exist in the area, which would once have supported native grasslands. Although re-creating native grasslands is apparently near-impossible, representative plants from the local grasslands could be used for revegetation. If weeds were adequately controlled, and several of the more showy species planted (e.g. Milky Beauty-heads), such sites may be able to effectively display – albeit as a somewhat artificial exhibit – some of the original character of Safety Beach.

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References

- Anon (1857) Plan of the Parishes of Kangerong and Wannaue, County of Mornington. Crown Lands Office, July 13th 1857.
- Calder WB (1972) The natural vegetation pattern of the Mornington Peninsula with particular reference to the genus *Encalyptus*. Unpublished MA thesis, Botany Department, University of Melbourne.
- Calder WB (1974) A History of the Mornington Peninsula as it relates to the vegetation. *Victorian Historical Magazine*, 5-29.
- Calder WB (1975) *Peninsula perspectives: Vegetation on the Mornington Peninsula, Victoria*. Hedges and Bell, PL, Sponsored by National Trust of Australia (Victoria), Victorian State Government.
- Carter O, Murphy A, Cheal D (2003) Natural temperate grassland. Department of Natural Resources and Environment, Heidelberg.
- Cook, D, Yugovic J (2003) Clyde-Tooradin grassland re-discovered. *The Victorian Naturalist* 120, 140-146.
- Costermans LF (1983) *Trees and shrubs of south-eastern Australia*. (Weldon Publishing: Sydney)
- Cross J (1827) Chart of part of New South Wales with plans of the harbours. (Released 1857, London).
- DSE (2001a) Pre-1750 EVC map layer (1:100,000). Available as 'Biodiversity interactive maps' at www.dse.vic.gov.au.
- DSE (2001b) Extant EVC map layer (1:25,000). Available as 'Biodiversity interactive maps' at www.dse.vic.gov.au.
- Entwisle TJ, Maslin BR, Cowan RS, Court AB (1996) Mimosaceae. In *Flora of Victoria vol II: Dicotyledons Winteraceae to Myrtaceae*. Ed. Walsh NG, Entwisle TJ (National Herbarium of Victoria/Inkata Press: Melbourne)
- Frood D. (1991) Grasslands and grassy woodlands of the Yarram district. Unpublished report to DSE.
- Frood D. (unpubl.) Typology for wetlands and related vegetation in Victoria. EVC descriptions: Existing, proposed amendments and new descriptions. Unpublished report to DSE.
- Geological Survey of Victoria (1967a) Sorrento sheet No. 867 Zone 7.
- Geological Survey of Victoria (1967b) Western Port sheet No. 868 Zone 7.
- Grimes C (1803) Port Phillip [map].
- Howitt W (1855) *Land, labour and gold; or two years in Victoria with visits to Sydney and Van Diemen's Land*. (Longman, Brown, Green and Longmans: London)
- Kirkpatrick J, McDougall K, Hyde M (1995) *Australia's most threatened ecosystems: the south-eastern lowland native grasslands*. (Surrey Beatty and Sons, In assoc. with the World Wide Fund for Nature Australia (WWF): Chipping Norton, NSW)
- Lunt ID (1990) Impact of an autumn fire on a long-grazed *Themeda triandra* (Kangaroo Grass) grassland: Implications for management of invaded, remnant vegetations. *The Victorian Naturalist* 107, 45-51.
- Lunt ID (1997) The distribution and environmental relationships of native grasslands on the lowland Gippsland Plain, Victoria: an historical study. *Australian Geographical Studies* 35, 140-152.
- Morgan JW, Rollason TS (1995) Base-line monitoring of a significant grassland remnant at Evans St, Sunbury Victoria. *The Victorian Naturalist* 112, 148-159.
- Nutt TH (1841) Plan of special survey cont. five thousand, one hundred and twenty acres selected by Hugh Jamieson esq. In the Parish of Kangerong, County of— (duplicate copies)
- Oates A, and Taranto M (2001) *Vegetation mapping of the Port Phillip and Westernport Region*. Arthur Rylah Institute for Environmental Research, Department of Natural Resources and Environment (now DSE; available on www.dse.vic.gov.au).
- Patton RT (1930) The factors controlling the distribution of trees in Victoria. *Proceedings of the Royal Society of Victoria* 42, 154-210.
- Patton RT (1935) Ecological studies in Victoria. Part IV - Basalt plains association. *Proceedings of the Royal Society of Victoria* 48, 172-191.
- Powell JM (1970) *The public lands of Australia Felix: Settlement and land appraisal in Victoria 1834-91 with special reference to the western plains*. (Oxford University Press: Melbourne)
- Ross JH, Walsh, NG (2003) *A census of the vascular plants of Victoria*. 7th Edition. (Royal Botanic Gardens: Melbourne)
- SAC (1994) Final recommendation on a nomination for listing: plains grassland (South Gippsland) community. Scientific Advisory Committee, Flora and Fauna Guarantee. Department of Sustainability and Environment, Melbourne.
- SAC (1996) Final Recommendation on a nomination for listing: herb-rich plains grassy wetland (west Gippsland) community. Scientific Advisory Committee, Flora and Fauna Guarantee. Department of Sustainability and Environment, Melbourne.
- Sinclair SJ, Tonkinson D, Downe J, Taranto M, Kefford E, and White M (2006) *Remnant native vegetation on the Mornington Peninsula: Mapping and condition assessment. Final report to Mornington Peninsula Shire Council*. (Arthur Rylah Institute for Environmental Research: Melbourne).

- Smythe GD (undated) Survey of the coast of Port Phillip from the mouth of Tangenong Creek to Arthur's seat with the internal features (duplicate copies).
- Stuwe J, Parsons RF (1977) *Themeda australis* grasslands on the basalt plains, Victoria: floristics and management effects. *Australian Journal of Ecology* 2, 467-476.
- Sutton CS (1916-1917) A sketch of the Keilor Plains flora. *The Victorian Naturalist* 33, 112-123, 128-143.
- Tuckey JH (1804) *Port Phillip in Bass's Strait surveyed by JH Tuckey 1st Lieutenant of HMS Calcutta Oct 1804*. (London)
- Vickery JW (1970) A taxonomic study of the genus *Poa* L. in Australia. *Contributions from the NSW National Herbarium* 4, 145-243.
- Willis JH (1964) Vegetation of the basalt plains in western Victoria. *Proceedings of the Royal Society of Victoria* 77, 397-418.
- Yugovic J, Mitchell S (2006) Ecological review of the Koo-Wee-Rup Swamp and associated grasslands. *The Victorian Naturalist* 123, 323-334.
- Yugovic J (unpublished). EVC information for Mornington Peninsula Shire. Provided by the author (Available in modified form on www.mornpen.vic.gov.au; under 'Shire Planting Guides')

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Use by birds and mammals of habitats of different complexity in remnant and revegetated sites in the Wannon Catchment, Western Victoria

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Abstract

Extensive land clearing in western Victoria has led to land degradation, loss of natural habitat and poor water quality. Tree planting has been used to combat these problems and improve biodiversity, but whether these programs are meeting their nature conservation objectives is equivocal. Here we examined the presence of birds and mammals in 12 revegetated sites of different ages and habitat complexity and four remnant habitat sites. We found remnant sites had the greatest abundance in species richness of both birds and mammals, and that use of revegetated sites increased as the sites aged and became more structurally complex. (*The Victorian Naturalist* 124 (3), 2007, 149-156)

Introduction

Land clearing has contributed to degradation of land and water resources, increased greenhouse gases and the decline of biodiversity. Soils are especially affected by clearing and over-use, with acidity, erosion, salinity and fertility loss lowering agricultural production (Gretton and Salma 1996). Clearing has also changed landscapes, often with few remaining patches of vegetation present in a larger matrix of crops or pasture grasses. Such patchiness may limit movements of fauna, thus reducing genetic diversity (Merriam and Saunders 1993; Deacon and Mac Nally 1998). Habitat destruction and fragmentation is considered a leading cause of the decline of biodiversity in Australia (Hobbs and Hopkins 1990; Recher 1993).

Revegetation is one strategy used to reduce these deleterious effects of land clearing. However, most revegetated patches are small, fragmented and linear with high edge to area ratios. Their value (and those of small and often linear remnants) in terms of mammal and bird conservation has only recently received attention, and the conclusions have been equivocal (Bennett 1990; Lynch and Saunders 1991; Hobbs 1993; Crome *et al.* 1994; Downes *et al.* 1997; Deacon and Mac Nally 1998; Rossi 2001). Recent studies of this kind that have been undertaken in south-eastern Australia have included Ryan (2000), Rossi (2003) and Loyn (2005).

Here we report on a study designed to measure presence of mammals and birds in remnant vegetation patches and in revegetated sites of different ages and structural complexity to see if revegetation can indeed help to provide suitable habitat for vertebrates, thus ameliorating the effects of land clearing on biodiversity.

Methods

We conducted the study in the catchment of the Wannon River in western Victoria where only 1.9% of the catchment area consists of remnant forest blocks (Glenelg-Hopkins Catchment Management Authority 2000). There has been a program of revegetation in the area for over 20 years, principally on private land in the form of windbreaks, grown along fence lines or in rows of less than 30 m width.

Sixteen sites were chosen, four of which were remnant sites at least 200m long. 'Remnant' here refers to patches of vegetation left uncleared after European settlement and having a natural structural complexity (Kimber *et al.* 1999). Sites were selected from a small pool of possibilities using the following selection criteria: size, accessibility, age of revegetation, availability of historical information, and connectivity.

The revegetated sites were grouped into four age classes: 0-5 years (3 sites), 5-10 years (3), 10-15 years (3) and over 15 years (3). All sites were fenced to prevent access to stock and thus allow for regeneration of grasses and shrubs, and were at least 200 m long. All sites were within 20 km of each other and within 15 km of the Wannon River. Geology, soils and climate were thus similar (Jamieson 2002).

The vegetation community is best described as Dry Red Gum Woodland (Land Conservation Council 1979) dominated by River Red Gum *Eucalyptus camaldulensis*, Yellow Gum *E. leucoxylon* and Manna Gum *E. viminalis* with a ground cover of Austral Bracken *Pteridium esculentum* and various species of Poaceae. Drier patches of Dry Heathy Forest (Land Conservation Council 1979) have Brown Stringybark *E. baxteri* and Messmate *E. obliqua* with Austral Grass Tree *Xanthorrhoea australis* and Smooth Parrot Pea *Dillwynia glaberrima* abundant. *Acacia*

spp. and *Allocasuarina* spp. are common middle-storey plants. The species used in revegetation include eucalypts listed above as well as some Swamp Gum *E. ovata*, Blue Gum *E. globulus*, Sugar Gum *E. cladocalyx* and Scent Bark *E. aromaphloia*. Shrubs were also usually planted or grew naturally once fencing excluded stock. These included Salt Paperbark *Melaleuca halmaturorum*, Scrub She-oak *Allocasuarina paludosa*, Slaty She-oak *Allocasuarina muelleriana*, Woolly Teatree *Leptospermum lanigerum*, Blackwood *Acacia melanoxylon*, Black Wattle *Acacia mearnsii* and Silver Wattle *A. dealbata*.

At each site a 200 m transect line was laid out using a 50 m tape and yellow flagging tape to identify 25 m intervals. Transect lines were located in the centre of the sites in the large patches (e.g. remnant sites 2, 3 and 6) at no less than 5 m from the vegetation edge. At 25 m intervals along the transect the following attributes were measured: plant species present, percentage of vegetation cover (% cover observed in overstorey, understorey and ground cover), vegetation structure (number of touches on a ranging pole), presence of tree hollows, hollow logs and ground-cover (leaf litter and grasses). We also measured the 'patchiness' of the vegetation along the 200 m transect as the number of gaps in vegetation that exceeded 10 m length.

Each transect was walked three times for one hour in early morning and late afternoon over a 10 week period, covering spring and summer in 2001/2002. Birds seen or heard within 5 m of the transect line were identified and recorded. Evidence of breeding and presence of nests were recorded.

Mammals were detected at the same time, using direct observation or indirect signs (scats, footprints, diggings, skeletal remains) using Triggs (1998). Elliott folding aluminium traps baited with peanut butter, rolled oats and honey were also used. Each site was trapped five times (60 trap-nights per site). Traps were placed randomly along the transect lines at least 25 m apart. Each transect line was spotted once for nocturnal mammals.

We used an ordinal scaling system

instead of habitat component counts to determine average abundances. This system is a useful way of standardising data when making statistical comparisons (e.g. for comparing habitat components with bird abundances).

Weeds and introduced mammals can deleteriously affect the presence of native species (Hobbs 1993, Panetta and Hopkins 1991). We noted the relative abundance of these exotic species.

Results

Habitat structure

The remnant sites were found to be more complex than the revegetated sites (Fig. 1). The microhabitat components (native grasses, leaf litter and rocky areas), vegetation densities, and the number of hollow logs were the structural components that contributed most to this difference. The data have been modified to allow comparison using arcsine transformation (Krebs 1999). The percentage values recorded for the variables were normalised and converted to a 0-5 abundance scale (1: 10%; 2: 10-25%, 3: 25-50%, 4: 50-75%, 5: >75%). Pair wise tests using ANOSIM (Krebs 1999) indicated the younger classes of vegetation (<10 years old) showed the greatest difference in structural complexity compared with the remnant sites (Jamieson

2002). SIMPER (similarity percentage) analysis (Clark and Gorley 2001) showed that for the three youngest revegetated sites, microhabitat components contributed the most to the structural differences between these sites and remnant sites, while vegetation density was the most significant feature that distinguished the older revegetated sites (>15 years old) from the remnant sites (Jamieson 2002).

Birds

Table 1 shows 45 species of birds were recorded (5 most abundant, 0 absent). The most frequently detected species are widespread and common and include the Willie Wagtail *Rhipidura leucophrys*, Crimson Rosella *Platyercus elegans*, Sulphur-crested Cockatoo *Cacatua tenuirostris*, Eastern Rosella *P. eximus*, Australian Magpie *Gymnorhina tibicen* and Little Raven *Corvus mellori*. Six species of parrots were seen.

The remnant vegetation sites had the highest abundance of birds and highest species richness. Abundance of birds increased with age of revegetation. More species were found in the remnant sites (38) than the revegetated ones, although interestingly more were also found in the younger revegetated sites (27 in the <5

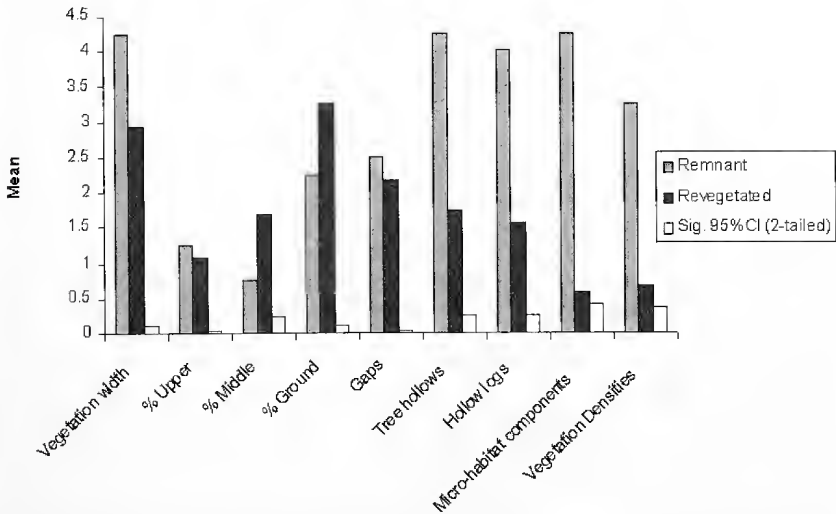


Fig. 1. Comparison of the mean ratings (max. 5) for structural habitat components found in the remnant and the combined revegetated sites.

Table 1. Species of birds found in each age group

Estimated level of abundance (0 low - 5 high score). Refer to methods on scoring system. Columns show vegetation age classes.

Common name	Scientific name	Remnant	1-5	5-10	10-15	15+
Family CASUARIIDEA						
Emu	<i>Dromaius novaehollandiae</i>	4	0	0	0	0
Family PHASIANIDAE						
Brown Quail	<i>Coturnix ypsilophora</i>	3	0	0	0	0
Family ANATIDAE						
Australian Shelduck	<i>Tadorna tadornoides</i>	0	1	1	0	0
Australian Wood Duck	<i>Chenonetta jubata</i>	2	1	1	0	0
Pacific Black Duck	<i>Anas superciliosa</i>	0	1	1	0	0
Family ARDEIDAE						
White-faced Heron	<i>Egretta novaehollandiae</i>	1	1	1	0	0
Family THRESKIORNITHIDAE						
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	0	0	0	4	0
Family ACCIPITRIDAE						
Wedge-tailed Eagle	<i>Aquila audax</i>	2	0	0	1	0
Little Eagle	<i>Hieraetus morphnoides</i>	2	0	0	0	2
Whistling Kite	<i>Haliastur sphenurus</i>	2	2	2	2	2
Family FALCONIDAE						
Brown Falcon	<i>Falco berigora</i>	0	2	2	3	2
Family CHARADRIIDAE						
Masked Lapwing	<i>Vanellus miles</i>	0	1	1	0	0
Family CACATUIDAE						
Yellow-tailed Black Cockatoo	<i>Calyptorhynchus funereus</i>	2	2	2	0	2
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	5	4	4	2	3
Family PSITTACIDAE						
Little Lorikeet	<i>Glossopsitta pusilla</i>	3	0	3	0	4
Crimson Rosella	<i>Platycercus elegans</i>	5	3	3	4	5
Eastern Rosella	<i>Platycercus eximius</i>	4	3	3	4	4
Red-rumped Parrot	<i>Psephotus haematonotus</i>	2	5	5	0	3
Family CUCULIDAE						
Pallid Cuckoo	<i>Cuculus pallidus</i>	2	0	0	0	0
Family TYTONIDAE						
Barn Owl	<i>Tyto alba</i>	0	0	0	1	0
Family STRIGIDAE						
Southern Boobook	<i>Ninox novaeseelandiae</i>	2	0	0	0	0
Family PODARGIDAE						
Tawny Frogmouth	<i>Podargus strigoides</i>	1	0	0	0	0
Family HALYCONIDAE						
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	1	2	2	2	2
Family CLIMACTERIDAE						
White-throated Treecreeper	<i>Cornobates leucophaeus</i>	0	0	0	0	2
Family MALURIDAE						
Superb Fairy-wren	<i>Malurus cyaneus</i>	4	2	2	0	3
Family PARDALOTIDAE						
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	2	2	2	3	0
Brown Thornbill	<i>Acanthiza pusilla</i>	3	1	1	3	0
Family MELIPHAGIDAE						
White-naped Honeyeater	<i>Melithreptus lunatus</i>	2	0	0	2	2
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	4	1	1	3	0
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	3	3	3	3	3
Little Wattlebird	<i>Anthochaera chrysoptera</i>	3	0	0	2	0

Table 1. (Cont.)

Common name	Scientific name	Remnant	1-5	5-10	10-15	15+
Family PETROICIDAE						
Flame Robin	<i>Petroica phoenicea</i>	5	1	1	0	2
Jacky Winter	<i>Microeca fascians</i>	0	0	0	0	2
Family PACHYCEPHALIDAE						
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	3	2	2	0	0
Family DICRURIDAE						
Willie Wagtail	<i>Rhipidura leucophrys</i>	5	5	5	3	4
Grey Fantail	<i>Rhipidura fuliginosa</i>	3	1	0	4	4
Magpie-lark	<i>Grallina cyanoleuca</i>	2	0	1	0	2
Family CAMPEPHAGIDAE						
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	2	0	0	0	0
Family ARTAMIDAE						
Grey Currawong	<i>Strepera versicolour</i>	3	0	1	3	3
White-browed Woodswallow	<i>Artamus superciliosus</i>	3	0	0	0	0
Australian Magpie	<i>Gymnorhina tibicen</i>	4	1	2	3	3
Family CORVIDAE						
Little Raven	<i>Corvus mellori</i>	3	4	4	3	4
Family CORCORACIDAE						
Apostle Bird	<i>Struthidea cinerea</i>	2	0	0	0	0
Family PASSERIDAE						
Red-browed Finch	<i>Neochmia temporalis</i>	3	0	0	0	0

year old sites, 28 in the 5-10 year old sites) than in the older ones (21 species in the 10-15 year old sites and 23 in the >15 year old sites). Nine species were only ever seen in remnant sites. Birds were often seen flying from one site to another of a different age. For example, a New Holland Honeyeater *Phylidonyris novaehollandiae* was seen to nest in a 12-year-old site and forage in a nearby 8-year-old site. Nests were detected only in sites that were >15 years old or remnant sites. However, foraging occurred in all sites.

While bird nests were found only in the remnant sites and the older revegetated ones, all sites were found to provide foraging habitat for birds. Nine species occurred only in the remnant sites; some, such as the Emu and Brown Quail, in reasonably high numbers.

Mammals

Table 2 shows that more mammal species were detected in the remnant sites (15) than in the revegetated sites (5, 7, 11 and 9 for the four groups of sites in order of increasing age). Four species were detected only in the remnant sites: Western Grey Kangaroo *Macropus fuliginosus*, Red-necked Wallaby

M. rufogriseus, Brush-tailed Phascogale *Phascogale tapoatafa* and Swamp Rat *Rattus lutreolus*. Evidence of four mammal species was found in sites of all ages: Eastern Grey Kangaroo *M. giganteus*, Red Fox *Vulpes vulpes*, Rabbit *Oryctolagus cuniculus* and House Mouse *Mus domesticus*. Other introduced species (Cats *Felis catus* and Black Rats *R. rattus*) were widespread and common, being absent from only one (Cat – 1-5 year old) or two (Black Rat – remnant and > 15 years old) age classes of vegetation.

A number of species were found only in remnant sites and in revegetation that was >10 years old: Black Wallaby *Wallabia bicolor*, Common Ringtail Possum *Pseudocheirus peregrinus*, Common Brushtail Possum *Trichosurus vulpecula*, Yellow-bellied Glider *Petaurus australis*, Koala *Phascogale cinereus*, Agile Antechinus *Antechinus agilis* (as well as the four detected only in remnant sites). The Short-beaked Echidna *Tachyglossus aculeatus* was found in the 5-10 and 10-15 year age class sites as well in remnant vegetation.

Table 2. Presence/absence survey results on mammal species at study sites. X = present, - = absent * = Listed as found in the study area by the Atlas of Victorian wildlife. s = sighted, c = scat identified, h = heard call, t = trapped, d = digging/tracks

Common Name	Scientific Name	Detection method	Remnant	1-5	5-10
Native mammals					
Eastern Grey Kangaroo (s,c)	<i>Macropus giganteus</i> *	s,c	X	X	X
Western Grey Kangaroo (s)	<i>Macropus fuliginosus</i>	s	X	-	-
Swamp Wallaby (s, c)	<i>Wallabia bicolor</i>	s,c	X	-	-
Red-necked Wallaby (s)	<i>Macropus rufogriseus</i>	s	X	-	-
Common Ringtail Possum (s, c)	<i>Pseudocheirus peregrinus</i> *	s,c	X	-	-
Common Brush-tail Possum (s,c)	<i>Trichosurus vulpecula</i> *	s,c	X	-	-
Brush-tailed Phascogale (c)	<i>Phascogale tapoatafa</i> *	c	X	-	-
Yellow-bellied Glider (h, s?)	<i>Petaurus australis</i>	h,s	X	-	-
Koala (s, c)	<i>Phascolarctos cinereus</i> *	s,c	X	-	-
Agile Antechinus (t)	<i>Antechinus agilis</i>	t	-	-	-
Swamp Rat (t)	<i>Rattus lutreolus</i>	t	X	-	-
Short-beaked Echidna (d, s)	<i>Tachyglossus aculeatus</i>	d,s	X	-	X
Introduced mammals					
Red Fox (s, c, d)	<i>Vulpes vulpes</i> *	s,c,d	X	X	X
Cat (s, c)	<i>Felis catus</i> *	s,c	X	-	X
Rabbit (s, c)	<i>Oryctolagus cuniculus</i>	s,c	X	X	X
Black Rat (t)	<i>Rattus rattus</i>	t	-	X	X
House Mouse (t)	<i>Mus domesticus</i>	t	X	X	X
Total No. of species		15	5	7	

Relationship between habitat complexity and fauna abundance

As the complexity of the habitat increased, the average number of birds and mammals seen on each survey increased. When Spearman's rank correlation was used to assess if a relationship existed between relative structural complexity values and abundance of all animals seen, there was a strong correlation for birds but not for mammals (Table 3). However, we found there was a positive relationship between vegetation density and abundance of native mammals (p=0.03). Factors which produced significant correlations for birds were vegetation density (p=0.03), tree hollows (p=0.05) and microhabitat components (p=0.04).

Exotic species

ANOSIM (Bray Curtis) analysis indicated there were no significant differences in the numbers of introduced carnivorous mammals (foxes, dogs, cats), herbivorous mammals (rabbits), and weeds between the four different aged revegetated sites and the remnant sites. However, weeds were observed to be most abundant in the younger sites. Introduced pasture grasses such as Smooth Meadow-grass *Poa pratensis*, Yorkshire Fog *Holcus lanatus* and

Cocksfoot *Dactylis glomerata* were the most common weeds present, along with Patterson's Curse *Echium plantagineum* and Serrated Tussock *Nassella trichotoma*.

Discussion

Over \$6 million is spent annually on revegetation of degraded lands in Victoria (Griffin 1999). Bennett (2000) has noted that whilst tree planting has been extensive in rural Australia over the last 15 years, only 2% of plantings have had as their main purpose conservation of flora and fauna. Nonetheless, most proponents of revegetation will state biodiversity conservation is an important consequence even if it is not the main purpose of such habitat improvement (Hobbs 1993, Bennett *et al.* 2000). Thus, some authors have questioned whether revegetation in small patches is of value, mainly because the patchiness impedes free movement of populations.

Our results show that in the Wannon catchment, revegetated areas do indeed provide habitat for mammals and birds as suggested by Bennett *et al.* (2000) and Hobbs (1993). This result concurs with work by Loyn (2005) who examined use of plantations by wildlife in north-eastern Victoria. Importantly, we found that as the

Table 3. Spearman's rank correlation coefficient of the relationship between species presence and habitat features. Upper number is correlation co-efficient, lower number level of significance. * indicates correlation is significant at 0.05 level.

Habitat Feature	Class Aves	Class Mammalia
Gaps	.301 .258)	.000 1.000
Tree hollows	.499* .049	.688 .199
Hollow logs	.493 .052	.688 .199
Micro-habitat components	.519* .040	.825 .086
Veg. Densities	.538* .032	.918* .028
% Upper	.260 .331	.395 .511
% Middle	-.096 .725	-.564 .322
% Ground	-.176 .514	-.821 .089

vegetation aged, its structural complexity increased and this provided for more species and higher numbers of animals. Remnant and revegetated sites mainly differed structurally in terms of vegetation densities and microhabitat components such as percentage cover by native grasses and leaf litter. In the early stage, plants in the upper and middle vegetation strata grow close together; as the plot ages and the upper layers become less dense, more light is able to reach the ground. Bennett *et al.* (2000) have noted the importance of microhabitat features such as leaf litter, mossy patches, rocks and grasses in providing habitat for invertebrates and small vertebrates. To date, revegetation schemes in the Wannon catchment have ignored microhabitat features. However, even though there has been no deliberate consideration of the establishment of a grassy understorey, we found that sites > 10 years old had a substantial level of litter and native grasses (Poaceae), especially *Themeda triandra*. Furthermore, as vegetation aged, weed levels decreased. While ANOSIM did not detect significant differences in the number of exotic mammals in

the five groups of sites, remnant sites had fewer foxes and rats than the early stages of revegetation. This is hardly surprising, as disturbance enhances colonisation by introduced species (Krebs 1999).

The bird species we detected have been found to be common in revegetated riparian strips in the same region (Merritt and Wallis 2004). There were no introduced bird species detected. In their similar study in the nearby Dundas Tablelands, Merritt and Wallis (2004) found only four introduced species (from 43 bird species) and these constituted only 63 of 5075 bird sightings. More birds and more species of birds were found in the remnant sites than in the revegetated ones. However, the relationship between age of vegetation and species richness was not linear, as more species were seen in the younger than the older revegetated sites.

Only two native mammal species (Eastern Grey Kangaroo and Short-beaked Echidna) were detected in sites <10 years old. On the other hand, there were nine species that were only found in sites >10 years old. The detection of Yellow-bellied Gliders (*P. australis*) in regrowth (15+ years old) is especially significant given the gliders' dependence on hollows that usually develop only in mature trees (Smith and Hume 1984). In turn, this indicates that adequate shelter, hollows and/or food are found only in the older sites. These observations are consistent with those of other workers. For example, Rossi (2001) concluded that richness and abundance of small mammals in south-eastern Australia depended on the age and structural complexity of the vegetation, while Deacon and Mac Nally (1998) found a direct correlation between the number of arboreal mammals and the number of tree hollows in central Victoria as demonstrated by Wilson *et al.* (1990). Connectivity of vegetation as well as complexity is also important for the presence and abundance of small mammals. Thus Crome *et al.* (1994) found no mammals used planted windbreaks that were isolated from remnant vegetation, while Rossi (2001) found mammals did use revegetated sites providing they were connected to established vegetation. In our study area, there were sufficient proximate remnant

sites to allow for colonisation of mammals and certainly birds.

We conclude that revegetated, fenced and relatively wide (at least 20 m) plantations can provide habitat for native birds and mammals in western Victoria and that their value in terms of biodiversity conservation increases as the patches become older and more structurally complex.

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References

Bennett AF (1990) Land use, forest fragmentation and the mammalian fauna at Naringal, south-western Victoria. *Australian Wildlife Research* **17**, 325-347.

Bennett AF (2000) Future directions in revegetation: Will biodiversity issues receive greater consideration? In *Directions in revegetation and regeneration in Victoria: Proceedings of a forum held at Greening Australia*, May 5 and 6, Heidelberg, Victoria. pp 101-107. Eds MJ McDonnell and NS Williams (Australian Research Centre for Urban Ecology: Cranbourne)

Bennett AF, Kimber S and Ryan P (2000) Revegetation and Wildlife – A guide to enhancing revegetated habitats for wildlife conservation in rural environments. Busheare National Projects Research and Development Program, Research Report 2/00, Melbourne.

Clark KR and Gorley RN (2001) *Primer v5: User Manual/Tutorial*. (Primer-E: Plymouth)

Crome F, Isaacs J and Moore L (1994) The utility of birds and mammals of remnant riparian vegetation and associated windbreaks in the tropical Queensland uplands. *Pacific Conservation Biology* **1**, 328-343.

Deacon JN and Mac Nally R (1998) Local extinction and nestedness of small mammal faunas in fragmented forest in central Victoria. *Pacific Conservation Biology* **4**, 122-131.

Downes SJ, Handasyde KA and Elgar MA (1997) The use of corridors by mammals in fragmented Australian eucalypt forests. *Conservation Biology* **11**, 718-726.

Glenelg-Hopkins Catchment Management Authority (2000) Draft Glenelg-Hopkins Native Vegetation Plan (Glenelg-Hopkins Catchment Management Authority: Hamilton)

Greton P and Salma U (1996) Land Degradation and the Australian Agricultural Industry (Commonwealth of Australia: Canberra)

Griffin NRM (1999) Native Vegetation National Overview (Commonwealth of Australia, Environment Australia: Canberra)

Hobbs RJ (1993) Can revegetation assist in the conservation of biodiversity in agricultural areas? *Pacific Conservation Biology* **1**, 29-38.

Hobbs RJ and Hopkins AJM (1990) From frontiers to fragments: European impact on Australia's vegetation. *Proceedings of the Ecological Society of Australia* **16**, 93-114.

Jamieson D (2002) A comparison of habitat complexity and fauna use, between remnant vegetation and revegetated sites within the Wannon catchment. (Unpublished BSc Hons Thesis, Deakin University)

Krebs CJ (1999) *Ecological Methodology* (Benjamin Cummings: Merlo Park)

Kimber SL, Bennett AF and Ryan PA (1999) Revegetation and Wildlife: What do we know about revegetation and wildlife conservation in Australia? A report to Environment Australia. (School of Ecology and Environment, Deakin University: Burwood)

Land Conservation Council (1979) *Report on the South-Western Area, District 2*. (Land Conservation Council: Melbourne)

Loyn R (2005) Plantations can benefit wildlife. *Victorian Landcare and Catchment Management* **34**, 10-11.

Lynch JF and Saunders DA (1991) Responses of bird species to habitat fragmentation in the wheatbelt of Western Australia: interiors, edges and corridors. In *Nature Conservation 2: The Role of Corridors*, pp 143-158. Eds DA Saunders and RJ Hobbs (Surrey Beatty: Chipping Norton, NSW)

Merriam G and Saunders DA (1993) Corridors in restoration of fragmented landscapes. In *Nature Conservation 3: Reconstruction of Fragmented Ecosystems*, pp 71-87. Eds DA Saunders, RJ Hobbs and PR Ehrlich (Surrey Beatty: Chipping Norton, NSW)

Merritt B and Wallis R (2004) Are wide revegetated riparian strips better for birds and frogs than narrow ones? *The Victorian Naturalist* **121**, 288-292.

Panetta FD and Hopkins AM (1991) Weeds in corridors: invasion and management. In *Nature Conservation 2: The Role of Corridors*, pp 341-351. Eds DA Saunders and RJ Hobbs (Surrey Beatty: Chipping Norton, NSW)

Recher JIF (1993) The loss of biodiversity and landscape restoration: conservation, management, survival. An Australian perspective. In *Nature Conservation 3: The Reconstruction of Fragmented Ecosystems*, pp 141-158. Eds DA Saunders, RJ Hobbs and PR Ehrlich (Surrey Beatty: Chipping Norton, NSW)

Rossi S (2001) The use of revegetated habitats by mammals at Yellingbo Nature Reserve. (Unpublished BSc Hons Thesis, Deakin University)

Rossi S (2003) Birds, mammals and their habitat in a variegated landscape in the Western Strzelecki Ranges. (Unpublished MSc Thesis, Monash University)

Ryan PA (2000) The use of vegetated areas by vertebrate fauna in Australia: a review. In *Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration*, pp 318-335. Eds RJ Hobbs and CJ Yates (Surrey Beatty: Chipping Norton, NSW)

Smith A and Hume I (1984) *Possoms and Gliders* (Surrey Beatty: Chipping Norton, NSW)

Triggs B (1998) *Tracks, Scats and Other Traces: a Field Guide to Australian Mammals*. (Oxford University Press: Melbourne)

Wilson BA, Robertson D, Moloney DJ, Newell GR and Laidlaw WS (1990) Factors affecting small mammal distribution and abundance in the Eastern Otway Ranges, Victoria. *Proceedings of the Ecological Society of Australia* **16**, 379-394.

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How Aboriginal studies ceased to be part of natural history

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Abstract

It was once common to include studies of Aboriginal culture and history within the purview of natural history studies. This perspective changed in Victoria from the early 1970s, with the concurrent development of a number of avenues for professional fieldwork and publication related to studying the Aboriginal past. These developments are detailed here along with the long-term impacts they had for the involvement of the FNCV in Aboriginal studies. (*The Victorian Naturalist* 124 (3), 2007, 157-162)

Introduction

Today, many of the interests of the Field Naturalists Club of Victoria (FNCV) are given effect through its Special Interest Groups, which collectively take in the widest gamut of natural history. Within the history of the FNCV, however, such groups are relatively recent and represent only the latest configuration of members' interests (Houghton and Presland 2005). In all areas of intellectual pursuit, from time to time the constituent parts change. So it is within the field of 'natural history' and this paper is about one such change.

Once upon a time, it was not unusual to think of the study of Aboriginal culture as part of the purview of natural history. From the earliest days of natural history study in this country, it was commonplace for naturalists to include aspects of Aboriginal culture within their range of interests (Finney 1993). This was largely a function of the European view of so-called 'primitive' cultures as being more closely related to nature than those of the western world. It was partly due also to the fact that, at the time of European settlement of Australia, the discipline of anthropology had not been developed. These perspectives regarding Aborigines remained influential, if not widely current, however, well into the twentieth century, as is evident in both academic and popular writing, as well as in museum practice. For example, works published in the 1970s, such as *The natural history of Sydney* (Various authors 1972), *Natural history of the Adelaide region* (Twidale *et al.* 1976) and *Sense of place* (Seddon 1972), all included chapters on the indigenous people of the respective studied areas. Today, while it is not unusual to

include a chapter, usually near the beginning, about local indigenous culture in local history studies, greater attention is paid to fitting this detail into the context of the wider work.

Within the National Museum of Victoria, the state's primary natural history museum, Aboriginal culture was an integral part of public exhibitions for most of the twentieth century. This aspect of the Museum's work was perhaps largely due to the influence of Baldwin Spencer, Director of the Museum from 1899 to 1927. Spencer's interest in anthropology had developed from his involvement in the Horn expedition of 1894 and he soon formed new collections on behalf of the Museum (Rasmussen 2001).

The attitudes that are evident in such practices would strike naturalists today as old-fashioned at best, and perhaps as something far worse. This is so because the accepted view of the place and worth of Aboriginal studies has changed substantially in the past 30 years. It is clear we no longer think of Aboriginal culture as part of natural history; but when did we stop doing that, and why? What brought about this change? This paper addresses these questions and looks, briefly, at the reasons why the study of Aboriginal culture was lifted out of the realm of natural history and achieved its more rightful place among other human-centred fields of study. In what follows, the activities and publishing of the FNCV are used as primary examples, firstly of the previous views, and secondly, of the changes that have taken place.

Anthropology and the FNCV

The inclusion of Aboriginal culture within the scope of naturalist studies was symptomatic of the wider, societal view of Aborigines, through most of the 20th century. It is not surprising, then, that it was also apparent in the various interests of the FNCV. Since its formation in 1880, the club has been a central force in maintaining both the practice and intellectual framework of natural history in this state. Thus, as the premier natural history body, in its programme of activities and through the pages of its journal, *The Victorian Naturalist*, the FNCV can be said to exemplify the practice of natural history.

In keeping with attitudes within broader society in Australia at the time, papers in Aboriginal studies were regular fare for members of the FNCV for the first century of the Club's existence. Indeed, during the 1920s and '30s, interest amongst members in anthropology in general and Aboriginal subjects in particular was sufficient to warrant forming a special interest group. The Ethnological Section of the FNCV had its inaugural meeting on 7 June 1928, with Alfred Kenyon presiding; Charles Daley was appointed Honorary Secretary (Anon 1928). Both of these men were active at the highest levels of the parent body: Daley had been President of the club from 1922 to 1924, and Kenyon was to hold that position from 1934 to 1935 (Houghton and Presland 2005). The Ethnological Section had a pre-cursor in a group called the Prehistoric Club, which had been formed by Kenyon in the previous year and which met at his home in Heidelberg (Griffiths 1996). In the first year of its life as part of the FNCV, the Ethnological Section met on a monthly basis, mostly at Latham House in Swanston Street, Melbourne. There, members heard lectures and took part in discussions on a wide range of subjects of anthropological and archaeological interest, including the early history of man, native cultures of South Africa and North America, and Aboriginal art and artefacts (Anon 1929).

In addition to these lecture meetings, which were open to all members of the FNCV, field trips to Aboriginal sites within Victoria were organized regularly. Destinations outside of the Melbourne area

for such trips included the Aboriginal stone quarries at Mount William and Cape Liptrap, and shell middens and stone tool scatters along the south Gippsland coast. A number of sites closer to Melbourne were visited frequently also. It is a matter of some regret that the number and frequency of visits to these Aboriginal sites (not always by members of the FNCV, of course), ironically, did them more harm than good. In the absence of any legislative protection, many visitors 'collected' examples of Aboriginal stone artefacts from sites. This occurred in the Altona area when an FNCV group visited shell middens in April 1918 (Anon, 1918) and November 1921 (Anon 1922). The Mount William stone quarry was another favourite site for those people interested in Aboriginal artefacts; it was visited by FNCV members in February 1908 (Anon 1908) and in May 1929 (Kenyon 1929). This collecting activity occurred to the point where, today, the smaller sites such as coastal middens have been virtually denuded of any artefactual material. An archaeological survey of Aboriginal sites in the Melbourne area in 1983, found that stone tool collectors had long-since stripped these sites clean of any useful scientific data (Presland 1983, 1984).

Further indications of the long-standing connections between natural history and Aboriginal studies can be seen in the numerous articles on Aboriginal culture that have appeared in the Club's journal. Although articles and shorter pieces on Aboriginal studies were published regularly throughout this period, the subject matter was never a major focus for the journal. In the 100 years of its publication, from 1884 to 1983, *The Victorian Naturalist* carried 342 articles relating to Aboriginal culture (Hall 1979). From the beginning of the twentieth century these articles averaged just over three per year, except for two peak periods – during the 1920s this average lifted to about six per annum; and during the 1960s it reached eight per annum.

A few of the writers of these pieces were specialists in Aboriginal studies or in anthropology, but the great majority were not; they were individuals with an interest in the natural world, and who thought of

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Note: Volume 123 part 4 comprises the Bryophyte special issue.

Aborigines and their culture as a part of that world. W Hanks, for example, had 12 articles published in *The Victorian Naturalist* in an eight-year period from 1930 to 1937. Of these, only one was about Aboriginal culture, relating to a campsite on the Merri Creek in Coburg (Hanks 1933). Similarly, in the mid 1960s, Percy Gressler published three short pieces on Aboriginal cemeteries, rock carvings and campsites, plus one on the regeneration of River Oak *Casuarina cunninghamiana* (Gressler 1965, 1966a, 1966b and 1966c). The most prolific writer on the subject of Aborigines was Aldo Massola, a curator in the Anthropology section at the National Museum of Victoria, from 1954 to 1964. He published 64 articles in *The Victorian Naturalist*, from volume 73 (1956) to volume 91 (1974), single-handedly accounting for the peak in Aboriginal material in the 1960s.

An interesting sidelight on the relationship between Aboriginal studies and natural history is cast by consideration of the Australian Natural History Medallion. This award was instigated by the FNCV and has been presented annually since 1940 in acknowledgement of outstanding work in any of the range of fields encompassed by the term 'natural history' (Houghton 1987). The Medallion has had three forms, the first of which was used from its beginnings until 1980 (Fig 1). This original design, which explicitly connects natural history and indigenous people, was the work of RH Croll who was President of the FNCV at the time (Houghton 1987). His more-than-passing interest in Aboriginal culture extended to an active membership of the Ethnological Section and the Victorian Aboriginal Group, which was formed in 1930 to promote better conditions (and Christianity) for Aborigines in the northern parts of Australia (Griffiths 1996).

In the 40 years that the Medallion bore this Aboriginal design, it was awarded, on four occasions, to individuals for their contributions in the field of anthropology. These awards were made to Charles Mountford in 1945; Stan Mitchell in 1955; Norman Tindale in 1968; and Edmund Gill in 1973 (Houghton 1987). It is evident from these instances that anthropology was considered a commendable part of natural history.

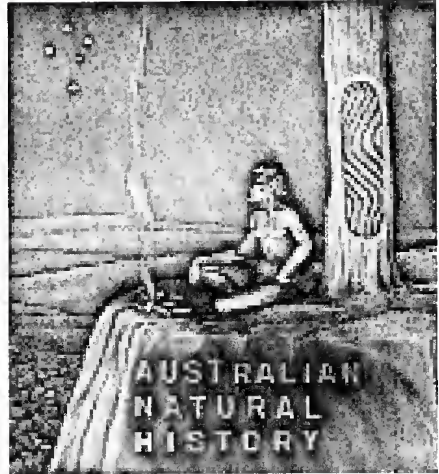


Fig. 1. Australian Natural History Medallion, 1940-1980.

However, the attitude that allowed such inclusion within natural history had clearly changed by the early 1980s. The Ethnological Section had long-since ceased to operate, dissolving in the early 1930s (Griffiths 1996). Although lectures on anthropological or Aboriginal subjects continued to be delivered at general meetings of the FNCV, their frequency was sporadic. If we are to judge from the contents of *The Victorian Naturalist*, from the end of the 1970s Aboriginal studies waned as a subject that found favour with the journal's editors. During the 1980s there were only five articles relating to an Aboriginal subject published in *The Victorian Naturalist*, and this number dropped to zero during the 1990s. Since volume 104 (1988), which contained a paper on the *Woi wurru* name for the Tuan (Scarlett 1988), there has been only one Aboriginal-related item published by the FNCV. That paper was included as part of the issue on fire (McLoughlin 2004).

Developments in Aboriginal studies

What had occurred to bring about this change in thinking? In the case of articles published in *The Victorian Naturalist*, Archer (2005) identified two factors that may have impacted on the range of subject areas published, including anthropology/Aboriginal material. The first of these, the influence of the journal's editor(s) at any given period, was perhaps of a

lesser importance in the time considered here. The effect of editorial control was diminished, firstly because none of the editors of *The Victorian Naturalist* in the periods when the subject areas appeared most often was especially involved with the subjects. Indeed, none of the major protagonists for anthropology within the FNCV — in the earlier days Kenyon, Mitchell, and Croll; and later Gill and Massola — served as Editor of the Club's journal. Secondly, the subject was one that (as with a couple of others) didn't command a sufficiently large following to warrant promotion by an editor. As Archer (2005) observes, in comparison with other areas of interest 'Geology and anthropology have never featured heavily as topics in *The Victorian Naturalist*'.

The second factor suggested by Archer as an influence on the content of the journal was the existence of other suitable publishing opportunities, and this was particularly applicable in the case of anthropology/Aboriginal material. A more likely cause of the decline in these subjects on the pages of *The Victorian Naturalist* lies in the emergence of other avenues where such material could be printed. The occurrence of these new possibilities was itself closely bound up in wider developments in the area of Aboriginal studies. It is necessary to consider these developments here, even briefly, because it was they, in fact, that impacted on the general area of natural history, leading ultimately to Aboriginal studies being separated as an independent field of enquiry.

The study of Australia's indigenous cultures, particularly through the application of archaeology, blossomed in the 1970s. Perhaps nowhere was this movement more evident than in Victoria, where a number of crucial initiatives occurred. Locally, the early part of the decade was a period of expansion in interest, even occasioning some excitement in local archaeological circles. These circles were small at the time but about to grow rapidly. Within the space of a few years, three separate developments took place within Victoria that saw a great deal more attention paid to Aboriginal sites in this state. The first of these, the establishment of a state government department in April 1973, coincided

and to a degree facilitated activities by researchers from interstate. An increasing interest in Aboriginal archaeology at universities in Sydney, Canberra and Armidale meant that more fieldwork was being undertaken in widespread areas, including Victoria (Presland 2001).

In this state, the *Archaeological and Aboriginal Relics Preservation Act* was proclaimed in May 1972, in order to give legislative protection to Aboriginal sites within Victoria. Among the groups that had campaigned for such protection was the Anthropological Society of Victoria, which included in its membership Stan Mitchell, Robert Croll and Aldo Massola, names that were familiar to the FNCV. The primary impact of this legislation was the creation, in April 1973, of the Archaeological and Aboriginal Relics Preservation Office (AARO). This state government instrumentality was originally located administratively within the Premier's Department but was relocated a number of times over its 22 year history. It also changed its name once — from July 1976 onwards it was called Victoria Archaeological Survey (VAS) (Presland 2000).

At the time, the Archaeological Society of Victoria (ASV) was the major interest group active in archaeological fieldwork in Victoria, although its activities in this regard were not extensive. The ASV was formed at the beginning of 1965, on a wave of enthusiasm by people who had attended a series of lectures on the broad subject of 'archaeology' over the previous five years. The series was run by Ron Ridley and Bill Culican, both of whom were in the Department of Classics at The University of Melbourne (Presland, 1998). The society was formed at the instigation of Culican, and he remained an important figure in the group until his sudden death in 1984.

Sandor Gallus was another important figure in the ASV's activities whose connection stemmed from that series of lectures. Dr Gallus was an Hungarian-trained archaeologist who was digging in his spare time on a series of sites at Dry Creek near Keilor. Beginning in 1966, members of the ASV worked with him on Sundays at Keilor until the work was brought to a sudden halt in 1973 by the almost simultane-

ous establishment of AARO and a major flood in the Maribyrnong River. However, it was not this fieldwork that became a significant factor in the shift in Aboriginal studies but, rather, the publication by ASV of a research journal, beginning in 1976.

The third major development relating to Aboriginal studies (particularly archaeology) in Victoria was the establishment in 1976 of the Prehistory Division, within the History Department, at La Trobe University. From a small beginning of a staff of two, this Division expanded rapidly and became a separate Department of Archaeology in 1980.

In the mid-1970s the existence of both VAS and La Trobe University Archaeology Department presented possibilities for fieldwork and practical involvement in Aboriginal studies to an extent that had been unavailable previously. And, along with the ASV, each created an avenue for the publication of research in this subject area. In the case of the VAS a new publication series, *Records of the Victorian Archaeological Survey*, was created. Primarily set up to publish the results of VAS fieldwork, the first issue in the series appeared in April 1976 (Coumts *et al.* 1976).

From its beginnings the ASV had a newsletter, from the third issue titled 'The Artefact', the purpose of which was to keep members informed of Society activities and to carry news items of archaeological interest. With an increased interest in archaeology and a greater number of professionals employed in the area, by 1975 the time was right to turn this chatty newsletter into something that was both more serious and more widespread. The dominant influence within the ASV at the time was Dr Wayne Orchiston, who was bent on making the Society a major player in Victorian archaeology. With more material available for publication, and a seemingly boundless energy, Orchiston transformed the Society's newsletter into a research journal in anthropology and prehistory. The focus of the new series of *The Artefact*, beginning in March 1976, in the words of the Editor was to be on 'the ethno history and archaeology of the Pacific region' (Orchiston, 1976).

A contributing factor in the availability of suitable material to publish came with the staging of a conference on 'Aboriginal

man and environment in southeast Australia: recent developments in Victorian prehistory'. The conference took place at The University of Melbourne in November 1975, and was jointly sponsored by the Continuing Education section of the university and the AARO. The fact that a conference on such a topic could take place successfully was symptomatic of the state of play in the discipline at the time and also helps explain something of the genesis of the new-style *The Artefact*. Thus began a publishing venture that continues to this day (Presland 2001).

While *The Artefact* doesn't have the long history of *The Victorian Naturalist*, from the beginning of its new form it became a more likely avenue for the publishing of Aboriginal research. Although there was a greater amount of research to be published, with the appearance of specialist journals of the kind described, there was less reason to offer this output to *The Victorian Naturalist*. Herein lies the cause of the waning of Aboriginal material published in the journal of the FNCV.

Of perhaps greater impact on the FNCV was the effect that VAS and La Trobe University had on those field activities of the club that might be related to the study of Aboriginal culture or history. Charged with giving effect to the legislation protecting Aboriginal sites, from the beginning VAS exercised a tight control over access to those sites, thereby severely limiting the possibilities for non-professional involvement in Aboriginal studies in Victoria. Activities such as excavating Aboriginal middens and campsites, and even collecting artefacts at such places — something field naturalists had done over many years — became illegal. Even the ASV had to cease its long-running excavations at Dry Creek, near Keilor. The site was considered of great importance by VAS and was one of the first sites to be declared an Archaeological Area under the *Archaeological and Aboriginal Relics Preservation Act* (Coumts, 1974).

Conclusion

In such an environment, it is not surprising that the study of Aboriginal culture ceased to be a viable area of interest within the gamut of subjects encompassed by the

FNCV and other natural history groups. Aboriginal studies had been effectively elevated to the level of an independent discipline. In the museum context this change took place in 1983 when the state's two major museums — the National Museum of Victoria and the Science Museum of Victoria — were amalgamated to form the Museum of Victoria. The internal structure of the new institution included a Division of Human Studies, one part of which was the Indigenous Studies department (Rasmussen 2001). Thus, within the Museum, the study of Aboriginal culture was lifted out of its natural history framework.

Essentially, this shift in attitude was symptomatic of a wider, social movement, one that had many contributing factors. Notable among these was the realisation that Australia's indigenous population had been in this country for a very long time indeed (Mulvaney and Joyce 1965; Flood 1990), and the winning of the 1967 Federal Referendum that gave Aborigines basic civil rights (Attwood and Markus 1997). One of the more important aspects of this development, which has been considered here, was its corollary — that Australia's indigenous population could be considered in its own right and not simply be studied as a part of natural history.

References

- Anon (1908) Excursion to Mount William, Lancefield. *The Victorian Naturalist* **25**, 9-11.
- Anon (1918) Report of activities. *The Victorian Naturalist* **35**, 17.
- Anon (1922) Report of activities. *The Victorian Naturalist* **38**, 84.
- Anon (1928) Ethnological Section. *The Victorian Naturalist* **45**, 86.
- Anon (1929) Report of the Ethnological Section. *The Victorian Naturalist* **46**, 57.
- Archer MS (2005) Changes in the content of *The Victorian Naturalist* between 1884 and 2004. *The Victorian Naturalist* **122**, 340-348.
- Attwood B and A Markus (1997) *The 1967 referendum, or, When Aborigines didn't get the vote* (Aboriginal Studies Press: Canberra)
- Coutts PJF (1974) State Relics Office: progress for 1973/4. *The Artefact* **32**, 1-3.
- Coutts PJF, Witter D, Mellwraith M and Frank R (1976) The mound people of western Victoria: a preliminary statement. *Records of the Victorian Archaeological Survey* **1**.
- Finney C (1993) *Paradise revealed: Natural history in nineteenth-century Australia* (Museum of Victoria: Melbourne)
- Flood J (1990) *The riches of ancient Australia: a journey into prehistory* (University of Queensland Press: St Lucia)
- Gressler PG (1965) Small camp-sites of the Aborigines Central Western New South Wales. *The Victorian Naturalist* **82**, 233-236.
- Gressler PG (1966a) Aborigine cemeteries and graves disturbed whilst digging out rabbit burrows. *The Victorian Naturalist* **83**, 10-12.
- Gressler PG (1966b) The regeneration of the River Oak *Casuarina cunninghamiana*. *The Victorian Naturalist* **83**, 79.
- Gressler PG (1966c) Aboriginal rock carvings at Turondale. *The Victorian Naturalist* **83**, 269-270.
- Griffiths T (1996) *Hunters and collectors: The antiquarian imagination in Australia*. (Cambridge University Press: Melbourne)
- Hall KE (1979) *The Victorian Naturalist Subject Index 1884-1978* (FNCV: Melbourne)
- Hanks W (1933) Aboriginal camp at Cohurg. *The Victorian Naturalist* **50**, 34.
- Houghton S (1987) *A history of the Australian Natural History Medallion*. (Field Naturalists Club of Victoria: Melbourne)
- Houghton S and Presland G (2005) *Leaves from our history: The Field Naturalists Club of Victoria 1880-2005*. (FNCV: Melbourne)
- Kenyon, AS (1929) Excursion to Mount William. *The Victorian Naturalist* **46**, 46.
- McLoughlin LC (2004) Patterns of pre-European Aboriginal vegetation management by fire in South-eastern Australia: What do we know? *The Victorian Naturalist* **121**, 99-106.
- Mulvaney DJ and Joyce EB (1965) Archaeological and geomorphological investigations on Mt Moffatt Station, Queensland, Australia. *Proceedings of the Prehistoric Society* **31**, 147-212.
- Orchiston DW (1976) Editorial comment. *The Artefact* **1**, 3.
- Presland G (1983) An archaeological survey of the Melbourne metropolitan area. *Victoria Archaeological Survey Occasional Report Series* **15**. (Ministry for Planning and Environment: Melbourne)
- Presland G (1984) The archaeology of Melbourne. *The Victorian Naturalist* **101**, 170-177.
- Presland G (1998) A.S. Gallus and the Archaeological Society of Victoria. *The Artefact* **21**, 9-13.
- Presland G (2000) Scratching the surface: A brief history of the Victoria Archaeological Survey 1972-1994. (Unpublished souvenir booklet)
- Presland G (2001) Artefact of history: a history of *The Artefact*. *The Artefact* **24**, 5-9.
- Rasmussen C (2001) *A museum for the people*. (Scribe Publications: Melbourne)
- Scarlett NH (1988) Ta-jerr and Tarr-nin — two squirrel brothers in Woi wurru mythology *The Victorian Naturalist* **105**, 146-149.
- Seddon G (1972) *Sense of place*. (University of Western Australia Press: Nedlands)
- Twidale CR, Tyler MJ and Webb BP (Eds) (1976) *Natural history of the Adelaide region*. (Royal Society of South Australia: Adelaide)
- Various authors (1972) *The natural history of Sydney*. (The Australian Museum: Sydney)

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Dietary preferences of captive Eastern Long-necked Turtles *Chelodina longicollis*

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Abstract

Fifteen adult Eastern Long-necked Turtles *Chelodina longicollis* (13 males, 2 females) were removed from billabongs located within the Ovens River floodplain, Victoria, during the summer of 1997/98 to examine their feeding preference in captivity, away from competitors, in a controlled environment. Four prey items were presented to the captive turtles: naucorids (Family Naucoridae), corixids (Family Corixidae), gudgeons (*Hypseleotris klunzingeri*) and caddisfly larvae (Family Leptoceridae). In total, 12.9% of prey was consumed without any dietary preference shown by turtles. It was concluded that turtles in captivity fed passively and opportunistically. Clearly, this may differ from their foraging strategy in the wild where the anti-predator behaviour of prey can differ greatly in the presence of refugia in a much larger and more complex habitat. (*The Victorian Naturalist* 124 (3), 2007, 163-166).

Introduction

Eastern Long-necked Turtles *Chelodina longicollis*, Broad-shelled River Turtles *C. expansa* and Murray Turtles *Emydura macquarii* in the Murray-Darling Basin exhibit habitat overlap and compete for prey. This is the case especially with the carnivorous, long-necked species, *Chelodina longicollis* and *C. expansa* (see Meathrel *et al.* 2002, 2004 and references therein). The sympatric Murray Turtle has a shorter neck, is omnivorous, grazes on periphyton, scavenges carrion and supplements its diet with aquatic insects and fish carrion to meet metabolic requirements (Chessman 1986; Spencer *et al.* 1998). *Chelodina longicollis* uses highly productive, ephemeral water bodies more often than the other two species (Chessman 1988), thereby lessening inter-specific competition (Kennett and Georges 1990).

One of the major challenges for wildlife ecologists is understanding how wild organisms perceive their environment and how that environment might be measured – the abundance and availability of prey, the level of inter- and intra-specific competition, etc. For freshwater turtles, the research relating habitat complexity with habitat selection and dietary partitioning is scarce. This study, therefore, examined the dietary preferences of *C. longicollis* under controlled laboratory conditions away from variable environments and competition.

Methods

Determination of the prey preference in captivity of *Chelodina longicollis* formed part of a larger study on the habitat preference and feeding ecology of freshwater turtles in billabongs in northeast Victoria (see Meathrel *et al.* 2004). Permission was obtained from the Victorian Department of Natural Resources and Environment (permit RP-97-170) and La Trobe University Animal Experimentation Ethics Committee (permit LSB96/24/V2) to place into short-term captivity (i.e. a period not to exceed three weeks) 15 adults of the most commonly encountered species *Chelodina longicollis* [13 males and 2 females, sexing followed Chessman (1978)] from the Ovens River floodplain (146°14'44" E, 36°14'05"S) between October 1997 and February 1998.

Laboratory housing consisted of 1.2 x 0.6 x 0.6 m fish tanks held at 22°C (i.e. the average temperature of water in the billabongs, unpublished data) and filled to 2/3 capacity and containing charcoal and fibreglass water filters to maintain water quality. No substratum (i.e. gravel, vegetation) was included in the tanks as this facilitated the quantification of prey items remaining following each trial. All turtles were in good health and allowed to habituate in individual tanks for 1 week prior to the commencement of feeding trials. They received food once every 24 hours for this period, but not within 24 hours of the feeding trials.

Prey offered were chosen on the basis of that which was common in the stomach contents of turtles examined in the field (Meathrel *et al.* 2004). Naucorids (Naucoridae) were collected from the Doctor's Point billabong in Albury, New South Wales; whereas corixids (Corixidae), gudgeons (*Hypseleotris klunzingeri*) and caddisfly larvae (Leptoceridae) were collected from a man-made lake located on the Wodonga grounds of La Trobe University. The amount of each prey type collected was variable. Hence, we were unable to replicate trials by presenting equal numbers of each prey type to each turtle for each of their two feeding preference trials.

For each experimental feeding trial, each turtle was presented with a range of prey items, totalling 40 to 60 individual prey items each trial. The turtles were then allowed 48 hours to consume prey (a procedure modified from Serrouya *et al.* 1995). After this time the turtles were removed and the tanks cleared of any remaining prey. These prey were counted and any missing items were assumed to have been eaten by the turtles.

At the completion of the first feeding trial, turtles were placed back into their individual tanks and starved for 24 hours to increase their appetite prior to presentation of a second group of prey (Serrouya *et al.* 1995). At the completion of all 30 feeding trials all turtles were released at their point of capture. No turtle was held in captivity for more than two weeks in order to meet the requirements of the animal ethics permit.

Data were analysed with the statistical package SPSS for Windows v. 12 using univariate ANOVA (Sokal and Rohlf 1995) comparing the preference of the turtles for different prey types. As we could not offer turtles the same number of each different prey type in both experimental feeding trials, we converted the data to the proportion of prey eaten out of all prey offered (i.e. preference).

Results

Of the total 1232 prey items offered to the 15 *Chelodina longicollis*, 159 (12.9%) were consumed (Table 1). Prey preference, measured as the number eaten out of the number offered, did not differ between

each turtle's two separate feeding trials ($F_{1,113} = 0.023, p > 0.05$) and these data were combined. Prey preference did not differ between the various types of prey fed to turtles in the laboratory ($F_{3,113} = 0.532, p > 0.05$) and suggested that the 15 *Chelodina longicollis* in captivity were non-selective foragers (Fig. 1). Statistical comparison of prey preference between the genders was not warranted because the data from only two females could not be validly tested against that of 13 males. However, it appeared that there was little difference in prey preference between male and female turtles. Generally, males ate a greater proportion of prey offered, but this may have been caused by males 4, 9 and 10 (Table 1) all of which ate approximately 35% of the prey offered as compared to just 5% for the other turtles.

Discussion

Long-held ecological principles of habitat use and foraging strategies suggest that organisms use optimality decision rules (= fitness maximising) to respond to changes in their feeding environment (Pyke *et al.* 1977; Chesson 1983). Changes can arise from extrinsic, environmental factors such as annual and seasonal variation in prey abundance and availability, exacerbated by the presence of competitors for the food resource, thereby rendering the study of an organism's preferred diet difficult. Hence, in this study 15 *Chelodina longicollis* were taken into the laboratory in an attempt to control for such change in order to simplify the detection of the potential existence of prey preference in this species of freshwater turtle.

The prey types and their relative proportions offered to the captive turtles in this study were the same as those gathered for a reference collection of aquatic fauna for the billabongs at Killawarra (Meathrel *et al.* 2004). The presence of these types of prey within the guts of wild turtles merely may have represented the preys' availability and accessibility rather than any specific preference the turtles may have had for them in the wild. To determine whether captive turtles were feeding preferentially or opportunistically in this study, all prey items were presented to the turtles without refugia such as snags, macrophytes or tur-

Table 1. The number of prey offered and eaten by captive Eastern Long-necked Turtles in captivity; data combined for the two trials per individual. F = female, M = male.

Turtle	Prey type	Naurcorids	Corixids	Gudgeons	Caddisfly larvae
F - 1	# prey offered	26	40	9	20
	# prey eaten	0	2	0	0
F - 2	# prey offered	16	40	9	8
	# prey eaten	2	1	0	1
M - 1	# prey offered	25	40	10	24
	# prey eaten	1	1	0	2
M - 2	# prey offered	25	40	10	24
	# prey eaten	10	5	0	2
M - 3	# prey offered	15	40	15	9
	# prey eaten	0	1	0	5
M - 4	# prey offered	17	40	7	7
	# prey eaten	3	22	0	1
M - 5	# prey offered	16	40	7	7
	# prey eaten	1	1	0	0
M - 6	# prey offered	16	40	7	7
	# prey eaten	1	3	2	2
M - 7	# prey offered	15	40	14	5
	# prey eaten	1	1	0	2
M - 8	# prey offered	16	40	19	4
	# prey eaten	0	5	2	0
M - 9	# prey offered	20	40	26	9
	# prey eaten	10	0	21	2
M - 10	# prey offered	20	40	26	10
	# prey eaten	1	11	24	1
M - 11	# prey offered	20	40	21	10
	# prey eaten	0	4	0	0
M - 12	# prey offered	16	40	9	6
	# prey eaten	0	0	2	0
M - 13	# prey offered	16	40	8	6
	# prey eaten	3	0	0	0

bid water, and so were readily available for capture. No prey preferences were shown by the turtles which suggested that the turtles were passive, opportunistic feeders. Chessman (1978, 1984) and Georges *et al.* (1986) also made this assumption, but Onkonburi and Formanowicz (1997) cautioned that the distinction between passive and active prey preference may be altered by the interaction between forager behaviour and prey antipredator behaviour.

Meathrel *et al.* (2004) found that male and female turtles in the wild appeared to consume the same prey items. Given the disparate sample sizes between the two genders, no definitive statements were warranted in this study of turtles in captivity. The female turtles brought into captivity were approximately 15% larger and 40% heavier than males (unpubl. data), and therefore should have consumed more than males. However, the two females consumed less than the 13 males. In fact, low

numbers (approx. 5%) of prey were consumed in the laboratory experiments, with turtles in some trials consuming nothing at all. This may have resulted from an insufficient habituation time due to permit restrictions. Although not observed, if subject to stress the turtles may have abstained from eating as they are capable of withstanding long periods with limited food supplies (Kennett and Georges 1990).

Although inferences of dietary preference in captivity can be applied only loosely to management of a species' natural habitat, managers of Australia's freshwater ecosystems should be aware that the level of 'pristine' habitat retained must not only meet the dietary metabolic requirements of species, but their ecological requirements as well. In the wild, with refugia and changing environmental conditions, more prey need to be retained to ensure that predators have the opportunity to encounter prey at levels sufficient to cover their

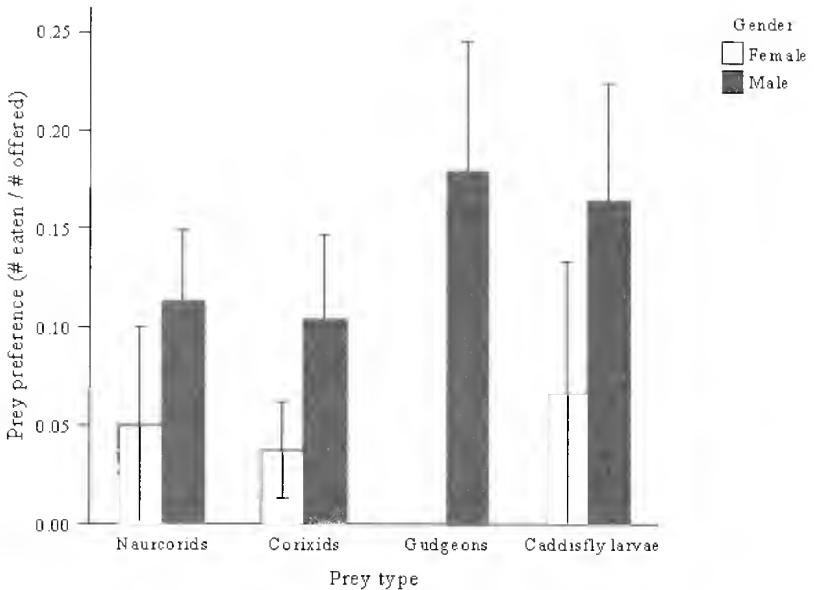


Fig. 1 Comparison of mean (± 1 standard error) prey preference for 2 female and 13 male adult *Chelodina longicollis* held in captivity.

metabolic requirements. Further research on the dietary preferences of Australia's freshwater turtles needs to explore how prey preference may change over many seasons and years.

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References

- Chessman BC (1978) Ecological studies of freshwater turtles in south-eastern Australia. (Unpublished PhD thesis, Monash University, Melbourne)
- Chessman BC (1984) Food of the snaked-necked turtle, *Chelodina longicollis* (Shaw) (Testudines : Chelidae) in the Murray Valley, Victoria and New South Wales. *Australian Wildlife Research* **11**, 573-578.
- Chessman BC (1986) Diet of the Murray turtle *Emydura macquarii* (Gray) (Testudines : Chelidae). *Australian Wildlife Research* **13**, 65-69.
- Chessman BC (1988) Habitat preferences of freshwater turtles in the Murray Valley, Victoria and New South Wales. *Australian Wildlife Research* **15**, 485-491.
- Chesson J (1983) The estimation and analysis of preference and its relationship to foraging models. *Ecology* **64**, 1297-1304.
- Georges A, Norris RH and Wensing L (1986) Diet of the freshwater turtle *Chelodina longicollis* (Testudines : Chelidae) from the coastal dune lakes of the Jervis Bay Territory. *Australian Wildlife Research* **13**, 301-308.
- Kennett RM and Georges A (1990) Habitat utilisation and its relationship to growth and reproduction of the eastern long-necked turtle, *Chelodina longicollis* (Testudinata : Chelidae), from Australia. *Herpetologica* **46**, 22-33.

- Meathrel CE, Suter PJ and Radford NM (2002) Niche segregation between three species of freshwater turtle in a large billabong during flood. *The Victorian Naturalist* **119**, 160-173.
- Meathrel CE, Suter PJ, Reid S (2004) Habitat and dietary preferences of freshwater turtles in ephemeral billabongs on the Ovens River, north-east Victoria. *The Victorian Naturalist* **121**, 4-14.
- Onkonburi J and Formanowicz DR Jr (1997) Prey choice by predators: effect of prey vulnerability. *Ethology Ecology & Evolution* **9**, 19-25.
- Pyke GH, Pulliam HR, Charnov EL (1977) Optimal foraging: a selective review of theory and tests. *Quarterly Review of Biology* **52**, 137-149.
- Serrouya R, Ricciardi A, Whoriskey FG (1995) Predation on zebra mussels (*Dreissena polymorpha*) by captive-reared map turtles (*Graptemys geographica*). *Canadian Journal of Zoology* **73**, 2238-2243.
- Sokal RR and Rohlf FJ (1995) *Biometry*, 3 ed. (WH Freeman: New York)
- Spencer R-J, Thompson MB, Hume ID (1998) The diet and digestive energetics of an Australian short-necked turtle, *Emydura macquarii*. *Comparative Biochemistry and Physiology, Part A* **121**, 341-349.

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Observations of diurnal activity in the Striped Legless Lizard *Delma impar*

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Abstract

Five separate observations of diurnal activity of adult Striped Legless Lizard *Delma impar* are described. Snout-to-vent length, tail length and mass were recorded. As well, another five sightings of active/basking *D. impar* on rocks or perched on the peduncles of Kangaroo Grass *Themeda triandra* tussocks were recorded. (*The Victorian Naturalist* 124 (3), 2007, 167-169)

The Striped Legless Lizard *Delma impar* has been the focus of considerable research effort over the past 17 years, leading to a recognition that its numbers have declined, due mainly to habitat modification and destruction (Coulson 1990; Kutt 1993; O'Shea and Hocking 1997; Rohr and Peterson 2003). Its preferred habitat, native temperate lowland grasslands, are recognised as threatened (Muir 1994; Kirkpatrick *et al.* 1995) and *D. impar* has been classed as 'endangered' (DSE 2003). However, many gaps still exist in the knowledge of the basic biology of *D. impar*, particularly in relation to its habitat utilisation and behaviour in the wild. While the general consensus is that *D. impar* is primarily diurnal (Martin 1972; Coulson 1990; Kutt 1993), it is evident that few individuals have been observed away from cover in the field. Instead, most are found beneath ground cover (stones) by day, and their diurnality has been inferred from the timing of their appearance in pitfall traps, and from daytime pigment tracking (Coulson 1990; Kutt 1993). Furthermore, a number of authors has inferred that *D. impar* is primarily terrestrial (Coulson 1990; Kutt 1993; Osmond 1994), though observations of the species in captivity indicate that they are adept climbers and routinely climb bushes and even sleep in them (Martin 1972).

Below I describe five separate observations of adult *D. impar* basking or active away from cover during daylight hours in the field. With one exception, all observations occurred in a former 30 ha area of remnant native grassland in Deer Park (144°46'E, 37°46'S), 17 km west of Melbourne, during the period 1991-93. The area was gently sloping with Kangaroo Grass *Themeda triandra* dominant, and abundant surface basalt. One of the observations (3 below) occurred

in grassland abutting the northern boundary of Derrimut Grassland Reserve (144°47'E, 37°48'S) (see Coulson (1990) for site description). The following abbreviations are used: SVL = snout-to-vent length, TL = (original) tail length and M = mass. Shade temperatures were recorded immediately after the observations.

1. 5 October 1991, 1030 hrs, full sun, 22°C. An adult *D. impar* was observed completely exposed and perched on a large flat-topped basalt rock (0.8 × 0.6 × 0.3 m) in full sun. The lizard lay motionless close to the perimeter, apparently basking, and did not react to being approached until I was within arm's reach. It responded with a rapid flick of the body and tail that resulted in it falling into relatively short grass (<0.15 m) around the base of the rock, causing me to momentarily lose sight of it. I flushed it out across a bare patch of ground towards another rock some 2 m away. Its movements were broadly S-shaped and saltatory. It skirted around the rock edge, eventually seeking refuge beneath it; on lifting the rock the lizard was revealed tightly curled-up. The surface of the rock on which the lizard was originally perched was quite cool to touch. Measurements were: SVL = 95 mm, TL = 203 mm and M = 5.7 g.

2. 25 January 1992, c.1400 hrs, overcast, 24°C. In the course of walking through a heavily grazed paddock I noticed a flicking movement from the top of a rock (0.36 × 0.34 × 0.16 m) about 3 m away in a small patch of Kangaroo Grass. The movement was that of a lizard dismounting the rock, but was not consistent with the movements of the Tussock Skink *Pseudemoia pagenstecheri* that are common in the area. On rolling the rock, an adult *D. impar* was revealed curled up, but within seconds it retreated into surrounding Kangaroo Grass

tussocks. After several minutes searching it was found curled up at the base of one of the tussocks. Both the lizard and the surface of the basking rock were warm to touch in comparison to the soil substrate, and the lizard was very active when handled. Measurements were: SVL= 80 mm, TL = 159 mm (original with tip missing).

3. 20 March 1993, c.1200 hrs, full sun, 30.1°C. An adult *D. impar* was observed perched 0.2 m above the ground on emergent Kangaroo Grass peduncles near a large well-embedded rock. It was evidently disturbed on my approach and with a flicking action dropped to the base of the tussock and could not be located.

4. 27 December 1991, 1120 hrs, sunny, 28°C. An adult *D. impar* was observed perched on a tangle of Kangaroo Grass peduncles in a dense swathe approximately 0.5 m off the ground. Within 2 m of my approach a flicking action of the body caused it to fall into the dense ground layer below and it could not be located.

5. 10 February 1992, 1530 hrs, completely overcast, 24°C. An adult *D. impar* was observed perched on a tangle of Kangaroo Grass peduncles and leaves in a small stand of tussocks approximately 0.4 m off the ground. Within 1 m of my approach the lizard rapidly flicked its tail and dropped into the tussocks below and could not be located.

In addition to these observations another five sightings of active/basking *D. impar* on rocks (n=2) and perched on the peduncles of Kangaroo Grass tussocks (n=3) were recorded. However, encounters were fleeting and the lizards were not located. All observations occurred during the months October to March when the species is known to be active (Coulson 1990).

The observations confirm the species' tendency to climb low vegetation, as observed in captive individuals (Martin 1972). Evidence of this climbing tendency was also apparent in pigment tracking studies in which pigment was located up to the middle or top of tussocks in approximately half of all lizards tracked (8 of 15; Kutt 1993). Given the tendency of Kangaroo Grass to form dense swards when burning is infrequent, this behaviour makes sense: the small size of lizards in relation to grass tus-

socks requires them to seek perches, such as protruding rocks and grass stems, in order to bask. Climbing has also been observed in two other species of *Delma* in the contexts of basking and prey pursuit (Martin 1972; Annable 1983). The peculiar flight reaction observed of *D. impar* (observation 1) is interesting given that saltation has been recorded in three congeners (Bush 1981; Maryan 1984, 1985; Bauer 1986); it was not accompanied by vocalisation as in some of these species. The observations above indicate that *D. impar* does engage in diurnal basking and that they are adept climbers, however, witnessing these behaviours in the field is not easy since they respond rapidly to disturbance and then are very difficult to locate amongst tussocks. *Delma impar*'s movements and reaction to disturbance are quite distinct and unlike those made by other similar-sized reptiles inhabiting the grasslands around Melbourne.

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References

- Annable T (1983) Some observations on vocalization and the use of limb flaps in the pygopodid lizard, *Delma inornata* Kluge. *Herpetofauna* 14, 80-82.
- Bauer AM (1986) Saltation in the pygopodid lizard, *Delma tincta*. *Journal of Herpetology* 20, 462-463.
- Bush B (1981) *Reptiles of the Kalgoorlie-Esperance region*. (Vanguard Press; Perth)
- Coulson G (1990) Conservation Biology of the Striped Legless Lizard *Delma impar*: an initial investigation. Department of Conservation, Forests and Lands: Melbourne. Technical Report Series No.106.
- DSE (2003) Advisory List of Threatened Vertebrate Fauna in Victoria - 2003. Department of Sustainability and Environment, East Melbourne.
- Kirkpatrick J, McDougall K and Hyde M (1995) *Australia's Most Threatened Ecosystems: the south-eastern lowland native grasslands*. (Surrey Beatty & Sons/World Wide Fund for Nature Australia: Chipping Norton, NSW)
- Kutt A (1993) A preliminary evaluation of the use of fluorescent pigments to track the movements of the Striped Legless Lizard *Delma impar* (Reptilia: Pygopodidae). In *Herpetology in Australia: a diverse discipline*, pp.179-183. Eds D Lunney and D Ayers. Transactions of the Royal Zoological Society of New South Wales. (Surrey Beatty & Sons: Chipping Norton, NSW)
- Martin K (1972) Captivity observations of some Australian legless lizards. *Herpetofauna* 5, 5-6.
- Maryan B (1984) Unusual defensive behaviour in captive *Delma australis* (Kluge) and in the wild. *South Australian Herpetological Group Newsletter* 1984, 7.
- Maryan B (1985) Unusual defensive behaviour by *Delma australis* in captivity and in the wild. *Herpetofauna* 15, 51.

Muir A (1994) Western (Basalt) Plains Grassland Community. Flora & Fauna Guarantee Action Statement 53. Department of Conservation and Natural Resources, Melbourne.

O'Shea M and Hocking C (1997) Field trials of alternative detection techniques for the Striped Legless Lizard (*Delma impar*), at the Albion Explosives Factory Site. Unpublished report to the Striped Legless Lizard (Victorian) Working Group.

Osmond H (1994) Habitat specialisation and isolation of remnant populations of the Striped Legless Lizard

Delma impar. Report to the ACT Parks and Conservation Service Wildlife Research Unit and the Australian National University, Canberra.

Rohr DH and Peterson GNL (2003) The Striped Legless Lizard in the Western District of Victoria: New Insights. Technical Report to the Glenelg-Hopkins Catchment Management Authority. Ecology Research Group, RMIT University: Melbourne.

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Regardfully Yours: Selected Correspondence of Ferdinand von Mueller Volume III: 1876-1896

edited by RW Home, AM Lucas, Sara Maroske, DM Sinkora,
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Publisher: *Peter Lang, Bern, 2006. 909 pages, 21 illustrations, hardback*
ISBN 3-906757-10-2. RRP US\$62.95
(A\$215 in the Royal Botanic Gardens bookshop)

Here is the volume of Mueller's correspondence that includes references to the Field Naturalists Club of Victoria (FNCV). This third and final volume spans the last two decades of Mueller's life, when he was 50 to 71 years old, and the first sixteen years of the FNCV's existence. During this period, Baron Ferdinand von Mueller was still Victoria's Government Botanist (in the Chief Secretary's Department) but no longer Director of Melbourne's Botanic Garden, and continued to document the Australian flora and enlarge and curate the government herbarium, and to speak and write prolifically on all matters botanical. Since the Baron was an honoured member and patron of the FNCV, it is not surprising that the pages of Volume III provide early glimpses of the Club – thirteen mentions in the index. Mueller's huge bibliography in Volume I includes his papers in *The Victorian Naturalist*. You can find information about Mueller and the project which has spawned three volumes of his selected correspondence in my review of the first two volumes in *The Victorian Naturalist* 122 (2), 2005.

One of my reasons for being a tad tardy in reviewing this volume is that it is so useful. I've been delving into the three volumes for several projects – Mueller's continuing interest in the acclimatisation of foreign plants, his contributions to international exhibitions, and his interactions with

Frederick McCoy, the professor of natural science at the University of Melbourne.

Some of the 326 letters and documents in Volume III show how Mueller continued to use his correspondence to complain bitterly at losing (in 1873) that essential adjunct to his position as Government Botanist – the Botanic Garden. Without it he could not test the cultivation of indigenous and foreign plants. And without the laboratory in the adjacent Domain, he could not have plant products prepared to showcase the Colony's botanical resources in museums and at local and international exhibitions. To add insult to injury, his successor, the Garden's curator, William Guilfoyle, sent timber and other exhibits from trees Mueller had had planted in the Botanic Garden. Mueller fumed (in German) that a quite uneducated gardener, who simply copies the Sydney flower garden ... can not only daily give himself airs before the public with *my* treasures, with the help of the assistants schooled for years by me, he can send things for the exhibitions from *my* plants [pp. 174-5 translation].

Mueller also complained to Joseph Hooker, Director of the Royal Botanic Gardens at Kew in England,

I am *daily hampered* for forest-investigations, for which I want the rich collection of *living trees*, established by me in the bot

Garden, including numerous species of Eucalypts [p. 157].

But, despite his humiliating and disruptive loss, Mueller continued to speak and write to press for forest conservation and to publicise (locally and internationally) the usefulness of indigenous and introduced plants, all the while continuing his taxonomic and herbarium work in the cramped Botanical Museum in the Government House Domain adjacent to the Botanic Garden.

Mueller claimed that his long-contemplated descriptive Eucalyptus Atlas would help to develop Victoria's forest resources. His *Eucalyptographia. A Descriptive Atlas of the Eucalypts of Australia* (1879-84) was based mainly on his earlier observations, when he had access to 'his' rich collection of eucalypts in the Botanic Garden. His preparation of *Eucalyptographia* was interrupted in 1880 by his return to the international stage of exhibitions – as commissioner and judge at the International Exhibition in Melbourne's new Exhibition Building in Carlton. His correspondence also mentions his participation in subsequent international exhibitions – in Amsterdam in 1883, Calcutta in 1883-84, London in 1886 and Melbourne in 1888. Mueller's exhibits included specimens of Australian timber, eucalyptus oil and other forest products, and his *Eucalyptographia*, *Key to the system of Victorian plants*, *Systematic census of Australian plants*, *Select extra-tropical plants, readily eligible for industrial culture or naturalization* and other publications.

Like *Eucalyptographia*, Mueller's *Select extra-tropical plants* was based initially on information he had gained, by 1873, from the cultivation of a huge diversity of plants in Melbourne's Botanic Garden, and later enriched with information from helpful correspondents. Mueller's successful request, penned in June 1876, for ministerial approval for the publication of his earlier work on indigenous and introduced plants suitable for cultivation in Victoria resulted in the publication of his 293-page book, *Select plants readily eligible for industrial culture or naturalisation in Victoria, with indications of their native countries and some of their uses* (1876). Since the information on useful plants was relevant to other temperate parts of the world, Mueller, ever the botanical publi-

cist, removed 'Victoria' from the title, added 'extra-tropical', and edited and enlarged *Select extra-tropical plants, readily eligible for industrial culture or naturalization* for NSW, Indian, American, German, French and Victorian editions. The Indian edition was printed in Calcutta for the international exhibition there in 1883-84. Mueller's letters are peppered with references to information contained in his *Select extra-tropical plants* and occasional requests for information for inclusion in future editions of this extremely popular compendium of useful information. The 466-page 1885 Victorian edition was sold out in seven months.

The FNCV was useful to Mueller. From 1884 its new journal, *The Victorian Naturalist*, provided a convenient vehicle for his taxonomic and other papers; and the publication of his *Key to the system of Victorian plants* was suggested at a Club meeting. In his FNCV presidential address in 1884, Dr Frank Stanley Dobson suggested that a Victorian equivalent of the dichotomous key in the Rev Spicer's *Handbook of the plants of Tasmania* be prepared under the Baron's supervision. The following extracts provide illuminating glimpses of the young FNCV. Several are from letters in the Club's Archives.

As you may know, the Baron accepted the position of FNCV patron but not president. In May 1883 Mueller wrote,

My health has been fluctuating for some years, so that with much regret I was obliged to beg of the Field Naturalists Club ... to confer the honor of President on another Gentleman than myself [p. 323].

In May 1886 he wrote to the Club's honorary secretary, Francis Barnard,

to express my deep appreciation of the generosity of the great Field Naturalists Club of Victoria, for having raised me to one of its Patronships. Among the many marks of distinction, with which I have been honored in life, I value this one as among the highest, because it is a tribute from that country, in which I spent most of my years and with which my labours are most directly identified. To me it is in connection with this new dignity also a highly pleasurable thought, that work, which I commenced in Australia nearly 40 years ago, will in various directions be carried on by young workers, whom

I met personally at your meetings, and who can be guided and can be encouraged by what was accomplished at my time; while they in their turn far on in the next century can inspire a younger generation, thus linking one century's scientific work to that of another! [p. 433].

Mueller's two-volume *Key to the system of Victorian plants* was a recurring topic in his correspondence. In August 1886, in response to a letter in Melbourne's *Argus* newspaper, criticising the recently published illustrated volume of the *Key*, Mueller wrote a long letter to his minister, the Chief Secretary, Alfred Deakin, offering 'some explanatory remarks on the supposed shortcomings of this work, as it is a Government's publication' [p. 440]. Mueller justified his inclusion of expensive illustrations from woodblocks, acknowledged the unfortunate presence of some errors, and pointed out that the *Key* was not aimed at state schools,

but more particularly for the Field Naturalists Club, and somewhat against my own opinion as to the plan, – the dichotomous method, – adopted by the late meritorious Revd Mr. Spicer for the flora of Tasmania [p. 443].

The difficult volume with the dichotomous key and diagnostic descriptions of species took much longer. Devising a dichotomous key without interrupting the affinities reflected in the taxonomic system challenged Mueller's wisdom and patience, and his exacting preparations consumed much more time than he had anticipated, irritatingly interrupting and delaying many other projects and duties. It proved so time-taking beyond all calculation, that I shall only be able to finish it in June or July [1887]; – and as for the early issue of it a demand was made in the Parliament here [p. 467].

A footnote explains that, in July 1886 (two years after his FNCV presidential suggestion), the lawyer-politician FS Dobson had asked in the Legislative Council when the *Key* would be published. In September 1887 Mueller noted that

the Field Naturalists here press me for the "Key to the Syst of Vict. Plants" for use still this spring, and altho' the printing *has* commenced, the work cannot appear for some weeks yet' [p. 474];

and in October that

I had no idea that the dichotomous method, demanded for the "Key to the system of Victorian plants", would take up so very much more time, than I estimated I hope however to finish the "Key" at last next month; and working on Papuan plants will then be my main-engagement in all hours which can be rendered free from urgent official duties [pp. 478-9].

According to Mueller's bibliography in Volume I of *Regardsfully Yours*, evidence in *The Victorian Naturalist* indicates that the descriptive, dichotomous volume of his *Key* was published toward the end of 1888. It was dedicated to the Chief Secretary, Alfred Deakin.

In 1889, on learning 'that some members are eager, to get the name changed of the Field-Naturalists Club', Patron Mueller advised the FNCV President, Arthur Lucas, that such a change *not* be made... The very word "Club" implies an union without rigorous ceremonies, a freer coming together, than in abstract science-societies, as evinced also by the membership of our Field-Naturalists Club being happily open to Ladies. By the change of the name, as far as I can see, nothing would be gained for our particular work, while much to us in our free scientific intercourse and in our unrestrained field-operations might be lost. I further have heard, that some members of the Club are anxious to establish *grades* in our union, according to greater or lesser accomplishments and experiences. This proposition came up formerly in more than one science-society of Australia, but I gave my advice against such a measure fully thirty years ago [p. 539].

During the FNCV's protracted efforts to have Wilson's Promontory reserved as a national park, Mueller wrote to Francis Barnard, regretting his inability to attend a Club meeting in April 1890 [p. 552];

I feel honored with being made a member of the Committee of the Field-Naturalists Club for preservation (in apt localities) of the indigenous vegetation and marsupials as well as various birds. I have however held from the commencement of this movement, that we could not possibly induce the Government, to cede so large an area for that purpose as the whole of Wilson's promontory; the distance from the metropolis would also be too great for the multitude of the

people, to derive an adequate advantage from such reservations. In my opinion our *first attention* should now be given, that not all the most picturesque vallies get defaced and alienated from the crown. Thus an application might be made to the hon the Minister of Lands *at once* for withdrawing from selection the best of the *Waratah-Vallies* in Eastern Gippsland, also all places in which large cataracts or cascades exist.

Prof [Baldwin] Spencer and his companions of the [FNCV's] E. Gippsland-tour, made a year ago, would be able to describe these vallies and cascades as regards *precise localities*, so that the district-surveyors might become instructed, to keep these glorious spots intact, and perhaps some arrangements might be made thus far also, to prevent shooting in these reserved localities. Places at Mt Baw Baw, the Buffalo-Ranges and towards Cape Otway might also be protected.

Respectfully your
Ferd von Mueller

The month before he died, Mueller wrote advising Thomas Stephen Hart, at the Ballarat School of Mines, 'to start at once a Field-Naturalists Club' [p. 746] in prosperous Ballarat, and requesting plant specimens for his preparation of the proposed third edition of his *Systematic census of Australian plants* (which was never published).

I gave it as my opinion, when addressing the Field-Nat Club here at its last annual gathering that every town throughout Australia ought to have some such Association' [p. 748].

The FNCV was among the many contributors of flowers to Baron Sir Ferdinand von Mueller's funeral on Wednesday, 13th October 1896, at the St Kilda Cemetery.

The correspondence in this volume shows that, during the last two decades of his life, Mueller continued to document Australian plants and expand Victoria's herbarium into THE reference collection of Australian, not just Victorian, plants – with specimens from his huge network of collectors across Australia and the government's rare purchase of herbaria rich in authenticated specimens of Australian species. Meanwhile he pressed for conservation reserves, supported exploratory expeditions in inland Australia, Antarctica and New Guinea and contributed to vari-

ous government inquiries, scientific and geographic societies, museums and exhibitions. And all the while he was writing, writing, writing – articles and books, as well as letters. Mueller's documentation of the Australian flora deservedly earned him an international reputation, and, as his published correspondence reveals, his correspondents included respected botanists across the European-controlled world – a veritable who's who of late nineteenth century botany.

As in the first two volumes, letters were selected on the basis of their scientific importance and their relevance to Mueller's life and work, and to show the wide range of his correspondents and the subjects discussed. I agree with the editors that

the letters selected shed fascinating light on the final two decades of the extraordinary career of an extraordinary man, as well as, more generally, on the cultural and intellectual history of Australia at a crucial stage of its development and on the history of the field sciences in the final years of the nineteenth century [p 45],

which of course includes the activities of the FNCV.

As well as the selected correspondence, Volume III of *Respectfully Yours* includes a substantial introduction, a biographical register of Mueller's correspondents, including Barnard, Lucas, Hart and other FNCV members (Appendix A), a list of Mueller's orders, offices, affiliations and honours (Appendix B), a bibliography of publications cited in footnotes, an index of botanical names and a general index.

Substantial indexes in all three volumes provide pointers to rich lodes of botanical and other information, but imagine what you will be able to find and follow on the future CD-ROM of the complete (known) correspondence, especially in conjunction with Mueller's biography, which is also keenly awaited. If you share my interest in nineteenth century Australian botanical history, check that your local library has the three volumes of *Respectfully Yours*, or beg, borrow or buy them.

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Cronin's Key Guide: Australian Wildlife

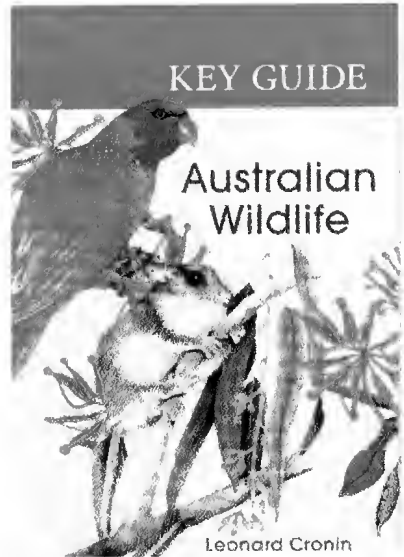
by Leonard Cronin

Publisher: *Allen & Unwin*. 2007, 235 pages.
ISBN 9781741750751 RRP \$35.00

How can one provide a guide to the great diversity of Australian fauna and flora in a little over 200 pages? Leonard Cronin's answer is to become familiar with a number of key species and then to apply that knowledge to further observations and different habitats. He chooses 380 animals (mammals, birds, reptiles, frogs, fish, marine and land invertebrates) and 222 plants from four habitats (rainforest, forests and woodlands, coastal heaths and dry country). Three to a page, each species' contribution includes a map, description, behaviour, breeding, diet and habitat for animals and a similar format for plants, without diet and substituting reproduction for breeding. Family, species name and size head each entry and a common name in larger font stands out at the beginning. A colour illustration of each species provides the primary identification tool.

The sample is exceedingly well chosen and the balance probably well matches the interests of most naturalists and the informed public. Each specialist would have liked a greater emphasis on a particular area, but specialists have their own sources. This book definitely falls into the 'one handy volume' genre. So who would buy? I would if visiting Australia, to give a broad view of the country's natural history and as a nice souvenir of the visit. It is a good starting point for anyone who wishes to get a feel for Australian nature, or who is asked for clarification by others. Future guides planned in this series will expand some of the areas covered.

When you view the illustrations you will be quite confident that you know what you are looking at, particularly if you have identified the subject in the field before, but there is not always quite enough discriminatory detail in the case of very similar species.



Information in the fauna section is current and quite consistent with specialist texts. However, I think that the merging of the Eastern Rosella and Pale-headed Rosella into White-cheeked Rosella *Platycercus adscitus* is premature, even though hybridisation between sympatric subspecies of each has been noted.

For the botanists the nomenclature is generally up to date, evidenced by genera such as *Corymbia*, *Senna* and *Bracteantha* appearing correctly in place of those more or less recently superseded. The only exception is the naming of plant families where the convention now is to name the family from the first genus described within it. Hence, Fabaceae replaces Papilion-aceae, Poaceae replaces Graminae, Astera-ceae replaces Compositae. I was a bit surprised to see that no Porcupine Grass was mapped in Victoria but that is because the key species is *Triodia irritans*, whereas our local one is *T. scariosa*. Calling *Eucalyptus viminalis* Ribbon Gum instead of Manna Gum reveals that the author hails from interstate.

The index combines scientific and common names with sensible indents for sub-categories; it is easy to use.

Author, illustrators, cartographer, designer and editor are to be congratulated on a useful and accurate publication.

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Crocodile: Evolution's Greatest Survivor

by Lynne Kelly

Publisher: *Allen & Unwin, Crows Nest, NSW, 2006, hard cover, 272 pages*
ISBN 9781741144987. RRP \$35.00

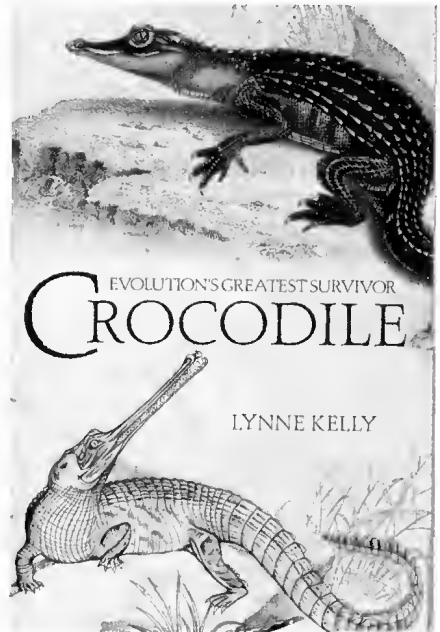
Those of us who are fortunate enough to work with reptiles do not, as a rule, expect to become celebrities. The closest we will usually get is perhaps a brief appearance on *Totally Wild* or to be quoted in a newspaper article. Witness then the staggering media status of Australia's *Crocodile Hunter*, the late Steve Irwin – arguably the most recognisable Australian in the world. Similarly, Paul Hogan finally became internationally famous when *Crocodile Dundee* was released in 1986. The common thread with these success stories is that both rode to international stardom on a crocodile's back, at times quite literally! Such is the awe-inspiring power of crocodilians.

The author of this latest book on crocodilians comes to the topic not as an expert on the subject, but as an enthusiastic researcher. In this manner, Lynne Kelly uses her book to allow others, including scientists, zoo keepers, bite victims, crocodile farmers and native peoples, to tell their stories. Of course both the extant and fossil crocodilians also have their stories to tell, and Kelly uses this information to provide a factual setting that allows the reader to put into context the myths, reverence and fear that inevitably surrounds crocodilians.

The first chapter details the excitement and privations of the early European explorers when first encountering crocodiles in tropical Australia. In the second chapter we learn that crocodilians are often important figures in the myths, stories and legends of native peoples from areas as diverse as Egypt, Papua New Guinea, India, Japan, Africa, North and South America, and Australia. Interestingly, native legends often depict crocodilians as the Creator, creating, variously, land, plants, other animals, and even the sky, and Kelly is struck by '...the respect, even veneration, with which these great beasts are regarded by the indigenous peoples who share their habitats' (p. 66). This chapter also introduces one of the themes of the book – numerous crocodilian

species from around the world are now threatened with extinction, most commonly due to habitat loss and/or over-exploitation.

In Chapter 3 Kelly examines the morphology and physiology of the crocodilians, and the behavioural functions of these forms. We discover the remarkable bite force of a crocodilian jaw, and how this relates to feeding behaviour. Kelly expresses justifiable wonderment at the crocodilian's heart morphology and the animal's ability to remain submerged for extended periods. This chapter also considers territoriality, mating and nesting behaviour, hatching and the early life of hatchlings. Chapter 4 examines the passionate (some might say obsessed) crocodilian researchers, and details the legendary (in Australian museum circles) scandal surrounding Gerard Krefft, the man who first recognised the Australian Freshwater Crocodile as a new species. Chapter 5 examines the crocodilian fossil record, including areas such as England where crocodilians



are long since extinct, and deplores the sad reality that some ancient lineages of crocodylians may become extinct in the near future due to human activities. This chapter also explores the popular idea that crocodylians are 'living dinosaurs', despite the fact that no extant species truly 'walked with the dinosaurs', and that, in a cladistic sense, crocodylians are more closely related to birds than lizards.

The following two chapters examine life and death from opposing perspectives. Firstly, we see how humans have long hunted crocs for food, leather, fat for fuel, and how humans protect themselves from, or retaliate against, a 'man-eater'. This is followed by chilling accounts from some of the very few people who have survived attacks by the Saltwater Crocodile. Farming of crocodiles is as controversial as the hunting of these animals. Even the experts remain divided on this topic; Steve Irwin was passionately opposed to this practice, whereas renowned croc expert Grahame Webb is equally vehement in his belief in the benefits for crocs of farming. Kelly also examines the role of farming and captive breeding in conservation.

The final two chapters examine the relationship of humans to crocodylians in captivity and in popular culture. The practicalities of keeping crocodylians as pets are discussed, followed by the role of these animals in zoological parks. At this point

the book provides a local flavour, with interviews with two of Victoria's most experienced reptile keepers – Jon Birkett from Melbourne Zoo and Greg Parker from the Ballarat Wildlife Park. Birkett exemplifies the devotion to conservation programs that is evident in so many zoo staff. Far from being glorified cage-cleaners, Birkett and his staff play an active and vital role in numerous conservation programs for threatened herpetofaunal species from around the world. The book concludes with an examination of crocodylians in popular culture, from *Peter Pan* and Rudyard Kipling, to *Crocodile Dundee* and the *Crocodile Hunter*.

This book is not a field guide, and is not entirely devoted to the biology of crocodylians (there are other, more 'dry' texts that fill that role). Rather, it provides an 'holistic' understanding of crocodylians, and their relationships with their environments, and perhaps the only other predator that a grown croc should fear – humans. I enjoyed this book, and believe that it will appeal to anyone with an interest in natural history or large, iconic predators.

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The Complete Field Guide to Dragonflies of Australia

by Gunther Thieschinger and John Hawking

Publisher: *CSIRO Publishing*, 2006, 376 pages, paperback; colour photographs, ISBN 0643090738. RRP \$49.95

Both the authors of this comprehensive guide have been studying Odonata for much, if not all, of their professional lives. Indeed Gunther Thieschinger, along with Tony Watson and Hilda Abbey, was a co-author of *The Australian Dragonflies* published in 1991. That book dealt largely with adults, and keys were provided only for that stage of the life cycle. The current volume can be seen as a 'descendant' of the

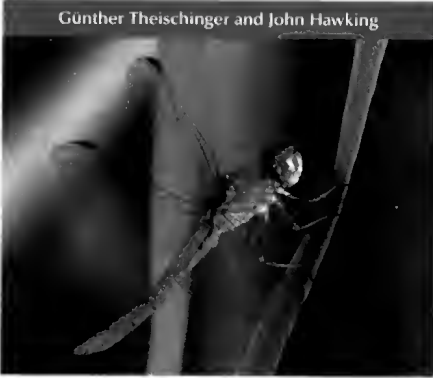
former publication and for the first time provides keys to the final instar larvae as well as to the adults, thus making it a useful, if not an essential, reference for the many freshwater biologists like myself who encounter these larvae. In what follows, I have restricted my comments largely to the larvae, as this is where my experience lies.

A total of 324 species are described and illustrated from 12 families of damselflies



THE COMPLETE FIELD GUIDE TO DRAGONFLIES OF AUSTRALIA

Günther Theischinger and John Hawking



and 18 families of dragonflies. Photos of adults and line drawings or photos of many larvae are given, although for a number of species larvae are still not known. Distribution details are provided on maps of Australia divided into 16 regions. (These are the same regions employed by Watson *et al.* in 1991.) The bulk of the book (pp.16-299), however, comprises species accounts which, in addition to descriptions of the adults and larvae, give habitat notes for almost every species, and information about extra-limital distribution where relevant. Descriptions of the larvae are somewhat shorter than those for the adults, but together with the keys that follow the species accounts, they should enable genera and many species of larvae to be readily determined. Unfortunately, not all species can be keyed at the larval level. However, the distribution maps should help here. Only the final larval instar is described and illustrated, and users need to realise that more immature larval stages will always be more difficult to put to species, as is the case for the larvae and nymphs of nearly all aquatic insects.

I worked my way through the larval key to families and generally found it easy to use. Separate larval keys are given to genera and some species for each family. An illustrated glossary is provided for both adults and larvae (before the keys). Such details are vital for beginners, who need to know their way around the anatomy of both larvae and adults if they are to be successful in identifying specimens. The only omission I noted was that the 'frontal plate' of a larva was not illustrated in the family key or in the glossary. However, it is illustrated in the species accounts for *Archaeosynthemis* and *Synthemis* as well as in the key to Synthemistid genera and species. It is a pity that the informative glossary of terms associated with larval anatomy given by the two authors in an earlier publication (*Dragonfly Larvae (Odonata): A guide to the identification of larvae of Australian families and to the identification and ecology of larvae from NSW*; CRCFE Identification Guide No. 34, Feb 1999) is not repeated in this book.

I feel sure this book will enable enthusiasts, both amateur and professional, to identify Odonata accurately and will greatly encourage study of this fascinating group of insects. In many parts of the world various groups of aquatic insects are poorly known because identification keys for the non-specialist are simply not available. By providing such keys the authors have given a great stimulus to studies (particularly field studies) of Odonata in Australia. The small size of the book (A5) will encourage its use in the field, and with experience identifications could be done on site, as the authors hope. The book should also pave the way for more concern about the conservation of dragonflies and damselflies, some of which have limited distributions.

I cannot recommend this book highly enough to those interested in Australian Odonata and freshwater habitats. It will appeal to everyone, from beginners to students and researchers, and should become the first reference book that anyone interested in Australian Odonata will consult.

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Grasses of South Australia

An illustrated guide to the native and naturalized species

by John Jessup, Gilbert RM Dashorst and Fiona M James

Publisher: Wakefield Press, 2006. 554 pages, hardcover; 456 figures, 20 plates.
ISBN 1862546940. RRP \$49.95

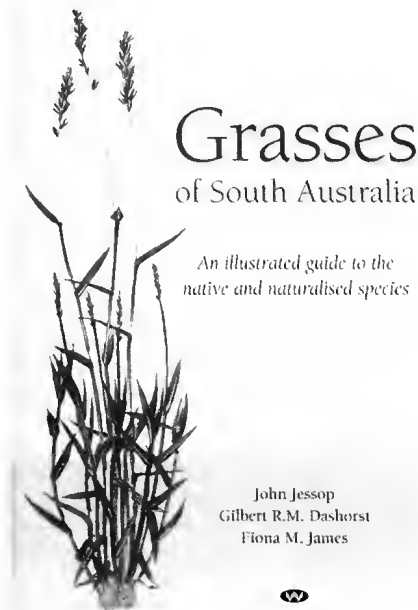
The authors introduce us to *Grasses of South Australia* by providing a history of the project. *Grasses of South Australia* began with a proposal by the Native Grass Resources Group to the Botanic Gardens of Adelaide and State Herbarium for a revised edition of the grass treatment in the 1986 *Flora of South Australia*. More than 36% of the names in *Grasses of South Australia* were not included in the 1986 flora, showing how vital was the need for a revision. This figure includes newly recognised grasses and corrected names.

Identifying grasses is notoriously difficult, and it is important to understand grass morphology and associated terms. The authors provide an excellent drawing of 'the typical grass plant', at the same time explaining that in a family of about 10 000 species a lot of variation occurs, and many species would bear no resemblance to the

'typical' grass. An excellent glossary is provided with many diagrams illustrating some of the more unusual terms such as puberulent, muricate or hispid surfaces and extravaginal and intravaginal shoots. Whether for those new to grass identification or those with some previous experience of botanical terminology, the glossary is a necessity as some of the terms used have a slightly different meaning from those occurring with other plant groups.

An illustrated key designed for those with limited knowledge of grass morphology and terminology precedes the key proper. The illustrations are excellent and easily allow identification of grasses into groups. Some of the more recognisable genera and species can be identified directly from the illustrations. These genera and species are eliminated early in the written key. Subsequent characters divide the family into groups from A-P. Smaller keys then divide these groups into genera. The groups from A-P are simply for convenience to facilitate identification of the genera, but also allow many genera to occur in more than one group. This is important where there are differences in key characteristics of species within a single genus. For example, *Distichlis* occurs in group K, which consists of species with a panicle, awned spikelets and with three or more bisexual lemmas, and in group P, which also has species with a panicle but spikelets do not have awns and have two or more bisexual lemmas.

Being experienced in the use of many keys for many different plant groups I always have found that division of a key into smaller sections is far more user friendly than a single large key. The smaller sections are not as daunting in the first instance, and allow one to determine if a mistake has been made earlier than when using a larger key.



Once specimens have been identified to genus, the index must be consulted to determine the page on which the genus is described. Depending on the number of species within the genus, a further key is supplied to identify the species. A description of each species follows, along with an account of its distribution and notes on its ecology. The accompanying drawings are expertly done and help confirm correct identification.

Grasses of South Australia is a much needed work. It is highly recommended and provides information in a simple and user friendly manner, enabling all with an interest in grasses to identify specimens from this huge family, regardless of their level of expertise!

Maria Gibson

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Mayfly Sonnet

no longer green around the gills
he is unsheathed from adolescence

four-oared and paddling the airwaves
in a kind of semaphore, his present tense

is part Icarus and part Romeo
blindly conforming in a blizzard of silent fervour—

confetti to choke the throats of animals
and smooth the tread of tyres—

until the complicit gesturing of time
and cosmic forces skew his balance and weight

his movements; a muddle of spirals
and spins that exposes nature's counterfeit

as merely a scent, drifting in earthly currents
betraying all in his nothingness

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Possible Evidence of the Southern Brown Bandicoot *Isoodon obesulus*, from Deal Island, Kent Group, Bass Strait, Tasmania

Observations

In March 1999 the authors visited Deal Island (Kent Group) to survey the island for burrowing crayfish species. The Kent Group is located about halfway between the southern tip of Wilsons Promontory and the northern tip of Flinders Island, and comprises about six islands, the main three being Deal Island (c. 1577 ha) and the conjoined Dover and Erith islands (c. 295 ha and 323 ha, respectively) about one kilometre to the west across a channel (39°28'S, 147°21'E). Deal Island is a conservation area but has been highly modified by a long history of fire, land clearing and grazing.

The pictured shelter/nest (Fig. 1) was located on the eastern side of Deal Island in closed *Allocasuarina* woodland. Given the size of the structure (see watch for scale), its location on the ground and the type of construction ("interwoven" sheoak needles), combined with the habitat (grassy *Allocasuarina* woodland), it is postulated that the builder *might* be a southern brown bandicoot, *Isoodon obesulus*. Unfortunately, no collections of scats and/or hair were made from within and around the structure, and no obvious conical diggings were observed in the vicinity.

Other ground-dwelling candidates as owner of the structure are the Tasmanian bettong *Bettongia gaimardi*, although there are no records of this species from the Bass Strait islands (Rounsevell *et al.* 1991), or long-nosed potoroo, *Potorous tridactylus*, although the structure appears to be too small for this species. The absence of ground predators, such as the Tasmanian devil *Sarcophilus harrisi* and species of quoll (*Dasyurus viverrinus* and *D. maculatus*), means that the structure could even belong to arboreal species such as the common brushtail possum *Trichosurus vulpecula* or the common ringtail possum *Pseudocheirus peregrinus*. The latter species often builds nests (dreys) in trees but might construct a nest on the ground in the absence of predators,

although this particular structure is unlikely to belong to this species. Further candidates for constructing such a shelter might include introduced rats such as *Rattus norvegicus*, which is recorded for the island (Brothers *et al.* 2001), or even native rats such as *Rattus lutreolus*, which is possibly present on the island (Brothers *et al.* 2001). However, given that the nest was in a remote part of the island (i.e. away from the main settlement) and in quite open vegetation, the possibility of a rat nest seems remote but is by no means impossible.

Rounsevell *et al.* (1991) indicated that the southern brown bandicoot is widespread throughout mainland Tasmania but is absent from all islands except Maria Island (where it is introduced), Bruny Island and "West Sisters Island" in the Furneaux Group (Hope 1972), where it was last collected in 1987.

Brothers *et al.* (2001) did note that the southern brown bandicoot occurs on Deal Island and the nearby Erith Island, but no evidence is available to support this observation (in the form of database or museum records), although its veracity is not questioned. If the structure described in this note does belong to a southern brown bandicoot, the observation may be significant because the species is only formally known from Inner (West) Sister Island off the northern tip of Flinders Island. Similar structures to the one pictured have been observed on nearby Erith Island and despite camera-trapping (remote-controlled nocturnal photography), the owners were not detected, although introduced rats were (D Pemberton pers. comm.), and footprints possibly belonging to the bandicoot were also observed (D Pemberton and B Lazenby pers. comm.).

Hope (1972) and Brothers *et al.* (2001) listed the common brushtail possum as being present on the Deal Island and the nearby Erith and Dover Islands. Brothers *et al.* (2001) indicated the long-nosed potoroo as being present on Erith Island

and Hope (1972) reported subfossil collections of the potoroo from Deal Island from a gully above Winter Cove.

In conclusion, in the absence of other evidence such as scats or hairs, it is not possible to confirm the identity of the owner of this structure. However, the information is presented to allow discussion of its possible significance, especially if further evidence comes to light of southern brown bandicoots, common ringtail possums or long-nosed potoroos being present on Deal Island itself or on nearby Erith and Dover Islands. Further surveys for mammals on the Kent Group using a variety of techniques (e.g. hair-tubes, camera-traps, small and large cage traps, spotlighting, scats and tracks survey) appears to be warranted.

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References

- Brothers N, Pemberton D, Pryor H and Halley V (2001) *Tasmania's Offshore Islands: Seabirds and other Natural Features*. (Tasmanian Museum and Art Gallery, Hobart)
- Hope JH (1972) Mammals of the Bass Strait islands. *Proceedings of the Royal Society of Victoria* **85**: 163-195.
- Rounsevell DE, Taylor RJ and Hocking GJ (1991) Distribution records of native terrestrial mammals in Tasmania. *Wildlife Research* **18**: 699-717.
- Triggs B (1996) *Tracks, Scats and Other Traces: a Field Guide to Australian Mammals*. (Oxford University Press, Melbourne)



Fig. 1. Structure made predominantly of sheoak needles. The entrance is c. 10 cm diameter and extends for about 20-30 cm back into the image. The raised Sheoak needles at the top centre of the image are where they rest against a small diameter Sheoak stem. The watch provides a scale. It is noted that the structure is remarkably similar to the nest of a Long-nosed Bandicoot *Perameles nasuta* picture on page 216 of Triggs (1996).

Arthur James Farnworth MBE, PhD

30 September 1923 – 10 December 2006

It was with great regret that we heard the news of Arthur's death. Arthur was President from 1990-1993, and was one of the most dedicated and influential presidents that the Club has had. He came to – was thrust into – the position at a time when the Club was at a very low ebb. Membership had been falling for several years, *The Victorian Naturalist* seemed to be on the verge of foundering, and our tenure at the Herbarium was becoming increasingly insecure. Initially somewhat daunted by the position he found himself in, Arthur tackled these problems with energy and determination.

Arthur Farnworth was elected to the Club in 1986, with the intention of quietly pursuing his interests in natural history and honing his skills in nature photography. He and his wife Enid, who ably supported him throughout his presidency, attended Botany Group meetings, where he fell under the talent-spotting eye of Marie Allender. In the lead-up to the 1990 AGM, Marie suggested to me that Arthur would be a good person to have on Council. I contacted him, and he agreed to stand. My approach might have been a little disingenuous, because I knew that I would not be standing for re-election as Vice-President, as I was going overseas later in the year, and the hunt was already on to find another candidate. On a Botany Group excursion, Marie and I put the suggestion to Arthur that he should stand for this position. (In those days we had only one Vice-President.) In May 1990 he was duly elected. But we had no President, and in August the person who had subsequently been appointed, resigned. Arthur, totally unexpectedly and with some dismay, found himself in the position.

Two major problems immediately confronted him: the lateness of *The Victorian Naturalist*, and the confusion of the membership records. The failure to get *The Victorian Naturalist* out on time, so that members had notice of meetings and



excursions before they occurred, had existed for some time, and Council had regularly discussed the feasibility of having a newsletter. Nothing had come of this because no-one seemed willing to undertake the task of producing one. In October 1990 Arthur sent an open letter to all members announcing that a newsletter would be included with the bi-monthly *The Victorian Naturalist*, and that measures were being undertaken to ensure that the journal appeared on time. The Field Naturalists Club of Victoria Newsletter January/February 1991 duly appeared, under the able editorship of Dr Noel Schleiger. From the outset it became a stand-alone publication, but remained bi-monthly until August 1994, when, under the title *Field Nats News*, it became monthly. It has appeared regularly from the outset, without a break, since then, and nowadays there is an efficient system in place that ensures its production and mailing. *The Victorian Naturalist* also began to be published more on schedule. In the early days there was much burning of the midnight oil to achieve this, in which Arthur played a major role. He was fortunate that he gathered around him a willing band of helpers, but he inspired people, and they responded to this. He was quick to express

his appreciation of anyone's efforts, with the quotation 'I dips me lid', which he used whenever he thought it merited.

In January 1991 an editorial sub-committee was set up to assist the editors in the planning and costing of *The Victorian Naturalist* and the *Newsletter*. The Club had been late in submitting its application for the Treasury grant, which it had previously received. Arthur rectified this by writing to the Premier, and the grant of \$1500 was restored.

The Club's membership records had been computerised in 1985, but the system was outsourced, and there were many pitfalls; the situation was aggravated in 1990 by the lackadaisical attitude of the current Subscription Secretary. This was another problem that Arthur had to tackle, and again willing helpers, such as Margaret Potter, came to his assistance. It took more than two years to sort out the confusion, but the provision of office space in the Astronomer's Residence, as a result of negotiations with the Herbarium, made the administration of the Club easier, and in 1993 the membership records were installed on our own computer.

Amongst other matters needing attention was the future of the Club's Kinglake property. Council had always understood that by the terms of Harold Frahm's will the Club was unable to dispose of the block. However, diminishing use of it by the Club, together with an increasing vandalism, and resulting expense, made it important that some action be taken. Arthur initiated investigation of the Club's position, and it was established that it was under no legal obligation to retain the property. The money from the sale of the Kinglake block, though long delayed, became an important contribution in the establishment of the Club in its present home and so we may thank Arthur for the part he played in this.

Arthur was a superb nature photographer, and his slide shows were always informative. But it was not unknown for him to conclude with a very striking photograph

and the cheerful remark 'And I don't know what the hell this is!' He had a great sense of humour. His 1992 presidential address, entitled 'Kakadu and other interests', included slides which had tickled his fancy. His informative article in *The Victorian Naturalist* on the changes in Mallacoota Inlet was typical, full of comic asides and concluding with the comment that 'the jetties lying several centimetres below the surface of the lake, provided a golden opportunity for anyone with delusions of grandeur to practise walking on water,' adding that there were rumours that several MPs had occasionally been seen at Mallacoota Inlet!

Arthur Farnworth was born in Geelong on 30 September 1923, and was educated at the Gordon Institute of Technology, and the Universities of Melbourne and Leeds. After several years as Senior Lecturer in Textile Chemistry at the Gordon Institute, he became a Research Officer with CSIRO, where he developed Si-Ro-Set, the permanent press process, which smartened us all up. In 1961 he became Technical Director of the Australian Wool Board, Deputy Managing Director in 1970, and General Manager, Corporate Services and Research Division, Australian Wool Corporation in 1974. In 1946 he married Enid Brown, by whom he had three children.

In recent years Arthur's membership of the Club lapsed, as Enid's debilitating illness required increasing care, but he left a lasting legacy, primarily by the establishment of *Field Nat News*, but also in revitalising the Club at a time of crisis. We have good reason to be grateful. Our condolences go to his family.

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Dr Gretna Margaret Weste AM

5 September 1917 – 30 August 2006

Last year a long-standing and generous contributor to the FNCV died – Dr Gretna Weste, a Club member from 1978 until she left Victoria in 2003 to live near her daughter in Tasmania. Before leaving, Gretna contributed to my historical investigation of The University of Melbourne's Botany School, with which she had an even longer association. Because we were discussing her pre-1975 work, I didn't ask her why she joined the FNCV in 1978, something I now regret.

In hindsight, joining the FNCV seems entirely appropriate for someone with Gretna's interests and expertise. In the 1970s she was helping an amateur naturalist describe fungi, and teaching and researching in the Botany School, during which undergraduate excursions took her to Wilsons Promontory, and her research took her to dying patches of Victoria's diverse heathlands, woodlands and forests. Gretna was on a quest – to understand the ways and wiles of a destructive plant pathogen – and this required an ecological understanding of the bush it invaded. Her interest in and love of the bush was shaped by her childhood and university experiences, bush-walking, and perhaps her forester husband. Her parents, Arthur and Grace Parkin, took her bush-camping and encouraged her love of plants and the bush; and, although their names do not appear in FNCV membership lists, Gretna claimed to have enjoyed FNCV shows and meetings as a child. No wonder she joined the FNCV. By 1978 her three children were well and truly independent adults, and, sadly, her husband had died.

World War I was responsible for Gretna's Scottish birth and name. In 1917 her scientist father was working in the new, War-provoked munitions factory, 'H.M. Factory Gretna', near the Scottish border town of Gretna. At the end of the War, the Parkin family returned to Victoria, where Gretna grew up on the edge of suburbia in Surrey Hills. During the Depression, a scholarship allowed her to complete her secondary education at

Methodist Ladies' College in Hawthorn. In Victoria's Leaving examination in December 1934 she gained the Exhibition (top marks) in botany and first-class honours in enough subjects to win a government scholarship to Melbourne's only university in 1935.

During her honours-studded science degree course at the University of Melbourne, Gretna studied botany under several FNCV members. Dr Reuben Patton taught plant taxonomy and ecology, and Associate Professor Ethel McLennan taught mycology and plant pathology. Professor Alfred Ewart was also a FNCV member. Gretna was in his last Botany Part III class – in her third year in 1937. Ewart died just before Gretna presented her talk on a topic of little interest to her (soil pH measurement), thereby sparing her his usual scathing criticism. Gretna Parkin shared the exhibition in Botany Part III, and in April 1938 graduated BSc.

A Howitt Natural History Scholarship allowed her to undertake research for the University's MSc degree in 1938. In the Division of Forest Products of CSIR (later CSIRO) she investigated the 'tension wood' formed in response to bending in Australian hardwood trees, her foundation investigations gaining her the nick-name 'Gelatinous Gretna', due to the gelatinous layer inside the tension wood. In the spring of 1938 Gretna and other members of the Botany School helped to introduce Ewart's newly-arrived successor, Professor John Turner, to Australia's tall flammable forests beyond Marysville.

And then came the January 1939 bush-fires and World War II.

Early in 1939 Gretna Parkin gained first-class honours and shared the MSc exhibition in the Botany School, and was appointed a research officer in the Forests Commission of Victoria (FCV). Or so the paper-work of her appointment led her to believe. She investigated the problem of preserving the timber of the huge numbers of trees killed but not incinerated in the 1939 fires. Unlike her research officer col-



Gretna Parkin working in the Forests Commission of Victoria Laboratory in 1940. Photo courtesy of Sandra Heard née Weste.

leagues, all of whom were male, her salary did not increase incrementally, so she appealed to the Public Service Board, whose investigation of her research reports and typewriter-free laboratory somehow concluded that, as a woman, her classification and salary were those of a temporary typist. And that was that. Her research led to the FCV's policy of keeping salvaged timber sprayed with water, but her mycological paper on wood-rotting fungi on living forest trees was not published.

In December 1941 Gretna married Geoff Weste, a Creswick-trained forester, and, since married women were then not tolerated in the Public Service, she had to resign from the FCV. Fortunately marriage was not an explicit barrier to university women, and Professor Turner welcomed her back in the wartime-depleted Botany School in 1942, to continue (on a Commonwealth Research Scholarship) work he claimed was of national importance – her research on the pathology and preservation of timber salvaged after the 1939 fires.

In 1961, after two decades of family responsibilities and some school-teaching, Gretna was again welcomed back in the Botany School to teach increasing numbers of botany students in the 1960s. Beginning as a senior demonstrator, she also undertook research in plant pathology, and was

soon lecturing as well as demonstrating in plant pathology and first-year biology. In August 1969 lecturer Weste was awarded a PhD degree for her agriculturally-important thesis on a fungal disease of wheat. That year two timely events redirected Dr Gretna Weste's research focus to Victoria's indigenous vegetation – the decision to transfer University agricultural plant pathology across the System Garden to the Agriculture School, and the detection of symptoms of a non-agricultural pathogen in the Victorian bush. Frank Podger, who had recently shown that the devastating dieback in Western Australia's precious Jarrah *Eucalyptus marginata* forests was due to *Phytophthora cinnamomi*, accompanied Gretna's ecologist colleague, Dr David Ashton, on a botanical excursion to the Brisbane Ranges, where they noticed symptoms which were later confirmed to be due to *P. cinnamomi*. This was the first record of the disease in the Victorian bush, having probably reached the Brisbane Ranges during road-construction in the 1960s.

And so Dr Weste transferred her research gaze from an agriculturally-important soil-borne pathogen to one which devastates Australian indigenous ecosystems. In the Botany School she taught science and forestry undergraduates about interactions between micro-organisms and plants, and



Dr Gretna Weste pointing out an unusual Grass-tree she spotted in the Mary D White Heathland Reserve during an excursion with Friends of Angahook-Lorne State Park in February 2000. Later identified by Neville Walsh as *Xanthorrhoea caespitosa*, it was a new record for the Anglesea district. Photo courtesy of Margaret MacDonald.

supervised post-graduate research projects on diverse aspects of *P. cinnamomi* in the bush. Although *P. cinnamomi* was commonly known as ‘cinnamon fungus’ because of its initial discovery on cinnamon trees, with its motile (swimming) zoospores, it is more closely related to certain algae than fungi. Unfortunately this alien micro-organism has been found to be a virulent, root-invading pathogen of numerous Australian plants, its degree of destruction being influenced by the antagonistic activity of soil microbes. Also unfortunately, Australian nutrient-poor soils and gravels invariably lack sufficient micro-organisms to combat *P. cinnamomi*.

Dr Weste officially retired as Reader in 1982; in March 1984 the University of Melbourne honoured the foremost authority on the biology of *P. cinnamomi* in Australian ecosystems with a DSc degree for her published research papers; and in 1989, she was made a Member of the Order of Australia (AM) ‘For service to science, particularly in the field of botany’. Beyond all these, Gretna and her research students

continued to study the physiological and ecological consequences of *P. cinnamomi*. For more than three decades, beginning with Victoria’s rather wet growing season of 1970–71, which favoured its zoospore-led dispersion, they followed its fate and fancies in forests, woodlands and heathlands in the Brisbane Ranges, Wilsons Promontory, Grampians and East Gippsland.

These long-term studies have revealed the pathogen’s *modus operandi*, the susceptibility of thousands of Australian host species, and the cyclic nature of the infestation. By continuously monitoring vegetation in permanent quadrats in diseased and disease-free areas, they have documented the changing face of the disease. With the dieback and death of susceptible trees and shrubs (with the conspicuous evidence of dead Grass Trees *Xanthorrhoea australis*, noticed by so many field naturalists), drab, resistant vegetation (such as sedges) gradually replaces diverse, colourful, insect-, bird- and animal-attracting susceptible species (like peas, heaths and grevilleas) in

heathlands and shrubby understoreys. Then, decades after the initial infestation of *P. cinnamomi*, its density and distribution may decline, with the co-incident reappearance of susceptible trees and understorey species.

In the 1990s they recorded a welcome recovery on Wilsons Promontory – the reappearance of *X. australis* and Saw Banksias *Banksia serrata* on the northern slopes of Vereker Spur near the junction of Millers Landing Track and Five Mile Road. Dr Weste first noticed dieback there in 1970 (during a university botany excursion), probably originating from contaminated soil on a bulldozer brought in to help fight bushfires in 1962 and offloaded in a gravel pit. The disease was dispersed by the 'dozer, and subsequently by the use of infested gravel on roads and tracks, and by zoospores swimming after rain.

Dr Weste represented the Botany School on the Conservation Council of Victoria, and submitted botanical evidence to Victoria's Land Conservation Council. She was a foundation member of the Australian Conservation Foundation, and a member of numerous groups, including the FNCV, Victorian National Parks Association, Environmental Studies Association of Victoria, Friends of Warrandyte State Park and of the 100 Acres in Park Orchards, Montrose Environment Group, the Ringwood Field Naturalists Club, and the Maroondah branch of the Society for Growing Australian Plants (now Australian Plants Society).

In 1990 Dr Weste undertook a comprehensive investigation of the risk posed by *P. cinnamomi* to endemic plants throughout Australia for the new Endangered Species Unit of the Australian National Parks and Wildlife Service (ANPWS). Having just published the revised edition of *Rare or Threatened Australian Plants* (1988), the ANPWS did not publish her report on this particular biological risk to them, but did use information from her report. Further research by Weste and co-workers on rare and endangered species in the Brisbane Ranges and Grampians (Gariwerd) National Parks, has revealed the alarming news that over a dozen endemic species are not only susceptible to *P. cinnamomi* but are also at risk of conse-

quent extinction. The ecological threat of *P. cinnamomi* to Australian biodiversity is now officially acknowledged. 'Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)' is now listed as a 'Key Threatening Process' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

A foundation member of the Australasian Plant Pathology Society (APPS), Dr Gretna Weste was an executive member of the International Society of Plant Pathologists' Committee on *Phytophthora*, and chaired the Organising Committee of the Society's 4th International Congress of Plant Pathology, which was held in Melbourne in 1983. She was also a plant pathology research group leader in the International Union of Forest Research Organisations. In the 1990s she was made an Honorary Member of the APPS and Patron of the new Australasian Mycological Society.

Gretna's mycological activities included a productive collaboration with an amateur mycologist and long-standing FNCV member, Gordon Beaton. While Gordon collected, identified, described and illustrated small cup-fungi (Discomycetes) and other fungi, Gretna prepared their descriptive papers for publication. Their 20 joint papers, published from 1976 to 1984 in the *Transactions of the British Mycological Society*, include type descriptions of Australian fungi. *The Victorian Naturalist* (1978–80) carries five of their papers on Victorian fungi and Weste's obituary for Beaton in 1988. Gretna participated in the fungal forays, workshops and conferences of Fungimap, the realisation of Dr Tom May's 1995 suggestion to the FNCV's Botany Group of a mapping scheme for Australian fungi. At the 3rd Fungimap conference in Gowrie Park, Tasmania, in 2005, with her usual generous enthusiasm, Gretna helped professional and novice participants alike in their pursuit of fungi.

Undeterred by hip replacements and the occasional broken bone, Gretna continued to hike through the world's national parks and wilderness areas into the 21st century. With humour, hand lens and camera at the ready, she marvelled at the beauty as well as the ecology of landscapes and their plants and fungi. From the 1970s she

shared her biological wisdom and wonderment during engaging talks and enthusiastically-led excursions for the FNCV and other conservation groups, and founded and led walks for the Melbourne University and Alumni Bushwalkers

The patient, perceptive and persistent investigations of *P. cinnamomi* by Dr Gretna Weste and her students show the huge importance of sustained scientific research for the understanding and management of ecosystems and their pestiferous invaders. They have documented and explained the physiological and ecological destruction caused by this alien micro-organism that poses such a threat to Australia's biodiversity, and which, in our careless ignorance during road-works, logging and mining, we humans have introduced into Australian ecosystems.

Gretna leaves a substantial legacy of ideas and information – in the busy minds of her former research students and in her published papers, including over 100 papers on *Phytophthora cinnamomi*, in Australian and international journals such as the *Australian Journal of Botany*, *Australasian Plant Pathology*, *Phytopathology Zeitschrift*, *Phytophthora Newsletter* (International) and, of course, *The Victorian Naturalist*. The following four papers provide an overview of her protracted study of this destructive pathogen in the Victorian bush:

The cinnamon fungus. Is it a threat to Australian native plants? *The Victorian Naturalist* (1993) **110**, 78–84.

Is dieback declining? The threat of *Phytophthora cinnamomi*. *The Victorian Naturalist* (1997) **114**, 216–221.

Dieback at Wilsons Promontory. Is the battle won? *The Victorian Naturalist* (1998) **115**, 331–336.

Dieback threatens endangered native plants [in the Grampians]. Will they survive? *The Victorian Naturalist* (2004) **121**, 148–153.

And you might like to read her autobiographical 2005 Daniel McAlpine Memorial Lecture, 'A long and varied fungal foray', in *Australasian Plant Pathology* **34**, 433–437.

I thank Sheila Houghton, Gary Presland, Jason Benjamin, Jane Ellen, Tom May, Lorraine Gale, Marion King and Jean Galliot for their help.

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One Hundred Years Ago

POPULAR NAMES FOR NATIVE PLANTS - Following up the suggestion made in a paper read before the Field Naturalists' Club some little time ago, a sub-committee has been appointed to see what can be done towards compiling a list of popular names for our commoner native plants. The first step is, of course, to get as many lists of names as possible from observers in various parts of the state, and with that view the sub-committee requests all interested, especially teachers, who, perhaps, have better opportunities than others, to forward any names they may know of to Dr. C.S. Sutton, Rathdown-street, North Carlton, who has kindly consented to act as secretary to the movement. It is not to be expected that this work will be accomplished in one season, but, if started at once, it will not be long before a satisfactory foundation can be laid for future work, which, it is hoped, will include the publication of a Floral Calendar for the State. Parcels of dried specimens, with local names attached, may be forwarded to the care of Mr. J.A. Leach, M.Sc., Training College, Carlton.

From *The Victorian Naturalist* **XXIV** p 85, September 5, 1907

