The Victorian Naturalist

Volume 113 (1) 1996 February

Published by The Field Naturalists Club of Victoria
since 1884

From the Editors

Members Observations

As an introduction to his naturalist note on page 29, George Crichton had written:

'Dear Editors
...... I was not sure if it was of any relevance, as of late years the Journal has become very scientific, and ordinary nature reports or gossip of little importance ......'

We would be very sorry if members felt they could not contribute to The Victorian Naturalist, and we assure all our readers that the editors would be more than pleased to publish their nature reports or notes. We can, however, only print material that we actually receive and you are encouraged to send in your observations and notes or suggestions for topics you would like to see published. These articles would be termed Naturalist Notes - see in our editorial policy below.

Editorial Policy

Scope
The Victorian Naturalist publishes articles on all facets of natural history. Its primary aims are to stimulate interest in natural history and to encourage the publication of articles in both formal and informal styles on a wide range of natural history topics.
Authors may submit the material in the following forms:

Research Reports - succinct and original scientific communications.

Contributions - may consist of reports, comments, observations, survey results, bibliographies or other material relating to natural history. The scope is broad and little defined to encourage material on a wide range of topics and in a range of styles. This allows inclusion of material that makes a contribution to our knowledge of natural history but for which the traditional format of scientific papers is not appropriate.

Naturalist Notes - short and informal natural history communications. These may include reports on excursions, talks or noteworthy observations.

Book Reviews - priority is given to major Australian publications on natural history. Whilst reviews are commissioned, the editors welcome suggestions of books to be considered for review.

News - any items of news concerning the FNCV.

Obituaries - due to space restrictions please try to limit this to 500 words and one photograph.

The style should follow the traditional format of scientific papers. Preference will be given to short articles not exceeding 2500 words.

Review Procedures
Research reports and some contributions are subject to refereeing. *The Victorian Naturalist* is not in general a taxonomic journal but will publish taxonomic papers not provided for in Australian taxonomic journals. The editors reserve the right to accept or reject material submitted for publication.

Authors Copies
Five complimentary copies of the journal will be sent to authors for their use. Reprints and additional copies of the journal can be arranged at the time of the final submission of the paper.

The Victorian Naturalist

Volume 113 (1) 1996 February

Editors: Ed and Pat Grey

ISSN 0042-5184

Cover: Wombat carrying young. Photo by G.K. Smith. (see page 25)

Negative Effects of Fuel-reduction Burning on the Habitat of the Grey-crowned Babbler *Pomatostomus temporalis*

P. Adam[1] and D. Robinson[2]

Abstract

We examined the effects of annual fuel-reduction burning on the roadside habitat of the endangered Grey-crowned Babbler *Pomatostomus temporalis* in the former Violet Town Shire in northern Victoria. Approximately 25% of the Victorian population of the Grey-crowned Babbler is found in Violet Town Shire, and more than 90% of those birds depend on remnant woodland habitat found along the roadsides. Conservation of the Grey-crowned Babbler therefore requires appropriate management of roadside habitat. The numbers of trees, saplings, wattles, Babblers' nests and Babblers were recorded along the burnt and unburnt sides of an 11 km section of strategic firebreak road which supported 14 known groups of Grey-crowned Babblers. With the exception of trees more than 10 m tall, all other size-classes of trees and wattles were less common on the burnt side of the road than on the unburnt side. Five times as many Babblers' nests were recorded in plants on the unburnt side of the road as on the burnt side, and all Babblers seen during the survey were observed on the unburnt side. The results thus indicate that fuel-reduction burning is having a considerable impact on the habitat of the Grey-crowned Babbler and that fire-prevention practices need to be modified to protect roadside habitat for the Grey-crowned Babbler and other understorey-dependent species. A range of alternative fire-prevention practices is suggested here. (*The Victorian Naturalist* **113** (1) 1996, 4-9)

Introduction

The Grey-crowned Babbler *Pomatostomus temporalis* is a threatened species of woodland bird in south-eastern Australia. It lives in family groups of about two to fifteen birds which occupy permanent territories of about ten hectares in size. In contrast to many species of birds, the Grey-crowned Babbler sleeps in a nest at night, the whole family roosting together in a single nest. The bulky stick nests are built in eucalypt saplings, small trees or mature wattles, and several nests are usually in active use by the same family at any one time. The Grey-crowned Babbler has recently become extinct in south-eastern South Australia, is endangered in Victoria (CNR 1995) and is declining in parts of New South Wales and southern Queensland (Robinson *et al. in prep.*). In every part of its range, the principal cause of decline has been extensive habitat clearing (Robinson and Davidson *in prep.*). The other significant cause of decline has been, and still is, the severe modification of Babbler habitat by a range of degrading processes, notably grazing, intensified land use, roadside earthworks, weed invasion, and fire prevention works (Robinson *et al. in prep.*; Robinson and Davidson *in prep.*). Predation by cats and birds may also be a significant cause of decline in certain districts (Robinson and Davidson *in prep.*).

The habitat of the Grey-crowned Babbler in Victoria comprises five critical elements: woodland or open-forest vegetation communities on fertile or heavy soils; relatively many trees in the immediate landscape in contrast to sites without Grey-crowned Babblers; relatively many trees larger than about 60 cm trunk diameter at breast height (dbh); an understorey of young trees and shrubs in the 10-25 cm dbh range for nest sites and shelter and a relatively sparse ground layer with more litter and less grass cover than at non-babbler sites (Robinson and Davidson *in prep.*). Wherever one or more of these habitat elements is missing, or is removed, Grey-crowned Babblers are absent, or soon disappear (Robinson and Davidson *in prep.*).

In northern Victoria, the most significant element missing in the remaining woodland landscape is an understorey of young trees and shrubs. In the former Violet Town Shire - the most important

1 RMB 2066, Violet Town 3669

2 RMB 1134, Benalla 3673

locality in Victoria for Grey-crowned Babblers - 370 km (80%) of the 463 km of public road surveyed in 1993 had a sparse understorey or none at all, and 96 km (93%) of the 103 km of unused roads with trees had a sparse understorey or none at all (Robinson *et al. in prep.*). While grazing is the major cause of death of young trees and shrubs in the woodland landscape, fire-prevention works along selected roadsides in Violet Town Shire have been a significant, additional cause of the death of young trees and shrubs. Here we report on the effects of that control-burning on the habitat and abundance of the Grey-crowned Babbler.

Study Area and Methods

The former Violet Town Shire (now part of Strathbogie Shire) is located in north-eastern Victoria between the Strathbogie Ranges and the Broken River. The Shire contains by far the largest population of Grey-crowned Babblers found in the State (about 90 groups, or 25% of the known State population) (Robinson *et al. in prep*). The Strathbogie Shire is, furthermore, the principal public authority responsible for the conservation of the Grey-crowned Babbler in the Violet Town district; firstly because more than 90% of Babblers depend on vegetation found along public roads managed by the Shire (Robinson and Davidson *in prep.*), and secondly because the Grey-crowned Babbler is listed under the *Flora and Fauna Guarantee Act (1988)*. Accordingly, as stated under Part 1, 4(2) of the Act, 'a public authority must be administered so as to have regard to the flora and fauna conservation objectives'. These objectives include Part 1, 4(1): (a) to guarantee that all taxa of Victoria's flora and fauna other than the taxa listed in Schedule 1 can survive, flourish and retain their potential for evolutionary development in the wild; (b) to conserve Victoria's communities of flora and fauna; and (c) to manage potentially threatening processes.

As in many other Shires, Violet Town (Strathbogie) Shire and the Country Fire Authority have identified several roads to be managed as strategic firebreaks for the prevention of the spread of fire and access in the event of a fire. However, in contrast to the situation in most other Shires, two of these roads also provide habitat for the Grey-crowned Babbler, altogether supporting some 18 groups (20% of the Shire's population and 5% of the State's population) (Fig. 1). We used one of these strategic firebreak roads as our study area.

The Violet Town-Dookie Road is a three-chain-wide (60 m) road reserve which supports 14 Babbler groups over a 14 km section (Fig. 1). Management of both sides of the road in the Babbler section has been similar over the past 30 years, with the one exception of fire control (P. Adam, *pers. obs*). For the last 30 years, the east side of the road has been burnt every year, whereas the west side has never been burnt (apart from a 3 km section burnt three years ago. This was excluded from our study). On both sides of the road, a 5-m-wide firebreak is scraped close to the fenceline.

Three months after the east side of the Violet Town-Dookie Rd was burnt in late January, 1994, we travelled 11 km of road and counted on the east (burnt) side and west (unburnt) side, the number of eucalypts more than 10 m tall, eucalypts between 6 and 10 m tall, eucalypts between 2 and 5 m, eucalypts less than 1 m, Golden Wattles *Acacia pycnantha* more than 1 m high, Golden Wattles less than 1 m high and other wattles. We also recorded the number of Babblers' nests and the number of Babbler groups sighted. Because the area burnt is restricted to the road side of the scraped firebreak, we only collected information for the approximately 10 m wide area between the road edge and the scraped firebreak.

Results

Altogether, there were twice as many trees and shrubs on the unburnt side of the road as on the burnt side (Table 1). Trees more than 10 m tall were more common on the burnt side of the road. All other categories of plant were less common on the burnt side than on the unburnt side (Table1). In contrast to the well-estab-

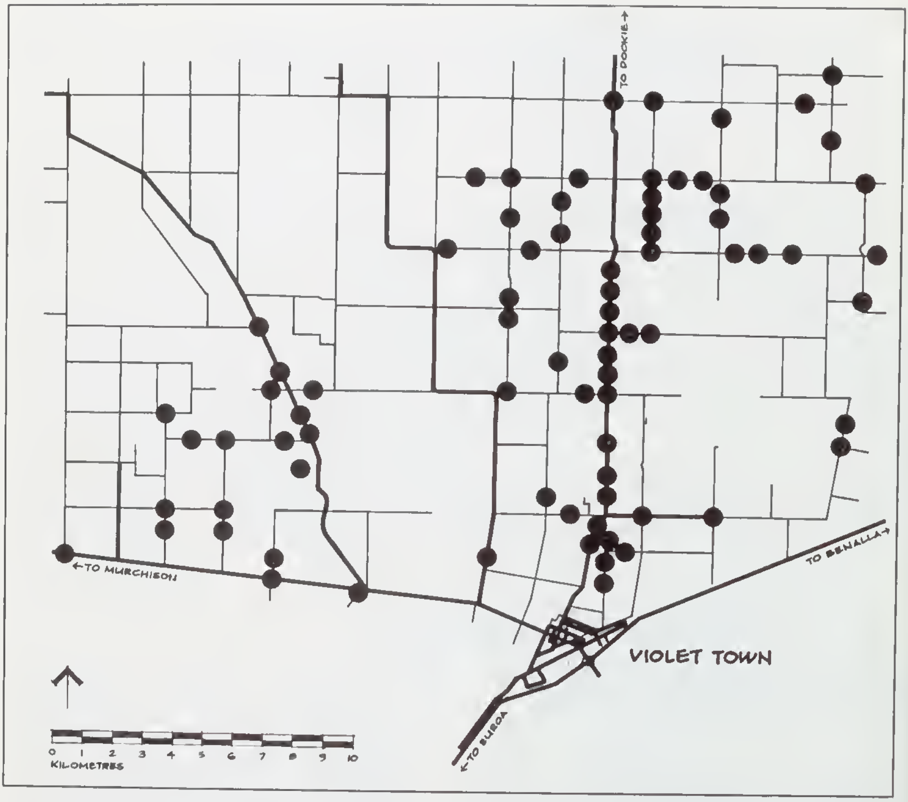

Fig. 1. The distribution of Grey-crowned Babblers and strategic firebreak roads in the northern part of Violet Town Shire. Roads marked 'to Murchison' and 'to Dookie' are strategic firebreak roads. Dots indicate localities of known groups of Grey-crowned Babblers. Broad black lines show sealed roads. Thin lines show unsealed roads.

lished finding that wattles are favoured by fires (Christensen and Kimber 1975; Purdie and Slatyer 1976; Gill 1981; Shea *et al.* 1981; Hamilton *et al.* 1991), the number of Golden Wattles shrubs on the unburnt side as on the burnt side, and every Babbler group sighted during the two-day survey was observed on the unburnt side (Table 1).More than 50 Varnish Wattles and several hundred of each of the three other species were counted on the unburnt side, while only 24 Bent-leaf Wattles, 40 Gold-dust Wattles re-sprouting from roots and 67 Spreading Wattles were recorded on the burnt side. No Varnish Wattles at all were recorded on the burnt side of the road. Significantly, nearly all of the wattles growing on the burnt side of the road were growing in unburnt 'islands'.

Considering only those trees and shrubs that represent potential nest trees for Grey-crowned Babblers (eucalypts between 2-10 m high and Golden Wattles > 1 m high), there were 2.5 times as many potential nest trees on the unburnt side as on the burnt side (Table 1). Five times as many babblers' nests were recorded in trees and-shrubs on the unburnt side as on the burnt side, and every Babbler group sighted during the two-day survey was observed on the unburnt side (Table 1).

Discussion

Most studies of the effects of fuel-reduction burning on landbirds in

Table 1. Numbers of eucalypts, wattles and Grey-crowned Babblers and nests on the unburnt and burnt roadsides of the Violet Town Dookie Rd. Potential nest trees comprise all eucalypts 2-10 m high and all Golden Wattles > 1 m high.

Category	Un burnt	Burnt	Ubnurnt/ Burnt Ratio
Eucalypts > 10 m high	888	964	0.9
Eucalypts 6-9 m high	931	721	1.3
Eucalypts 2-5 m high	494	264	1.9
Eucalypts < 1 m high	606	423	1.4
All Eucalypts	2031	1408	1.4
Golden Wattles > 1 m high	1100	26	42.3
Golden Wattles < 1 m high	351	36	9.7
All Golden Wattles	1451	62	23.4
Other Wattles > 1 m high	167	1	167.0
Other Wattles < 1 m high	1068	130	8.2
All Other Wattles	1235	131	9.4
All Potential Nest Trees	2525	1011	2.5
Babbler Nests	40	8	5.0
Babbler Groups	4	0	-

Australia have concluded that fuel-reduction burning either increases species diversity (Kimber 1974; Christensen and Kimber 1975; Christensen et al. 1985; McFarland 1988) or else has little long-term effect on bird populations (Cowley 1974; Loyn et al. 1992) - **so long as the area is not burnt too often.**

Our study clearly showed that fuel-reduction burning is having a considerable, detrimental impact on the habitat of the Grey-crowned Babbler and therefore on the bird itself. Because of repeated, annual burning, there were fewer numbers of saplings and wattles on the burnt side of the strategic firebreak road than on the unburnt side. There was consequently less understorey habitat in which the Babblers could nest or shelter. As a result, there was one-fifth the number of babblers' nests on the burnt side of the road. Control burning is thus effectively restricting the Grey-crowned Babbler population to one side of the road, and preventing new groups from establishing in otherwise suitable habitat along the burnt side of the road. The induction that fuel-reduction burning generally increases species diversity or benefits wildlife communities must therefore be regarded with caution (Wooller and Calver 1988): it has only been tested in a few environments; it is only applicable to certain wildlife communities or certain species and it is only valuable in those communities or for certain taxa if the land managers burn the environment according to ecological principles rather than for other reasons (Meredith 1988).

Given that

(a) the largest remaining population of Grey-crowned Babblers in Victoria is found in Violet Town (Strathbogie) Shire,

(b) 20% of the Shire's Babbler population is found along two strategic firebreak roads, and

(c) current fire-prevention practices are reducing the area of potential habitat for the Grey-crowned Babbler,

fire-prevention practices along those two roads and other strategic firebreak roadsides within the Grey-crowned Babbler's range need to be examined to establish whether or not changes can be made which increase the area of potential Babbler habitat without jeopardising the safety of human life or property.

The Shire and the Country Fire Authority have a legal responsibility under the *Country Fire Authority Act 1958* to minimise the risk of wildfire. They also have a legal responsibility under the *Flora and Fauna Guarantee Act 1988* to conserve the Grey-crowned Babbler. The critical issue from the perspective of conservation is that roadsides provide the principal habitat for 98% of all Babbler groups in Violet Town Shire. Furthermore, because Grey-crowned Babblers are dependent on sites with old trees (Robinson and Davidson in prep.), their habitat cannot easily be created elsewhere. Protection of roadside habitat consequently remains the priority for Babbler conservation for at least another 100 years until regeneration on private land can provide alternative, mature woodland habitat for the birds (Robinson and Davidson *in prep.*).

The Country Fire Authority has already undertaken the first step towards conservation of Grey-crowned Babbler habitat by only burning one side of the strategic firebreak roads in Violet Town Shire. The next step is to **evaluate whether there is any need for any fire control measures within the road reserves with Babbler habitat;** understanding that the strategic firebreak roads have the dual functions of preventing the spread of fire and of providing safe access in the case of fire (Shire of Violet Town 1993). The understorey and ground cover along the unburnt side of the Violet Town-Dookie Rd consists predominantly of Acacias and native grasses (mostly Danthonia spp., Stipa spp. and Elymus scaber) and the fire hazard may well be low (Meredith 1988). In that case, no fire-prevention works may be required, or else works may be needed only once every 5-20 years.

Even given that some fire-prevention measures are needed along the roads, **localised fire control could occur within Grey-crowned Babbler habitat by means which left some of the understorey intact** (e.g. by slashing or burning only areas of vegetation identified as having high fuel loads or as being a threat, Petris and Spittle 1994), or that which resulted in patches of unburnt and burnt clumps of understorey vegetation along the roadsides. Alternatively, if those sections of roadside with Babbler habitat were assessed as having high fuel loads, **the CFA could relocate the strategic firebreaks to other, low conservation-value roads;** although this option requires the existence of other wide roads that could provide the dual functions of the firebreak roads (only partly possible in Violet Town Shire). Another option might be to **construct alternative access routes** through nearby paddocks to avoid the roadside habitat with its many trees. Similarly, it might be better to **construct firebreaks on adjacent farmland** rather than maintaining firebreaks along the roadside and beneath trees (Oates 1994; Petris and Spittle 1994).

Without a detailed inspection of the strategic firebreak roads by fire-prevention planners and ecologists, it is impossible to prescribe the most appropriate means of fire control for either road. However, unless such alternatives as outlined above are considered soon, the understorey habitat required by the Grey-crowned Babbler and some other species of wildlife will continue to disappear, so preventing populations of those species from increasing in size or, in some instances, causing those species' further decline.

Acknowledgments

This project was part of a three year study conducted by the Royal Australasian Ornithologists Union with funding from the National Estate Grants Program, Vic Roads and the Department of Conservation and Natural Resources. To all of these organisations, we express our thanks. Our thanks also to Mr John Dunn, the former Shire Engineer of Violet Town Shire and to members of the Sheep Pen Creek Land Management Group for their support. Comments by David Baker-Gabb, Ian Davidson, Pat and Ed Grey, Sally Mann, Charlie Meredith, Stephen Petris and a referee improved earlier drafts.

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Sheila Houghton
FNCV, Hon. Librarian

Drifting Sand and Marram Grass on the South-west Coast of Victoria in the Last Century.

Jill Heathcote[1] and Sara Maroske[2]

Abstract
Poor land management from the time of white settlement quickly resulted in the degradation of coastal dunes on the south-west coast of Victoria. Local councils sought advice on how to stabilize the dunes from the Government Botanist, Ferdinand von Mueller. He recommended a combination of native and exotic species that could be used on the dunes. With colonial government support, and the success of local experiments by Samuel Avery, Marram Grass soon became the dominant species planted. Marram Grass *Ammophila arenaria* was exported to settlements along the Victorian coast, as well as to other colonies and overseas. Some native species of plants now appear to be re-establishing themselves on the dunes. *(The Victorian Naturalist* **113** (1) 1996, 10-15)

Introduction

The coastal dunes between Warrnambool and Port Fairy (formerly Belfast) have had more than their fair share of neglect and exploitation from the time of white settlement. Residents of both towns used the dunes for grazing, and practically all the timber was cut down for firewood. As the Harbour Master of Belfast, J. B. Mills, testified in 1858: 'the coast for about seven miles to the westward of Warrnambool is composed of moderately high sand hummocks, partly covered with brushwood with [a] few bare sand patches, forming a great contrast with the coast further to the westward, which is formed of low grass hummocks', (*Examiner* 9.4.1858). Within a few years the situation had deteriorated drastically and it was to be decades before the dunes were restabilized. Then they were not simply restored, because solutions favoured the introduction of exotics rather than what was widely thought of as 'native rubbish' (*Standard* 10.7.1886).

Drifting sand

Complaints about coastal sand drift were first made to the Belfast Council in 1865, and to that of Warrnambool in early 1866. The problem area for Belfast was identified as being near Gorman's Lane (below Tower Hill), and that of Warrnambool, between the Hopkins and Merri Rivers (Fig. 1). Warrnambool was also concerned about the build up of sand around Thornton's Jetty in Lady Bay, but this problem was eventually found to be due to tidal action rather than sand coming down the river (Gill 1985). Each council appointed a group 'to consider the best means of counteracting the evil' of drift sand (BM 23.1.1867), and Warrnambool's group recommended that stock should be fenced out of the eroded hummocks (*Examiner* 3.4.1866). The Town Clerk of Warrnambool, Henry Laurie, also suggested seeking advice from the Government Botanist, and Director of the Melbourne Botanic Garden, Ferdinand von Mueller who had been supplying plants to the Council's Botanic Garden since 1859 (WC 16.5.1866).

Independently, an unidentified citizen also wrote to Mueller for advice and received a reply which reiterated what the councils had already been told by their committees about excluding animals. To revegetate the sand Mueller recommended a combination of natives (*Allocasuarina verticillata and Mesembryanthemum sens. lat.*) and exotics (*Pinus pinaster* and *P. nigra* var. *corsicana*). He also suggested planting the flats with reedy grasses and the Sand Tea-tree *Leptospermum laevigatum* (which may not have been indigenous to the area)*. Mueller argued that the native plants were a cheap and efficient solution to the sand problem because they could be collected locally at little expense and were known to be able to grow in local contions (*Examiner* 15.2.1867). More than a year passed before a

[1] 136 Harrington Rd, Warrnambool, Victoria 3280
[2] The University of Melbourne, Department of History & Philosophy of Science, The University of Melbourne Parkville, Victoria 3052

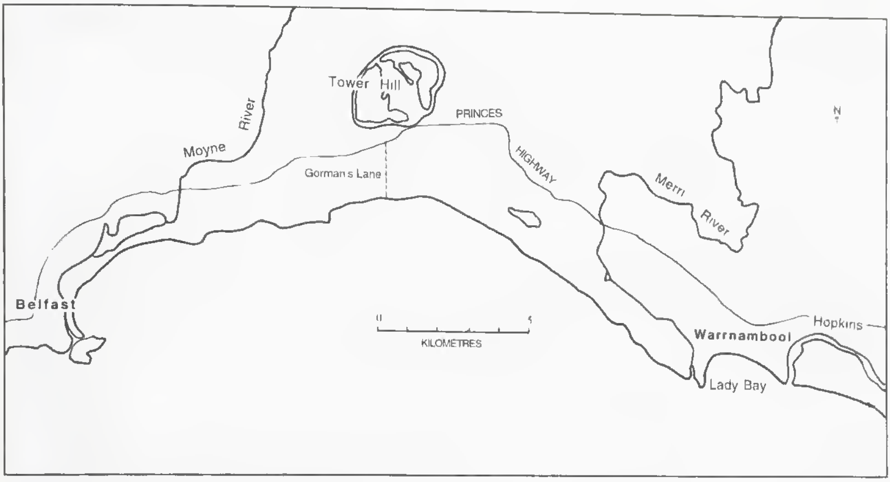

Fig. 1. Map of Warrnambool and Port Fairy coastline (based on Natmap 1:100,000 series).

Warrnambool Sand Committee inspected the hummocks, made suggestions about fencing and urged the Council to obtain the seeds Mueller had recommended (*Examiner* 5.5.1868). No one could accuse them of acting in haste!

In 1868 the Shire Engineer of Belfast, Thomas E. Rawlinson, also made a report on sand encroachment. Rawlinson had learned from old residents that the sea coast of Villiers Shire was formerly covered with bush and scrub consisting of honeysuckle (probably *Banksia marginata*), sheoak, dogwood or, as it was called locally, 'Bushy Sloe' (probably *Bursaria spinosa*) (Hannaford 1860), and grasses on the sandhills. The timber on the dunes had almost wholly disappeared and the grass had vanished in extensive areas, with the remainder rapidly receding. Rawlinson thought it would only be a matter of time before the sand advanced on the adjacent farm land. In a conclusion that seemed well ahead of his times Rawlinson proposed that Mounts Eccles and Napier, with the surrounding stony country and Tower Hill reserve, should be included in the list of state forests, with restrictions for sheep runs and regulations for the conservation of timber (*Examiner* 5.5.1868).

In 1875 Mueller visited the south-west coast in person and was very critical of the two councils. He thought it was reprehensible that the coastal strip had ever been used for pastoral commons because the result had been 'a total annihilation of all the trees, bushes, sedges, creeping herbs and grasses' (*Standard* 13.7.1875). The coastal land from the mouth of the Merri River to Gorman's Lane was not gazetted as a reserve until 1873, and 194 acres of land between the Hopkins and Merri Rivers was only reserved for public purposes in 1875 (*Standard* 18.2.1873, 10.8.1875). Echoing his letter of nearly ten years before, Mueller recommended that no traffic or animals be allowed on the dunes. He reproduced his list of suitable sand-stays and added to it native Couch-grass (probably *Cynodon dactylon* now commonly regarded as exotic), Moonah *Melaleuca lanceolata* and for the first time the exotic Marram Grass *Ammophila arenaria*. In his encyclopedic work *Select Extra-Tropical Plants* Mueller identified the coasts of Europe, North Africa and Middle North America as the home of 'moram', 'marram' or 'bent grass'. He recommended it as one of the most important grasses for binding drift sand because of its long creeping roots (e.g. Mueller 1876, 1895a).

Mueller's recommendations were publicized by the local press of both Warrnambool and Belfast. More importantly they were sent to the Victorian Government which then sent the first of a number of seed consignments to Warrnambool in 1876. Warrnambool shared them with Belfast, Portland and Koroit (*Standard* 28.7.1876). The seed consignments included Marram Grass *Ammophila arenaria*, Lyme Grass *Leymus arenarius*, Sandstay Bush *Leptospermum laevigatum*, and Sand Coast Tea-tree *Melaleuca lanceolata* (*Standard* 29.5.1879). Sea Rocket *Cakile maritima* was also introduced around this time and its seeds are now eaten by the threatened Orange-bellied Parrot *Neophema chrysogaster* (RAOU 1985). The gorse *Ulex eruopaeus* is now a problem weed in coastal areas at Portland, and Buffalo Grass *Stenotaphrum secundatum* grows in unexpected places in the coastal areas of Warrnambool. Both were recommended as sand-stays by Mueller (1876). The dunes are also host to large numbers of the European snail (*Theba pisana*), which was probably introduced during the trials of various plants.

Warrnambool's attempts at revegetation were plagued with difficulties. By 1879 the Merri River was almost blocked by a large shifting dune at Levi's Point (Fig. 2). Vandals pulled up cuttings and cut the Couch Grass (*Standard* 24.6.1879). Rabbits were a constant nuisance (the Ranger reported that they were even eating Boxthorn) (*Standard* 21.8.1879). Fires burnt out areas of vegetation**, and stock were still getting onto the hummocks. Belfast appears to have been more successful and planted between 30-40 acres (12-16 ha) with Marram Grass. In 1885 the Belfast Parks Committee informed Mueller of the excellent results they had achieved in arresting drift sand (*Gazette* 13.3.1885). Mueller sent them some more Marram Grass seeds and requested information of the results of the planting so that he could publicize it (e.g. Mueller 1894, 1895a, 1895b, 1895c).

Much of Belfast's success with Marram Grass can be attributed to the Ranger, Samuel Avery, who discovered a reliable way of establishing it. After propagating the seeds he transplanted the grass into rows, the depth of planting depending upon the nature of the soil (Fig. 3, Anon. 1893). Avery concluded to Mueller, 'I do certainly say that if any person has got any sandy land which is of a shifting nature,

Fig. 2. Levi's Point Homestead c1873 with bare sand dunes clearly visible in the background (original watercolour in the possession of Russell Everard, Warrnambool).

Fig. 3. Method of planting Marram Grass (engraving taken from a photograph obtained from Port Fairy by Mueller, Gardeners' Chronicle 16.12.1893).

Fig. 4. Marram grass at Rutledge's Cutting, 1994 (photographed by J. Heathcote).

and on which they can get nothing to grow, I would advise them to plant that grass, and they would soon have the land covered with vegetation, which would prevent the sand from drifting, and be feed for cattle, and the more the grass is dug out, burnt, or eaten off, the better it improves', (Anon. 1894). Mueller was so impressed with Avery's efforts that in July 1893 he offered to nominate him as a Fellow of the Royal Horticultural Society in England. When the matter was brought

Table 1. Distributions of Marram Grass from Port Fairy and Warrnambool, 1887-96.

Year	Port Fairy
1887	Request for Sorrento Park, 29 June
	Thanks from Queenscliff, 7 July
1889	H. Zerwonki asks for 10 tons (PM 26 June)
	Zerwonki states grass received in unsatisfactory condition (PM 7 July)
	Department of Public Works, Melbourne requests 50 tons at 21s per ton (PM 7 July)
	Avery receives jewellery from Zerwonki (PM 30 October)
1892	Department of Public Works, Melbourne orders 10 tons (PM 6 June)
1893	Mueller requests grass for WA, NZ and Natal (PM 21 June)
	1 ton of seed sent to SA (*Gazette* 7 July)
	Requests received from Robe (SA), Nhill, Agricultural Bureau, Narracoorte (SA), Stockton (NSW), Adelaide, Stawell, Hobart, Engineer-in-Chief of SA, and Orbost (Standard 18 August)
	M asks for seed and a photograph (Gazette 13 October)
1894	7 tons despatched (Standard 31 August)
	Applications from various parts of the colony, and Harbours & Rivers Department of NSW.
	Grass sent to Brazil (Gazette 11 June)
1895	M requests seedlings for India (Gazette, 11 January)
1896	M asks for seed to send to India (PM 15 January)
Year	**Warrnambool**
1892	Request from Queenscliff (Standard 22 June)
	Request from Fremantle, and Van Dieman's Land Company (Standard 6 July)
1893	Request from J. H. Conner of Barwon Heads (Standard 16 August)
1894	Grass sent to Bellarine Council with man to superintend planting. Small parcels sent to Sydney and NZ. (Standard 29 August)

up at a Port Fairy Council meeting (Belfast reverted to its original name of Port Fairy in 1887), the councillors laughed at the idea of 'Sam' being a FRHS and they 'but common councillors' (*Standard* 1.7.1893).

Once Avery's method of growing Marram Grass was perfected, it was planted extensively all along the south western coast of Victoria (Fig. 4). Joseph Maiden, botanist and soon to be Director of the Sydney Botanic Gardens, concluded, 'It has proved to be the most effectual sand-stay ever planted', (Maiden 1895). By the late 1880s Port Fairy, and later Warrnambool, sold it by the ton around Australia and overseas (Table 1, Port Fairy Borough Council [1895]). In 1889, for example, the Department of Public Works ordered 50 tons at 21 shillings a ton from Port Fairy (PM 10.7.1889) so it seems that the Council did very well financially out of what began, for them, as a problem.

After Mueller's death in 1896 the Warrnambool Council acknowledged its debt to him by proclaiming, 'if it had not been for him introducing Marram Grass, the sand dunes would now be overrunning the country' (*Standard* 21.10.1896). Port Fairy was less grateful and when the question of erecting a memorial to Mueller was raised, one councillor said he could not see any connection between the benefit received by the labouring class and the late Baron, who, he considered, had only done his duty as Government Botanist, and had been well paid for his services (*Gazette* 10.12.1897).

Conclusion

If, in the early days of settlement, the inhabitants had had the foresight to leave the hummocks alone, when the native vegetation was providing adequate cover, none of the subsequent problems would have arisen. The councils were prompt to seek advice on how to stabilize the sand but were very slow to act on it. As late as 1939 the Department of Lands and Survey proposed to lease the foreshore between

Dennington and Gorman's Lane for grazing (*Standard* 28.7.1939), and cattle still get into this area today, illegally. Mueller suggested a variety of plants as sand-stays, native and exotic, but with the success of Avery's work in Port Fairy *Ammophila arenaria* soon became the cure-all. It is heartening to see now that in some places that indigenous vegetation is slowly taking over from Marram Grass, particularly Hairy Spinifex *Spinifex sericeus* along the high-tide mark and Coast Beard-heath *Leucopogon parviflorus*, and Small-leaf Clematis *Clematis microphylla* in the dunes.

* Importations of *Leptospermum laevigatum* seed are recorded in: *Examiner* 5.5.1868, 2.6.1868; Standard 29.5.1879, 3.3.1881, 3.8.1892.

** Coastal fires are recorded in: *Standard* 16.1.1877, 31.12.1878, 6.1.1886.

Acknowledgements

We would like to thank Neville Walsh and Roger Spencer for providing current botanical names, Betty Beavis, John Williams and the Warrnambool City Library for assistance with research, and Tom May for comments on our drafts. Thanks to Russell Everard for permission to reproduce the watercolour in Fig. 2. The research was supported by the Mueller Project, Department of History and Philosophy of Science, University of Melbourne, and the Royal Botanic Gardens, Melbourne.

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Books Available from FNCV

The Club has, over the years, published a number of books on natural history topics which can be purchased from the Book Sales Officer. It is currently distributing four, as follows:

'What Fossil Plant is That?' (J.G. Douglas) $12.50

A guide to the ancient flora of Victoria, with notes on localities and fossil collecting.

'Wildflowers of the Stirling Ranges'. (B. Fuhrer and N. Marchant) $7.95

144 magnificent illustrations of the spectacular flora of this region.

'Down Under at the Prom'. (M. O'Toole and M. Turner) $16.95

A guide to the marine sites and dives at Wilson's Promontory (with maps and numerous colour illustrations).

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A reprint of the earlier book with additional photographs and incorporating name changes.

Alan Parkin
Book Sales Officer
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A Transient Soil Seed Bank for the Yam-daisy *Microseris scapigera*

Ian D. Lunt[1]

Abstract
An experiment was undertaken to assess the longevity of *Microseris scapigera* seeds in the soil. Seeds were buried in small bags of nylon mesh in a long-ungrazed and long-unburnt *Themeda* grassland in Canberra. Replicate seed bags were unearthed after 3, 8 and 12 months. *M. scapigera* was found to have a transient soil seedbank, since virtually all seeds germinated rapidly, and no viable seeds persisted for longer than 3 months. The implications of these results for the conservation management of *M. scapigera* in remnant grasslands are discussed. (*The Victorian Naturalist* **113** (1) 1996, 16-19)

Introduction

Two centuries ago, Yam-daisies (Fig. 1), or Murnong (*Microseris scapigera*), were abundant across the grassy plains of south-eastern Australia, providing a nutritious food supply for many Aboriginal tribes (Gott 1983). One European settler reported 'millions of murnong or yam, all over the plain', and the wheels of E.M. Curr's dray 'used to turn them up by the bushel' (Gott 1983).

However, Yam-daisies proved extremely palatable to sheep and rabbits (Farrington and Mitchell 1966; Cunningham *et al.* 1981; Gott 1983), as noted by Curr: 'several thousand sheep not only learnt to root up these vegetables [murnong] with their noses, but they for the most part lived on them for the first year, after which the root began to get scarce' (Curr 1886, in Gott 1983).

Microseris scapigera is now uncommon to rare in lowland grasslands and grassy woodlands, and most large grassland populations occur in ungrazed remnants on roadsides, rail-lines and cemeteries (Prober and Thiele 1993; McDougall and Kirkpatrick 1994). Fortunately, the species remains common in other, less disturbed ecosystems, such as dry sclerophyll forests. Recently, as part of a larger experiment with ten grassland species, I investigated the longevity of *M. scapigera* seeds in the soil. Seed longevity is a critical factor in plant ecology, as long-lived seeds can form a buried seed bank, which enables a population to re-establish after mature plants are killed (e.g. by fire or grazing). By contrast, if all seeds germinate quickly, the population cannot recover if all existing plants die before flowering, unless new seeds migrate into the site.

Methods

Microseris scapigera seeds (propagules of *Microseris scapigera* are technically called 'achenes', but are here called 'seeds' for simplicity) were collected in November 1993 from a remnant *Themeda* grassland in Canberra, ACT. They were dried and stored indoors until early 1994, when they were placed in bags of fine nylon mesh (mesh size 0.85 mm x 0.95 mm). Twenty filled seeds were placed in each bag, and broken and unfilled seeds

Fig. 1. *Microseris scapigera* (Photograph courtesy of James Ross).

[1]School of Botany, La Trobe University, Bundoora, Victoria 3083.

were discarded. On 27 May 1994, the bags were buried in a closed *Themeda* grassland in the Majura Valley next to Canberra Airport.

The study site supported a long-unburnt and long-ungrazed natural grassland with a dense, closed canopy of *Themeda triandra*. Associated species included *Asperula conferta*, *Desmodium varians*, *Eragrostis trachycarpa*, *Plantago varia*, *Tricoryne elatior* and the exotic herbs, *Conyza* species, *Hypochoeris radicata* and *Tragopogon porrifolius*. The soil was a dark brown, silty clay loam of pH 6.1 (S. Sharp 1995, *pers. comm.*). Weather conditions during most of the experiment were extremely dry, as the region was experiencing a severe drought.

The bags were arranged (with more bags containing seeds of other species) at regular intervals on a grid measuring 19 m x 19.5 m. Half of the seed bags were pinned to the soil surface, beneath the closed grass canopy, and the other half were buried approximately 1 cm deep. Eight surface and eight buried bags were unearthed after approximately 3, 8 and 12 months. In total, 160 buried and 160 surface seeds were unearthed at each date.

Results and discussion

Virtually all *M. scapigera* seeds germinated rapidly, and no viable seeds persisted for longer than 3 months (Table 1). Two intact and visually healthy seeds were recovered at 3 months (Table 1), but their viability remains questionable as neither could be induced to germinate in a petri dish. A few intact seeds were recovered after eight and 12 months, but all were brown inside and obviously inviable.

Table 1. Percentage of *Microseris scapigera* seeds remaining viable after various periods in the soil.

Date	Event	Surface seeds	Buried seeds
27 May 1994	seeds sown	100.00	100.00
29 August 1994	first recovery (3 months)	1.00	0.00
19 January 1995	second recovery (8 months)	0.00	0.00
6 May 1995	third recovery (12 months)	0.00	0.00

Microseris scapigera germination was not inhibited by a dense grass cover or extremely low soil moisture levels. In August 1994, when the first seeds were unearthed, the topsoil was completely dry and dusty, and few seeds of the other species studied had germinated (Lunt, *unpubl.*). Drought conditions persisted throughout 1994, and there seems little doubt that all *M. scapigera* seedlings would have perished.

Little information is available on seed persistence in Australian grassland herbs. M. scapigera was the only species, of the ten studied in Canberra, for which no seeds remained viable after a year in the soil (Lunt, *unpubl.*). At least 20% of the seeds of each of the other species remained viable after 12 months. Indeed, more than 70% of *Vittadinia muelleri* seeds, and over 80% of surface seeds of *Briza maxima* remained viable after a year in the field (Lunt, *unpubl.*). Seeds of the grassland daisies, *Chrysocephalum apiculatum* and *Leucochrysum albicans*, can remain viable in the soil for at least a year (Gilfedder and Kirkpatrick 1993; Lunt 1995), whereas most seeds of species such as *Burchardia umbellata*, *Craspedia variabilis* and *Rutidosis leptorrhynchoides* rapidly germinate in native grasslands, with few seeds remaining viable after 6 months (Lunt 1995; Morgan 1995). Like *M. scapigera*, *R. leptorrhynchoides* has declined dramatically in abundance since European settlement.

The data presented here were obtained from seeds from one population, grown at one place in just one year, and it remains to be seen whether seeds from other populations behave similarly. The grassland habitat at Canberra is structurally similar to any unburnt and ungrazed grasslands in south-east Australia (e.g. Lunt 1990; McDougall and Kirkpatrick 1994). *Microseris scapigera* is a variable species with many distinct forms (Gott 1983), and seed behaviour may well differ between populations, as occurs in *Leucochrysum albicans* (Gilfedder and Kirkpatrick 1994).

However, in a concurrent experiment in the Melbourne area, Watson (1995) found that less than 2% of M. scapigera seeds remained viable after being buried for 6 months in a recently burnt native grassland, and no seeds remained viable after being buried for 6 months in an unburnt grassland, which accords with the results found here.

The absence of a persistent seed bank for M. scapigera has three major implications for conservation management, especially in productive grassland remnants which rapidly accumulate a thick grass cover after fire.

1. If mature *M. scapigera* plants are absent before a fire or other disturbance, then no seedling recruitment can be expected after the disturbance, unless seeds are introduced to the site. (Although *M. scapigera* seeds have a large pappus, it is scaly and lacks feathery appendages, and seeds are unlikely to be dispersed into isolated remnants by wind).

2. If mature plants do occur at the site, then substantial recruitment can only occur immediately after a year of high flower and seed production, as few (if any) viable seeds will be present in other years (Lunt 1994).

3. If mature plants do occur at the site, then seedling recruitment is unlikely to occur immediately after spring burning, as most (if not all) seeds will have germinated earlier in the year. Small seedlings are likely to be killed by a high intensity fire. (Seedling recruitment may occur in future years though).

If this model proves to be correct, then the principal impact of fire on grassland forbs with transient soil seed banks, may be to enable existing plants to produce more flowers and seeds, from which new seedlings can grow in the following year. This scenario of delayed post-fire recruitment differs from the model of direct, fire-promoted recruitment from a soil seed bank, which is commonly reported from forest ecosystems (e.g. Purdie 1977; Wark et al. 1987).

The absence of a persistent seed bank in the soil may provide an additional clue to the rapid demise of *M. scapigera* following European colonisation. The unearthing of mature plants, selective grazing of surviving plants, and absence of buried seeds, led to the irretrievable demise of this once-abundant species. This scenario echoes the conclusion of many writers (e.g. Groves and Williams 1981; Kirkpatrick et. al. 1988), that the most dramatic changes to grassland ecosystems occurred extremely quickly, within the first few years of occupation by Europeans and their sheep.

Acknowledgments

This project was funded by the Australian Nature Conservation Agency, under a grassland research grant administered by the ACT Parks and Conservation Service. Considerable thanks are due to Sarah Sharp, who collected the seeds, selected the study site and provided accommodation and administrative assistance throughout the project. Pat Tratt and Raz Martin helped count the initial seed lots and sewed the seed bags. Gill Earl, John Morgan, Bob Parsons and Sarah Sharp kindly commented upon the manuscript and James Ross provided the photograph.

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Mueller - Commemorative Issue
The Victorian Naturalist
August 1996

1996 is the centenary of the death of Baron Ferdinand von Mueller. A special issue of The Victorian Naturalist will be published in August 1996 to commemorate Mueller's involvement with the FNCV as a foundation member, and as its first patron.

For this issue we have invited a number of authors to write on a variety of topics including Mueller's collecting work, his and the club's involvement with Wilsons Promontory, the FNCV's contribution towards his monument in St Kilda cemetery, as well as other aspects of his wider natural history interests.

We invite **YOU** to contribute to this commemorative issue by writing on anything you know about Mueller. If you do not want to write, perhaps you have some suggestions for topics or articles that you would like to see included? Please let us know, ***as soon as possible***, if you have any suggestions or are able to write for the journal. Written material will be needed by the end of May 1996.

The editors are looking forward to hearing from you.

All replies to: The Editors, *The Victorian Naturalist*,
Locked Bag 3,
PO Blackburn 3130,
or phone (home) 03 9435 9019.

Fauna Survey Group Contribution No. 18

The Little Pygmy-possum *Cercartetus lepidus*; An Addition to the Fauna of South-west Victoria.

Lawrence E. Conole[1]

Introduction

The Little Pygmy-possum *Cercartetus lepidus*, the smallest of all possums, has a disjunct modern distribution in south-eastern Australia, but its prehistoric range shown in the fossil record was less fragmented (Green 1983). Until comparatively recently, *C. lepidus* was thought to be confined to Tasmania, but it was found on Kangaroo Island, South Australia in 1964 (Aitken 1970). The first living records on the Australian mainland, both in 1976, were from near Pinnaroo, S.A. (Aitken 1977), and in the Sunset Country of north-western Victoria (Dixon 1978). A slightly earlier mainland record from near Kingston S.E. in South Australia in 1974 has since been documented by Barritt (1978).

In Tasmania, *C. lepidus* is found mostly in dry sclerophyll forest, and to a lesser extent in wet sclerophyll forest, but not in rainforest (Green 1983). On Kangaroo Island it occurs in dry sclerophyll forest (Green 1983), while in the Sunset Country and Big Desert of Victoria and contiguous South Australia it occurs in sandplain heath and mallee (Dixon 1978; Bennett *et al.* 1989). The distribution of *C. lepidus* spans the climatic range from a maximum annual rainfall in western Tasmania of about 1200 mm to a minimum of 300 mm in the Victorian mallee. In Tasmania, C. lepidus is sympatric with the Eastern Pygmy-possum *C. nanus*, but on Kangaroo Island and the south-eastern mainland it is sympatric with the Western Pygmy-possum *C. concinnus* (Green 1983).

In this paper, I report the capture of *C. lepidus* in dry sclerophyll forest in the Jilpanger Flora and Fauna Reserve, in the northern Wannon region, south-western Victoria. These represent the southernmost records, and the first records from dry sclerophyll forest in Victoria. *Cercartetus lepidus* has not previously been recorded as a component of the fauna of south-western Victoria (Menkhorst and Beardsell 1982; Flannery 1994).

[1]2/45 Virginia Street, Newtown, Victoria 3220

Fauna survey at Jilpanger Flora and Fauna Reserve

Jilpanger Flora and Fauna Reserve is 8,290 ha in size (ERIN 1991) and is in the northern part of the Wannon region with a line of sight to the Victoria Range of Gariwerd (Grampians) National Park. It is bounded to the north by the Wimmera Highway, to the south by the Douglas-Wombelano Road, and to the east and west by farmland. Jilpanger is an area with annual rainfall of approximately 550 mm (Bureau of Meteorology and Walsh 1993). Most of the reserve is dry sclerophyll forest and woodland consisting of Desert Stringybark *Eucalyptus arenacea* on low siliceous dunes with a Desert Banksia *Banksia ornata* and heath understorey (Conn 1993). Small areas of Yellow Gum *E. leucoxylon* woodland occur on clay pans, River Red Gum *E. camaldulensis* woodland in wetlands, Manna Gum *E. viminalis* on waterlogged sandy soils, and Grey Box *E. microcarpa* and Buloke *Allocasuarina luehmanii* woodland on various clay soils (Conn 1993).

Brief descriptions of the initial four pitfall trapping sites are as follows:

(i) JP-1. On top of a high, yellow, sand dune. Area burnt in wildfire during the summer of 1990/91. Low woodland (*c.* 4-5 m high) of *E. arenacea*, abundant flowering Austral Grasstrees *Xanthorrhoea australis*, regenerating *Hakea* and other species and colonising ground cover plants over large areas of bare sand.

(ii) JP-2. Lower altitude, yellow sand dune but with dark humic soil development under heavy leaf litter. Abundant 0.5-0.75 m regeneration of Oyster Bay Pine *Callitris rhomboidea* underneath large, *circa* 10 m *E. arenacea* with old fire scars (last fire 1978, DCNR fire map, Horsham office per David Venn).
(iii) JP-3. Clay pan with woodland of *E. leucoxylon*, with Scarlet Bottlebrush *Callistemon rugulosus* scrub and Gold-dust Wattle *Acacia acinacea* and Common Fringe-myrtle *Calytrix tetragona* ground cover.
(iv) JP-4. *B. ornata* scrub with emergent *E. arenacea* on low, white sand dune. Other abundant shrubs include Lavender Grevillea *Grevillea lavandulacea* and Heath Tea-tree *Leptospermum myrsinoides*.

In September 1991 as part of a biological survey of the Jilpanger Flora and Reserve, the Fauna Survey Group of the The Field Naturalists Club of Victoria installed four lines of pitfall traps (total = 40 traps) in the south-western corner of the reserve. During the December 1991-January 1992 and April 1992 survey work, a number of *Cercartetus* were trapped at three out of the four lines. On 28 December 1991 a small male *Cercartetus* sp. was captured at site 3 along with a male *C. concinnus* (Fig. 1). After examination of its dentition, I identified the animal as *C. lepidus* by the presence of the diagnostic fourth molar (not present in *C. concinnus* or *C. nanus*, Merrilees and Porter 1979; Green and Rainbird 1983). Additional *C. lepidus* were captured during the December 1991-January 1992 field trip. The overall survey at Jilpanger is still in progress and other *C. lepidus* have subsequently been captured in pitfall traps there (Russell Thompson *pers. comm.*). The first *C. lepidus* died and will be lodged with the Museum of Victoria as a voucher specimen.

Discussion

The capture of the Little Pygmy-possum *C. lepidus* at Jilpanger Flora and Fauna Reserve in 1991 is an addition to the fauna of south-western Victoria. In Desert Stringybark *E. arenacea* dry sclerophyll forest, approximately 13 years after the last wildfire (site JP-2), it was relatively more abundant than sympatric Western Pygmy-possum *C. concinnus*, Silky Mouse *Pseudomys apodemoides* and the introduced House Mouse *M. musculus* (Fig.1). However, it was not captured at the other trap sites.

Green (1983) described *C. lepidus* as a species that has contracted in range prior to European settlement of south-eastern Australia, and concluded that land clearing

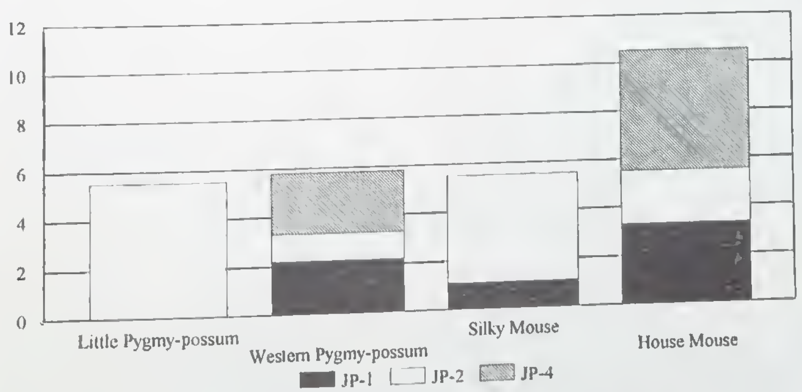
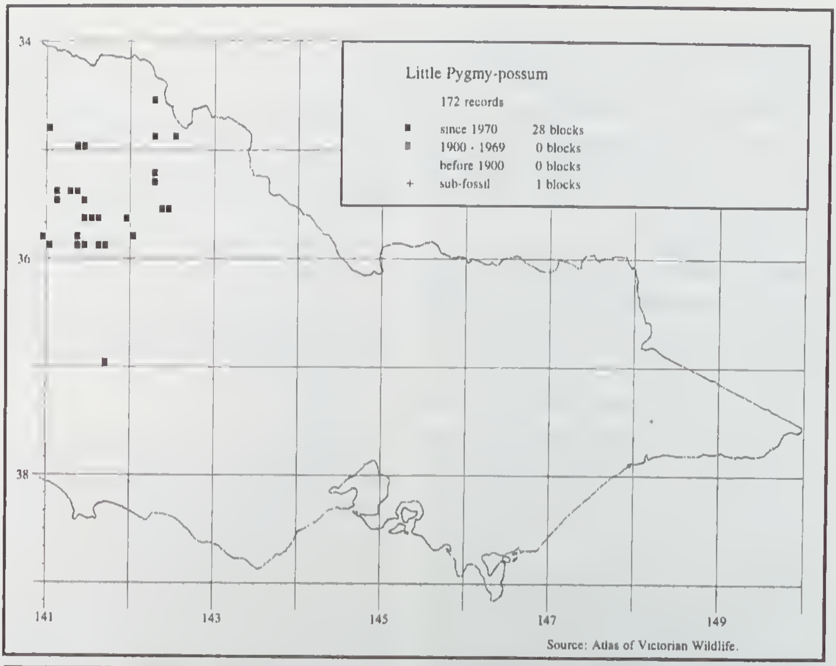


Fig. 1. Capture rates of four species of small mammals at Jilpanger Flora and Fauna Reserve in 19991/92. Capture rate is number of captures per 100 pitfall trap nights.



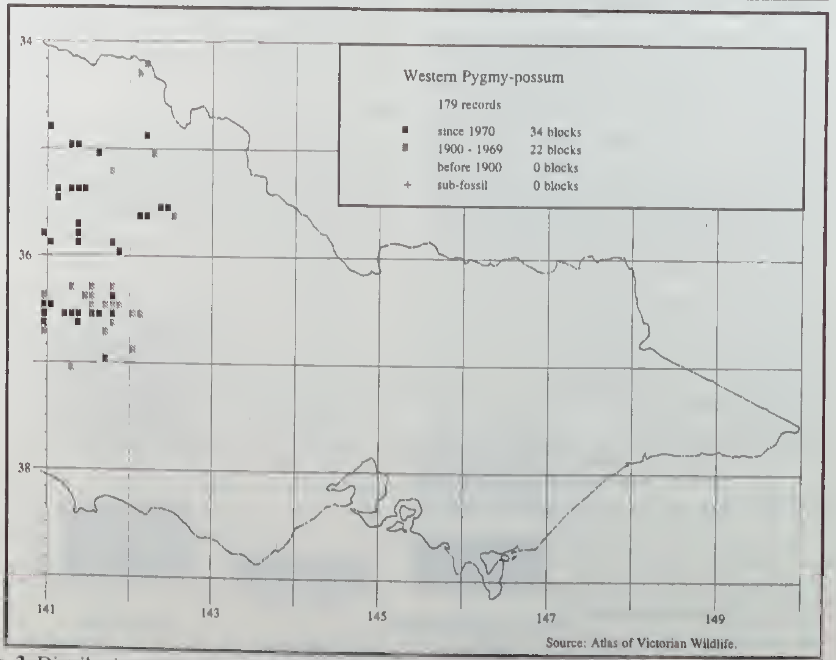


Fig. 2. Distribution maps of (a) Little Pygmy-possum *Cercartetus lepidus* and (b) Western Pygmy-possum *C. concinnus* in Victoria from the Atlas of Victorian Wildlife. The isolated five minute square to the south of the main block on the Little Pygmy-possum map shows the position of Jilpanger Flora and Fauna Reserve.

in the time since then has exacerbated the decline. Flannery (1994) speculated that the diminutive size and secretive behaviour of *C. lepidus* may have led to it being overlooked in some areas, and that it may be more widespread on the mainland than current records suggest. Emison *et al.* (1978) and Menkhorst and Beardsell (1982) are the only systematic accounts of mammal surveys in the Wannon Region, but neither survey employed pitfall traps (the most effective method for trapping *Cercartetus*) at Jilpanger or in other similar woodland remnants.

Distribution maps produced by the Atlas of Victorian Wildlife after the inclusion of the captures reported in this paper show *C. lepidus* and *C. concinnus* to be broadly sympatric in western Victoria, with an apparent absence of *C. lepidus* from the Little Desert (Fig. 2). Woinarski (1988) claimed to have captured a *C. lepidus* in the Little Desert, but no specimen was taken and the record was not accepted by the Atlas of Victorian Wildlife (Peter Menkhorst *pers. comm.*). The specimen backed record from Jilpanger, south of the Little Desert, makes it likely that *C. lepidus* does indeed occur in the Little Desert. Barritt (1978) reports *C. lepidus* from Fairview and Jip Jip Conservation Parks near Kingston S.E in South Australia; both in an area of similar latitude and habitat range to the Little Desert. Museum of Victoria specimens of *C. concinnus* from the Little Desert probably now need to be examined for the presence of misidentified *C. lepidus.*

At Jilpanger, on the small amount of 1991-92 trapping data, *C. lepidus* appears more abundant than *C. concinnus* in *E. arenacea* dry sclerophyll forest, but the situation is reversed in *B. ornata* scrub. This observation is similar to that of Ward (1992) for the two species in the Big Desert. Interestingly, analogous Brown Stringybark *E. baxteri* forest only about 60-70 km to the east in Gariwerd (the Grampians) is occupied by the Eastern Pygmy-possum C. *nanus* (Emison *et al.* 1978). Wakefield (1963) postulated that *C. concinnus* and *C. nanus* might be narrowly sympatric somewhere near the north end of the Grampians, but the added presence of *C. lepidus* at Jilpanger means that the three species may be very close to overlapping at a point near to that which Wakefield nominated. The records of *C. concinnus* at Jilpanger in 1991-92 are also the first on the southern limit of its range since 1961 (Atlas of Victorian Wildlife).

Flannery (1994) has characterised the conservation status of *C. lepidus* as vulnerable because of the retraction in its range, although Andrew Bennett (*pers. comm.*) and Menkhorst (1995) regard the species as well represented in the large conservation reserves of the Sunset Country and Big Desert in Victoria. The newly discovered population at Jilpanger can be seen as significant for the conservation of the species in Victoria, in that it broadens both the known geographic and habitat range of the species in the state. Much of Jilpanger carries similar vegetation to the first *C. lepidus* trap site, and so the potential exists for *C. lepidus* to be widespread and for the large conservation reserve to hold a numerically significant population. Relatively little has been published on the natural history of *C. lepidus* since early observations in Tasmania (Hickman and Hickman 1960; Green 1980) and Kangaroo Island (Aitken 1974), an indication of which is that the species account in Flannery (1994) merely paraphrases Green (1983). Ward (1992) published limited details of *C. lepidus* life history in the Big Desert, and the Department of Conservation and Natural Resources has collected abundant data on habitat usage and body weights in the Victorian deserts (Andrew Bennett *pers. comm.*). At Jilpanger *C. lepidus* is relatively abundant and accessible, and this population would be ideal for inclusion in a study of *C. lepidus* biology on the Australian mainland.

Acknowledgements

David Venn (Horsham Department of Conservation and Natural Resources [DCNR]) suggested the Jilpanger survey as a Fauna Survey Group project. Permits issued by the DCNR empowered the Fauna Survey Group to trap and handle protected species. Barbara Baxter and other staff of the Atlas of Victorian Wildlife, DCNR Heidelberg, provided data and distribution maps of *Cercartetus* species. Andrew Bennett (DCNR, Heidelberg) made valuable comments on a draft of this paper. Peter Menkhorst (DCNR, Heidelberg) examined the *C. lepidus* specimen and concurred with my identification.

The first pitfall sites at Jilpanger were selected by Lawrie Conole, and lines were dug and installed by Lawrie Conole, Grant Baverstock, Russell Thompson and Peter Hansen. FSG personnel for the subsequent surveys were:

PROJECT MANAGER (1991/92): Lawrie Conole. SURVEY TEAM (1991/92): Grant Baverstock, Damien Cook, Russell Thompson, Peter Hansen, Andrea Dennis (Equipment Officer), Tom Sault, Julian Grusovin (Records Officer), Felicity Garde, Peter Lynch, Mark Greatorex, Stephen Spillard, Michael Howes, Ian Faithfull, Amy Harris, Sharon Mason, Peter Maiden, Stacy Malcolm, Alistair Traill, Alena Glaister, Ian Glaister, John Smith, Bill Farrugia, Mibel Aguilar, Ray Gibson.

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Little Pygmy-Possum *Cercartetus lepidus.* (Photo courtesy Andrew Bennett.)

Wombat Behaviour

About noon on the 12 August 1995, while cross-country skiing in the Kosciusko National Park (NSW), my friends and I were privileged to see a mother Wombat giving a rather large baby a piggy-back ride across the snow. When the mother reached a patch of grass the baby climbed off (Fig. 1) and fed on grass alongside the mother. It should be noted that the baby was approximately a third the size of the mother. The snow was not particularly soft as the mother only sank to abut 100 mm in the softest sections and most of the snow was quite firm. While the mother was feeding, the baby strayed briefly onto the snow and did not appear to have any problems with movement. The wombats showed no signs of apprehension with the presence of humans, so I slowly walked down to within 2.5 m of them to take a few photos. The rest of our group kept a little further distance. After feeding, the baby climbed back onto the mother and was carried off across the snow at a slow walk (Fig. 2). This piggy-back ride was observed for at least 20 m before our group had to leave them to ski to our agreed rendezvous point for lunch.

This behaviour raised a number of questions. Has the baby had trouble following the mother across the soft snow when it was younger (just out of the pouch) and now continues the practice out of habit? Alternatively, does the baby have a problem with cold feet in the snow? The other unusual aspect of this sighting is that the wombats were active at noon in the heat of a bright sunny day. I wonder if the scarcity of food due to the exceptionally heavy snow cover had forced the normally nocturnal wombats to feed during the day.

The location of this sighting was not far from Horse Camp Hut, in a tributary valley of Munyang River, upstream from Munyang Power Station. The power station is abut 6 km from the Guthega Resort in the Kosciusko National Park. There were about 8 people who witnessed this unusual behaviour. Some members from my group and some from another group of cross-country skiers.

I wonder if other readers have observed similar wombat behaviour of adults piggy-backing their young, or feeding during the middle of the day. Please send details of similar observations to the editors.

Garry K. Smith

5 Fourth St. ,Seahampton NSW 2286

Fig. 1

Fig. 2

From our Naturalist in Residence, Glen Jameson

The Editors are pleased that the 'Naturalist in Residence' series will continue in 1996 with Glen Jameson writing a series of six articles on the seasons of the Middle Yarra Valley.

Middle Yarra Timelines

The Middle Yarra Timelines project is being developed by The Field Naturalists Club of Victoria, Gould League and Yarra Valley Parklands (Melbourne Parks and Waterways), in an attempt to record and analyse seasonality themes of the natural history of the Middle Yarra area, its relationships, interactions and sequence of events . The Middle Yarra area is the broad catchment area that begins at the confluence of Watson Creek and the Yarra River at Kangaroo Ground in the east and in the west ends at the Burke Road bridge over the Yarra. The project is endeavouring to establish a data base of information that, hopefully, will be essential to land managers, eco-tourist providers, environmental educationalists and those interested in Natural History. From the data supplied by naturalists, a six season calendar year has been produced. The seasons are cyclic, regulated by climatic variability and delineated by the occurrence and associations of natural phenomena.

The idea behind this series of articles is to represent a mythical day for each of those seasons, a day that incorporates all of the important seasonal indicators and patterns that are characteristic of that season.

High Summer

High Summer and you wake up with the sun in your eye, and there it stays all day. Wander down to the Yarra River under apricot dawn skies to breathe in the cool, muddy smells before the day's heat destroys it all. On the *waters edge* in the *riparian forest*, River Lomatia *Lomatia myricoides* has its last flowers, having been out fully on the Summer solstice. Timelonic* moments of truth as the Wood Duck *Chenonetta jubata* calls from along the river. Its call is carried by the steep river gorge walls for miles.

The shallow, sun warmed river water, generates a rich benthic plant life growing on rocks and other plants. The diatoms especially are actively growing and in turn support a great variety of invertebrates, many of which, in the ideal conditions, complete successive generations. *Chironomids*, Water Pennies *Sclerocyphon* sp., Mayflies *Tasmanocoenis* sp., Caddis-Flies *Cheumatopsyche* sp. and *Ecnomus* sp., Water-Boatman. *Micronecta* sp. and others supply food for small young fish, only months old, to grow quickly. Spotted Galaxids *Galaxis truttaceus* and Australian Grayling *Prototroctes maraena* disperse from estuary breeding grounds to colonize the river, while Tupong *Psuedaphritis urvillii* continue their upstream migration past the High Summer period. All take advantage of the rich feeding opportunities that the low flow river provides.

River Reed *Phragmites australis* stimulated by the drop in water levels of the river, flowers and amongst the thick debris of its leaves the Buff-banded Rail *Gallirallus philippensis* sleuths. Welcome Swallows *Hirundo neoxena* gather to glide above the glassy top of the water on which a cool layer still sits as the last wifts of mist evaporate with an almost audible fizz. Sacred Kingfisher *Halcyon sancta* in fast 'hummingbird' flight, a breath above the water, skims the only layer of cool air. It returns to the big Yellow Box *Eucalyptus melliodora* on the Riverbank where it has young in a hollow. Occasional Manna Gums *Eucalyptus viminalis* are in flower, on one an immature Night Heron *Nycticorax caledonicus*, perches warily. Yesterday an adult bird in flight, with its nuptial feather streaming behind it, followed the river's course upstream. The young of the Dusky Woodswallows *Artamus cyanopterus* have already fledged from nests made in the folds of peeling bark on Manna Gums. At the feet of the Manna Gums, Hop Goodenia *Goodenia ovata* sports plenty of flowers. Prickly Coprosma *Coprosma quadrifida*, full of sweet red berries, attracts visits from nesting Red-browed Firetails *Neochmia temporalis* and Blue Wrens *Malurus cyaneus*. Pick a few of the dark red, well ripened ones which are sweet to eat and listen to the scissoring sounds of the Shining Flycatcher *Myiagra alecto*. The Tree Violet's *Hymenanthera dentata* ripened fruits, smelling like sultanas, feed an array of birds. Later, in cool weather, large numbers of seeds often germinate under Silver Wattles *Acacia dealbata* after being voided by birds. Purple fruits of the Muttonwood *Rapanea howittiana* sometimes prolific during the wet summers, cluster on the bare wood of the branches above the running river water. In a thicket of Burgan *Kunzea ericoides* a nesting Rufous Fantail *Rhipidura rufifrons* male, fusses with caught and offered insects. Amongst the rocks on the river rapids a young Eastern Brown Snake *Pseudonaja textilis* hunts amongst the crevices for a few frogs. In the mud built up around the rapid's rocks, *Pratia pedunculata* flowers. The last few seed cases of the Silver Wattles float past to new destinations.

Downstream, ***billabongs and wetlands*** are going through a metamorphosis. Responding to low water levels, quick growing herbaceous plants run riot on the drying mud of the expanding littoral edge. The emergent herbfield is full of *Centipedia cunninghamii*, *Callitriche sonderi*, *Polygonum plebeium* and *Amphibromus fluitans*. Upon the water of the wetlands a floating herbfield of *Azolla pinnata*, *Azolla filiculoides*, *Wolffia australiana*, *Lemna disperma* and *Riccia duplex* create a tapestry of red and green.

Along the wetland edge quick movements of Lewins Rail *Gallirallus pectoralis* finishing its hunting along the rich littoral pickings. Also stalking the fringe is the White-faced Heron *Ardea novaehollandiae*, Straw-necked Ibis *Threskiornis spinicollis* and the Intermediate Egret *Egretta intermedia*. Occasionally a Latham's Snipe *Gallinago hardwickii* takes off with a great flapping in a twisting, weaving flight. Fairy Martins *Hirundo ariel* leave their mud nests in culverts to busily feed upon insects by the waters edge. Hidden amongst the thick leaves of Cumbungi *Typha domingensis* Clamorous Reed-warblers *Acrocephalus stentoreus* give their melodious call and the River Red Gums *Euclayptus camaldulensis* above them begin to flower. Olive-backed Oriole *Oriolus sagittatus* and Rufous Whistlers *Pachycephala rufiventris* are still feeding young.

On ***grassy slopes*** full of flowering Yellow Rush-lily *Tricoryne elatior* morning sun warms papery wings and Common Brown Butterflies *Heteronympha merope* chase about in the Kangaroo Grass *Themeda triandra*. Many Butterflies busy themselves, Brown-shouldered *Heteronympha penelope*, Australian Admirals *Vanessa/Eastern itea*, Eastern Ringed Xenica *Geitoneura acantha*, Dingy Swallowtail *Papilio anactus* and Imperial Whites *Delias harpalyce* search for partners and sip nectar from the profusely flowering Sweet Bursaria *Bursaria spinosa* which provides an important source of nectar for a range of insects during this time.

The seed of most local acacias drop to the ground providing food for the Common Bronze-wing Pigeon *Phaps chalcoptera*. Many other plants are in seed, such as the elegant Pomaderris, Native Hemp *Gynatrix pulchella*, as well as the Grasses and the lanky Lomandra *Lomandra longifolia*, all helping to provide food for the migrating birds, down for the High Summer.

From the ***ridge tops***, the view of the horizon is distorted by the swaying haze of the heat waves. Bright pink Hyacinth Orchids *Dipodium punctatum*, tropical in appearance, belie the dryness of the hills. In fact all is dry. Summer has sloughed off its last skin of moisture while the grasses turn brown and crackle underfoot. It is the peak dry period of the year. Lightwood

Acacia implexa, that handsome tough wattle, shrugs off the heat and thirst with a profuse flowering amidst its sickle leaves. Jacky Lizards *Amphibolurus muricatus*, with bright orange mouths in vivid contrast to the dried colours, hunt on the rocky escarpments. Dusky Woodswallows swoop in well-practiced sweeps, catching insects - the smooth-flying harvesters of the ridge tops.

A Black-shouldered Kite *Elanus notatus* pair, after an afternoon stretch of playful aerialism, lock feet together and fall towards the ground in a fast death defying spiral, pulling apart at the very last moment. Cicada orchestras in rhythmic pulses and swings of momentum, fill the afternoon with vibrating musical patterns.

Above the Yarra in the Warrandyte Gorge, a huge flock of White-throated Needletails *Hirundapus caudacutus*, whose first appearance marked the beginning of High Summer, now feast on a wave of insects using the updraft of the cool river air to gain height. The Needletails sweep the airways with long raking glides, gracefully manoeuvering at high speed to intercept the insects. Working each area until the food supply is exhausted, they move off in front of the changing weather conditions and herald a cool change. The change in the weather marked by the Needletails will become more frequent towards the end of High Summer.

The hot weather can often have a balanced, focused power which radiates through the ecosystem and energizes everything, although this is not always the case with High Summer. In the days of extreme north winds when temperatures soar and threaten to ingnite every living thing, there is an awesome terror in their power.

In the ***gloaming dusk*** of an enervating High Summers day, bats take advantage of the prolific numbers of insects. Often, bats seems to be almost as prolific as birds when they feed in the darkening skies. The incandescent night is full of the pleasant chirruping of Long-horned (Katydids) Grasshoppers *Caedicia olivacea* and the lovely whirring calls of the Owlet Nightjar *Aegotheles cristatus*. They are interrupted only occasionally by the harsh rasps of juvenile Tawny Frogmouths *Podargus strigoides* amongst Red Box *Eucalyptus polyanthemos* as they find their way around their home territory.

Once ***evening*** has fallen, a few Southern Brown Tree Frogs *Litoria ewingi* and Spotted Marsh Frogs *L.tasmaniensis* call from wetlands and occasionally they are joined by the Pobblebonks *Limnodynastes dumerilii*. However they are all out-called by the maniacal cackle of the Peron's Tree Frog *Litoria peronii*. The Peron's Tree Frog marks out the length of High Summer. It only calls during the warmest weather, starting on occasional balmy nights in September and finishing as High Summer does, when the Yarra Valley cools and mists return to dominate the morning sky.

* Timelonic - a particular observation of a natural phenomenon which gives insight into the function or nature of an interaction or association.

Acknowledgements
I would like to thank Malcom Calder, Cecily Falkinham, Patrick Fricker, Ed Grey, Pat Grey, Alan Reid, John Reid, Elizabeth Seviour, Ken Simpson, George Paras, Vin Pettigrove, the Middle Yarra Timelines Committee and all who have contributed to the data bank of information for the Project so far.

Glen Jameson
PO Box 568, Templestowe, Victoria 3106.

AUTHOR'S COPIES

After publication of an article in *The Victorian Naturalist*, the author receives five (5) complimentary copies of that issue. Normally this would be sufficient when combined with photocopying. However, additional copies of *The Victorian Naturalist* may be ordered from the editors when a paper is submitted. Costs for 1996 will be:

25 copies ....$30 plus postage
50 copies ....$60 plus postage

Greater Glider *Petauroides volans* with Pouched Young

27 September 1995 at 21.35 hours.

Whilst spotlighting in mixed species, wet sclerophyll forest near Healesville (Natmap 8022, AMG grid number 711Easting, 336Northing, altitude 100 m), a Greater Glider *Petauroides volans* was seen with pouched young. The baby's eyeshine, although faint, was still quite distinct under red light and also when viewed through 8 x 40 binoculars. The form of the baby could not be distinguished against the abdomen of the adult.

Movement to the left and right side of the animal in an endeavour to sight both of the baby's eyes was unsuccessful. The reason for this may have been that only one side of the head was visible, or because the animal was so small that both eyes appeared as one. I believe the baby would have been developed (furred) and that the posture of the adult on the limb was responsible for the protuberance of the baby's head from the pouch. The animals were observed for 2-3 minutes. Then, to give one so young a rest from the light, we diverted our attention to a Yellow-bellied Glider *Petarus australis* nearby. On returning to view the Greater Glider some five minutes later, the adult's posture on the limb had altered slightly and the young one was not visible.

It seems, from a discussion with staff of the Department of Conservation and Natural Resources - Steve Craig, Jerry Alexander, Lindy Lumsden, Andrew Bennett (*pers. comm.*) - that a sighting such as this is rare, in that of the four people spoken to, who between them have had countless hours of spotlighting experience, none had been privy to such a sighting. My thanks to each of them for their comments.

R.G. Taylor

22 Coven Avenue, Bayswater North, Victoria 3153

Magpies

Our fauna as well as our flora seem to be having a battle to cope with the hazards of our modern technology. The following is a case in point. For years Magpies, with their young, have appeared on our back verandah asking for assistance in satisfying the voracious appetites of their young. Later they would be brutally attacking them, driving them off to fend for themselves.

This year only one lonely adult arrived to ask for food. This was for its young still in the nest, presumably somewhere across the street since it disappeared into the many large gums amongst the houses on that side. Last Sunday it arrived but flew up to the top of a power pole to feed a juvenile that was fluttering its wings in the usual fashion. It came back to the verandah for more food and then flew across the street in the usual way. So there was obviously still young that had not yet ventured far away from the nest. Shortly afterwards I drove out onto the street and there at the bottom of the power pole lay the bodies of the adult Magpie and the young one. The power pole carries a transformer and amidst the host of wires and insulators the young bird was being fed. Obviously reaching across from two neighbouring wires the birds had been electrocuted. We felt almost as if it had been a human tragedy

G.A. Crichton

6 Ainslie Park Avenue, Croydon, Victoria 3136

Photography

Wendy Clark[1]

Introduction

Photography can be a wonderful tool for a field naturalist, covering anything from identification, illustrations in both books and journals, or displays for talks and meetings, illustration of behaviour, wall decoration or simply travelling down memory lane. The hard part is to decide which to do. The skill level and techniques for each type can be anything from basic to expert.

Activities

Photography can be useful on any field excursion for any of the groups within Field Nats e.g. photos of fungi for identification or illustrations on Botany Group excursions or surveys, photos of insects, lizards or mammals at Fauna Survey camps, just to mention a few. The onc potential problem that could occur is if the act of photographing takes over, and starts holding up the excursion too long. If your interest in nature photography itself becomes overriding, then maybe separate photography field excursions would become necessary.

Books

Designing Wildlife Journals - Joe McDonald. This book I own and it is excellent.
Nikon Guide to Wildlife Photography - B. 'Moose' Peterson
How to Photograph Insects and Spiders - Larry West with Julie Ridl. This book is new and may not be in Australia yet.
Landscape Photography - Kodak
The Backpackers Photography Handbook - Charles Campbell

Equipment

Thesc days technology has made life much simpler with auto-flashes, flash metcrs, auto-exposure and auto-focus (sometimes uscful) though beware - the systems can be fooled. Many people still prefer a lot of the manual systems.

Automatic cameras with zoom and macro (fixed lens) - useful for scenery and some close-ups ie groups of flowers geological features and larger animals.

Manual or Automatic cameras (preferably with manual override) with interchangeable lenses. These can be used for any subject, depending on the lenses you have:

wide angle lens - landscape and illustrative;
standard lens - landscape, people, large animals and objects;
macro lens 50mm - all purpose close up;
macro lens 100mm - great for close ups without getting too close (like snakes);
telephoto lenses - animals, birds, people, landscapes, features etc.
Useful extras - Tripod, flashes, Flash metre, Extension tubes or diopters, microscope attachments, lens hood are a few of the useful extras, though they will depend on your exact field and degree of interest.

Clubs and societies

Local Camera groups for general photography.

Field Naturalist groups for special interest photography. The level of information and help available will depend on who is active in each group. Otherwise these will provide the opportunity and subject matter for experimentation.

Journals

Nature Photograhcr
Outdoor Photographer
Australian Camera
Camera and Darkroom
Darkroom Techniques and Creative Photography

Enquiries

Wendy Clark, 2 Cityview Rd, North Balwyn, Victoria 3104. Tel: 9859 8091.

Arthur Farnworth, 47 The Boulevarde, Doncaster, Victoria 3108. Tel: 9848 2229.

[1] 2 Cityview Rd, Nth Balwyn, Victoria 3104.

Saving a Continent. Towards a Sustainable Future

by David Smith

Publisher: *University of New South Wales Press, Sydney, 1994. 185pp. RRP $29.95 (sb)*

This is a book about Australia and its biota and environments. It covers a diverse range of topics, not only providing a background to the evolutionary history of Australian landforms, animals and plants, but also the environmental threats facing our biodiversity, and some of the successes in overcoming the devastating problems of overpopulation and over-exploitation of resources.

Many naturalists will fondly remember the ABC television series *Nature of Australia* which provided the basis for the book's first edition; it was originally published in 1990 as *A Continent in Crisis*. The new version has a much more optimistic title and as the back cover notes '...Australia's investment in environmental research is starting to pay off: a great many Australians are working at solving the problems and are achieving notable successes. In a very real sense Australian research is leading the world towards solving the problems of overpopulation and overexploitation of resources. The key to achieving true ecological sustainability is to redefine the goals of society by substituting a model that incorporates two vital elements missing from current economically dominated approaches - long-term strategic thinking and concern for social well-being.'

On reading the scope and aims of the book, I immediately had two concerns:

- how can a book of 185 pages possibly hope to cover such a range of topics in an informative way?

- will this simply be another product which comforts us saying that all is well and there is no need to worry about an environmental crisis (rather like US economist Julian Simon who claims we now have the technology to overcome all our problems!)

My two concerns have indeed been allayed! Amazingly, the book treats the description of our land, its environments and its flora and fauna in a highly entertaining, yet very informative fashion. The writing is clear, well-presented and technically sound. Smith's scientific training and expertise shines through as he dispenses with the pseudo-scientific values of GAIA and the positively unscientific creationists. The examples he uses are up-to-date, topical and well chosen.

Whereas the first half of the book sets the scene describing Australia's geological and evolutionary history, and some adaptations and diversity of our flora and fauna, it is the second component which is so relevant. Here Smith addresses some of the difficulties facing our continent, e.g. land degradation through overclearing, introduced species and overpopulation. His philosophy is not completely that of 'she'll be right' - the examples used to illustrate the back cover's 'notable successes' are used sensitively to show just what can be done provided we have a change of political and philosophical outlook. The overall impression I came away with was a feeling that there are ways which can help in solving some of our problems, but change will only occur if we are willing to think differently and to shift our collective mindsets away from policies designed to maximise immediate economic gains at the expense of long term ecological sustainability.

Other good features of the book are its 32 colour plates (probably many derived from the filming of *Nature of Australia*), the inclusion of a glossary (fairly necessary for those with a weak scientific background) and the inclusion of valuable tables and graphs from scientific articles which have been included in a reference list. Students will find the inclusion of so much data very valuable.

If I was to make a criticism it would have to be the degree of scientific detail. Coming from a practising scientist, this criticism may seem somewhat odd. However, I really wonder whether lay readers need to know about the life cycle of a moss, the digestive anatomy of the Koala or the microstructure of the Platypus electroreceptor? On occasions I almost had the impression some technical figures were included to make the book seem more authoritative, when it may simply have the effect of turning away readers who are unfamiliar with scientific jargon.

To whom would this book appeal? Certainly naturalists with an interest in the origins and diversity of our biota, but especially those interested in its future. This would also be an ideal book for first year tertiary environmental science and biology students at university who have a particular interest in flora and fauna management. A good value book, well worth reading!

Robert L. Wallis
School of Aquatic Science & Natural Resources Management, Deakin University - Rusden Campus, Clayton, Vic 3168.

The Dingo in Australia and Asia

by Laurie Corbett

Publisher: *University of New South Wales Press, Sydney 1995. Softcover, 200 pp, RRP $24.95*

This publication is the latest in the University of NSW's 'Australian Natural History' series, a collection of books each designed to give a readable but highly accurate picture of a particular Australian animal.

Laurie Corbett is a CSIRO zoologist of long standing and I am delighted that he has put pen to paper to produce this very readable account of the Dingo. Corbett is undeniably 'Mr. Dingo' and he has spent the greater part of a scientific career spanning 30 years in studying the animal. I am also particularly pleased to note that the book is dedicated to the late Geoff Douglas, former Chairman of the Vermin and Noxious Weeds Destruction Board in Victoria and a friend and mentor of both Laurie and myself.

Corbett's description generally follows a logical sequence and begins with an account of the origin, ancestry and distribution of the animal. This will provide the first shock to most lay readers because most of us were brought up with the notion that the dingo is 'Australia's native dog'. In fact, the animal is found over vast areas of Asia and we have no real claim to sole ownership. Ample evidence for this is provided in the book.

The second chapter, dealing with methods of studying dingoes is, in my view, badly placed and would have been better situated as one of the Appendices. Nonetheless, this is a useful account and, if for no other reason, demonstrates that an enormous amount of time and effort has been dedicated to the study of this animal throughout most of its range in Australia. This includes not only the work of Corbett and his CSIRO colleagues, but a very large and comprehensive study of the animal in WA by Peter Thompson of the Agriculture Protection Board.

Then follows a chapter on the characteristics and identity of the animal. Together with the final chapter on the future of expatriate dingoes, this is likely to raise the ire of the various dingo breeding and dingo protection societies throughout Australia each of which has a view on what is a dingo. Here, Corbett gathers together a good deal of careful observation and study to justify the current scientific name of the animal - Canis lupus dingo. This tells us that the animal is a single subspecies of the grey wolf. Furthermore, dingo populations are uniform throughout their huge distribution in Asia and Australia. This does not rule out the existence of regionally distinct populations which may represent subspecies.

There follows a series of chapters on the basic biology of the Dingo. These cover breeding, social behaviour, diet, and population dynamics. They will be useful for the student and casual reader alike although, for the latter, much of the information will be too complex. This applies particularly to some of the figures and graphs which I found a little too technical. Spectrographs of howls, for instance, are a little difficult to translate into real sounds! The information varies from highly detailed accounts of social interactions etc. in small captive colonies to more general accounts of general biology of the animal in the wild.

Of particular interest to many readers will be the chapter headed 'Predator-prey Interactions'. This, after all, is the reason why the dingo has been afforded the status of 'vermin' in most States and why so much money has been spent on dingo control and on the erection and maintenance of dingo fences. In this chapter, I feel that the author has not really done justice to the topic of dingo predation on sheep. While case studies are provided in the case of cattle predation, sheep losses are dismissed in a mere half page or so. Victoria and South Australia still spend considerable sums of money to protect their sheeplands from the depredation's of dingoes and some better indication of the extent of the damage and of control measures used would have been in order. Electric fencing, for instance is now being used by a number of pastoralists but this is not mentioned.

The final chapter heading, 'The Future of Expatriate Dingoes' is a nice touch and sets the scene for the following discussion. The author believes that in the more heavily settled areas, hybridisation is increasing so that the 'pure' Dingo is a vanishing breed. This conclusion is not fully shared by some other researchers, notably Jones (1990 Australian Wildlife Research 17: 69-81) but such differences in interpretation are to be expected when dealing with an animal whose morphology is variable over its range. I am pleased to see that the author has politely but firmly put paid to the idea of maintaining 'pure' dingoes by keeping them as pets etc.

There is a series of 21 colour plates in the centre of the book which illustrate, amongst other things, morphological variations of the animal. I was particularly impressed by the photo of a dog abattoir in Thailand for it amply demonstrates that one person's mate is another person's meal! It also illustrates Corbett's dedication to his task.

In conclusion, this is a very readable and interesting account of a fairly "political" animal. From time to time the authors laconic style and humour (for which he is well known), peep through and add to the readability. If I were to pick one major failing, it would be the fact that the main body of the text is not referenced so that the reader is unaware as to the origin of the particular subject matter being discussed. This is a great pity because the serious student will not easily find the original research paper or book reference being used. Also, it tends to give the impression that all of the subject matter is drawn from the author's own work. This is not so. Notwithstanding this, no-one could deny the author's knowledge of his subject. He has, over the years risked life and limb in remote corners of Asia studying his subject. This book will be a very useful contribution to our understanding of the Dingo in Australia and elsewhere in the world.

Brian J. Coman
Animal Control Technologies of Australia
1/56-60 Export Drive, Brooklyn, Victoria 3025

Wildlife of the Australian Snow-country

by Ken Green and William Osborne

Publisher: *Reed Books, Chatswood, 1994*
200pp. RRP 39.95.

This is a book about animals that live in Australian habitats which are subjected to a seasonal cover of snow. It rightly points out that although such habitats occupy a tiny area of Australia, alpine and subalpine habitats nonetheless support a varied and interesting fauna which has only recenly begun to be studied scientifically.

One of the book's great strengths is its stunning photography. Indeed, I suspect the publishers may well have toyed with the notion of making this a 'coffee-table' publication instead of a scientific account, on the basis of the photos alone.

Clearly the authors have a great knowledge and interest in these high altitude environments and their fauna. With the wealth of excellent natural history books around at present, I must admit I was looking forward to an enthralling and stimulating written account to match the superb visual presentation. Unfortunately, the writing is quite laboured at times and presented in a dry, scientifically sterile manner which I am sure could have been made more interesting. For instance, I am certain more stimulating prose could have been found for:

'..in Australia it is the snow rather than the altitude which determines the reactions of many of the animals living in the higher mountains. It is this theme that attracted the authors to this topic and it is one which will recur throughout this book.'

Indeed, I suspect one of the faults of the book is that the authors do treat it as a scientific work, rather than one of natural history imbued with science (à la David Attenborough). The first chapter, although technically very sound and authoritative, is far too text book oriented in its approach and would certainly turn away 'amateur naturalists' for whom the book is written. The authors try, in fact, to pitch the work at 'amateurs and specialists alike', and rather patronisingly apologize for the need to use scientific names, the implication being presumably that naturalists would be confused by them. In my experience, naturalists often have a greater knowledge of a wider list of scientific names than the so called experts!

Once the book leaves the rather dry introduction which describes the physical aspects of the environment, there is a marked improvement when we meet the fauna themselves. Here the authors' experience and knowledge shines through as they describe aspects of the habitats our alpine animals use and behavioural adaptations to such a harsh environment. A glossary and excellent reference list are good aids which have been included. The two chapters on insects and other invertebrates are an added bonus - so often these important groups are ignored, usually because so little is known about them.

A few minor problems should also be mentioned. The authors claim bats "arrived in Australia from Asia about 15 million years ago..". Most mammalogists have been aware for some time that fossil bats have been known from Murgon in southern Queensland which are some 55 million years old and certainly 25 million year old bats have been described from

Riversleigh. The use of references has been somewhat selective; some important refernces have been omitted for a couple of the species accounts. The discussion of over-wintering strategies ignores daily torpor (the authors believe mammals either hibernate or remain active). Such an omission is fairly critical in the extensive discussion of competition between the two species of *Antechinus*.

I suspect some editorial changes have altered the placement of Figures and Tables to suit spacing requirements with little thought to where the material is referred in the text. Early on some photographs refer to 'Main Range' but it is some time before the reader is made aware of its location. The discussion on the genus *Kosciuscola* occurs on p. 152, but the relevant Table does not appear until p. 171.

These problems aside, I believe thc book serves a very useful purpose in introducing readers to the Australian alpine fauna - its diversity, history and adaptations. The photography is excellent and the factual information in the many tables and figures most useful.

Robert L. Wallis
School of Aquatic Science and Natural Resources Management, Deakin University - Rusden Campus, Clayton, Vic 3168.

Kangaroos. The Biology of the Largest Marsupials

by Terence J. Dawson

Publisher: *University of New South Wales Press*

RRP $25.95

'Kangaroos' is the tenth and latest book in the Australian Natural History Series published by University of New South Wales Press. Previous books have covered species such as the platypus, koala, wombat, dingo, lyrebird and goannas, as well as the lesser-known mountain pygmy possum. Now the archetypal Australian mammals, the kangaroos, have joined the stable. The aim of the series is to make wildlife research accessible to a lay audience. The series has largely been successful, and the first book ('The Platypus' by Tom Grant) remains a model of how to convey scientific information to the interested but non-technical reader.

There have been surprisingly few books about kangaroos, aside from an assortment of photographic compilations. Frith and Calaby's classic, 'Kangaroos', was published as long ago as 1969. It reported the first ecological research, conducted mainly by CSIRO, on free-ranging kangaroos in the Australian arid zone. The next major contribution was 'Kangaroos. Their Ecology and Management in the Sheep Rangelands of Australia' (edited by Caughley, Shepherd and Short), which was a detailed study of kangaroos as part of grazing system in Kinchega National Park near Broken Hill. This was followed by 'Kangaroos, Wallabies and Rat-kangaroos' (edited by Grigg, Hume and Jarman), which was a valuable compendium of the burgeoning research in the 20 years after Frith and Calaby, but as a collection of scientific papers was not very accessible to the general reader, and with a price tag of $148 was prohibitively expensive. Terry Dawson's new book has been long-awaited.

'Kangaroos' covers most topics that would be expected. There are chapters on classification of kangaroos, social organisation, population dynamics, reproduction, life history, feeding, ecophysiology and interactions with aboriginal and European humans. Presented in this order they seem a little disjointed, and repetition occurs in some places, for example the observation of 12 Black Wallaroos feeding together occurs twice (p. 24, 35) and the details of birth (p.69) are summarised in a subsequent chapter (p. 79). A more traditional approach would have been to deal with the workings of individual kangaroos, then their relationships with other members of their species and ultimately their interactions with humans.

I enjoyed most the chapter on environmental physiology. This is Dawson's research speciality and it shows. He nicely outlines the immense problems faced by the kangaroos as they juggle temperature and water requirements in the extremes of the arid zone, and the elegant solutions that have evolved. Some other chapters do not reach the same standard. This is most evident in the chapter on social organisation. There are generalisations that can be made about the social organisation of kangaroos, which at times can be disconcertingly fluid, but these are not drawn out clearly. In particular, the outline of social organisation of the Eastern Grey Kangaroo would have benefited by the inclusion of some of the work of Peter Jarman and his colleagues at the University of New England, as featured in the excellent ABC television program 'Faces in the Mob'.

There are a few omissions from the book. Readers of *The Victorian Naturalist* would expect to be told that the Eastern Grey and Western Grey Kangaroos overlap in central and western Victoria and south-eastern South Australia, as well as semi arid areas of New South Wales and South-western Queensland as stated on p.12. Diseases of kangaroo are discussed (pp. 59-60), but there was obviously not enough lead time to cover the recent epidemic of Choroid Blindness Syndrome that has affected many kangaroo populations in New South Wales, Victoria and South Australia. Dawson points out that kangaroos are unique amongst large animals in getting around by hopping, and covers the energetic benefits of this gait in some detail, but fails to mention the unique passive breathing system described by Russell Baudinette at Flinders University, wherehy the viscera act as a piston that bounces up and down with each stride, giving even more energy savings.

I detected few serious errors: Dawson refers to the Family Macropodinae (pp. 4-5) but Sub-family is the appropriate taxonomic level, and the German word *Flehmen* is miss-spelt twice on page 74. The equations for estimating age from molar index (p. 100) are unnecessarily complex — a small table of equivalent ages (in years) for a set of index values for the three species would be far more user-friendly.

'Kangaroos' has a strong focus on the research done by Dawson and his colleagues at Fowler's Gap Station north of Broken Hill. This represents both the strength and the weakness of the book. The book is strengthened by its personal style and obvious familiarity with the animals, the environment and the researchers working there. It is refreshing indeed to read Dawson's acknowledgement (p. 120) that, after more than 30 years of research, he had only recently appreciated that the efficiency of forearm licking to dissipate heat is enhanced by kangaroos holding the evaporative surface in the shade of their bodies. The limitation of the personal emphasis is that important research conducted by others elsewhere is given less attention. However, we then may be immersed in too much detail.

The balance is about right. Terry Dawson has produced a readable and informative book on an intriguing group of animals. *Kangaroos* deserves to sit on your shelf alongside the others in the Australian Natural History Series.

Graeme Coulson
Department of Zoology,University of Melbourne

The Fauna of Tasmania: Birds

by R.H. Green

Publisher: *Potoroo Publishing, Launceston 1995.*
RRP $14.95

This is a substantial and well-presented soft-backed book comprising 170 pages of informative text and 192 photographs of Tasmanian birds. The photographs alone constitute probably the most comprehensive photographic record of Tasmanian birds yet published. The quality of some of the photographs is not good, but they do represent a fairly full photographic record of the birds which are likely to be encountered in Tasmania.

This volume is in many ways a companion volume to Green's previous work 'Birds of Tasmania' (1993) which lists species, status and distribution of all recorded Tasmanain birds. This latest work, part 2 of his series on the fauna of Tasmania, deals with each species in more detail but in a more anecdotal manner than in his previous work.

Before addressing the species themselves, there is a brief introductory section on the origins of Tasmanian and another on the special features of Tasmania and its birds. here the reader will find listed the 12 endemic species and reference to another 18 endemic sub-species, although unfortunately these are not listed.

The main body of the book deals with the various groups and families in taxonomic order as Green presents information on each species or group of species in turn.

If the reader is expecting a field guide, he/she will be disappointed. it is not for use in the field and I believe it was never intended to achieve that end. This book is really much more a summary of some of the vase amount of information Dr Green has accumulated over his lifelong interest in Tasmanian Wildlife, and in particular, its birds. The book is festooned with personal experience and anecdotal information based on the author's broad experience which comes through on every page and , as such, is a very interesting read.

I found it refreshing to find some information describing breeding habits of on the majority of the species, information which is often missing from modern bird books. Similarly, the numerous references to the habitats of birds clearly show that this book has been written by a person with a great reservoir of personal information and very little has been 'borrowed' from other literature sources.

I fear the 'essay' form of the text will somewhat devalue the lasting or long-term useful value of the book as this format does not make it an easy-to-use reference work. I believe the presentation would have been significantly improved in the discussion of each species by having a more formal section with sub-headings for the various topics under review. However, having said that it was probably the authors' intent to get away from a more formal format.

I did miss a bibliography for major works on Tasmanian birds. This would have provided a valuable reference list for serious birders.

This is a book aimed at the broader community, more, I felt, for those with a very general interest in birds. Whilst there is a considerable amount of information that this reviewer, for one, has not seen published elsewhere, the presentation is clearly aimed at the 'generalist'. However, this does not detract in any way from what is a very valuable and interesting addition to Tasmanian bird literature.

Peter Brown

Parks and Wildlife Service, Hobart, Tasmania 7001

In Search of the Buttercup - A Ramble

by Frank Shepherd

Publisher: *Private. RRP 29.95 (plus $5 postage). Available from PO Box 484, Turramurra, NSW 2074*

The title of this privately published, soft-covered book on A4 paper, is a little misleading. It's not so much a ramble as an expedition.

The author is a retired engineer who has spent over a decade of his spare time in travel and literature searches to resolve a personal challenge. The challenge began with two plants that he knew to be 'buttercups' but of very different appearance even though growing together in the same habitat.

The book has 250 pages, of which the first 148 are a record of the author's literature searches, both in Australia and abroad. There are several sub-sections in this part of the book dealing with the early expeditions by European botanists to the southern hemisphere, the botanists involved and the people who collected for them. Because so many Ranunculaceae are found at higher altitudes, there is a section devoted to naturalists in the mountains. Writers of books, from John Hill, 'Hortus Kewensis', 1768, and his successors, Carl Linnaeus, Banks, Solander and Dryander with a new book of the same name; Robert Brown, 'Prodromus Florae Novae Hollandiae' of the early nineteenth century; and others up to the present time, are given due acknowledgement.

Brief but informative sections on the history of botany, nomenclature, and the importance of herbariums, both private and public, are included. These are followed by an essay on the history and importance of botanic gardens, beginning with their connection to medical studies in the sixteenth and seventeenth centuries and including the founding of the Melbourne Botanic Gardens in 1846. This section of the book concludes with a brief look at the geological record and the world distribution of the genus Ranunculaceae. Footnotes represent a comprehensive bibliography.

The next hundred pages, dealing with the species, begin with a very useful glossary of the terms used in the following descriptions of forty-six species, which include subspecies and varieties. Each is accompanied by a standard description format from the root structure to the floral parts, with notes on habitat and the locations where they were observed. Line drawings by the author illustrate quite effectively the general appearance of each specimen, with additional details for many of them. All of the twenty-two native species or varieties currently recognised in Victoria are included, but none of the eight introduced species. This could be seen as an unfortunate omission, as in many cases they are the most likely ones to be seen by the casual observer, especially in the more settled areas. Most of the introduced species are found throughout Australia in one area or another.

The descriptions appear to be accurate in detail, based mainly on those of the Flora of New South Wales, and are in line with those of current Victorian publications with small variations in terminology. Nomenclature is almost without exception that in current use. One exception is the use of *R.. ligulatus* where the current name is *R. millanii*.

Distribution information is generally restricted to the locations visited by the author, and this would need to be supplemented by reference to other publications.

The observations and line drawings have mainly been made in situ and reflect the author's travels in all States, and especially the high country of New South Wales and Tasmania. The book begins with a detailed table of contents and concludes with a comprehensive index.

For an introduction to botanical history and methodology, with particular reference to the genus Ranunculaceae, the book would appear to be good value at the price, to members of the FNCV., of $29.95 (plus $5 p. & p.), and is available from the author at PO. Box 484, Turramurra, NSW., 2074.

R. J. Fletcher

4/48 Newport Rd, Clayton South, Victoria 3169

Notice of the Annual General Meeting

The Annual General Meeting of The Field Naturalists Club of Victoria will be held at 1 Gardenia Street, Blackburn, Victoria 3130, on

Sunday, 5 May 1996 at 2.00 pm

Agenda

1. To confirm the minutes of the previous Annual General Meeting held on 10 April 1995
2. To receive and adopt the Annual Report for the year ended 31 December 1995
3. To receive and adopt the Financial Statements and associated reports
4. To appoint Auditors (remuneration determined by Council)
5. To elect Members of Council
6. To elect Office Bearers
7. To consider, and if thought fit, to pass as special resolutions the following resolutions:
   a) That the Club, which is at present a company limited by guarantee, be authorised to apply for incorporation under the Associations Incorporation Act 1981
   b) That the Statement of Purposes circulated to the members at least three weeks prior to the meeting be approved as a Statement of Purposes to apply from the date of incorporation under the Associations Incorporation Act 1981
   c) That the Rules circulated to the members at least three weeks prior to the meeting be approved as the rules of the Association to apply from the date of incorpor-ation under the Associations Incorporation Act 1981
8. Any other business of which proper notice has been given in accordance with the Articles of Association
9. President's Address

Election of Councillors and Office Bearers

All members of Council and Office Bearers retire annually but are eligible for re-election. Nominations by two financial members of the Club are required for the following positions:

Council

President	2 Vice-Presidents	Secretary
	Treasurer	Six other members

Office Bearers

Assistant Treasurer	Editor (Field Nat News)	Activities Coordinator
Editor s (The Victorian Naturalist)	Excursion Secretary	Publicity Officer
Sales Officer (The Victorian Naturalist)	Book Sales Officer	Conservation Coordinator
	Librarian	

Nomination and Proxy Forms

Please carefully consider these positions and arrange a nomination for yourself and/or encourage a fellow member to be nominated. Nominations and Proxies should be in the hands of the Secretary before the start of the Annual General Meeting. Nomination Forms and Proxy Forms are available from the Honorary Secretary, Geoffrey Paterson on (03) 9571 6436 or from the FNCV Office.

By Order of the Council
Geoff Paterson (Honorary Secretary)

Notes
1. A member entitled to attend and vote at the meeting is entitled to appoint a proxy to attend and vote instead of the member. The proxy must be a member of the Club.
2. A special resolution is not passed unless it is approved by three quarters of the members voting in person or by proxy.

The Field Naturalists Club of Victoria

Established 1880

In which is incorporated the Microscopical Society of Victoria

OBJECTIVES: To stimulate interest in natural history and to preserve and protect Australian flora and fauna.

Membership is open to any person interested in natural history and includes beginners as well as experienced naturalists.

Registered Office: FNCV, 1 Gardenia Street, Blackburn, Victoria 3130. Phone/Fax (03)9877 9860

Patron

His Excellency, The Honourable Richard E. McGarvie, The Governor of Victoria

Key Office-Bearers June 1995

President: Professor ROBERT WALLIS, School of Aquatic Science and Natural Resources Management, Deakin University (Rusden), Clayton, 3168. (03)9244 7278, Fax (03)9244 7403.
Hon. Secretary: Mr GEOFFREY PATERSON, 11 Olive Street, South Caulfield, 3162. AH (03)9571 6436.
Hon. Treasurer: Mr ARNIS DZEDINS, PO Box 1000, Blind Bight, 3980. (059)987 996.
Subscription-Secretary: FNCV, Locked Bag 3, PO Blackburn, 3130. (03)9877 9860.
Editors, The Vic. Nat.: ED and PAT GREY, 8 Woona Court, Yallambie, 3085. (03)9435 9019.
Librarian: Mrs SHEILA HOUGHTON, FNCV, Locked Bag 3, PO Blackburn, 3130. AH (054)28 4097.
Excursion Secretary: DOROTHY MAHLER. AH (03)9435 8408.
Sales Officer (The Victorian Naturalist): Mr D.E. McINNES, 129 Waverley Road, East Malvern, 3145. (03)9571 2427.
Book Sales: Dr ALAN PARKIN, FNCV, Locked Bag 3, PO Blackburn, 3130. AH (03)9850 2617.
Publicity: Miss MARGARET POTTER, 1/249 Highfield Road, Burwood, 3125. (03)9889 2779.
Programme Secretary/Newsletter Editor: Dr NOEL SCHLEIGER, 1 Astley Street, Montmorency, 3094. (03)9435 8408.

Group Secretaries

Botany: Mr JOHN EICHLER, 18 Bayview Crescent, Black Rock, 3143. (03)9598 9492.
Geology: Mr DOUG HARPER, 33 Victoria Crescent, Mont Albert, 3127. (03)9890 0913.
Fauna Survey: Ms FELICITY GARDE, 18 College Parade, Kew, 3101. (03)9818 4684.
Microscopical: Mr RAY POWER, 36 Schotters Road, Mernda, 3754. (03)9717 3511.

The Victorian Naturalist

All material for publication to The Editors, FNCV, Locked Bag 3, PO Blackburn, Victoria 3130

MEMBERSHIP

Members receive *The Victorian Naturalist* and the monthly Field Nat News free. The Club organises several monthly meetings (free to all) and excursions (transport costs may be charged). Research work, including both botanical and fauna surveys, is being done at a number of locations in Victoria, and all members are encouraged to participate.

SUBSCRIPTION RATES for 1996

(Subscriptions are due on 1 January.)

First Member	
Metropolitan	$40
Concessional (pensioner/student/unemployed)	$30
Country (more than 50km from GPO)	$30
Junior (under 18)	$15
Additional Members	
Adult	$15
Junior	$5
Institutional	
Australian Institutions	$55
Overseas Institutions AUD	$65
Schools/Clubs	$35

Printed by Brown Prior Anderson, 5 Evans Street Burwood, Victoria 3125

The Victorian Naturalist

Volume 113 (2) 1996 April

Published by The Field Naturalists Club of Victoria
since 1884

Our New Home

Official Opening

Sunday, 7 July, 2 pm

This will be the official opening of our new home at 1 Gardenia Street, Blackburn.

The well-known naturalist and broadcaster Alan Reid will be the key speaker. He will talk about the role of Natural History in creating an environmentally aware community. This will lead into a discussion of the Club's role and how it can play its part in the future.

Entry is free and refreshments will be served

We look forward to a bumper roll-up of members and friends

New Members

The Council of the FNCV extends a warm welcome to the following new members.

Ms Linda Archbold	Doncaster East
Ms Barbara Archer	Esperance
Ms Lisa Booth	Thornbury
Ms Linda Condon	Hawthorn
Ms Suzanne Holmes	Clayton North
Mr Rob Jones	Glen Waverley
Mr Clinton Le Page	Heidelberg Heights
Mr Robert	and
Mrs Mary Lukis	East Ivanhoe
Mrs Deanna Marshall	Mitcham
Mr Gordon McKenzie	Hawthorn
Ms Debora Medcalfe	and
Mr Greg Dunmill	Diamond Creek
Ms Josephine Milne	Pearcedale
Ms Linda Moon	Cranbourne North
Ms K.A. Pantzopoulos	Point Cook
Ms Lisa Pittle	Northcote
Ms Jill Plowright	Surrey Hills
Mr John Rocke	Box Hill
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The Victorian Naturalist

Volume 113 (2) 1996 April

Editors: Ed and Pat Grey

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ISSN 0042-5184

Cover: Jim Willis (right) chatting to John Mitchell on an FNCV tour of the Volcanoes of South-western Victoria, March 1993,(see page 44)

James Hamlyn Willis
1910-1995

Margaret Corrick[1]

With the sudden death of James Hamlyn Willis D. Sc., AM on 10 November 1995 The Field Naturalists Club of Victoria lost one of its long-standing and most revered members, known to us all simply as Jim. Above all, those whose lives had touched Jim in any way, however small, felt that they had lost a friend. His cheerful personality, friendly greetings and wise counsel illuminated and enriched any gathering in which he participated.

Jim was born in Oakleigh on 28 January 1910, the second son of Benjamin James Willis, then a teller in the Bank of Australasia (now the ANZ Bank) at Yarram. In 1913 Benjamin Willis was promoted to manage the bank's branch in Stanley, Tasmania, where Jim had his early schooling, first from his father and then at the local primary school. In 1924, at the age of fourteen, Jim came to Melbourne to attend Melbourne High School. After matriculating in 1927 he was awarded a three year scholarship to the Victorian School of Forestry at Creswick. After receiving his Diploma in 1930 he was posted back to the Creswick district as a cadet Field Officer with the Forests Commission.

It was in Creswick that Jim met his future wife Mavis Howie. During October 1932 Jim was appointed Assistant Forest Officer at Belgrave and a year later, on 13 October 1933, he and Mavis were married and went to live at Cockatoo.

Jim was elected a country member of The Field Naturalists Club of Victoria in December 1932 and in April 1934 his first papers appeared in *The Victorian Naturalist*. Entitled 'The Agaricaceae or Gilled Fungi', 'Beef Steak', 'Punk' and 'Blackfellows Bread' these papers filled the whole of Part 12 of Volume 50 and aroused a great deal of interest. A note in the July 1934 issue refers to the demand for reprints of the April issue; more than 600 copies were required to fill orders from Melbourne Teachers Training College and Melbourne University Botany School, as well as orders from overseas institutions. These papers formed the basis of a book entitled *Victorian Fungi* published by the Club in 1941. It was reprinted in 1950 with the new title of *Victorian Toadstools and Mushrooms*. Further reprints appeared in 1957 and 1963.

Jim led his first Club excursion on 30 May 1934 - a 'Fungus Foray' to Cockatoo Creek (June 1934, *The Victorian Naturalist* **51**, 45-48). This was the first of many such excursions and the 'Fungus Foray' became a regular event in the Club's calendar.

In 1937 Jim negotiated a transfer from the Forests Commision to the Lands Department and in October 1937 began his distinguished career with the Royal Botanic Gardens and National Herbarium which lasted until his retirement in 1972 when he held the position of Assistant Government Botanist and Acting Director of the Royal Botanic Gardens and National Herbarium.

Shortly after Jim began work in Melbourne the Willis family moved to Brighton and Jim commenced part-time study at Meboume University, graduating in April 1940 with the degree of B. Sc. (Hons.). The move to Melbourne enabled Jim to take a more active part in the Club. On 20 November 1937 he led his first general excursion to the Frankston area with Ethel McLennan as joint leader (Jan. 1938, *The Victorian Naturalist* **54**, 144) and in July 1938 he gave his first talk to the Club entitled 'The Alluring World of Fungi', illustrated 'by many colourful lantern slides and projections by the epidiascope'. A large collection of fungi was also displayed contributed by J.H. Willis, H.C.E. Stewart and A.A. Brunton (July 1938, *The Victorian Naturalist* **55**, 38).

Following his retirement in 1972 Jim was able to travel more widely and many

[1] 7 Glenluss Street, Balwyn, Victoria 3103

of these trips became the subject of talks illustrated with his slides. The lecture hall was always well filled on these occasions and the audience was assured of hearing well chosen words, clearly spoken and audible throughout the hall without amplification. Apart from speaking at Club meetings Jim was in constant demand as a speaker on a wide variety of topics to other groups and societies in Melbourne as well as in country Victoria and interstate. One of his last talks was delivered on 13 October 1986 to the Botany Group of the Club, when he spoke for one and a half hours on his trip to China.

Jim held several official positions in the Club; the first as a Committee member in 1941-43; Council member 1974-76; Vice-President 1944, 1971-72 and 1973-74; acting Editor of *The Victorian Naturalist* for 6 months from July 1945, Assistant Editor 1947-48 and Editor 1948-51. He was a member of the Plant Names Sub-Committee from 1943 and its Secretary 1948-1957 and a member of the Natural History Medallion Award Committee in the 1960's and again in 1973-76.

A master of the written as well as the spoken word, Jim contributed articles on a variety of subjects to *The Victorian Naturalist* as well as to numerous Australian and overseas journals and local suburban publications. Apart from botanical subjects Jim was a knowledgeable historian and wrote widely about early Australian explorers and botanists. His published works numbered over 800 including 452 individual botanical and biographical entries in *The Australian Encyclopedia* (1958). Over 200 of his papers appeared in *The Victorian Naturalist* and he took a modest pride in having published more papers there than anyone else. In the first 21 years after moving to Melbourne he published 150 papers of which all but 25 appeared in *The Victorian Naturalist.*

As well as *Victorian Toadstools and Mushrooms* Jim was author or co-author of three other books and published major revisions of two others. *A Handbook to Plants in Victoria* Vol.1 (1962), 2nd edn. (1973) and Volume 2 (1972) were landmarks in his publishing career. They were the first comprehensive publications on the Victorian flora since A.J. Ewart's long outdated *Flora of Victoria* (1931). The two handbooks formed the major part of his thesis presented to Melbourne University for which he received a Doctorate of Science in 1974. In 1968 *Flowers and Plants of Victoria* (in collaboration with R. Cochrane, E. Rotherham and B. Fuhrer) was published in association with the Field Naturalists Club of Victoria. The captions to the 543 plates in the book were entirely Jim's work. The royalties from the book made a major contribution to the Club's publishing fund. In 1975, after his retirement, Jim revised *Ferns of Victoria and Tasmania* by N.A. Wakefield, another Club publication. In 1982 *Shrubs and trees for Australian Gardens* by the late E.E. Lord, revised 5th edn. by J.H. Willis was published.

Jim was a great lover of nature in all its aspects, he delighted in any activity which took him outdoors and into the countryside. He was a tireless walker and even in the city he never lost an opportunity of walking through the parks. If business took him from the Herbarium to the City he preferred to walk through the parks rather than take a tram. He participated in an enormous range of botanical and exploratory trips throughout Victoria and various parts of every Australian state, to New Guinea and New Zealand. After his retirement he travelled with Mavis in Great Britain, Europe, Iceland and China. At the age of 81 he made a memorable trip to Borneo where he completed the arduous walk almost to the summit of Mt. Kinabalu. He was very disappointed that, due to shortness of breath, he was restrained from attempting the last short, rocky scramble to the summit.

Jim never drove a car, he did his forestry work first by bicycle and later on horse back. He continued to ride his bicycle to work from Brighton to the Herbarium until 1960 when Mavis became worried about his safety in the increasing traffic. The lack of a car did not affect his ability to get out on bush trips; to take Jim as passenger was a sought after pleasure;

his wide knowledge of history and local history as well as botany made him a most entertaining and informative passenger.

In the early 1980's some of the more active Club members felt the need for botanical and general interest weekend camps which would provide more opportunity for walking and exploring than was available on the usual day trips by car or bus. At first these (Five Good Camp-outs, 1985, *The Victorian Naturalist* **102**, 5, 167-177). were organised by John Milligan and subsequently by Will Ashburner. Jim, often accompanied by Mavis, was an enthusiastic participant. Usually the first astir in the mornings he would have returned by breakfast time with a little bag of botanical specimens to be discussed and usually pressed for donation to the Herbarium. Jim always travelled with a small bundle of newspaper and, as a passenger mindful of space limits in a companion's car, would often travel sitting on his bundle of pressings. His collecting notes were always clearly written in his beautiful handwriting on the smallest scraps of recycled paper; as a true conservationist nothing was wasted and it is doubtful if a search of his many collections in the Herbarium would reveal that he ever used new paper for his notes. Jim also had a keen sense of smell and taste and both were often employed as an aid to identification of plants.

Jim had a wide range of hobbies and interests apart from botany; he was an avid collector of almost anything unusual or interesting, including books, minerals, shells, coins and postage stamps featuring plant life. He was an accomplished pianist and had a fine baritone voice. He sang in the choir and was a local preacher with the Methodist Church (now the Uniting Church) near his home in Brighton. He spoke French and German and, with the aid of a dictionary and elementary grammar taught himself Latin and Welsh. He also had some knowledge of Icelandic.

The name of James Hamlyn Willis is perpetuated in eight plants named after him:

Acacia jamesiana Maslin (from Great Victoria Desert to Yalgoo and Wiluna);
Epilobium willisii Raven and Engelhorn (from sub-alpine Victoria and Tasmania);
Eucalyptus willisii Ladiges, Humphries and Brooker (from SA and Victoria);
Goodenia willisiana Carolin (from SA, NSW and Victoria);
Grevillea willisii R.V. Smith and McGillivray (from north-east Victoria).
Oleanites willisii I. Cookson (a fossil olive from Yallourn);
Pottia willisii G.O.K. Sainsbury (a moss from Standley Chasm, NT), and
Steccherinum willisii M. Geesteranus (a hydnoid fungus from Lamington National Park, Queensland).

Jim himself described 64 plant species, two thirds of these as sole author, several new varieties and made many new combinations. In 1958-9 Jim held the position of Australian Botanical Liaison Officer at Kew. In 1964 he was awarded the Australian Natural History Medallion and in 1973 the Royal Society of Victoria Silver Medal for research. In 1974 the Faculty of Science, Monash University appointed him an Honorary Fellow and in 1976 he was appointed a Fellow of the Linnaean Society of London. In June 1995 he became a Member of the Order of Australia.

Jim is survived by his wife Mavis, two sons, three daughters, 15 grandchildren and four great-grandsons.

. The breadth and depth of Jim's scientific achievements place him in the front rank of contemporary botanists; he was to the National Herbarium this century what Mueller was in the last, but his many friends and colleagues will remember him most for the simple things; his cheerful personality, welcoming smile and sincere greeting which made one feel a person of value. From eminent scientist to young student, all who sought his advice or help received the same courtesy. With his passing we have lost a true friend*.

*A more detailed biographical sketch of Jim's life and a list of publications was published in 1975 *Muelleria* **3** (2), 69-88. An updated list of publications will appear in the 1997 issue of *Muelleria*.

Secondary Juvenile Period and Community Recovery following Late-Spring Burning of a Kangaroo Grass *Themeda triandra* Grassland

J.W. Morgan[1]

Abstract

The vegetative regeneration, flowering and community recovery of a regularly burnt, ungrazed *Themeda triandra* grassland was followed for one year after a late-spring fire. The response to burning was compared to that observed in a grassland that had been burnt six months previously in autumn. All perennial species present pre-fire were found resprouting in the post-fire environment. Four species flowered prolifically in the summer following spring burning whereas 63% of all perennial species produced zero or few flowers in the same period. This may favour the regeneration by seed of some species over others, although the effect may be moderated by the regeneration strategy of the species concerned (i.e. seedling versus vegetative). The secondary juvenile period is extremely short for most species. One year after spring burning, all perennial species other than *Lomandra micrantha* had flowered. *Themeda* cover recovered quickly but differences remained at one year between the spring- and autumn-burnt grasslands. The effect of a late-spring fire on the grassland flora is probably minimal from a long-term ecological perspective when compared to the effects of fires in other ecosystems. Any effect of burning at this time may be magnified as the frequency of burning increases. Those species with increased post-fire flowering may be favoured whilst susceptible life stages (e.g. seedlings) may be disadvantaged by burns at this time. (*The Victorian Naturalist* **113**, 47-57).

Introduction

Great uncertainty exists about the optimum timing of burning in Kangaroo Grass *Themeda triandra* grasslands. Some of this apprehension is probably due to the differing management objectives of grassland fires. On the one hand, fire is crucial to the maintenance of species diversity by preventing the dominant grasses from outcompeting smaller, intertussock forbs (Stuwe and Parsons 1977; McDougall 1989). On the other hand, burning is suggested as a potential means of favouring native over exotic species in invaded remnants. Stuwe (1986), for instance, postulated that spring burning may favour native perennial species over exotic annual species by preventing seed set in the annual grasses, thereby reducing the potential for recruitment in subsequent years. Annual spring burning prior to seed shed for five to seven years may be necessary, however, to eliminate these species from grasslands (Hitchmough *et al.* 1994). Late-autumn burning has been shown to favour germinating annual grasses at a time when the summer-growing *Themeda* is unlikely to provide much competition (Lunt 1990). As such, late-spring burning in degraded remnants has been recommended by Stuwe (1986).

However, despite the importance of burning, there is little empirical, or even observational, evidence of its effects on community functioning in *Themeda* grasslands other than the work of Groves (1974), McDougall (1989) and Lunt (1990; 1995). The debate on the optimum season and frequency of burning cannot be furthered until the effects of fire are more widely documented.

One way to consider the effect of burning is to determine the time that it takes for resprouting plants to flower after the fire, i.e. secondary juvenile period, (Johnson *et al.* 1994). Lunt (1990, 1995) has shown that many herbaceous grassland species flower prolifically in the spring after an autumn burn (six to nine months after burning), presumably because the fire occurs when most species are vegetatively dormant and precedes the normal growth and flowering period for most resprouting herbaceous species (i.e. winter/spring). The effects of spring burning at a time when most species are actively growing or flowering, however, are largely undocumented. Scarlett and Parsons

[1] School of Botany, La Trobe University, Bundoora Victoria 3083

(1982) suspect that spring-flowering Fabaceae may have been eliminated from rail reserves that traditionally have been burnt in spring/summer, although the high frequency of burning (i.e. annual) may have been more important than seasonal effects (McDougall 1989).

Some information on the recovery of the plant community following autumn burning is available, albeit mostly from grassland remnants that have a history of grazing by domestic stock and infrequent burning. Lunt (1990) found that all perennial species at the Derrimut Grassland Reserve regenerated vegetatively following burning and only 19% of native species recruited by seedlings. There were no obligate seed regenerators present in the native flora. Exotic annual grasses such as *Briza* spp. and *Vulpia bromoides* increased dramatically after this fire. Rates of biomass accumulation suggest that pre-fire biomass levels can return in these grasslands within two to four years (McDougall 1989) with considerable regrowth occurring in late-spring when *Themeda triandra* is actively growing (Groves 1965; McDougall 1989). Morgan and Rollason (1995) found that nine months after an autumn burn in a species-rich grassland, *Themeda* had recovered a canopy cover of 43%.

A fire in the last week of November 1993 in a diverse *Themeda* grassland provided the opportunity to observe and document the effects of a late-spring fire. This paper reports the post-burn flowering responses of native and exotic species and the rate of recovery of the community in the year following spring burning, and compares these features to those observed in a grassland burnt in autumn, a time that is usually considered the 'norm' for management burns in grasslands.

Methods

Study Sites

All studies were undertaken in grassland remnants on the Melbourne-Geelong railway line. A feature of these rail reserve remnants is that they have been burnt regularly for fire protection and have been protected from domestic stock grazing. The two study sites were located in the vicinity of the old Manor station (37°56´S, 144°35´E), approximately 35 km south-west of Melbourne. The sites have been previously described by Stuwe (1986), McDougall (1987) and the Department of Conservation and Environment (1990). Average annual rainfall for the area is 540 mm.

Both remnants are on Quaternary basalt, on flat to gently sloping terrain and are dominated by *Themeda triandra*. The community is part of the Keilor Plains association described by Willis (1964). The intertussock flora consists of a range of forbs, dominated by species from the Asteraceae. Four rare or threatened species are recorded for the area: *Comesperma polygaloides*, *Pimelea spinescens*, *Rutidosis leptorrhynchoides* and *Senecio macrocarpus* (Gullan *et al.* 1990). Exotic annual grasses (e.g. *Briza maxima*, *B. minor*, *Vulpia bromoides* and *Aira* spp.) at November 1993 had a mean overlapping cover of 18.5 ± 2.3% (± 1SE) (J. Morgan *unpubl. data*).

The two remnants discussed in this paper had the following characteristics:

(i) late November 1993 burnt grassland (hereafter referred to as the 'spring-burnt' grassland). Prior to the fire, this remnant had been unburnt for three years. Mean biomass at the time of burning was 2600 ± 250 kg/ha. Overlapping cover was 98.5% and cover repetition was 6.83 ± 0.28 (J. Morgan *unpubl. data*).

No data exists for the spring fire event which was undertaken for fuel reduction purposes. Immediate post-fire biomass was negligible indicating a thorough fire. At the time of burning (29 November 1993), most annual grasses were flowering or developing seed. Many native species were also flowering, although *Senecio macrocarpus* had flowered, shed seed and had begun to die back to an underground rootstock.

(ii) late April 1993 burnt grassland (hereafter referred to as the 'autumn-burnt' grassland). This grassland remnant, approximately 3 km south-west of the spring-burnt site, is included here for comparison as it represents the time of burning usually undertaken in grasslands. From casual observations of floristic composition, it is assumed to have had the same characteristics as the above site prior to being burnt.

No data exists for the autumn fire event although casual observations again indicate a thorough fire.

Regrowth Flowering

Following spring burning, observations of regrowth and flowering were made from January to May 1994. At each visit, all perennial species were classified according to the following response categories:

1) **vegetative regrowth only** - no post-fire flowering within six months of burning.

2) **flowering much less than expected** (from prior knowledge of the species) or from that observed in the autumn-burnt grassland.

3) **flowering similar to that expected** or observed in the autumn-burnt grassland.

4) **flowering much greater than expected** or observed in the autumn-burnt grassland.

Observations of the spring-burnt grassland were also made at one year from burning (October - December 1994) to determine whether species that had remained vegetative in the first summer subsequently flowered at one year from burning.

Community Recovery

i) Changes in Cover

Twelve 12 m transects were established in both the autumn- and spring-burnt grasslands and the percentage of overlapping cover and cover repetition was determined at April and November 1994 (approximately 4.5 and 12 months from spring burning) by the point quadrat method (Kent and Coker 1992). A 3 mm diameter pin was lowered into the grassland at 20 cm intervals along each transect and all species and the number of touches per species was recorded. A total of 720 points was recorded for each grassland on each occasion. Differences in percent overlapping cover and cover repetition were compared at November 1994 (one year from spring burning) using a single classification analysis of variance (ANOVA) (Sokal and Rohlf 1981).

ii) Changes in Biomass

At April and November 1994, biomass was determined in each grassland by collecting 12-15, $0.25 m^2$ samples of vegetation harvested to ground level. Samples were dried at 80°C for 48 hrs before being weighed. Differences in mean biomass between the two grasslands at November 1994 was compared using a single classification ANOVA (Sokal and Rohlf 1981).

iii) Light Quantity at Ground Level

The amount of light reaching the ground surface relative to that above the canopy was determined in both grasslands at April and December 1994. A total of 15 readings were taken in each grassland using a LiCor Li 185 light meter with Quantum sensor. Differences in the percent of light at ground level were compared at December 1994 using a single classification ANOVA (Sokal and Rohlf 1981).

Results

Species Recovery

A total of 51 perennial species were observed during this study, comprising 43 native species and eight exotic species. All perennial species observed prior to the spring fire were found resprouting in the post-fire flora. No annual exotic grasses (four species) were observed in the flora until winter-spring 1994, approximately nine months after spring burning.

Post-fire Flowering

Sixty-three percent of perennial species produced zero or few flowers in the six months following spring burning despite exceptionally high summer rainfall (185% of average; Fig. 1; Table 1). Four species (8%) produced substantially more flowers than was observed in the autumn-burnt grassland (Table 1).

Post-fire flowering was initially inhibited amongst monocots, relative to dicots, and amongst native species relative to exotic species (Table 2). All life forms showed reduced flowering (Table 2).

The four rare and threatened species differed in their response to spring burning. The flowering of *Comesperma polygaloides* and *Rutidosis leptorrhynchoides*

Table 1. Post-fire flowering response grouped according to life-form of the study species in the six months following a late-spring fire. Life-forms are according to Tremont (1994) and McIntyre *et al.* (1995) or based on personal observation. * denotes exotic species.
Key: **1**= Vegetative only; **2**= Reduced flowering, **3**= Unchanged flowering; **4**= Pulse flowering

Resp-onse	Life- form			
	Phanerophyte	**Chamaephyte**	**Hemicryptophyte**	**Geophyte**
1.	*Asperula scoparia*	*Dianella revoluta*	*Acaena echinata*	**Romulea rosea*
	Pimelea glauca	*Calocepha lus citreus*	*Carex breviculmis*	
			**Cynara cardunculus*	
			Danthonia setacea	
			Dichelachne crinita	
			Eryngium ovinum	
			Goodenia pinnatifida	
			Leptorhynchos squamatus	
			Linum marginale	
			Lomandra micrantha	
			Minuria leptophylla	
			**Nassella trichotoma*	
			Plantago gaudichaudii	
			Poa sieberiana	
			Podolepis jaceoides	
			Ptilotus spathulatus	
			Schoenus apogon	
			Stipa bigeniculata	
			Velleia paradoxa	
			Vittadinia cuneata	
2.	*Pimelea curviflora*		*Comesperma polygaloides*	
			Danthonia duttoniana	
			Haloragis heterophylla	
			Rutidosis leptorrhynchoides	
			Themeda triandra	
3.	*Pimelea spinescens*		*Brachyscome dentata*	*Caesia calliantha*
			Chloris truncata	
			Chrysocephalum apiculatum	
			C. semipapposum	
			Convolvulus erubescens	
			**Foeniculum vulgare*	
			Homopholis proluta	
			**Hypochoeris radicata*	
			Oxalis perennans	
			**Paspalum dilatatum*	
			Pelargonium rodneyanum	
			**Plantago coronopus*	
			**P. lanceolata*	
			Wahlenbergia luteola	
4.			*Geranium retrorsum*	
			Glycine tabacina	
			Senecio macrocarpus	
			Wahlenbergia communis	

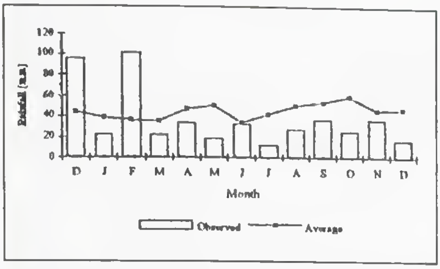

Fig. 1. Mean monthly rainfall totals for the period December 1993 to December 1994 versus long-term average recorded at the Werribee meteorological station (approx. 7-10 km north of the study sites).

was inhibited whilst flowering of *Senecio macrocarpus* was substantially promoted. The winter flowering *Pimelea spinescens*, which was only marginally scorched during the fire, did not appear to be affected by the burn.

By one year from burning (December 1994), all species that were initially vegetative in the summer after spring burning were observed to have flowered, with the exception of *Lomandra micrantha*. By contrast, the immediate promotion of flowering of *Geranium retrorsum* and *Glycine tabacina* and, to a lesser extent, *Senecio macrocarpus* and *Wahlenbergia communis*, was not sustained into the second flowering season.

There appeared to be little difference at December 1994 in the flowering intensity between species in grasslands burnt 12 months (spring-burnt) and 18 months (autumn-burnt) previously.

Community Recovery

1) Changes in Cover

Canopy cover recovered rapidly after spring burning (Table 3). By April 1994 (4.5 months after burning), the cover had returned to 84%, almost all of which was attributable to *Themeda* (99%). By one year from burning, the cover of the spring-burnt grassland was not significantly different ($p>0.05$) from the autumn-burnt grassland that had been burnt six months previously. Cover repetition was marginally, but significantly, lower in the spring-burnt versus autumn-burnt grassland at November 1994 (Table 3; $p < 0.05$).

Table 2 . Post-fire flowering response in the six months after late-spring burning as influenced by life form, origin and growth form.
1 = % of species with reduced flowering,
2 = % of species with unchanged flowering,
3 = % of species with increased flowering.

	Flowering Response		
	1	2	3
Monocots	75	25	0
Dicots	53	36	11
Exotics	33	67	0
Natives	65	26	9
Geophytes	50	50	0
Hemicryptophytes	58	33	9
Chamaephytes	100	0	0
Phanerophytes	75	25	0

The overlapping cover of annual grasses one year after burning was 0% in the spring-burnt grassland, as it was in the autumn-burnt grassland.

2) Biomass

Biomass accumulation was significantly lower in the spring-burnt grassland than in the autumn-burnt grassland at November 1994 (Table 3; $p < 0.01$). At one year from burning, the spring-burnt grassland had attained 36% of its pre-burn biomass.

3) Light Quantity

The amount of light at ground level declined to 60% in the 4.5 months following spring burning but by December 1994 (one year after burning), was 73% of the amount of light above the canopy. There was significantly more light at the ground level in the spring-burnt versus autumn-burnt grassland at December 1994 (Table 3; $p < 0.001$).

Discussion

All perennial species found in the pre-fire flora resprouted vegetatively in the post-fire flora. Purdie (1977) calls such species 'fire-resistant'. There were no obligate seed regenerators (or 'fire-sensitive' species *sensu* Purdie (1977)). Post-fire recovery of this grassland, with a history of recurrent fire, appeared to follow the model of initial floristic composition

Table 3. Community recovery following burning in autumn 1993 and late-spring 1993 at May 1994 and November 1994. All values are means ± 1SE.

Month of Observation	Parameter	Spring-burnt	Autumn-burnt
May 1994		(6 months since burnt)	(12 months since burnt)
	Total % Cover	84.2 ± 1.4	92.5 ± 1.0
	Total Cover Repetition	2.7 ± 0.1	3.9 ± 0.1
	Biomass (g/m^2)	115 ± 14	138 ± 5
	% Light at Ground	61 ± 4	40 ± 3
November 1994		(12 months since burnt)	(18 months since burnt)
	Total % Cover	90.3 ± 2.0	93.5 ± 0.9
	Total Cover Repetition	3.1 ± 0.1	3.6 ± 0.1
	Biomass (g/m^2)	94 ± 7	166 ± 7
	% Light at Ground	73 ± 2	50 ± 3

(Egler 1954). Lunt (1990) observed similar patterns of recovery following burning of a long-grazed *Themeda* grassland.

Vegetative recovery following spring burning is not surprising when it is considered that 90% of perennial species are hemicryptophytes or geophytes, with protected basal meristems/buds at or below the ground level (Chapman and Crow 1981). The close correlation between the capacity to resprout and the presence of protected buds from which shoots can develop after burning is well known and is considered to be a characteristic feature of vegetation in fire-prone environments (Keeley and Zedler 1978; Frost 1984).

Whilst a spring fire did not lead to a loss at the species level, the response may be more significant at the individual or population level (Daubenmire 1968; Purdie 1977). The susceptibility of a plant to fire is partly a function of its phenological state at that time (Daubenmire 1968; Frost 1984).

Plants which are actively growing or reproducing when burnt will experience a greater loss of active tissue and, because of depleted resources, a reduced capacity for regrowth, than will plants that are dormant at the time of burning. This may lead to the production of fewer ramets in those species that are rhizomatous. Amongst the grasses, once a tiller begins to grow, it becomes progressively more susceptible to defoliation (Tainton *et al.* 1977). One might therefore predict that spring-burning may have a greater influence on vegetative population dynamics than would a late-summer or autumn fire. This remains to be verified.

By far the most obvious impact of late-spring burning, despite above-average rainfall immediately after the fire, was its effect on regrowth flowering potential in the following summer. Three response categories were recognised (Table 1):

(i) no or little regrowth flowering possible in the following six months (**decreasers**);

(ii) flowering unchanged relative to autumn-burnt areas (**unchanged**) but greater than would be expected in long unburnt areas; and,

(iii) pulse flowering (**increasers**).

The proximate cues for post-fire flowering are poorly understood (Hulbert 1988; Le Maitre and Brown 1992; Lamont and Runciman 1993). Changes in daily temperature fluctuations in the soil following fire, increased soil temperatures, better light penetration, changes in physical and chemical characteristics of the soil, reduced competition, increased water availability, leaf removal *per se*, a longer growing season, increased tillering and the production of ethylene have all been postulated as being important (Gill and Ingwersen 1976; Frost 1984; Le Maitre and Brown 1992; Lamont and Runciman 1993; Johnson *et al.* 1994). However, these are most important for stimulated post-fire flowering that is usually observed in the spring after a summer or autumn fire. Following late-spring burning, the ability to flower either 'unchanged' or 'increased' in the following months of summer must also depend on other more immediate factors. Two seem appropriate to help explain the response observed in this *Themeda* grassland: a) phenological development at the time of burning and, b) growth habit/life form.

a) phenological development - three of the four species exhibiting pulse flowering (*Geranium retrorsum*, *Glycine tabacina* and *Senecio macrocarpus*) were largely inactive at the time of burning. *Senecio macrocarpus* had already flowered, set seed and died back to below-ground rootstock when burnt, and *Geranium retrorsum* was also in a phase of returning to dormant rootstock, as evidenced by the senescing canopy. *Glycine tabacina*, it appeared, had not produced any new growth for the season. Its pulse flowering after burning is in contrast to the prediction of Scarlett and Parsons (1982) that late-flowering Fabaceae are disadvantaged by late-spring burning, apparently because flowers are consumed by fire and there is little regrowth flowering. The reasons for the response seen may, in part, have been due to the post-fire climate and the interval since the last fire (i.e. three years). Alternatively, the reason for the decline in Fabaceae from regularly burnt rail reserves may have been the inability of new season's seedlings to cope with late-spring burning. A once-off spring burn, however, does not appear to have been detrimental to mature plants of this native pea.

At the other extreme, decreasers at the time of burning were largely either flowering or about to flower (with the possible exceptions of *Carex breviculmis*, *Romulea rosea* and *Schoenus apogon*). Fire destroyed flowers or flowering primordia, and there was either insufficient time to develop new flowers following burning, or an environmental control on flowering (e.g. photoperiod, thermoregulation) prevented re-flowering (Frost 1984).

Of the species that showed the unchanged flowering response, some species may have been burnt prior to growth and flower formation (e.g. ?*Pelargonium rodneyanum*, *Pimelea spinescens*) whilst others, with perhaps unspecialised flowering initiation requirements (e.g. *Chrysocephalum apiculatum*, *C. semipapposum*, *Wahlenbergia luteola*), took advantage of the favourable soil moisture conditions over the summer. Some may have responded by growing and flowering over their normal growth period. The C4 grasses *Chloris truncata*, *Homopholis proluta* and *Paspalum dilatatum* were the only grasses that appeared to flower 'normally' while all C3 grasses failed to produce any substantial regrowth flowering. *Themeda triandra*, whilst a C4 grass, also produced few flowers in the post-fire environment, possibly because it had initiated growth earlier (i.e. October) than the other C4 grasses (McDougall 1989).

b) growth habit/life form - some of the responses observed may be explained in part by the presence or absence of substantial subterranean storage organs. Certainly *Caesia calliantha*, *Convolvulus erubescens*, *Geranium retrorsum*, *Hypochoeris radicata*, *Oxalis perennans*, *Plantago coronopus* and *P. lanceolata* would have been able to exploit their stored energy and nutrient reserves to flower soon after fire. Some geophytes of South African fynbos can exploit below-ground storage organs to flower within 7-14 days of burning (Frost 1984). All the above species, except *Caesia calliantha*, were flowering within eight weeks of burning.

Most of the species that do not possess storage organs of any note (J. Morgan *pers. obs.* and *unpubl. data*) were also the species with decreased flowering following spring burning (e.g. *Asperula scoparia*, *Haloragis heterophylla*, *Leptorhynchos squamatus*). Sixty-eight percent of decreasers possess small storage organs (relative to plants such as *Geranium retrorsum* and *Hypochoeris radicata*). By contrast, only 36% of unchanged species or increasers do not possess sizeable storage organs.

However, the failure of some species with storage organs to flower at all (e.g. *Acaena echinata*, *Podolepis jaceoides*, *Ptilotus spathulatus*) shows that the response is clearly more complex than the mere presence or absence of stored root reserves. The relationship between storage organs and phenological development may be crucial.

By one year from late-spring burning, all species other than *Lomandra micrantha* had or were flowering at levels far greater than are usually seen in long unburnt grasslands (Lunt 1995). The secondary juvenile period for grassland plants is therefore extremely short.

The time to secondary flowering is even shorter for most grassland species after an autumn fire, presumably because burning occurs at a time when most species are dormant and post-fire conditions allow rapid and substantial accumulation of carbohydrate for flowering. Lunt (1990) found that all but 6% of perennial native species had flowered nine months after an autumn burn at the Derrimut Grassland Reserve, Melbourne, whilst all nine herbaceous species studied in detail at Munro, Gippsland by Lunt (1995) flowered six months after burning, although there were similar increases and decreases in flowering, as reported here, when compared to grasslands that had been burnt two years previously.

The differential species response observed after spring burning was maintained only for the first summer following burning. One year after the fire, there appeared to be no difference in either the number of species flowering or the intensity of flowering when compared to an area burnt in autumn, six months prior to the spring fire.

The annual grasses *Aira cupaniana*, *Briza maxima*, *B. minor* and *Vulpia bromoides* all failed to germinate immediately post-fire despite above-average summer rainfall. This may be due to inherent dormancies of these species that prevents germination during the hotter months. Below-average winter rainfall (Fig. 1) may have caused the subsequent very low densities observed in both grasslands during 1994 and contributed to the decline in annual grass cover from 18.5% at November 1993 to 0% at November 1994 in the spring-burnt grassland. Significantly, the autumn-burnt grassland also had 0% annual grass cover at November 1994, suggesting that environment was a greater factor than the time of burning on the annual grass component.

Anecdotal evidence from annually burnt grasslands in western Victoria (McDougall 1989; Hitchmough *et al.* 1994) suggests that the species most affected by burning at this frequency in early summer will be either the larger seeded species such as *Briza maxima* that have not made their way into the soil or late-flowering species (e.g. *Phalaris aquatica*). Most annually burnt grasslands have an exotic annual grass component that is dominated by small-seeded species such as *Aira cupaniana* and *Briza minor*. *Briza maxima* is largely absent from these sites. Late-spring burning may kill most seed either on the plant or on the soil surface and may reduce the relative dominance of these species in the following year. However, in the absence of follow-up late-spring fires, the reduced population of survivors could theoretically produce large quantities of seed so that pre-burn densities and cover may re-establish (Daubenmire 1968; McDougall 1989). For this reason, Hitchmough *et al.* (1994) suggest that annual burning would be necessary for 5-7 years to eliminate many annual grasses from the grassland community.

Following spring burning, the community recovered rapidly. Six months after the fire, the total overlapping cover had returned to 84%. This is not unexpected as the main contributor to cover, *Themeda triandra*, is a C4 grass whose normal growth period is the warmer months of the year (Groves 1965; McDougall 1989) and growth would have been possible over the entire summer period due to above-average rainfall.

Autumn-burnt grasslands initially recover a canopy cover much more slowly than spring-burnt grasslands (Morgan and Rollason 1995), primarily because the first six months of growth do not coincide with the dominant species' growth period. In this study, the autumn-burnt grassland at May 1994 had an overlapping cover of 93% compared to 84% in the spring-burnt grassland despite an extra six months growth. Total cover repetition, however, was significantly greater in the autumn-burnt grassland indicating greater rates of vegetative regrowth here. This caused significantly greater shading in the autumn-burnt grassland relative to the spring-burnt grassland.

Rates of biomass accumulation were much slower following burning than has previously been reported. At 12 months from spring burning, biomass was 939 kg/ha whilst in the autumn-burnt grassland, at 18 months after burning, biomass was 1660 kg/ha. Groves (1974) recorded rapid biomass accumulation after September burning of a *Themeda* grassland; 2500 kg/ha at one year after burning. Similarly, Lunt (1995) recorded a biomass of 4600 kg/ha two years after a spring fire. Productivity therefore varies markedly from site to site and absolute comparisons of biomass are perhaps meaningless. Rather, the rate of regrowth or biomass accumulation at a single site is of more significance. At this study site, 36% of pre-fire biomass had returned by one year from burning. One would therefore predict that pre-burn biomass levels will return within three years of burning.

Immediate post-fire recruitment by species that do not store seed in the soil is constrained by the amount of seed produced in the summer after the spring fire (Lunt 1995; Morgan 1995). Sixty-three percent of perennial species did not flower substantially until one year after the spring fire, with seedling recruitment potentially unable to take place until at least 18 months after the fire. The grassland microsite environment may be largely antagonistic at this time to seedling growth (e.g. absence of large canopy gaps and associated low light levels (Morgan 1996)) given that *Themeda* has had two growing seasons to recover from fire. Autumn-burnt grasslands, that have had only one growth cycle of *Themeda* by the time to potential recruitment, may present a less hostile seedling environment to many species. This remains to be quantified.

However, those species whose flowering was either unchanged or increased after spring burning may be favoured over decreasers by potential seedling recruitment only six months after burning in a grassland environment of lower biomass, lower shading and lower canopy cover relative to autumn-burnt grasslands where recruitment may have to wait until one year after burning. Repeated late-spring burning may ultimately favour species with rapid summer regrowth flowering potential over those species that cannot flower until the following spring. The effect, however, will be determined primarily by the regeneration strategy of the species concerned (Purdie 1977). Given the apparently low reliance on seedling regeneration by many grassland species (i.e. the regeneration strategies appear to be primarily the obligate vegetative re-sprouters and auto-regenerating long-lived sprouters described by Bell *et al.* (1984)), this may be of little concern to all but a few species that are short-lived and more reliant on seedling regeneration for turnover (e.g. *Leptorhynchos squamatus*; J. Morgan *unpubl. data*). Since many of the most diverse remnants are found on rail reserves that have a history of late-spring burning (Scarlett and Parsons 1982), such regimes cannot have been overly deleterious to the many native species which are now abundant at these sites (Lunt 1995). Certainly, the effects of burning infrequently (e.g. five or more year intervals) appear to have been much more detrimental to the richness and diversity of native grasslands (McDougall 1989; Scarlett and Parsons 1990) than any effect of frequent late-spring burning.

Summary

All perennial native species resprouted after a late-spring fire and more than 35% of species flowered substantially in the six months immediately after the fire. No native species were 'fire sensitive' obligate seeders. One year after burning, there was little difference in the flowering intensity of the spring-burnt grassland relative to the autumn-burnt grassland. Thus, it appears that mature plants of most grassland species seem to be relatively robust and insensitive to the effects of fire season. Regular late-spring burning (e.g. at intervals of two years or more) is unlikely to harm grassland composition. Many of the most diverse remnants have been burnt in spring/summer virtually every year for decades. By contrast, in productive sites with rapid *Themeda* regrowth, far greater losses to plant diversity are likely to arise from deferring burns for intervals greater than 3-4 years due to diminished flowering and seed set, increased seedling mortality and senescence of mature plants due to competition (primarily for light) with the grassland dominant.

Acknowledgements

Tamzin Rollason provided assistance in the field. Ian Lunt, Bob Parsons and Neville Scarlett kindly commented on early drafts of this paper. This research was supported by an Australian Post-Graduate Research Award.

Glossary

C3: plants that use the C3 pathway of carbon dioxide fixation in the process of photosynthesis.
C4: plants that use the C4 pathway of carbon dioxide fixation in the process of photosynthesis.
Chamaephyte: with perennating buds or shoot apices borne close to the ground.
Cover repetition: derived from point quadrat data: Total number of times all leaves of species A 'hits' the pointing pin per transect/Number of points per transect (in this case, 60).
Geophyte: perennating buds below ground level.
Hemicryptophyte: perennating buds at or just below ground level.
Percent overlapping cover: derived from point quadrat data: (Number of points at which species A is recorded per transect/Number of points recorded per transect (in this case, 60)) X 100.
Phanerophyte: perennating buds or shoot apices on aerial shoots.

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Fauna of the Grantville Gravel Reserve, with Reference to Vegetation and Conservation Significance

A.S. Kutt[1] and J.V. Yugovic[2]

Abstract

This paper presents a summary of a report titled 'Flora and Fauna Assessment and Review of Management Issues, Grantville Gravel Reserve, Victoria' (Yugovic and Kutt 1995) prepared for the Bass Coast Shire Council by Biosis Research Pty. Ltd. The flora and fauna of the Grantville gravel reserve, a remnant of native coastal vegetation on Western Port, were surveyed in 1994. The fauna survey recorded a total of 134 vertebrate species from primary and secondary sources for the reserve and surrounding area. Six species are assessed as being of conservation significance: the Swamp Antechinus *Antechinus minimus*; Haswells Frog *Crinia haswelli;* the Common Blue-tongue *Tiliqua scincoides*; the Metallic Skink *Pseudemoia metallica* and the Long-nosed Bandicoot *Perameles nasuta*. The vegetation survey recorded seven vegetation communities and a vascular flora comprising 221 taxa. All vegetation communities are considered to be of state (Grassy Woodland, Swamp Scrub) or regional (Dry Heathy Woodland, Dry Forest, Riparian Forest, Wet Heathy Woodland, Wet Scrub) conservation significance. There is a discussion on the flora and fauna, and the significance of the gravel reserve and surrounding area for nature conservation. (*The Victorian Naturalist* **113**, 58-66).

Introduction

A preliminary flora and fauna survey was conducted at the Grantville gravel reserve (hereafter gravel reserve), 1.5 km south of Grantville, 85 km south-east of Melbourne (Map 1). The gravel reserve is approximately 100 ha in area and is bounded by the Bass Highway road reserve to the north-west, by the Stanley Road road reserve and private residential land (the Adams Estate) to the north-east, and by the (proposed) Grantville State Nature Reserve (hereafter nature reserve) to the south. Located in the centre of the study area are three large gravel pits (Shire of Bass pit, Vic Roads pit, public pit) and a landfill. The remainder (approximately half) of the study area supports native vegetation which is contiguous with the adjacent, undemarcated nature reserve. The gravel reserve has a complex topography ranging from 18 m in elevation in the west along the Bass Highway, to 82 m in the east. A prominent creek runs through the centre of the study area, while smaller drainage lines, also running to the west, occur near the north and south boundaries.

Methodology

The fauna survey was conducted in March 1994. Techniques used and survey effort are as follows: active searching (16 search-hours, 11 predator scats found and analysed); cage trapping (37 trap-nights); Elliott trapping (180 trap-nights); hair-tubing (160 tube-nights); bat (harp) trapping (6 trap-nights); spotlighting (4 spotlight hours); pitfall trapping (24 pit-nights); bird census (4 hours), and frog census (1 hour). Additional records for the study area and

Map 1: Location of Grantville gravel reserve (indicated by arrow).

[1] current address Australian Centre for Tropical Freshwater Research, James Cook University, Townsvillle, Queensland 4811.
[1 and 2] Biosis Research Pty. Ltd., 322 Bay Street, Port Melbourne, Victoria, 3207.

surrounding state nature reserve were obtained from the Department of Conservation and Natural Resources (DCNR), Atlas of Victorian Wildlife, the Western Port Group of the Bird Observers Club of Victoria and from personal communications with DCNR staff.

The flora survey was conducted in March, August and November 1994. The study area was traversed on foot, and the composition, structure and condition of the vegetation were examined. The vascular flora (ferns, conifers, flowering plants) was recorded. Seventeen 30m by 30m quadrats were sampled across the range of vegetation types evident from aerial photography and ground-truthing (verified on the ground). Vegetation classification utilised a computer-based, numerical procedure followed by manual-sorting of the computer out-put to further refine vegetation community descriptions (Gullan 1978).

Results

A total of 91 terrestrial vertebrate fauna species (52 native and 3 introduced bird species, 16 native and 3 introduced mammals, 9 reptiles and 8 amphibians) were recorded during the present survey. The Western Port Group of the Bird Observers Club of Victoria have recorded a further 36 bird species for the study area, while the Atlas of Victorian Wildlife records an additional seven species (1 bird, 2 mammals, 2 reptiles and 2 amphibians) from the local area which includes the adjacent nature reserve (N 38° 25′, S 38° 27′, E 145° 33′, W 145° 30′). Unconfirmed sightings of a Red-necked Wallaby *Macropus rufogriseus* and Lace Monitor *Varanus varius* from the nature reserve by DCNR staff have also been reported. A composite species list is presented in Appendix 1. Species recorded from hair-tubes, scat analysis, pit-fall traps, Elliott and cage traps, including trap effort, are presented in Table 1. In reference to Appendix 1, all species not identified in Table 1 and not indicated as being recorded from the secondary sources listed above, were observed during the bird census, frog census or incidentally during the course of the survey.

The recorded vascular flora (ferns, conifers, flowering plants) comprises 221 taxa (species and varieties of plants), of which 182 are indigenous. Given the size of the area, indigenous plant species diversity is relatively high due to the range of vegetation communities present and the intact condition of most of the vegetation. Seven vegetation communities were defined and their distribution is indicated in Fig. 1.

1. Dry Heathy Woodland - a widespread, extensive vegetation community generally dominated by Narrow-leaf Peppermint *E. radiata* from 8 to 18 m with Coast Manna Gum *Eucalyptus pryoriana* co-dominant in places. Below the tree canopy is a 4-6 m high shrub layer of *Leptospermum myrsinoides* and *L. continentale* and a ground layer comprising a range of typical heath species adapted to dry and low nutrient conditions such as *Xanthorrhoea australis, Pteridium esculentum, Epacris impressa* and *Amperea xiphoclada.*

2. Damp Forest - a scattered and localised forest community co-dominated by Narrow-leaf Peppermint and Messmate *E. obliqua,* 18-25 m in height. There is relatively little shrub cover and *Pteridium esculentum* is prolific in the ground layer.

3. Grassy Woodland - a woodland or open-forest community is confined to north-facing slopes above the central creek and co-dominated by Messmate and Narrow-leaf Peppermint, 20-25 m in height. Below the eucalypt canopy *L. continentale* and *Banksia marginata* provide a patchy shrub layer 4 m tall. The ground layer is relatively rich in species (e.g. *P. esculentum, Themeda triandra, Stipa mollis, Acrotriche serrulata, Hypericum gramineum, Lomandra longifolia, L. filiformis, Bossiaea prostrata, Wahlenbergia gracilis, Lepidosperma concavum*).

4. Riparian Forest - a forest vegetation community restricted to the narrow, alluvial plain along the central creek and co-dominated by Messmate and Narrow-leaf Peppermint, 25-30 m in height. Below the eucalypt canopy is a patchy layer of smaller understorey trees, *Acacia melanoxylon, B. marginata, Melaleuca squarrosa,*

Table 1. Species recorded from Elliott and cage trapping (E), hair tubes (H), predator scats (S), pitfall traps (P) and bat (harp) traps (B), including total survey effort and vegetation communities from which they were recorded. * indicates introduced species. Numbers in parentheses indicate the total individuals trapped by cages, Elliotts or pitfalls. Vegetation community types corresponding to numbers are described in the text.

	Vegetation Community						
	1.	2.	3.	4.	5.	6.	7.
Species							
Swamp Antechinus *Antechinus minimus*	H			E(2)			H
Brown Antechinus *Antechinus stuartii*		E(1)		E(1)			E(2)
Common Ringtail Possum *Psuedocheirus peregrinus*	E(2), S			S			
Long-nosed Bandicoot *Perameles nasuta*	H						
Swamp Wallaby *Wallabia bicolor*	H						S
Bush Rat *Rattus fuscipes*	E(9),S,H	E(3), H	E(2)	E(1)	E(5), H	H	E(6),H
Chocolate Wattled Bat *Chalinolobus morio*	B(2)						
Southern Forest Bat *Vespadelus regulus*	B(2)						
Little Forest Bat *Vespadelus vulturnus*	B(5)				B(1)		
Lesser Long-eared Bat *Nyctophilus geoffroyi*	B(6)				B(5)		
Dog* *Canis familiaris*	S						
Fox* *Vulpes vulpes*	S			S			
Striped Marsh Frog *Limnodynastes peronii*	P(1)						
Pobblebonk (Banjo) Frog *Limnodynastes dumerilii*	P(1)						
Common Froglet *Crinia signifera*		P(1)					
McCoys Skink *Nannoscincus maccoyi*		P(2)					
Trap/survey effort							
Elliott/cage trap-nights	41.00	12.00	20.00	40.00	40.00	24.00	40.00
Bat (harp) trap-nights	3.00				3.00		
Pitfall trap-nights	18.00	6.00					
Predators scats analysed	7.00			3.00			1.00
Tube-nights	60.00	20.00			40.00	20.00	20.00

A. verticillata, 4-10 m tall and a dense ground layer (70-90% cover) of species typical of moist alluvial situations such as *Goodia lotifolia*, *P. esculentum*, *Calochlaena dubia*, *Todea barbara* and *Gahnia radula*.

*5. **Wet Heathy Woodland*** - a scattered and localised woodland community on infertile, frequently wet sites, co-dominated by Messmate and Narrow-leaf Peppermint, 10-16 m in height. Below the eucalypts is a sparse shrub layer of *L. continentale* and *Allocasuarina paludosa*, 3-6 m tall with 5% cover. The ground layer supports typical wet heath species such as *G. radula*, *X. minor*, *Bauera rubioides*, *Gonocarpus micranthus*, *G. tetragynus*, *Hibbertia procumbens*, *Poa clelandii*, *Lindsaea linearis*, *Selaginella uliginosa* and *Schoenus tenuissimus*.

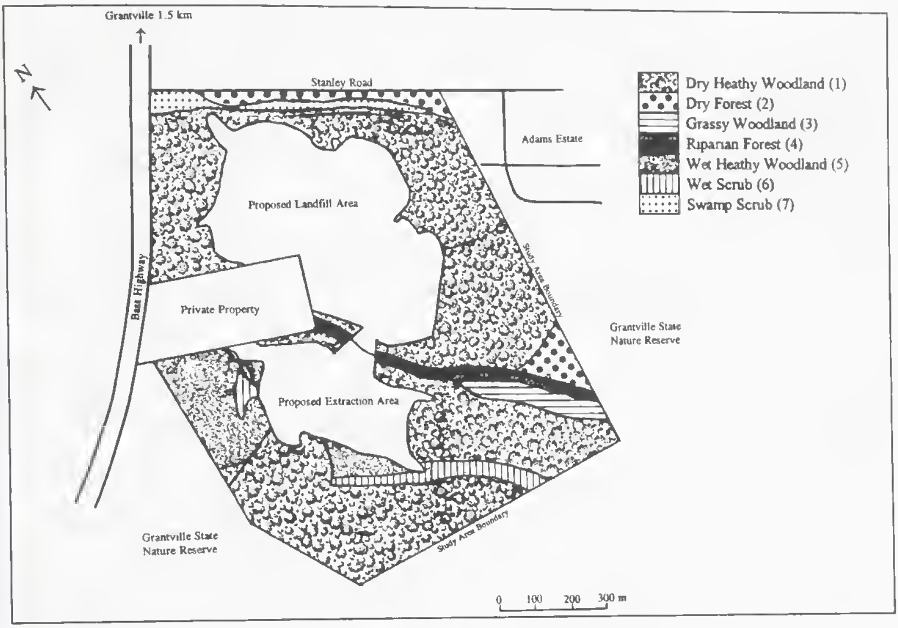

Fig. 1. Distribution of vegetation communities in the Grantville gravel reserve.

6. Wet Scrub - a scrub community restricted to wet, infertile drainage lines that is co-dominated by *L. continentale* and *M. squarrosa*, 4-5 m in height. The ground layer comprises a relatively small range of wet-adapted species such as *Gahnia radula, Selaginella uliginosa, B. marginata, Leucopogon australis, Schoenus tenuissimus, Dillwynia glaberrima, Gonocarpus humilis, H. procumbens and Schizaea asperula*. Emergent trees of Messmate occur in places.

7. Swamp Scrub - a scrub community confined to the relatively fertile, northern drainage line and dominated by Swamp Paperbark *M. ericifolia* and *L. continentale*, 10-12 m in height. An emergent layer of Swamp Gum *E. ovata* occurs in places. The ground layer consists of wet-adapted species such as *Lepidosperma laterale, P. tenera, Gahnia radula, Coprosma quadrifida, Gonocarpus humilis, Senecio minimus, Viola hederacea, Clematis microphylla, Danthonia semiannularis, Goodenia ovata* and *Microlaena stipoides*. Introduced Blackberry *Rubus discolor* occurs along disturbed margins.

Discussion

The large number of terrestrial vertebrate fauna species (134) recorded from all sources represents a rich and diverse community for such a small area (100 ha) and a short survey period (5 days). This is a reflection of the excellent undisturbed condition of the native vegetation communities in the area and the diversity of available habitat types. A survey of The Gurdies, a similar area of remnant native coastal vegetation on the eastern shores of Western Port and located 3.5 km north of the study area, also highlighted the richness of the vertebrate fauna (Wilson 1990).

Other species, not found in the Grantville survey, have been recorded for the area. Wilson (1990) recorded three mammals from The Gurdies - the Sugar Glider *Petaurus breviceps*, the Koala *Phascolarctos cinereus* and the Swamp Rat *Rattus lutreolus*. Additionally, the Atlas of Victorian Wildlife identifies the Water Rat *Hydromys chrysogaster* and a historical record (pre-1900) of the Feathertail Glider *Acrobates pygmaeus* for the area which includes the gravel and nature reserve. However, given the low total spotlight and trap effort in the 1994 study, it is likely that, with a more intensive survey, these species may be recorded here. There is also the potential for a number of additional significant, but more elusive, species to occur within the gravel and nature reserves including the Swamp Skink *Egernia coventryi*, the Glossy Grass Skink *Pseudemoia rawlinsoni*, the Eastern Pygmy-possum *Cercartetus nanus*, the White-footed Dunnart *Sminthopsis leucopus* and the Long-nosed Potoroo *Potorous tridactylus*.

Given the short period of survey, there was an emphasis on indirect techniques such as hair-tubing and predator scat analysis to supplement trapping and observational data. For many genera, indirect techniques are generally criticised for not providing an acceptable level of surety in identification or location. Lobert and Lumsden (1991) attempted to quantify the accuracy and reliability of the microscopic examination of mammalian hair, and grouped Victorian taxa into reliability categories: reliable; possible, and unreliable. With reference to the present survey, three species recorded by hair analysis are regarded as reliably identified: Long-nosed Bandicoot *Perameles nasuta*, Swamp Wallaby *Wallabia bicolor* and Bush Rat *Rattus fuscipes* (Lobert and Lumsden 1991). The latter two species were also observed or trapped and though the Long-nosed Bandicoot was not trapped, numerous diagnostic diggings were also present in the habitat in which the hair samples were recorded.

The Swamp Antechinus *Antechinus minimus* is considered to be unreliably identified by hair samples and easily confused with the Dusky Antechinus *A. swainsonii* (Lobert and Lumsden 1991). Two Swamp Antechinus were trapped in Riparian Forest and confidently identified as such. However, two hair samples collected in Dry Heathy Woodland and the Swamp Scrub and identified as *A. minimus/swainsonii* (B. Triggs *pers. comm.*) represent problematic records. Dusky Antechinus are typically found in damp, high rainfall and altitude environments with a dense ground vegetation cover to 1 m (Menkhorst 1995). Disjunct coastal populations also exist in wet heath habitat in the south-east Wannon region, the Otway Range, the Mornington Peninsula and Wilsons Promontory, and in coastal wet heath, Banksia woodlands and coastal forest in East Gippsland (Menkhorst 1995). Both the available habitat types and the ambiguous hair-tube result suggests that the Dusky Antechinus may occur in the gravel and nature reserves.This further highlights the need for additional survey in the site and the overall significance of this area of remnant coastal vegetation.

The bird community recorded from the gravel reserve is reasonably species rich, and includes a number of interesting records for the Western Port region. The Eastern Whipbird and the Red-browed Treecreeper represent isolated populations that are approximately at the western limit of their coastal range, while the Southern Emu-wren, Beautiful Firetail and White-browed Woodswallow are all uncommon species along the coast of Victoria (Emison *et al.* 1987). A number of bird species recorded in Appendix 1 are more typically associated with open wetlands, beaches and intertidal areas (e.g. Pacific and Silver Gull, Sacred and Straw-necked Ibis, Pacific and White-faced Herons, Australian Pelican, Little Pied Cormorant, Maned Duck, Hoary-headed Grebe). The gravel reserve does not naturally provide habitat for these species, however, the presence of the landfill and permanent standing water in the previously quarried extraction area has created both an artificial food source and wetland habitat for these species.

Of the vertebrate species recorded, one species of state conservation significance (Swamp Antechinus *Antechinus minimus*) and five species of regional conservation significance (Haswells Frog *Crinia haswelli*, Common Blue-tongue *Tiliqua scincoides*, Metallic Skink *Pseudemoia metallica*, Long-nosed Bandicoot *Perameles nasuta*) were identified. Significance was assessed according to current documented accounts of regional (the Western Port Catchment) and state distribution and conservation status (Andrews *et al.* 1984; DCNR 1995). These are discussed briefly below.

Swamp Antechinus - this species is classified as rare in Victoria (DCNR 1995), and has been recorded in a range of habitats ranging from near-coastal dense wet heath, wet tussock grassland and sedgeland and Brown Stringybark forest with a wet heath understorey (Menkhorst 1995). In the Western Port area it is considered to be very rare and restricted (Andrew *et al.* 1984), with the most recent record being one individual trapped in dense heathy shrubland at The Gurdies in 1984 (Wilson 1990). Two individuals were trapped in Riparian Forest, a vegetation type that has many structural and floristic similarities to the Brown Stringybark forest recorded as Swamp Antechinus habitat by Menkhorst and Beardsall (1982).

Long-nosed Bandicoot - this species has been previously unrecorded in the coastal woodlands and foothills surrounding Western Port, except the southern tip of the Mornington Peninsula (Andrew *et al.* 1984; Menkhorst 1995). Within most of its Victorian range, the Long-nosed Bandicoot is restricted to wetter riparian sites, being more common in high-rainfall areas such as the Eastern Highlands, Gippsland Plain, East Gippsland and the Otway Range (Menkhorst 1995). In the Western Port catchment it is restricted to higher altitude forested ranges where it is considered widespread but uncommon (LCC 1991; Menkhorst 1995). Two separate hair-tube samples were collected from Dry Heathy Woodland and these are considered as reliable records for reasons outlined earlier.

Metallic Skink - in Victoria the Metallic Skink is almost exclusively confined in distribution to coastal, woodland and forest areas in central and southern Gippsland (Cogger 1993). Although it is widespread and moderately common in the Western Port region (Andrews *et al.* 1984; LCC 1991), this species is restricted in South Gippsland, the islands of Bass Strait and Tasmania (Cogger 1993). Therefore, all sites in South Gippsland are important for the conservation of this skink species in Victoria. Two individuals were recorded in Dry Heathy Woodland.

Common Blue-tongue - in the Melbourne region, this large skink is most commonly found in grasslands and grassy woodlands associated with the western basalt plains and is considered to be moderately common in the Melbourne Area District 2 (LCC 1991). It has not been recorded previously in the Western Port catchment (Andrews *et al.* 1984) and is not expected to occur in South Gippsland where the Blotched Blue-tongue *Tiliqua nigrolutea* is the common species (Cogger 1993). Therefore, the individual recorded in Dry Heathy Woodland during the present survey may either represent a new record for the local area or could possibly be a specimen collected from outside the Western Port catchment and released into the reserve.

Haswells Frog - this frog is found in habitats associated with water in wet and dry forests, woodlands, shrublands and coastal heath in eastern Victoria (Hero *et al.* 1991). It is considered to be restricted and uncommon in the region (Andrews *et al.* 1984; LCC 1991), being recorded most commonly from The Gurdies, Hastings and Grantville areas. Two individuals were heard calling in Riparian Forest.

The vegetation over most of the study area, away from the existing pits, is considered to be in excellent, undisturbed condition. Large areas have not been burnt for at least 45 years; this may have led to a temporary reduction in species diversity. The forest along the central creek is in particularly good condition, and appears never to have been logged. Large, mature trees are common in this area; one Messmate has a girth at breast height of 4.9 m. Weed levels are very low, even in the Riparian Forest and Swamp Scrub, habitats usually prone to weed invasion.

All vegetation communities within the study area are considered significant for nature conservation, due to their depletion either within Victoria or the Western Port region. Two communities (Grassy

Woodland, Swamp Scrub) are of state significance due to their depletion in Victoria resulting from land clearance, alteration of remnants (particularly through weed invasion) and their inadequate reservation. Five communities (Dry Heathy Woodland, Dry Forest, Riparian Forest, Wet Heathy Woodland, Wet Scrub) have regional significance due to their depletion within the region. In addition, several of the communities recorded in this survey are poorly reserved in the coastal areas around Western Port and Port Phillip bays. Management of these areas of remnant vegetation to protect flora and fauna is a priority for conservation in the region.

The gravel reserve is under considerable pressure for further development. In its Final Recommendations for the Melbourne Area District 2 Review, the Land Conservation Council recommended division of the gravel reserve into a northern Grantville refuse area (M14) to facilitate establishment of a landfill based on the existing, almost worked-out gravel pit, and a southern stone reserve (L1) to facilitate further sand/gravel extraction (LCC 1994). A regional landfill and transfer station is proposed for M14; these require relatively little vegetation clearance (<2 ha). Details of the proposed development and environmental mitigation measures are given in the site management plan for the proposed landfill and transfer station (AGC Woodward-Clyde 1994). Mineral exploration leases cover the remainder of the gravel reserve (L1).

The detailed report on the gravel reserve (Yugovic and Kutt 1995), recommends that consideration be given to transferring the south-eastern section of the gravel reserve, which includes the creek environment, to the adjacent nature reserve. This highly significant 17.5 ha area supports five vegetation communities, including Riparian Forest and Grassy Woodland. The forest along the creek and adjacent slopes is in particularly good condition and appears never to have been cleared. Since gazetting of the nature reserve has not taken place, this transfer would be administratively convenient.

The recommended transfer has been adopted in the draft regional sand extraction strategy - Lang Lang to Grantville - prepared for the Department of Planning and Development through a public consultative process (AGC Woodward-Clyde 1995). The draft strategy addresses conservation issues, particularly the need to maintain vegetation linkages between the Grantville nature reserve/gravel reserve and areas of native vegetation further north, to facilitate wildlife movement and enhance reserve viability.

The Grantville gravel reserve lies adjacent to, and continuous with, the (proposed) Grantville state nature reserve (an area of 378 ha). It is likely that all vegetation communities and fauna species recorded in the gravel reserve also occur in the nature reserve. These reserves represent the southernmost remnant of native vegetation in a chain of partially connected remnants which collectively comprise most of the remaining native vegetation in West Gippsland, an area which is over 95% cleared. Sand mining, residential development and land management are important issues affecting the future maintenance of these connections. Given these conflicting land-use pressures, gazetting this reserve should be a priority for regional conservation authorities. A complete survey and inventory of the flora and fauna of the entire Grantville nature reserve is required for a more confident assessment of the conservation significance and management potential of this area.

Acknowledgments

The authors wish to thank Sid Larwill and Charles Meredith, Biosis Research Pty. Ltd., for reviewing and editing this manuscript, Barbara Triggs ('Dead Finish' Genoa Vic, 3891), for hair and scat analyses and Bessie Tyers (Westerport Bird Observers Club) for additional bird records. All trapping was conducted under the terms of Department of Conservation and Natural Resources (DCNR) wildlife research permit RP-92-154.

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Appendix 1 All fauna species recorded or reported from the Grantville gravel reserve and surrounding local area. 'W' denotes species recorded in the reserve by the Western Port Group of the Bird Observers Club of Victoria. 'AVW' denotes records from from the Atlas ot Victorian Wildlife for the local area (N 38° 25′, S 38° 27′, E 145° 33′ W 145° 30′) including the gravel and nature reserve. 'Anecdotal' denotes species reported from the reserve by Department of Conservation and Natural Resources staff but requiring confirmation.

Native Birds

Hoary-headed Grebe *Poliocephalus poliocephalu* W
Australian Pelican *Pelecanus conspicillatus*
Litle Pied Cormorant *Phalacrocorax melanoleucos* W
Paci fic Heron *Ardea pacifica* W
White-faced Heron *Ardea novaehollandiae*
Sacred Ibis *Threskiornis aethiopicus*
Straw-neck ed Ibis *Threskiornis spinicollis* W
Maned Duck *Chenonetta jubata* W
Marsh Harrier *Circus aeruginosu* W
Brown Goshawk *Accipiter fasciatus* W
Wedge-tailed Eagle *Aquila audax*
Whistling Kite *Haliaster sphenurus* W
Black-shouldered Kite *Elanus notatus* W
Australian Hobby *Falco longipennis* W
Brown Falcon *Falco berigora*
Silve r Gull *Larus novaehollandiae*
Pacific Gull *Larus pacificus*
Purple Swamphen *Porphyrio porphyrio* AVW
Common Bronzewing *Phaps chalcoptera*
Yellow-tailed Black-cockatoo *Calyptorhynchus funereus*
Galah *Cacatua roseicapilla*
Rainbow Lorikeet *Trichoglossus haematodus*
Crimson Rosella *Platycercus elegans*
Eastern Rosella *Platycercus eximius*
Pallid Cuckoo *Cuculus pallidus*
Fan-tailed Cuckoo *Cuculus pyrrhophanus* W
Horsfields Bronze-cuckoo *Chrysococcyx basalis*
Shining Bronze-cuckoo *Chrysococcyx lucidus* W
Southern Boobook Owl *Ninox novaeseelandiae*
White-throated Needletail *Hirundapus caudacutus* W
Laughing Kookaburra *Dacelo novaeguineae*
Sacred Kingfisher *Halcyon sancta*
Welcome Swallow *Hirundo neoxena* W
Black-faced Cuckoo-shrike *Coracina novaehollandiae*
Whites Thrush *Zoothera dauma*
Scarlet Robin *Petroica multicolor*
Eastern Yellow Robin *Eopsaltria australis*
Jacky Winter *Microeca leucophaea* W
Crested Shrike-tit *Falcunculus frontatus* W
Golden Whistler *Pachycephala pectoralis*

Rufous Whistler *Pachycephala rufiventris*
Grey Shrike-thrush *Colluricincla harmonica*
Leaden Flycatcher *Myiagra rubecula*
Satin Flycatcher *Myiagra cyanoleuca*
Grey Fantail *Rhipidura fuliginosa*
Rufous Fantail *Rhipidura rufifrons* W
Willie Wagtail *Rhipidura leucophrys*
Eastern Whipbird *Psophodes olivaceus*
Southern Emu-wren *Stipiturus malachurus* W
Superb Fairy-wren *Malurus cyaneus*
White -browed Scrub-wren *Sericornis frontalis*
Striated Thornbill *Acanthiza lineata*
Yellow Thornbill *Acanthiza nana* W
Brown Thornbill *Acanthiza pusilla*
Buff-rumped Thornbill *Acanthiza reguloides*
Yellow-rumped Thornbill *Acanthiza chrysorrhoa* W
Varied Sitella *Daphoenositta chrysoptera* W
Red-browed Treecreeper *Climacteris erythrops* W
White-throated Treecreeper *Climacteris leucophaea*
Brown Treecreeper *Climacteris picumnus* W
Red Wattlebird *Anthochaera carunculata*
Noisy Miner *Manorina melanocephala* W
Yellow-faced Honeyeater *Lichenostomus chrysops*
White-eared Honeyeater *Lichenostomus leucotis* W
White-plumed Honeyeater *Lichenostomus penicillatus* W
Brown-headed Honeyeater *Melithreptus brevirostris*
White-naped Honeyeater *Melithreptus lunatus*
New Holland Honeyeater *Philidonyris novaehollandiae*
Crescent Honeyeater *Philidonyris pyrrhoptera*
Eastern Spinebill *Acanthorhynchus tenuirostris*
Mistletoebird *Dicaeum hirundinaceum* W
Spotted Pardalote *Pardalotus punctatus*
Striated Pardalote *Pardalotus striatus*
Silvereye *Zosterops lateralis*
Beautiful Firetail *Emblema bella* W
Red-browed Firetail *Emblema temporalis*
Olive-backed Oriole *Oriolus sagittatus* W
Australian Magpie-lark *Grallina cyanoleuca*
White-browed Woodswallow *Artamus superciliosus* W
Dusky Woodswallow *Artamus cyanopterus* W
Grey Butcherbird *Cracticus torquatus* W
Australian Magpie *Gymnorhina tibicen*
Grey Currawong *Strepera versicolor*
Australian Raven *Corvus coronoides*
Little Raven *Corvus mellori*

Introduced birds
Common Blackbird *Turdus merula*
European Goldfinch *Carduelis carduelis* W
House Sparrow *Passer domesticus* W
Common Myna *Acridotheres tristis*
Common Starling *Sturnus vulgaris*

Native mammals
Short-beaked Echidna *Tachyglossus aculeatus*
Swamp Antechinus *Antechinus minimus*
Brown Antechinus *Antechinus stuartii*
Southern Brown Bandicoot *Isoodon obesulus*
Long-nosed Bandicoot *Perameles nasuta*
Common Brushtail Possum *Trichosurus vulpecula*
Common Ringtail Possum *Pseudocheirus peregrinus*
Red-necked Wallaby *Macropus rufogriseus* *Anecdotal*
Eastern Grey Kangaroo *Macropus giganteus*
Swamp Wallaby *Wallabia bicolor*
Common Wombat *Vombatus ursinus*
White-striped Freetail Bat *Tadarida australis*
Chocolate Wattled Bat *Chalinobus morio*
Southern Forest Bat *Vespadelus regulus*
Little Forest Bat *Vespadelus vulturnus*
Lesser Long-eared Bat *Nyctophilus geoffroyi*
Bush Rat *Rattus fuscipes*
Swamp Rat *Rattus lutreolus* AVW
Water Rat *Hydromys chrysogaster* AVW

Introduced mammals
Dog *Canis familiaris*
Rabbit *Oryctolagus cuniculus*
Fox *Vulpes vulpes*

Reptiles
Tree Goanna (Lace Monitor) *Varanus varius* Anecdotal
Southern Water Skink *Eulamprus tympanum*
Eastern Three-lined Skink *Bassiana duperreyi*
Garden Skink *Lampropholis guichenoti*
McCoys Skink *Nannoscincus maccoyi*
Grass Skink *Pseudemoia entrecasteauxii*
Metallic Skink *Pseudemoia metallica*
Blotched Blue-tongue Lizard *Tiliqua nigrolutea*
Common Blue-tongue Lizard *Tiliqua scincoides*
Lowland Copperhead *Austrelaps superbus*
White-lipped Snake *Drysdalia coronoides* AVW
Tiger Snake *Notechis scutatus* AVW

Amphibians
Southern Brown Tree Frog *Litoria ewingii*
Growling Grass Frog *Litoria raniformis* AVW
Whistling Tree Frog *Litoria verreauxii*
Victorian Smooth Froglet *Geocrinia victoriana*
Pobblebonk (Banjo) Frog *Limnodynastes dumerilii*
Striped Marsh Frog *Limnodynastes peronii*
Spotted Marsh Frog *Limnodynastes tasmaniensis*
Haswells Froglet *Crinia haswelli*
Common Froglet *Crinia signifera*
Southern Toadlet *Pseudophryne semimarmorata* AVW

From our Naturalist in Residence, Glen Jameson

Middle Yarra Timelines

The Middle Yarra Timelines project is being developed by The Field Naturalists Club of Victoria, the Gould League and the Yarra Valley Parklands (Melbourne Parks and Waterways), to record and analyse seasonality themes - the relationships, interactions and sequence of events of the natural history of the Middle Yarra area. The project is establishing a data base of information that will be of critical value to land managers, eco-tourist providers and environmental educationalists.

An interim six season calendar year has been produced from this data. The seasons are cyclic, sensitive to climatic variability and delineated by the occurrence and associations of natural phenomena, rather than dates. The idea behind this series is to represent a mythical day for each of those seasons, a day that incorporates all of the important seasonal indicators and patterns, characteristic of that season.

Late Summer

The coolness of the morning air is striking as you walk in the thick mist that traces the journey of the river, mists that present a new world, shrouded in mystery and magic. Silver mists that shimmer or catch golden shafts of morning sun before they melt and race quickly downstream, following the flow of water. A chorus of ten Kookaburras *Dacelo novaeguineae* break the morning skies with a seasonal flocking of the local Kookaburra population.

Manna Gums *Eucalyptus viminalis*, resplendent after shedding their bark during High Summer, with their sleek and elegant trunks and boughs and lush canopy of deep green dotted with cream flowers; they are a commanding presence along the river. Winding down from the nights foraging, a female Koala *Phascolarctos cinereus*, with a young on its back, prepares for a quiet doze on a chosen bough. Last night a male was calling from along the river, marking out territory. A mixed flock of Yellow-rumped Thornbills *Acanthiza chrysorrhoa* and White-plumed Honeyeaters *Lichenostomus penicillatus* work the Riparian tree leaves for invertebrates. River Reed *Phragmites australis* continues to flower on the river's edge.

The river level is a little higher, and its pale creamy chocolate colour describes the degree of turbidity and suspended materials that have been washed down with the rains, which have also caused localised erosion. This in turn affects the biological productivity of the Yarra River which is largely limited by the degree of turbidity. The river water is still reasonably clear and warm enough to support a high diversity of aquatic invertebrates. However, the life cycles begin to slow, with no new instars being formed as the populations of Chironomids, Mayflies *Tasmanocoensis* sp. Caddis Fly *Cheumatopsyche* sp., Water Boatmen *Micronecta* sp. and others, mature and begin to die off. The invertebrate fauna over the True Spring to Late Summer period is dominated by fauna of tropical region origins. During the cooler, Winter months, invertebrate fauna with Gondwana affiliations will dominate.

It is the time for young Platypus *Ornithorhynchus anatinus* to emerge from Riverbank nests for the first time since hatching in October or November. The downstream migration of Short-finned Eels *Anguilla australis*, known as Silver Eels in this part of their life cycle, picks up momentum with a peak in migration of mainly mature females, between 10 and 20 years old, heading towards the estuaries. The slower swimming males have been leaving since True Spring. All the Silver Eels will now begin a 2 to 3 month swim towards the Coral Sea to spawn. Tupong *Pseudaphritis urvillii* will complete its upstream migration from estuary breeding grounds, reduced water flow and higher water temperature assisting its upstream migration.

Over the past weeks, the mists have been slowly building up, especially after Thunderstorms and subsequent rain. The

Thunderstorms dramatically descend upon the Yarra Valley after sweeping across the flat landscape of the western basalt plains, breaking up the pleasant settled weather patterns of the late Summer, weather that is some of the most pleasant and liveable for the whole year. It is a time for gatherings and celebration; a flocking of birds, a traditional gathering of the Wurundjeri Tribe and Kulin Nation at Bolin Bolin to dance the Gaggit and other healing ceremonies, and marching at Moomba. The winds preceding the change cause an enormous amount of leaf to fall and carry flocks of White-throated Needletails *Hirundapus caudacutus* that feed on the abundance of invertebrates swept up in the updraught caused by the change in weather. However, this is the last season before they return to Eastern Siberia, maintaining an eternal Summer (to the envy of the great Australian beachcomber).

Sacred Kingfisher *Todiramphus sancta* having completed their breeding cycle are often observed relaxing on their favourite perches before their northern trek. However, some Rufous Fantails *Rhipidura rufifrons* still have young in a nest in a damp gully and will need to work hard to be ready for the northward migration to New Guinea, 10,000 km away. The Pied Currawongs *Strepera graculina* have returned from their secretive mountain breeding places used over the True Spring and High Summer. They tour in huge assemblies, along the river valley with their whistling, ringing range of calls announcing their Timelonic* triumphant return to the lowlands. After this, they break into smaller groups to forage or to harass resident birds such as the Collared Sparrowhawk *Accipiter cirrhocephalus*. Gang Gang Cockatoos *Callocephalon fimbriatum* have also returned from the mountains and both they and the Pied Currawongs take full advantage of the ripe fruit of the highly invasive pest plant Hawthorn *Crataegus monogyna*, which has become naturalised along the Riverine environment.

Downstream billabongs and wetlands metamorphose further; low river levels and lack of substantial floods during this past year have meant that the older and shallower billabongs, such as the Annulus, are almost completely dry. A scattering of Carp *Cyprinus carpio* corpses mark a critical low water level for these exotic fish. However, Bolin Bolin Billabong, which was formed more recently and has a lower river ingress level, managed to fill during the last modest rise in river levels in August last year. Its waters are still fairly deep and support a range of wildlife including Darters *Anhinga melanogaster* that are breeding further downstream. Nomadic Black-fronted Dotterels *Elseyornis melanops* work the Wetland margins where Small Mud-mat *Glossostigma elatinoides* with pale mauve flowers, Small Knotweed *Polygonum plebeium* and Spreading Sneezeweed *Centipeda minima* try to cover the available space. There is still an occasional Latham's Snipe *Gallinago hardwickii* to see before they migrate to Japan during the next season. The Frogs are generally quiet and will need a good soaking rain to re-activate them again. The Peron's Tree Frog *Litoria peroni*, have stopped calling altogether.

The rains that have fallen have begun the greening of the grassy valley slopes where the bright-red, bell flowers of Cranberry Heath *Astroloma humifusum* bloom, and the white orchid Parson's Bands *Eriochilus cucullatus* join the Autumn Bird-orchid *Chiloglottis reflexa* and the Autumn Greenhood *Pterostylis revoluta* to mark the change of season. Occasional flowering of Twining Rush-lily *Tricoryne elatior* and Golden Weather-glass *Hypoxis hygrometrica* occurs as more temperate conditions return. Sweet Bursaria *Bursaria spinosa* and Lightwood *Acacia implexa* will complete their flowering. Flocks of up to thirty Eastern Rosellas *Platycercus eximius* feed on the ground among the native and exotic grasses. Large flocks of Sulphur-crested Cockatoos *Cacatua galerita* feed on the corms of the well-established pest plant, Onion Grass *Romulea rosea*.

Candlebark *Eucalyptus rubida* has also shed its bark over High Summer and now gleams white in the afternoon sun. On one of its boughs a Drooping Mistletoe *Amyema pendulum* flowers, a food plant for the larvae of the Olane Azure Butterfly *Ogyris olane ocela*. Silver-leaf Stringybark *E. cephalocarpa* is also in flower and these trees are scattered throughout the Middle Yarra but are a more dominant species in the vegetation towards Ringwood and beyond. A few clouds have begun to drift over the skies and are more of a feature of the Late Summer as more moisture gathers in the atmosphere.

Excitable family flocks of Australian Magpies *Gymnorhina tibicen* sweep the tree tops, their ranks swollen with the now aerially able, sub-adults of the last breeding season. Sugar Gums *E. cladocalyx*, in flower, provide an important focus for increasingly larger flocks of Musk Lorikeet *Glossopsitta concinna* and Rainbow Lorikeets *Trichoglossus haematodus*. Over the past few years they have swept the Yarra Valley in vast flocks, numbering over a thousand birds as was observed at Petty's Orchard in Yarra Valley Parklands last year. Swift Parrots *Lathamus discolor* also take advantage of this and other nectar feeding opportunities on the mainland, after their winter migration from Tasmania.

Long-leaf Box *E. goniocalyx* is in flower along the ridge tops. Its wood was not valued by timber harvesters over the years, therefore it is often the dominant remnant tree on the drier hilltops. Snakes are more often observed now that the very hot weather has passed, out for the last feeds prior to inactivity over winter. The last of the Late Summer generation of Imperial Whites *Delias harpalyce* and some Wood Whites *D. aganippe* feed on the flowers of Box Mistletoe *A. miquelii*, also a food plant for the larvae of both species. Common Brown Butterflies *Heteronympha merope* are plentiful and often accumulate on the ridge tops awaiting breeding opportunities. Some mornings they may be found fluttering helplessly on the ground until their wings dry out from the overnight dew. Dusky Woodswallows *Artamus cyanopterus* have begun to flock, as a prelude to migration after a busy Late Summer of feeding. Often a group will sit huddled along a dead branch, preening and sunning.

In the mid afternoon heat on a dry rocky ridge, Sugar Ants *Camponotus 'consobrinus'* are in the process of launching winged reproductive males and females in anticipation of a change in weather, needing windy days to help their dispersal. A chain of frenetically busy 'worker' ants are helping the winged 'Flying Ant' reach the top of a small flat rock which will be the launching pad. An immense amount of the Sugar Ant colony's energy is put into preparing each 'Flying Ants' for the launch. Huge 'Soldier' Ants strut around the perimeter checking security details. The whole process takes hours and requires such a high degree of social planning that it must be the envy of every Moomba procession organizer.

A Common Myna *Acridotheres tristis*, and other birds, will take advantage of Sugar Ants swarming prior to Late Summer rainstorms by 'anting' themselves (that is, using the ants to de-louse their bodies). They will either take up a posture over the ant colony entrance, forcing the ants to climb over its body or by actively picking up ants and placing them under its wing.

A huge gathering, almost fifty birds, of Black-faced Cuckoo-shrikes *Coracina novaehollandiae*, having radiated out into the local forests of Warrandyte and Eltham to feed during the day, are now returning to their roosting trees in the late afternoon. After returning from all points of the compass, they have congregated in two large Red Box *E. polyanthemos* on a commanding ridge overlooking the Warrandyte Gorge.

Mole Crickets *Gryllotalpa* sp. ring out their vibrating calls just prior to a sunset which has a spectacular range of texture and colour due to the smog-painted atmosphere above Melbourne's city centre. The settled Late Summer weather is conducive to the build up of the smoggy pollutants produced by the daily routines of industrialised cities and, with very little breeze to blow them to other environments, they become concentrated .

Sugar Gliders *Petaurus breviceps* with

some newly weaned young, move into the flowering Sugar Gums as soon as night falls, taking advantage of the prolific nectar and pollen production of this non-indigenous Eucalypt. Unfortunately the Sugar Gums being well pollinated by their many visitors have begun to spread into nearby Bushlands and hybridise with local Eucalypts. Deep into the darkness of the starry night, haunting deep calls of the Powerful Owl *Ninox strenua*, boom out from a heavily wooded gully, resonantly filling the river valley with its mystery and strength.

* Timelonic – a particular observation of a natural phenomenon which gives insight into the function or nature of an interaction or association.

Acknowledgements

I would like to thank Malcom Calder, Cecily Falkingham, Ed Grey, Pat Grey, Alan Reid, John Reid, Elizabeth Sevior, Ken Simpson, Vin Pettigrove, the Middle Yarra Timelines Committee and all who have contributed to the data bank of information for the Project so far.

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Glen Jameson

PO Box 568, Templestowe, Victoria 3106.

And from one of our naturalists in the country

An Ibis Rookery

The summer of 1995/6 was a particularly grassy year. Beautiful level crops of Rye Grass gladdened the hearts of the hay-makers, if not those of the hay-fever sufferers. Both common species of Ibis worked over the newly-cut paddocks in their thousands. The country between the township of Mirboo North and the district of Mardan is hilly with smooth rolling hills and broad-floored valleys, and many of the minor creeks have been dammed for irrigation purposes. On one of these lakes the Australian White Ibis *Threskiornis molucca* has established a rookery. We estimated about 200 birds on nests this past spring/summer. It is quite a spectacular sight in the peak of their season on this private property. On the paddocks both species of Ibis were intermingled, but only the Australian Whites appeared to be breeding. The nests are on the flattened tops of the drowned gully vegetation. The colony has apparently been there for some years.

Powerful Owls

On Australia Day in January of this year we had the pleasure of watching two Powerful Owls *Ninox strenua*, temporary visitors I think, in Morwell National Park. They were roosting in thick dark Blackwoods or Pittosporums, and had been under observation for some days previously, beside the creek track. The big birds suffered walk, talk and gawk parties with patience and aplomb. Ringtail Possums are a very plentiful species in Gippsland but we are a little nervous as to the fate of our few known Greater Gliders. There was no evidence of long-time roosting, so perhaps the owls were just passing through.

Ellen Lyndon

7 Steele Street, Leongatha, Victoria 3953

An Inlet Lost - An Inlet Regained

(with apologies to John Milton)

Arthur Farnworth[1]

Mallacoota Inlet, well-known to many FNCV members, has been described as 'a quiet little fishing village some 520 km east of Melbourne near the border of Victoria with New South Wales'. It is an estuarine system comprising two rivers (Genoa and Wallagaraugh) flowing into the upper of two lakes which are connected by a narrow strip of water and finally discharging into the Tasman Sea through a narrow inlet across a sand bar (Fig. 1).

During the last Ice Age (20,000 years ago) neither lake existed and the rivers flowed directly to the sea. As the polar ice caps melted, the sea-level rose and drowned the Genoa River Valley. Waves and currents then deposited sand, creating dunes and forming a barrier that closed off the lakes from the sea, apart from a narrow inlet, the position of which occasionally changes by short distances, depending on sea action and river flow.

However, late in 1994 a combination of low rainfall upstream (which slowed the flow of the rivers) and rough seas (which deposited tons of sand) made the sand bar massive (1.8 m above lake level at its highest point) and closed the inlet (Fig. 2). It remained so for over a year. Local historians believe it is only the third time this century that this has happened. The first occasion was in the 1920's when the inlet was re-opened after a few weeks by dredging and carting away the sand by horse and dray. The next closure was in 1987 and lasted for several weeks, until heavy storms inland created a river flow sufficiently powerful to break through the bar.

The latest prolonged closure in 1994/95 caused the water level in the lakes to rise quite markedly and created several problems and considerable concern because:

-the rivers upstream flooded adjacent low-lying farms and caused salinity problems;

-the professional fishermen, licensed to net in Bottom Lake, claimed the fish balance was being disturbed because of the lack of migration between sea and lake;

-several of the jetties around the lakes were partially or totally submerged so that boat owners had to climb up rather than step down from the jetty into their boat (fig. 3);

- sections of the road connecting a residential area with the town were flooded and became impassable;

- resultant ecological changes either attracted more water birds to the area or led the existing already-large population to congregate in specific locations around the lake (Fig. 4).

An unexpected outcome of this was an almost epidemic outbreak of 'pelican itch', a parasitic infection associated with the combined effects of large numbers of water birds and low, or no, water movement, and which affected humans making contact with the water.

In mid-July 1995 the East Gippsland Shire Council, the Port Authority and the Victorian Department of Conservation and Natural Resources joined forces to try and open a channel using earth-moving equipment, though without too much optimism because the difference between the water level on either side of the bar was only about 0.3 m. In the event a breakthrough was achieved but produced merely a trickle rather that a hoped-for 'ruddy blush'. Within hours the inlet was closed once more, thanks to the movement of sand by the waves.

By mid-October the situation had become quite critical and a decision was taken to bring in a large bulldozer and again try to excavate a channel across the bar. This was done on Tuesday, 24 October and by lunchtime a trickle of water was flowing across a newly-created wide, low, flat area of sand. Then nature

[1] 47 The Boulevarde, Doncaster, Victoria 3108

Fig. 1. The normal situation - the lake and sea connected by the inlet/outlet across the sand bar.

Fig. 2. An intact sand bar seals off the lake from the sea.

intervened. Ten centimetres of rain had fallen upstream over the preceding four days and this created enough turbulence downstream to start moving sand. The steady flow across the flat became increasingly vigorous, cutting a channel, the sides of which kept collapsing inward to increase its width. By the following

Fig. 3. One of the many jetties around the lakes partially or totally submerged by the rising water, leaving boats high but far from dry.

Fig. 4. The clan gathers - pelicans congregate in specific areas, survey the scene and discuss the increasing level of the lake.

morning a brand new 50-metre-wide inlet existed and the level of the lake had dropped considerably. A further fall of 15-20 cm of rain over the next few days ensured that the new channel 'stayed put'. Mafeking had been relieved!! After being 'lost' for just over a year, Mallacoota's inlet had been 'regained'.

And, as they say in the classics, truth is stranger than fiction. The local newspaper, 'The Mallacoota Mouth', reported that 'people were carrying off bags of fish which they had plucked semi-stunned from the shallow sea water near the edges of the boiling torrent. One lucky local had managed to wrestle a giant Flathead to shore bare handed'.

One final reflection on this most unusual occurrence; the jetties, lying a few centimetres below the surface of the lake, provided a golden opportunity for anyone with delusions of grandeur to practice walking on water. Rumour hath it that several MPs of all political persuasions were occasionally seen at Mallacoota Inlet during the latter months of 1995!!!

The You Yangs Range

by Trevor Pescott

Publisher: *Yaugher Print, 4 Victoria Terrace, Belmont, Victoria 3216.*
112 pages, size 21x15 cm. RRP $17.95. Available from bookshops or Yaugher Print.

This well presented book will appeal to most readers interested in local natural history. It is divided into 3 parts, the physical study of the You Yangs range itself (along with the extremes of climate that have fashioned it), the flora and fauna and, for the historians, the human history of the area.

As you read each, the reader realises that there has been much detailed research and experience gone into developing each section. The book is essential for the quarter million visitors per year making day excursions to the Park.

The You Yangs Range is unique in that it is a granitic residual projection, over 300m above the Plio-Pleistocene basalt plain. Attractively-coloured photographs throughout the book illustrate the physical aspects of the range as well as the flora and fauna. This breaks up the text, but the photographs then encourage the reader to search the text for more detail on a particular topic.

Bird observers are well catered for as well as those who are keen on the botany of the area. In a book of this size it is impossible to specialise in every topic, but the essentials are there - orchids, grasses, fungi and flowering plants.

Finally the history - from Aboriginal through European settlement to the present time - is treated from the local view-point. Pages 101-103 then deal with species which have disappeared and the factors which have influenced this. It is interesting to read what early field naturalists from Melbourne and Geelong thought about the You Yangs when it was explored during the last century.

There is a two-page reference section at the end of the book and most date from 1950 to the present. A useful index finishes the document.

Trevor Pescott has clearly made a most interesting and valuable summary of scientific and historical information on the You Yangs, and anyone interested in the area, perhaps wishing to explore this region within a limited time, or wishing to do a local study is well advised to buy a copy. It is also a must for field naturalists and day visitors to the area and good value at the RRP of $17.95.

Noel Schleiger
35/20 Were Street, Montmorency, , Victoria 3094

The Field Notebook
Recording your Observations

Alan J. Reid[1]

When you are out in the field, whether casually observing or undertaking a systematic survey, an organised field notebook or standardised recording pad is a must. It is obviously so much easier for transferring your data to your permanent files, if the layout of the notebook or pad reflects the nature of your file recording at home.

A simple lay-out

Up until 1995, I found that the simplest organisation for a notebook page was a two column format. In the smaller column I placed background details like **date, time, place** and **weather;** in the larger, I would record details of the event and include sketches if needed.

To more easily find a reference to a species whilst browsing through the book, I would either underline the species name or place it in the first column.

In the field it was easier to use a simple kind of personal shorthand - omitting prepositions, articles or conjunctions; using initials and abbreviations for the names of well-known animals and plants; including symbols for weather conditions. Below is an example:-

Date, Place, etc	**Event**
13/11/94 Kildun 03.0,090 f2w0 cloudy 20 10am	<u>BFCS</u> nest 10m dead <u>swamp gum</u> N of lake - incubating AJR TA
Translated this meant:-	At the Kildun property at Glenburn, on the 13th of November 1994 at 10am, the weather was cloudy with a force 2 westerly wind. The temperature was 20 degrees. At grid reference point 03.0,090, we found the nest of a Black-faced Cuckoo-shrike, ten metres up in a dead swamp gum on the north side of the lake. A bird was on the nest. The observers were Alan Reid and Tim Anderson

Meaningful recording

The most useful records are those that demonstrate connections between organisms and between organisms and events. Consider the differences between these two recordings of the same observed event:-

'Today I saw a Yellow Robin sitting on a stump. While I was watching it flew down to the ground and pecked at something in the litter'

'4.35pm. <u>Yellow Robin</u> in teatree scrub picked up <u>woolly-bear caterpillar</u> from ground litter. Sorted through litter - found 1 <u>millipede</u>, 2 small <u>centipedes</u> & 4 <u>mould hoppers</u>'.

Note the meaningful follow-up action recorded in the second observation!

Recording for computer entry

If you are using card files, a journal or filing cabinet folders as the final resting place for your permanent records, then you will have the task of indexing and cataloguing your records for easy recovery. You may even have to make double or triple entries to cope with complex events like those described above.

Now that the Timelines Australia Project is operating, we at the Gould League are encouraging naturalists to record their observations in a standardised format suitable for

[1] RMB 6297, Burns Road, Glenburn, Victoria 3717

computer entry into and extraction from local and national databases of seasonal information. This reporting requires the use of codes to categorise such information as **locality, vegetation, weather, behaviour** and **numbers** in addition to the event description.

The cuckoo-shrike observation above would now read as follows in my database file:-.

Date Time	Locality Lat/Long	Veg. Code	Weather Code	Action Code	Species	Count Code	Event Described
131194 10 am	Glenburn 37°.25′, 145°.27′	B03 F01	D	16.00	BFCS Swamp Gum	1AM 1AF	BFCS nest in dead Swamp Gum on N side of lake 10m high

In this example B03 = low, open forest, F01 = lake, D = Overcast, light breeze, 16 = incubating, BFCS = Black-faced Cuckoo-shrike, 1AM = one adult male and 1FM = one adult female.

Details of the codes can be found in the Gould League's new nature diary, 'Banksias & Bilbies'. Copies of the standardised recording sheets for the Timelines Project can also be obtained from the League.

But, of course, the basic ingredient is that first observation. If the recording in your field notebook can be tailored to fit into this scheme, opportunities for combining and sharing our knowledge of Australian natural history will be vastly increased.

Anointment of a Naturalist

It is said that one can't ride a bike until one takes a fall, an actor doesn't become an actor until one breaks a leg, a racing car driver doesn't earn his stripes until he has had a bingle, so there may be something in why this article is headed as it is, I leave it for the reader to decide.

Whilst surveying with staff of Melbourne Parks and Waterways (Craig Lupton) in the Stonyford Creek area at Silvan on the night of 15.11.95, dull eye shine in the mid storey was observed at a distance of approximately 150 m. Identification with the aid of binoculars could not be made due to the density of foliage. As each encountered animal was being documented, it was necessary to obtain correct identification. One of the difficulties in pushing into the scrub for such a distance towards the animal is that you lose your bearing somewhat, especially when the undergrowth is so dense. Also unless there is some outstanding feature to hone into, it is very difficult to recognise the tree you think the animal was in.

To overcome these problems, the method used in this instance was for the light to be held on the animal, or where it was last seen by person (A). Another person (B) then moves into the scrub for 25-30 m and spotlights the point where (A) has his/her beam of light, and (A) then moves a further 25-30 m. This leap-frog action is repeated until you reach your subject. This time when we arrived at the locality, nothing could be found. We were confident we were within metres of where the eye shine was first sighted and cast around with the light for 2-3 minutes before we were rewarded with a large bundle of light grey, soft fur reclining in the fork of a sapling some 5 m above ground. We had found the source of the eye shine - a Koala, who was now fast asleep. So after all this trivia, we have reached the reason why this article is titled as it is.

Looking skywards soft rain began to fall, the precipitation, at first very light, fell on my shoulders and down the front of my jacket - immediately one became aware of a distinct eucalyptus fragrance and as the precipitation fell on my face astigmatism immediately took place. The culprit was found to be a Greater Glider.

If his happening can be considered as an induction into the realm of the Naturalist, it was indeed, *a not too unpleasant experience.*

Bob Taylor

22, Coven Avenue, Bayswater North, Victoria 3153

The Bird-Book Book

by Ken Simpson

Publisher: *Natural Learning Pty Ltd, 1995. CD-ROM*
RRP $99.00
Requires a multimedia personal computer with a minimum requirement of 16mhz CPU, SVGA graphics, 30 mb hard disk, 8 bit soundcard, CD-ROM drive with 150 k+ bps transfer. A 486 cpu or better with 8 mb RAM and Windows 3.11 is recommended.

The Bird-Book Book is not a book at all, rather it is a CD-ROM-based bibliography of over 4600 bird books, reports and monographs from Australia and the southern Pacific covering the period 1800-1992/3. It does not cover the general periodical literature i.e. scientific journals like *The Victorian Naturalist.*

The package comes with seven pages of notes covering hardware requirements, the installation process (which is very simple), as well as a brief overview of the program and some key functions such as searching the database.

Upon starting the program you face a screaming Barn Owl and some program options, the main one being *Contents*. On selecting it you are presented with a screen which mimics a book with sections such as *Foreword, Preface, Acknowledgements, Books & Publications* and *Tutorial.*

The main function and purpose of the program is within the *Books & Publications* section. Here there are four options, the key ones being the related *Bird Publications* and *Browser*. Selecting *Bird Publications* presents you with a well laid-out screen showing details of the first publication with sections for author, title, year published, contents and description (physical) and on a separate page, region (e.g. Australia, New Zealand, Hawaii), category (e.g. checklist, field guide, report, poetry) and topic (e.g. biology, conservation, genetics, taxonomy). The *Browser* presents the same information as the *Bird Publication* function, except that it is arranged as paragraphs rather than fixed fields. I found *Browser* the better way to peruse the data.

The publications are arranged alphabetically by author, and you can move sequentially through them, or click on a letter to move to the first author whose name starts with that letter. For each letter there is also an index of the first three letters of the author's name and you can quickly jump to any of these. There is also a simple search function that allows you to query the database by author, title, year, region, category and topic. While eventually becoming used to it, I did find the search definition process to be somewhat cumbersome and limiting in that you cannot query all of the fields (e.g. you cannot select a keyword from the contents field) and, you can only conduct '*and*' searches e.g. you cannot retrieve articles by author Jones *or* Smith.

Another aspect that confused me is that there are two databases covering *Main* and *Undated* publications. A search of one database did not necessarily find listings in the other. Perhaps they could be combined.

With many multimedia programs, finding your way to the section you want can be likened to navigating a maze, a good feature in this program is that you can click on a '*?*' icon to give you a chart of all the key functions and clicking on the desired item takes you straight there.

The bibliography itself is very comprehensive (bearing in mind that the periodical literature is not covered). Overall, I found the program to be easy-to-use and I can recommend it to libraries and to anyone with a need to search the literature on Australian and Pacific birds.

Simon Bennett
DCNR 123 Brown Street,
Heidelberg, Victoria 3084

Wilsons Promontory Marine & National Park Victoria

by Geoff Wescott

Publisher: *University of New South Wales Press, 1995. RRP $24.95.*

Geoff Wescott's cnthusiasm for Wilsons Promontory spills from the pages of this new book from UNSW Press. There is a wealth of information about the Park to keep any reader thoroughly engrossed for hours: history, geology, vegetation, flora and fauna, coasts, camping, walking - in fact, just about everything you can see or do in the Park. The section on human impact, (which includes Aboriginal history and post-European history) and the marine life are especially welcome, as this sort of information about the Park is not readily available elsewhere. While the content is clearly oriented to thc local visitor, interstate and overseas visitors are well provided for with special information relevant to them. The pagcs are full of superb colour photographs that will make even the seasoned Prom visitor itch to get there.

Unfortunately, the positive aspects of the book are marred by a number of mistakes and surprising omissions. I also found the layout vcry crammed and confusing, but perhaps others may not find this a problem.

The main map has numerous errors (for example, it does not show the track between Roaring Meg and South Point, and it shows a continuous beach between Millers Landing and Chinaman Long Beach where only mangrove swamps and tidal mudflats exist).

Spelling mistakes and typographical errors, especially with scientific names of plants and animals detract from the impact of the book. There are also mistakes in some figure captions.

While the major plant and animal species are well described, there is no mention of liverworts (at least 50 species), lichcns (other than those on coastal rocks) or fungi (probably hundreds of species). Sedges are an important part of the Promontory flora, yet true sedges (*Carex* species) are not mentioned at all. The idea that *Gahnia* could be 'like grasses at first glancc' is rather interesting. I'll be more carcful mowing the lawn next weekend. An odd omission from the descriptions of common scabirds is thc Silver Gull, surely the most common of the seabirds; it is mentioned only in passing on page 122.

Walks arc well described, with one important exception. The cut-out track from Five Mile Road (*not* Millers Landing) to Chinaman Long Beach is not one for inexperienced walkers, as it is faint and often unmarked and passes through Chinaman Swamp, which can be chest-deep in spring: a far cry from 'the track can be damp after heavy rain'! A notablc omission is the fact that, during peak holiday periods, Mt Oberon Road is usually closed to day-trippers, and a free shuttlc bus runs between Tidal River and Telegraph Saddle.

To top things off, the errors continue into the index, including carrying over spelling errors from the text, such as *Poa poainformis* and *Tetrahena lunea*; and misordering entries. The matter in tables is not indexed, and often these contain the only references to some items, such as various rare plants and animals. There is also no cross-indexing.

But perhaps all this can be set aside for the majority of readers. The book is still very much an essential addition to the library for anyone planning a trip to the Prom, or for anyone who simply wants to know more about the Park, its history, what it protects, and what it offers visitors. Buy this book, but put away your dictionary, buy a good map, and rely on additional advice from the National Parks Service.

David Meagher
Department of Conservation and Natural Resources,
123 Brown Street, Heidelberg, Victoria 3084.

Periodicals in the FNCV Library

Journals

Australian Journal of Botany
Australian Journal of Zoology
Australian Plants
Bulletin of the American Museum of Natural History
Fieldiana - Botany
Fieldiana - Geology
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International Union for the Conservation of Nature Bulletin
Journal of the Adelaide Botanic Gardens
Journal of the Royal Society of Western Australia
Kew Bulletin
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Pacific Science
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Proceedings of the Linnaean Society of New South Wales
Proceedings of the Royal Society of New Zealand
Proceedings of the Royal Society of Queensland
Proceedings of the Royal Society of Victoria
Publications in Zoology (University of California)
Records of the Auckland Institute and Museum
Records of the Australian Museum
Records of the Canterbury Museum
Records of the Queen Victoria Museum, Launceston
Records of the South Australian Museum
The Australian Birdwatcher
The Emu
The Tattler (Australasian Wader Studies Group)
Transactions of the Royal Society of South Australia
Wildlife Research

FNC Journals

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Geelong Naturalist
Junior Naturalist (Hawthorn Junior FNC)
North Queensland Naturalist
Queensland Naturalist
South Australian Naturalist
Western Australian Naturalist

Newsletters

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Australian Shell News
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Regent Honeyeater Newsletter
SGAP Newsletter
University of Queensland, Department of Geology - Papers
VPNA Newsletter
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Magazines

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Outdoors (DCNR)
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Tree Society Review (WA)
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From the Editors

Interesting Articles

We feel that our members would appreciate a brief description on articles of interest found in the journals held in the FNCV library.
Are there any members who would like to peruse the latest journals in the library (or others elsewhere) and write a few lines on any article that appeals to them? Alternatively, if any one comes across an interesting article, please write a few lines about it. Send these to:-
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Established 1880

In which is incorporated the Microscopical Society of Victoria

OBJECTIVES: To stimulate interest in natural history and to preserve and protect Australian flora and fauna.

Membership is open to any person interested in natural history and includes beginners as well as experienced naturalists.

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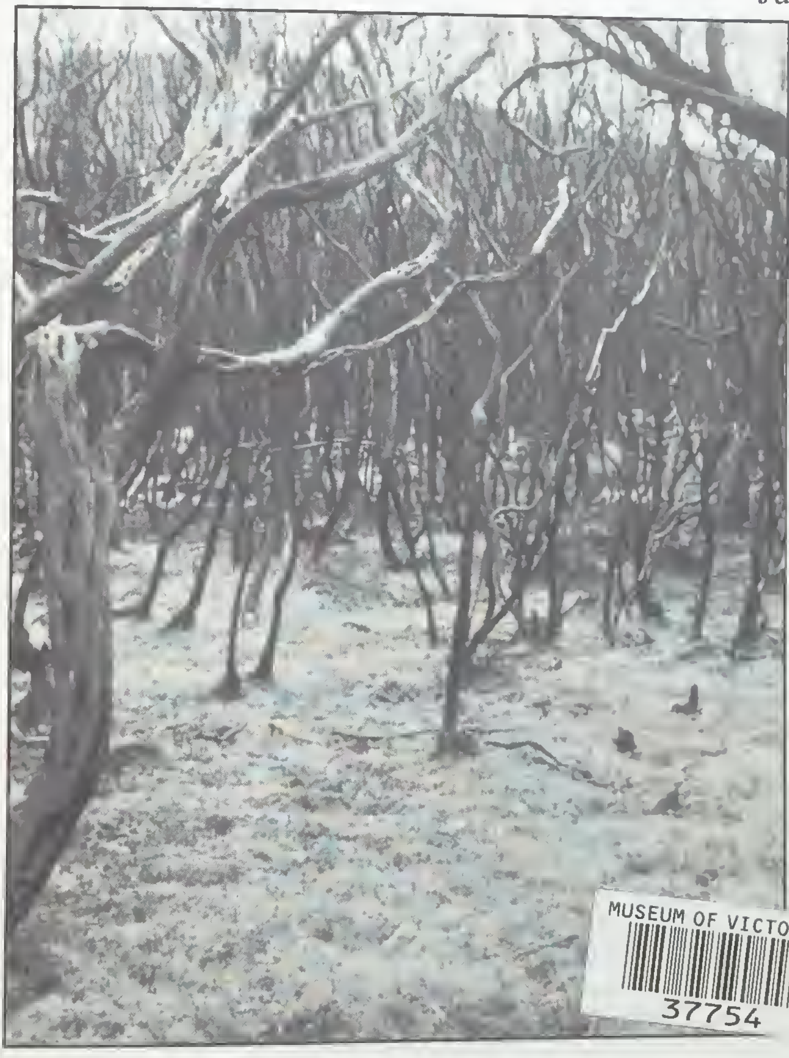
Printed by Brown Prior Anderson, 5 Evans Street Burwood, Victoria 3125

The Victorian Naturalist

Volume 113 (3) 1996
June



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Errata

Volume **113** (1) 1996, 4-9. Negative Effects of Fuel-reduction Burning on the Habitat of the Grey-crowned Babbler *Pomatostomus temporalis.*

Page 6, column 1, line 4 and following should read -
... the number of Golden Wattles was 23 times greater on the unburnt side than on the burnt side of the road and the number of mature Golden Wattles more than 1 m tall was 42 times greater. Other wattle species showed similar patterns. The total number of four wattle species (Bent-leaf Wattle *A. flexifolia*, Gold-dust Wattle *A. acinacea*, Varnish Wattle *A. verniciflua* and Spreading Wattle *A. genistifolia*) was 9.4 times greater on the unburnt side than on the burnt side, while the total number of these wattle species more than 1 m high was 167 times greater on the unburnt side (Table 1). More.....
Page 7, Table 1, final column heading should be - Unburnt / Burnt Ratio
Page 7, column 1, lines 4 and 7 - et al. Should be in italics
Page 7, column 1, para 2, lines 6 and 7 should read - ... there were fewer saplings
Page 8, column 1, para 1, lines 12 and 13 - Danthonia, Stipa and *Elymus scaber* should be in italics
Page 8, column 1, para 2, line 9 should read - **or which resulted in patches of unburnt and burnt clumps of understorey vegetation**

The Editors and Printers apologise for these errors and suggest that readers mark the changes in their copy of the journal.

Wilsons Promontory Expedition

Friday 26 July - Monday 29 July

To celebrate the 100th anniversary of the death of Baron Ferdinand von Mueller, an expedition has been organised to revisit sites and document the fungi and bryophytes (mosses and liverworts) where Mueller collected in the 1850s. Leaders will be Bruce Fuhrer, Tom May, David Meagher and Arthur Thies and a variety of collecting walks and learning workshops will be included.
Accomodation is at the lodge at Tidal River or by making your own arrangements. Contact Noel Schleiger (9435 8408) for bookings.

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Please ring us on 94359019

The Victorian Naturalist

Volume 113 (3) 1996 June

Editors: Ed and Pat Grey

ISSN 0042-5184

Cover: Funaria hygrometrica under burnt tea-tree near Chinaman Long Beach, Wilsons Promontory, photo D. Meagher

The Bryophyte Flora of Wilsons Promontory

David Meagher[1]

Abstract
Wilsons Promontory was one of the founding regions for bryological studies in southern Australia. Mosses and liverworts were first collected there by Ferdinand Mueller in 1853, and a succession of collectors have added to the long list of species found there. This paper reviews the history of bryophyte collections from Wilsons Promontory and presents the results of the author's recent systematic survey of bryophytes on the Promontory. The survey confirmed the presence of 122 moss species and at least 55 liverwort species. Thirty-four mosses and 28 liverworts were recorded for the first time from the Promontory, and another six mosses and seven liverworts were recorded for the first time since the 1850s. Eighteen mosses and at least nine liverworts previously recorded were not found in the 1994-95 survey. (*The Victorian Naturalist* **113** (3) 1996, 84-96)

Introduction

In the 1850s the knowledge of Victoria's native flora, and especially that of bryophytes, was in its infancy, despite the extensive explorations of the region that had taken place in the preceding 50 years. The few collections that had been made had invariably found their way to European herbaria, particularly the Kew Gardens in London. But in 1852 a young German botanist came to the Victorian goldfields from Adelaide to start a pharmaceutical business, fortuitously at a time when Governor LaTrobe was searching for a competent botanist to undertake the first great survey of the Victorian flora (Willis 1960).

Ferdinand Mueller, a doctor of philosophy from Kiel University, was already well known in Europe through his writings on the South Australian flora and through his donations to various European herbaria. Thus Sir William Hooker, who had been impressed by young Mueller's competence, did not hesitate to recommend his appointment as Colonial Botanist to LaTrobe (Willis 1960). Mueller commenced his duties enthusiastically in 1853 by almost immediately heading to the Victorian Alps on the first of many botanical expeditions around the state. From the Alps he headed south to Port Albert and from there by ship to Wilsons Promontory, where he stayed at Sealers Cove (then the centre of a thriving timber industry) during May 1853, collecting and describing the flora of the wet forests in that area.

Mueller must have found the area particularly interesting, as he returned in August 1854 and also ordered his assistant, John Walter, to procure wood samples from Sealers Cove in the winter of 1857, for an exhibition. Most of Mueller's bryophyte specimens lodged in the National Herbarium, Melbourne, are labelled 'Sealers Cove', the exceptions often being labelled merely 'Wilsons Promontory'; the precise locations of his bryophyte collections are thus unknown, although he is known to have collected vascular plants from around Sealers Cove, Mt Hunter and Darby River. His collections from these trips included what were probably the first significant collections of bryophytes in Victoria - collections that have remained the principal source of information about Wilsons Promontory's bryophyte flora for over 140 years.

History of collections

Mueller's collections in the 1850s numbered 45 moss and 19 liverwort species, including perhaps some collected by Walter (Gottsche 1880, Mueller 1882). After Mueller, more than 70 years were to pass before the next known collection of mosses from the Promontory was made in 1925, when J.R. Leslie (Leslie 1925) visited the area and collected at least 30 species. Garnet (1971) suggested that there might have been a collection from the lighthouse area in 1874, but there are no herbaria collections from that time or location. In 1951 Jim Willis collected 45 species and further collections were made by Coralie Skewes in 1953, Mary Gillham (on Sandy Island) in 1959 and Sophie Ducker in 1960.

These collections were the basis of the lists of 85 mosses and 23 liverworts in Ros Garnet's 'The Wildflowers of Wilson's Promontory', published in 1971. The lists prepared by Jim Willis, then Assistant Government Botanist, were the result of considerable herbarium research

[1] 18 Banool Road, Surrey Hills, Victoria 3127

and personal field work, and represented much more than a mere list of species; they summarised the only knowledge available of Promontory bryophytes from nearly 120 years of collections, commencing with Mueller in 1853-54.

Another 11 mosses and 4 liverworts were recorded by various researchers in the following 20 years: T.M. Howard and G.S. Hope in 1970 in their study of *Nothofagus* forest (Howard and Hope 1970); David Ashton and Rohan Webb in 1976 in their study of granite outcrops (Ashton and Webb 1976); George Scott in 1982 at Lilly Pilly Gully (MUCV records); Chris Cargill (Pike) and Bruce Fuhrer in 1982 in the northern section (MUCV records); Arthur Thies in 1982 during an FNCV field trip (Thies 1982), and subsequently (Thies all references), and Evan Chesterfield *et al.* in 1990-92 on the Yanakie Isthmus (Chesterfield *et al.* 1995).

Collections have also been made on the nearby islands, notably by Mary Gillham in 1959 (Gillham 1961), J.S. Turner, S.G.M. Carr and E.C.F. Bird in 1962 (Turner *et al.* 1962) and G.S. Hope and G.K. Thomson in 1971 (Hope and Thomson 1971, these records are included in Appendices 1 and 2 for completeness).

The 1994-95 survey

Methodology

In early 1994 a systematic survey of bryophytes on Wilsons Promontory commenced. By December 1995, 74 sites had been surveyed, covering a complete sample of habitats present on Wilsons Promontory (Fig. 1). Sites were chosen to provide representative samples of broad habitats (open forest, closed forest, fern gully, granite outcrop, sand dune, seashore meadow, swamp), and to ensure that microhabitats within those broad habitat types were sampled. Each site was limited to an area no greater than 100 square metres, and within that area all available microhabitats were surveyed. For practical purposes, most sites were located close to tracks and roads, although several were off-track. Incidental collections were made of two species not recorded at survey sites: *Sphagnum cymbifolioides* and *Funaria salsicola*. Identifications were based on descriptions and keys in Scott, Stone and Rosser (1976), Catcheside (1980), Vitt (1980), Ando (1982), Scott (1985), Lewinsky (1989), Touw and Falter van den Haak (1989), Whitehouse and Crundwell (1991), Beever *et al.* (1992) and Frahm (1994).

As well as field surveys, collections in the three major Victorian cryptogamic herbaria (at the National Herbarium of Victoria MEL, University of Melbourne MELU and Monash University MUCV) were searched for specimens from Wilsons Promontory.

The islands of the National Park were not surveyed, largely because of the difficulty of access. They remain a potential source of interesting finds for those willing to make the effort.

Collections were made under National Parks Service permits 934/118 and 945/121, and specimens representing new records for the area have been lodged with the National Herbarium, Melbourne.

Taxonomy

Nomenclature follows Streimann and Curnow (1989) for mosses and Scott and Bradshaw (1986) for liverworts, with the following exceptions:

Lethocolea squamata is now *Lethocolea pansa* (*Symposia Biologica Hungarica* **35**, 211) and

Tortula princeps is now *Tortula antarctica* (*Journal of the Hattori Laboratory* **65**, 81-144).

Because Scott and Stone (1976) is still the major reference for identifying mosses in southern Australia, the following changes to nomenclature since its publication are given in Table 1. Authorities are given by Streimann and Curnow (1989).

Specimens that could not be determined to species level (usually because there was no fertile material) were identified to genus level only. Groups in which taxonomic difficulty arose were treated as follows:-

***Bryum* species.** The genus *Bryum* presents considerable difficulties for most bryologists, the distinguishing characters generally being the colour, shape and size of microscopic 'tubers' attached to rhizoids in the soil. The identities of a number of *Bryum* specimens collected during the survey need further investigation; several more species probably occur on

Table 1. Nomenclature changes since Scott and Stone (1976).

Name in Scott and Stone (1976)	Name in Streimann and Curnow (1989)
Barbula australasiae	*Trichostomopsis australasiae*
Barbula torquata	*Didymodon torquatus*
Campylopus pallidus	*Campylopus pyriformis*
Catagonium politum	*Catagonium nitens* subsp. *nitens*
Dicranoloma billarderii var. *robustum*	*Dicranoloma robustum*
Eurhynchium muriculatum	*Rhynchostegiella muriculatum*
Funaria gracilis	*Entosthodon subnudus* var. *gracilis*
Funaria microstoma	*Funaria salsicola*
Grimmia apocarpa	*Schistidium apocarpum*
Macromitrium tenue	*Macrocoma tenue* subsp. *tenue*
Macromitrium weymouthii	*Macromitrium microstomum*
Rhizogonium mnioides	*Pyrrhobryum mnioides*
Rhizogonium parramattense	*Pyrrhobryum parramattense*
Sematophyllum amoenum	*Rhapidorrhynchium amoenum*
Tortella calycina	*Barbula calycina*

Wilsons Promontory. The spelling of *Bryum billardierei* follows Jarman and Fuhrer (1995).

Campylopus australis. A specimen collected from the slopes of Mt Bishop has remarkable similarities to herbaria specimens of *C. umbellatus*, a tropical Queensland species, but Dr Jan-Peter Frahm (1994), an expert in *Campylopus*, has identified the specimen as *C. Australis* (*pers. comm.*). He advised that the species might intergrade, or one might have evolved from the other.

***Drepanocladus aduncus* s.l.** This species was found in a freshwater seashore meadow on Corner Inlet. There appear to be some differences between the specimen and the type material of *Hypnum aduncum* Hedw. (= *D. aduncus*). The genus is soon to be revised, and this specimen is likely to be placed under a new name.

Fissidens australiensis. A *Fissidens* specimen from a site on Mt Margaret Track has been identified as *F. australiensis*. Earlier collections of this species are certain to have been attributed to *F. tenellus*, since the two species are outwardly similar (Stone 1990).

Hypnum cupressiforme. This species presents particular difficulties because of the enormous variation in its morphology. Ando (1982) has gone a long way to resolving the confusion by describing the varieties found in our region. Howard and Hope (1970) recorded *Hypnum cupressiforme* var. *filiforme* from *Nothofagus* forest on Wilsons Promontory. However, all Promontory specimens that, on the face of it, appear to be this variety seem always to be *H. cupressiforme* var. *mossmanianum*. I have assumed that this is also the case for their record.

***Macrocoma tenue* subsp. *tenue*.** Streimann and Curnow (1989) follow Vitt (1980) in transferrring *Macromitrium tenue* to the new genus *Macrocoma*, and I accept this view reluctantly. The erection of a new genus largely on the basis of the straightness of the leaves seems rather tenuous and unnecessary.

Results

The survey recorded 119 mosses, including 34 new records for the Promontory. This brings the total number of moss species recorded for the Promontory to 139, about 30% of the known Victorian moss flora (Appendix 1). Six of these were found for the first time since Mueller collected them in the 1850s, but 18 that were recorded previously were not found.

Forty-five liverworts were recorded, including 28 new records for the Promontory, bringing the total number of species recorded to 70, about 30% of the known Victorian liverwort flora (Appendix 2).

Several records from previous collections were reviewed during the study, and the following conclusions were drawn:

- The unconfirmed record of an *Andreaea* species (probably from Mt Oberon summit) listed in Garnet (1971) is doubtful: the altitude (558 metres) is much lower than other *Andreaea* records from Victoria, the genus being mostly alpine or subalpine; searches of a number of likely

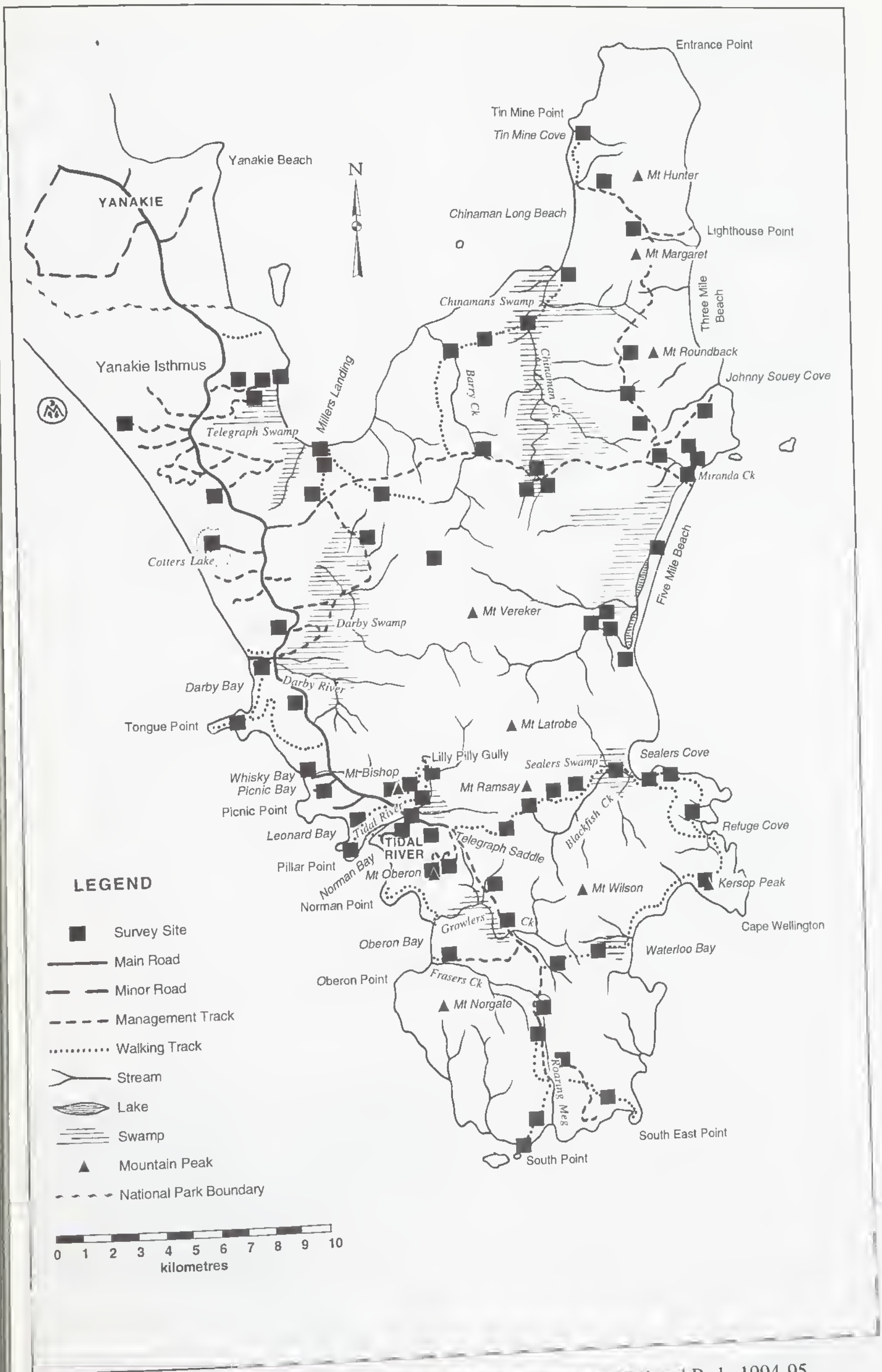

Fig. 1. Locations of bryophyte sampling sites, Wilsons Promontory National Park, 1994-95.

sites has failed to find any *Andreaea* species, and the original specimen cannot be located. I have therefore chosen not to include it as a legitimate record for Wilsons Promontory.

- *Campylium polygamum* was recorded for the first time in Victoria by E. Leach in 1972. The annotation on the original specimen in MEL is: 'fen behind Corner Inlet, Wilsons Promontory National Park'. However, the duplicate in MUCV is annotated 'Yanakie Beach, Victoria ... in drainage channel in sand dunes', and Scott and Stone (1976) record the location as 'not far from Wilsons Promontory'. The likely location seems to be Yanakie Beach or Red Bluff Beach, both well outside the National Park. However, I have chosen to let the record stand for Wilsons Promontory, as it might well occur in the marshy sands around Corner Inlet and could easily be overlooked as a robust form of *Rhyncostegium tenuifolium*.

- Mueller's record of *Sematophyllum leucocytus* is uncertain for the Promontory, as the original specimen in MEL is labelled merely 'vicinity of Wilson's Promontory'. However, I have chosen to let it stand in the list as it is a species that is likely to be present in closed forest.

- A specimen collected by David Ashton and provisionally identified as an *Andrewsianthus* species (Ashton and Webb 1976) is *Cephaloziella exiliflora*. The specimen is in MUCV.

- Mueller's record of *Blasia pusilla* from Sealers Cove is extremely doubtful. Scott and Bradshaw (1986) note that the species is otherwise exclusively found in the northern hemisphere and this single collection is therefore extremely improbable. They suggest that the species should be removed from the Australian list and I have followed that suggestion here. The specimen cannot be located.

- Mueller's record of *Riccardia multifida* (as *Aneura multifida*) is also doubtful, as this is also an otherwise northern hemisphere species. It is likely to have been *Riccardia bipinnatifida*. This specimen, too, cannot be located.

Discussion

Many species that are now common in the area and easily found were not recorded by early collectors. They include sand-country species such as *Barbula crinita* and *Didymodon torquatus*, forest species such as *Bazzania involuta*, *Campylopus clavatus*, *Fissidens tenellus*, *Isopterygium limatum*, *Lophocolea muricata* and *Pogonatum subulatum*, widespread species such as *Gymnostomum calcareum*, *Kurzia compacta*, *Triquetrella papillata* and *Zoopsis argentea*, and rocky outcrop species such as *Grimmia laevigata* (Fig. 2), *Jamesoniella colorata* and *Rhacomitrium crispulum*.

The lack of records of now-common sand-country mosses might be due to the changes in vegetation that have occurred on the Promontory in the last 50 years, particularly on the Yanakie Isthmus. For a full description and discussion of these changes, see Chesterfield *et al.* (1995). The typically exposed, sandy areas of the isthmus probably expanded under pressure from grazing and burning, and the invasion of banksia woodland by Coast Tea-tree *Leptospermum laevigatum* may have further contributed to the increase in exposed areas. Fires, particularly the severe fires in 1907 (Ewart 1909, 1910), the early 1950s and to a lesser extent in 1961, may have permanently altered many forested areas, and the construction of tracks, roads, firebreaks and utilities has created bare soil and clay banks that can be colonised by species such as *Fissidens tenellus*, *Lunularia cruciata* and *Pogonatum subulatum*, which otherwise occur mainly on bare soils around the roots of fallen trees, on the banks of streams, on landslips and so on. In fact, the track from Oberon Saddle to Sealers Cove, along which many of these species

Fig. 2. *Grimmia laevigata* on southern slopes of Mt Oberon.

are now common, was not constructed until 1940. *Bazzania involuta* is very common, especially in closed forest, and its absence from early records is thoroughly inexplicable. *Lophocolea muricata* is similarly common, but its smallness and superficial resemblance to *Lophocolea semiteres* might have led to it being overlooked.

It is harder to explain the lack of early records of common rocky outcrop species. On Wilsons Promontory *Grimmia laevigata* is not as common as it is in similar habitats in other parts of Victoria, but it is still readily found. *Rhacomitrium crispulum* is a reasonably common species on the higher exposed granite outcrops, and is not likely to be confused with any other moss.

On the other hand, a number of species that are commonly found in similar habitats elsewhere in Victoria have not been found in the present survey. They include *Goniobryum subbasilare*, *Grimmia apocarpa*, *Conostomum pusillum*, *Cratoneuropsis relaxa* and *Hypopterygium rotulatum*. *Papillaria flavolimbata* is a moderately common epiphyte in Victorian rainforests, but it too has not been found in the current survey despite careful searches in accessible typical habitat. It is possible that fires and other more subtle changes in local conditions (or even human interference) may have brought about its demise from these sites, but it is likely to still occur in protected areas of less accessible fern gullies and rainforest. *Hypnodendron comosum* is a very distinctive species and is unlikely to be overlooked or mistaken for any other species. Mueller's superb specimen is in the National Herbarium of Victoria (MEL). It is quite possible that this species still occurs in unburnt rainforest on the eastern side of the Promontory, although initial searches have failed to find it. *Polytrichadelphus magellanicus*, normally a common coloniser of damp clay banks, seems not to be at all common on the Promontory. Arthur Thies has recorded it from the slopes of Mt Oberon and I have found it at only one site on the east coast.

At least eight liverworts were not rediscovered in the 1994-95 survey. They include *Trichocolea mollissima*, *Gackstroemia weindorferi* and *Schistochila lehmanniana*, all liverworts of *Nothofagus* forest and thus likely to be present in the rainforests of the eastern Promontory. *Frullania pentapleura* occurs mainly on rocks in river valleys, *Lepidozia obtusiloba* is likely to be found on montane rocks, and *Pallavicinia spinosa* might be found on wet open ground in higher areas.

Typical bryophytes of broad vegetation types

From the sites surveyed it is possible to describe a set of species that are typical of broad vegetation types on the Promontory. These lists should be treated only as guides to the species most likely to be found in these habitats; bryophytes rely for the most part on particular microhabitats for their survival. Vegetation descriptions are derived from CFL (1987) and personal observations. Vascular nomenclature follows Ross (1993) and the updates of the National Herbarium, Melbourne.

Granite outcrops

Devonian granite outcrops are very common throughout the Promontory, especially above about 160 metres altitude. These outcrops do not carry a typical vascular flora because they occur in virtually all broad habitat types. The rocks provide perhaps the only substratum where bryophytes can grow without competition from vascular plants, although they do compete to a great degree with lichens. Species marked with an asterisk (*) grow only (or almost only) on rock. The other species require some soil, but are still typical of this habitat.

No species can be said to be dominant on granite outcrops, but perhaps *Campylopus bicolor* is the most common on large, flat outcrops where water runs off slowly and there is some soil. On boulders the more common species are *Dicnemoloma pallidum*, *Frullania probosciphora*, *Grimmia tricophylla*, *Hedwigia integrifolia* and *Rhacomitrium crispulum*.

Campylopus species dominate shaded and lower granite outcrops on the Promontory, *Campylopus bicolor* being noticeably dominant on flat, exposed rocks. The cover on rocks is sometimes close to 100 per cent, especially where

Thuidium furfurosum is present. *Dicnemoloma pallidum* is common on boulders north of Tidal River, but not common in southern areas. *Grimmia* species occur sporadically but are not as prominent as they are on and north of the Great Dividing Range.

Bryophytes found on exposed granite tops

Campylopus bicolor	*Lophocolea semiteres*
Campylopus clavatus	*Rhacomitrium crispulum**
Campylopus introflexus	*Rhacocarpus purpurascens**
*Frullania probosciphora**	*Sematophyllum homomallum*
*Grimmia laevigata**	*Thuidium sparsum*
*Grimmia tricophylla**	
*Hedwigia integrifolia**	

Bryophytes found on rocks in shade or at lower altitudes

Breutelia affinis	*Dicnemoloma pallidum**
Bryum billardierei	*Hedwigia integrifolia**
Campylopus bicolor	*Lophocolea semiteres*
Campylopus clavatus	*Sematophyllum homomallum*
Campylopus introflexus	*Thuidium furfurosum*

Open forests

Open eucalypt forest dominates the granitic central spine of the Promontory. The dominant vascular species are Messmate Stringybark *Eucalyptus obliqua*, Brown Stringybark *E. baxteri* and Yellow Stringybark *E. muelleriana*. On the Promontory much of this forest type has been altered by fires. The tall trees that once grew in these forests have been replaced by Prickly Moses *Acacia verticillata*, Tree Everlasting *Ozothamnus ferrugineus*, Hazel Pomaderris *Pomaderris aspera* and Musk Daisy-bush *Olearia argophylla*. Areas of the once-common Smithton Peppermint *E. nitida* (previously thought to have been Shining Peppermint *E. willisii*, D. Rankin, *pers. comm.*) and Mountain Ash *E. regnans* still occur in less inaccessible areas, mostly on the eastern side of the Promontory. Isolated stands of Drooping She-oak *Allocasuarina verticillata* occur on drier granite ridges and slopes.

Closed forests and fern gullies

Closed forests, which were once more widespread on the Promontory, are now confined to unburnt areas on the east coast and to sheltered gullies and alluvial flats in other areas. Lilly Pilly *Acmena smithii* and Blackwood *Acacia melanoxylon* are dominant species at lower altitudes, but

Typical bryophytes of open forests, albeit occurring in a range of microhabitats.

Acrocladium chlamydophyllum	*Pogonatum subulatum*
Bryum billardierei	*Polytrichum juniperinum*
Campylopus introflexus	*Ptychomnion aciculare*
Campylopus pyriformis	*Rhacopilum convolutaceum*
Cephaloziella exiliflora	*Rhyncostegium tenuifolium*
Ceratodon purpureus	*Sematophyllum amoenum*
Dicranoloma billardierei	*Sematophyllun homomallum*
Dicranoweisia microcarpa	*Symphogyna podophylla*
Fissidens oblongifolius	*Tayloria octoblepharis*
Gymnostomum calcareum	*Thuidium furfurosum*
Hypnum cupressiforme	*Thuidium sparsum*
Isopterygium limatum	*Triquetrella papillata*
Kurzia compacta	*Zoopsis argentea*
Lophocolea semiteres	*Zoopsis leitgebiana*
Metzgeria furcata	*Zygodon menziesii*

Blackwood gives way to Sassafras *Atherosperma moschatum* in higher areas and to Myrtle Beech *Nothofagus cunninghamii* in sheltered catchments and gullies.

Some of the closed forests of the Promontory represent the southernmost extension of our warm temperate rainforests, and are thus of considerable scientific importance (Howard and Hope 1970; CFL 1987). Lilly Pilly and Myrtle Beech are codominant in sheltered sites on the eastern side of the Promontory, forming an unusual meld of warm temperate and cool temperate rainforest. Myrtle Beech was once widespread on the Promontory, but in the last 5000 years has contracted to small, sheltered areas (Howard and Hope 1970). The fires of 1907 left few Myrtle Beech stands unscathed, and although most appear to have recovered, the effect on the bryophyte flora is unknown.

In fern gullies the understorey is usually dominated by Soft Tree-ferns *Dicksonia antarctica*, and Slender Tree-ferns *Cyathea cunninghamii* are not uncommon in some areas. Some easily accessible fern gullies appear to have been degraded by the construction of tracks and the unavoidable trampling and abrasion to which bryophytes are particularly susceptible. Lilly Pilly Gully, in particular, is noticeably more depauperate in bryophytes than the less accessible comparable areas on the eastern side of the Promontory.

Typical bryophytes of closed forests (other than fern gullies)

Atrichum androgynum	*Lophocolea muricata*
Bazzania involuta	*Lophocolea semiteres*
Breutelia affinis	*Metzgeria furcata*
Campylopus introflexus	*Plagiochila fasciculata*
Cephaloziella exiliflora	*Pogonatum subulatum*
Chiloscyphus argutus	*Ptychomnion aciculare*
Cyathophorum bulbosum	*Pyrrhobryum mnioides*
Dawsonia superba	*Radula buccinifera*
Dicranoloma menziesii	*Rhacopilum convolutaceum*
Fissidens asplenioides	*Rhizogonium distichum*
Fissidens oblongifolius	*Rhyncostegium tenuifolium*
Fissidens tenellus	*Sematophyllum amoenum*
Hypnum cupressiforme	*Sematophyllum homomallum*
Isopterygium limatum	*Symphogyna podophylla*
Kurzia compacta	*Thuidium furfurosum*
Lepidozia ulothrix sp. agg.	*Tylimanthus tenellus*
Leptostomum inclinans	*Wijkia extenuata*
Leucobryum candidum	*Zoopsis argentea*
Lophocolea bidentata	*Zoopsis leitgebiana*

Typical bryophytes of fern gullies.

Achrophyllum dentatum	*Leptostomum inclinans*
Bryum billardierei	*Leptotheca gaudichaudii*
Catagonium politum	*Leucobryum candidum*
Chiloscyphus argutus	*Lophocolea bidentata*
Cyathophorum bulbosum	*Lophocolea muricata*
Dicranoloma menziesii	*Lophocolea semiteres*
Distichophyllum microcarpum	*Metzgeria furcata*
Fissidens taylorii	*Plagiochila fasciculata*
Fissidens tenellus	*Sematophyllum amoenum*
Hymenodon pilifer	*Symphogyna podophylla*
Hypnodendron vitiense	*Thuidium furfurosum*
Hypnum cupressiforme	

Heaths and heathy woodlands

Heaths and heathy woodlands occur on infertile soils, in areas exposed to salt spray and wind, and in areas with little topsoil. On the western side of the Promontory these areas occur largely on calcareous sandy soils, while on the eastern side they are mainly on siliceous sandy soils. In the northern Promontory, Saw Banksia *Banksia serrata* is the dominant species, although Coast Tea-tree *Leptospermum laevigatum* is advancing across large areas that have not been burnt for a long time. This advancing tea-tree is particularly noticeable near Fell Swamp. Eucalypts, particularly Brown Stringybark *E. baxteri*, are scattered through the heathy woodland.

Typical bryophytes of heaths and heathy woodlands.

Barbula calycina	*Rhacopilum convolutaceum*
Barbula crinita	*Sematophyllum homomallum*
Bryum billardierei	*Thuidium sparsum*
Ceratodon purpureus	*Tortula papillosa*
Didymodon torquatus	*Triquetrella papillata*
Gymnostomum calcareum	*Zygodon menziesii*
Kurzia compacta	
Lophocolea semiteres	

Grasslands

The southern part of the Yanakie Isthmus supports extensive grasslands, probably formed as a result of regular burning and cattle grazing. The flats behind Oberon Bay were also once used for grazing, and still support a population of feral deer. Introduced grasses and weeds are common in these areas: Perennial Rye-grass *Lolium perenne*, Dog's Tails *Cynosurus* spp., Cat's-ear *Hypochoeris radicata*, Suckling Clover *Trifolium dubium* and Ribwort *Plantago lanceolata*. The dominant native species is Blady Grass *Imperata cylindricata*.

Coastal cliffs support a distinctive grassland dominated by Blue Tussock-grass *Poa poiformis*. There are also small tussock grasslands in wind-blown areas such as Windy Saddle, usually dominated by Tussock-grass *Poa labillardierei*. Bryophytes are often abundant in grasslands, but are mostly pleurocarpous (weft-forming) because there is little bare soil for acrocarpous (tuft-forming) mosses to colonise. Grasslands support the only known introduced bryophyte on the Promontory, *Brachythecium albicans*.

Typical bryophytes of the grasslands.

Brachythecium albicans	*Hypnum cupressiforme*
Bryum billardierei	*Lophocolea semiteres*
	Thuidium sparsum

Sand dunes

Wilsons Promontory supports large areas of sand-dune vegetation. On the western side these dunes are calcareous, while on the eastern side they are siliceous. New dunes are colonised by Sea-wheat Grass *Agropyron junceum*, Hairy Spinifex *Spinifex hirsutus* and Marram Grass *Ammophila arenaria;* the last species being an introduction to help stabilise shifting dunes in many coastal areas in Victoria. Older dunes are colonised by Coast Everlasting *Ozothamnus turbinatus* and Coast Daisy-bush *Olearia axillaris*. Coast Banksia *Banksia integrifolia* and Drooping Sheoak *Allocasuarina verticillata* may colonise older dunes.

Typical bryophytes of the sand dunes.

Barbula calycina *Campylopus introflexus* *Ceratodon purpureus* *Didymodon torquatus* *Lophocolea semiteres*	*Sematophyllum homomallum* *Tortula antarctica* *Tortula papillosa* *Zygodon menziesii*

Turner *et al.* (1962) recorded 11 bryophytes from sand dunes on Sandy Island in Corner Inlet: *Barbula calycina, Brachythecium salebrosum, Bryum affine, Bryum pachytheca, Campylopus introflexus, Ceratodon purpureus, Funaria hygrometrica, Hypnum cupressiforme, Lophocolea semiteres, Sematophyllum homomallum* and *Tortula antarctica.*

Swamps

Swamps were once widespread on the Promontory, but fires, early timber harvesting, cattle grazing and altered drainage patterns have reduced many, such as Sealers Swamp and Chinamans Swamp. Swamp Paperbark *Melaleuca ericifolia*, Scented Paperbark *Melaleuca squarrosa* and Woolly Tea-tree *Leptospermum lanigerum* dominate the swamp flora. Bog Gum *Eucalyptus kitsoniana* and Swamp Gum *E. ovata* occur occasionally. Sedges, rushes and reeds grow in the more permanently water-logged swamps, such as at Darby River and Five Mile Swamp. Bryophytes are generally absent from swamps on the Promontory, mostly occurring sporadically as epiphytes (e.g. *Hypnum cupressiforme, Lophocolea semiteres*). *Sphagnum cymbifolioides* occurs sporadically in the northern section of the Promontory, principally in or alongside small creeks emerging from tea-tree thickets.

Sea-shore meadows

A single freshwater sea-shore meadow is known on Corner Inlet, but others are likely to occur. It consists of a grassy bog fed by a spring at the base of the foredune. Although regularly inundated with saltwater and permanently exposed to saline spray, this meadow supports several bryophyte species.

The most abundant species in the sea-shore meadows.

Drepanocladus aduncus s.l. *Hypnum cupressiforme*	*Rhacopilum convolutaceum* *Sematophyllum homomallum* *Thuidium furfurosum*

Conservation status of species

Little is known of the conservation status of bryophytes in Australia because of the general lack of distribution and abundance data. There is no published list of bryophytes that are threatened nationally, but there is a list of rare species for Victoria (Stone 1989). Seven mosses and two liverworts known from Wilsons Promontory are considered to be rare in Victoria (Table 2).

In addition, 25 mosses and 18 liverworts are considered by the author to be locally rare because (a) they have been recorded from only one locality on the Promontory, or (b) they have not been recorded on the Promontory within the last 50 years (Table 3). This 'locally threatened' list perhaps reflects the paucity of data as much as the true conservation status of some of these species, and the local status of some species will no doubt change as further records are gathered.

Table 2. Species considered to be rare in Victoria

Mosses *Dicranoweisia microcarpa* *Distichophyllum microcarpum* *Echinodium hispidum* *Eriopus apiculatus* *Eriopus brownii*	*Fissidens humilis* *Weymouthia cochlearifolia* **Liverworts** *Fossombronia alata* *Lepidozia obtusiloba*

Acknowledgements

I am indebted to Dr George Scott for encouraging my interest in bryophytes and for teaching me most of what I know of them. George helped with field work, identified many of the liverwort specimens, provided important references, and confirmed a number of difficult mosses.

Table 3. Species considered to be locally rare.

Mosses	
Bartramidula pusilla	recorded from one site since 1853
Brachythecium salebrosum	recorded from one site, in 1962
Bryum affine	recorded from one site since 1853
Bryum sp. aff. *alpinum*	recorded from one site, in 1995
Bryum dichotomum	recorded from one site, in 1995
Campylium polygamum	recorded from one site, in 1972
Cratoneuropsis relaxa	recorded from one site, in 1951
Drepanocladus aduncus s.l.	recorded from one site, in 1995
Echinodium hispidum	recorded from one site, in 1995
Entosthodon subnudus var. *gracilis*	recorded from one site, in 1960
Eriopus brownii	recorded from one site, in 1994
Fissidens humilis	recorded from one site, in 1995
Goniobryum subbasilare	recorded from one site, in 1953
Holomitrium perichaetiale	recorded from one site since 1853
Hypnodendron comosum	not recorded since 1925
Macromitrium archeri	recorded from one site since 1853
Macromitrium microstomum	recorded from one site, in 1994
Philonotis scabrifolia	recorded from one site, in 1970
Pohlia nutans	recorded from one site, in 1994
Pseudoleskea imbricata	recorded from one site, in 1995
Rhyncostegiella muriculatum	recorded from one site, in 1995
Sauloma tenella	recorded from one site, in 1995
Schistidium apocarpa	not recorded since 1853
Sematophyllum leucocytus	not recorded since 1853
Sphagnum cristatum	recorded from one site, in 1953
Liverworts	
Anthoceros ?laevis	recorded from one site, in 1995
Asterella drummondii	recorded from one site, in 1982
Chaetophyllospis whiteleggei	recorded from one site, in 1995
Cheilolejeunea ?mimosa	recorded from one site, in 1995
Chiloscyphus argutus	not recorded since 1853
Diplasiolejeunea plicatiloba	recorded from one site, in 1994
Fossombronia alata	recorded from one site, in 1982
Frullania deplanata	recorded from one site, in 1995
Frullania pentapleura	not recorded since 1853
Goebelobryum unguiculatum	recorded from one site, in 1995
Lejeunea gunniana	recorded from one site, in 1995
Lepidozia obtusiloba	recorded from one site, in 1976
Lophocolea ?minor	recorded from one site, in 1994
Lophocolea ?biciliata	recorded from one site, in 1995
Megaceros gracilis	recorded from one site, in 1995
Pallavicinia spinosa	recorded from one site, in 1960
Riccardia multifida	not recorded since 1853
Riccia sp.	recorded from one site, in 1994

Thanks are also due to: Lucille Turner of the Arthur Rylah Institute for Environmental Research (ARIER) for her advice, support, and help on field trips; Jane Dickins, Phil Wierzbowski, Annette Muir, Susie Duncan, Sue Berwick and Jill Smith (ARIER) and Barry Traill and Stephen Patterson for their support on field trips; Vin Wright, Craig McKenzie, Jim Whelan and Paul McDiarmid of the National Parks Service for their support and assistance during the field work; Dr Helen Ramsay of the State Herbarium of NSW and Dr John Spence (Canada) for the use of their unpublished keys to the Australian Bryaceae being prepared for the Flora of Australia; Dr Lars Hedenås (Sweden) for identifying *Drepanocladus aduncus* s.l.; Hisa Ando (Japan) for confirming *Hypnum cupressiforme* var. *mossmanianum*; Dr Jan-Peter Frahm (Netherlands) for identifying *C. australis*; Dr H.L.K. Whitehouse (England) for confirming *Gymnostomum calcareum*; Dr David Ashton for his advice about *Sphagnum cymbifolioides* at Wilsons Promontory; David Rankin (ARIER) for advice on *Eucalyptus nitida*; The Botany Department, University of Melbourne, for access to the cryptogam collection; The Botany Department, Monash University, for access to the cryptogam collection, and especially Chris Cargill for her help; The National Herbarium of Victoria for access to the cryptogam collection, and especially Dr Tom May for his help and advice; The National Parks Service, Victoria, for permission to collect material within the National Park.

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Fig. 3. *Dicranoloma dicarpum*. A new record for Wilsons Promontory.

Fig. 4. *Funaria hygrometrica* at Tin Mine Cove track.

Appendix 1. Mosses recorded from Wilsons Promontory National Park
x = not found in 1994-95   n = new species record for Wilsons Promontory   * = introduced
The following letters refer to records derived from various sources, including searches of the the cryptogamic herbaria at the National Herbarium of Victoria (MEL), University of Melbourne (MELU) and Monash University (MUCV).
V = F Mueller 1853; L = JR Leslie 1925; W = JH Willis 1951; A = DH Ashton 1951+; S = SC Skewes 1953; G = M Gilham 1959; D = S Ducker 1960; B = JS Turner, SGM Carr & ECF Bird 1962; H = TM Howard & GS Hope 1970; Y = L Leach 1972; X = DH Ashton and RN Webb 1976; P = DC Pike and BA Fuhrer 1982; Z = GAM Scott 1982; T = AW Thies 1982+; C = Chesterfield *et al.* 1992; M = DA Meagher 1994-95

n	*Acrocladium chlamydophyllum*	M
	Achrophyllum dentatum	VLWSM
	Atrichum androgynum	VLWTM
	Barbula calycina	VBXZCM
	Barbula crinita	TCM
	Bartramidula pusilla	SM
n*	*Brachythecium albicans*	M
	Brachythecium rutabulum	ZM
x	*Brachythecium salebrosum*	B
	Breutelia affinis	VWSGDXTM
x	*Bryum affine*	VB
n	*Bryum* sp. aff. *alpinum*	M
	Bryum billardierei	VLWSGDHXTCM
	Bryum campylothecium	XM
	Bryum capillare	VM
	Bryum ?crassum	P
n	*Bryum dichotomum*	M
	Bryum chrysoneuron	VM
	Bryum pachytheca	WSBM
	Calyptogon mnioides	TM
	Camptochaete arbuscula	VWSHTM
	Camptochaete gracilis	SM
x	*Campylium polygamum*	Y
n	*Campylopus australis*	M
	Campylopus bicolor	WSDXM
	Campylopus bicolor var. *ereciticola*	AM
	Campylopus clavatus	AM
	Campylopus introflexus	VLWSGBXTM
	Campylopus introflexus var. *muticous*	M
	Campylopus pyriformis	VLWSATM
	Catagonium nitens subsp. *nitens*	VSAXM
	Ceratodon purpureus	LWSBAM
x	*Conostomum pusillum*	WS
x	*Cratoneuropsis relaxa*	W
	Cyathophorum bulbosum	VLSHM
	Dawsonia superba	VLWSDM
	Dicnemoloma pallidum	VWAXTM
	Dicranoloma billardierei	VLWSPTM
n	*Dicranoloma dicarpum*	M
	Dicranoloma menziesii	VSHM
n	*Dicranoloma platycaulon*	M
n	*Dicranoloma robustum*	M
n	*Dicranoweisia microcarpa*	M
	Didymodon torquatus	CM
n	*Distichophyllum crispulum*	M
	Distichophyllum microcarpum	LWSM
	Distichophyllum pulchellum	SM
n	*Ditrichum cylindricarpum*	M
	Ditrichum difficile	LSXTM
n	*Drepanocladus aduncus* s.l.	M
n	*Echinodium hispidum*	M
x	*Entosthodon subnudus* var. *gracilis*	D
n	*Eriopus apiculatus*	TM
n	*Eriopus brownii*	M
n	*Fissidens australiensis*	M
	Fissidens asplenioides	SM
n	*Fissidens humilis*	M
n	*Fissidens leptocladus*	M
n	*Fissidens oblongifolius*	M
	Fissidens pallidus	LSTM
	Fissidens pungens	DM
	Fissidens taylorii	SM
	Fissidens tenellus	ZM
	Funaria hygrometrica	LWSBM
n	*Funaria salsicola*	M
	Gigasperma repens	SAM
x	*Goniobryum subbasilare*	S
	Grimmia laevigata	XM
	Grimmia pulvinata	WM
n	*Grimmia tricophylla*	M
	Gymnostomum calcareum	WM
	Hedwigia ciliata	WDXM
	Hedwigia integrifolia	LWXTM
	Holomitrium perichaetiale	VM
	Hymenodon pilifer	VLWSM
x	*Hypnodendron comosum*	VL
n	*Hypnodendron spininervium*	M
	Hypnodendron vitiense	VLWSHM
	Hypnum cupressiforme	VWSBHXTM
	Hypnum cupressiforme var. *mossmanianum*	HM
	Hypnum cupressiforme var. *lacunosum*	M
x	*Hypopterygium rotulatum*	VWS
	Isopterygium limatum	WM
	Lembophyllum divulsum	VWSM
	Leptostomum inclinans	VHM
	Leptotheca gaudichaudii	LSM
	Leucobryum candidum	VWSHAPTM
	Lopidium concinnum	VLWM
	Macromitrium archeri	VM
x	*Macromitrium hemitrichodes*	V
n	*Macromitrium microstomum*	M
	Macrocoma tenue subsp. *tenue*	VSM
	Mittenia plumula	WSTM
	Orthodontium lineare	TM
n	*Orthotrichum tasmanicum*	M
x	*Papillaria flavolimbata*	VH
x	*Philonotis scabrifolia*	H
	Philonotis tenuis	SM
x	*Pleuridium nervosum*	X
	Pogonatum subulatum	TM
n	*Pohlia nutans*	M
x	*Polytrichadelphus magellanicus*	LTM
	Polytrichum juniperinum	LWSXTM
n	*Pseudoleskea imbricata*	M
n	*Ptychomitrium australe*	M
n	*Ptychomitrium mittenii*	M
	Ptychomnion aciculare	VLWSHATM
	Pyrrhobryum mnioides	VM
n	*Pyrrhobryum parramattense*	M
	Rhacomitrium crispulum	DHXM
	Rhacocarpus purpurascens	SDAXTM
	Rhacopilum convolutaceum	LWSAGCM
	Rhapidorrhynchium amoenum	VWXM
	Rhizogonium distichum	VLWM

Appendix 1 cont.

n	*Rhizogonium novaehollandiae*	M		*Thuidium sparsum*	VLWSGTM
n	*Rhyncostegiella muriculatum*	M	n	*Tortella cirrhata*	M
	Rhyncostegium laxatum	VLM		*Tortula muralis*	TM
	Rhyncostegium tenuifolium	VWSM		*Tortula papillosa*	VCM
n	*Sauloma tenella*	M		*Tortula antarctica*	LBWTM
x	*Schistidium apocarpum*	V	n	*Trichostomopsis australasiae*	M
	Sematophyllum homomallum	VLWGBXTM		*Triquetrella papillata*	WSM
n	*Sematophyllum jolliffii*	M		*Weissia controversa*	LWSM
x	*Sematophyllum leucocytus*	V	n	*Weymouthia cochlearifolia*	M
x	*Sphagnum cristatum*	S		*Wijkia extenuata*	VWSM
	Sphagnum cymbifolioides	SDAM		*Zygodon intermedius*	VSM
	Tayloria octoblepharis	VLSTM		*Zygodon menziesii*	WDTM
	Thamnobryum pumilum	SM		*Zygodon minutus*	VM
	Thuidium furfurosum	VLWSGXTCM			

Appendix 2. Liverworts recorded from Wilsons Promontory National Park
x = not found in 1994-95 n = new species record for Wilsons Promontory
The following letters refer to records derived from various sources, including searches of the the cryptogamic herbaria at the National Herbarium of Victoria (MEL), University of Melbourne (MELU) and Monash University (MUCV). V = F Mueller 1853; U = Audas & St John 1908; W = JH Willis 1951; S = SC Skewes 1953; G = M Gillham 1959; D = S Ducker 1960; H = TM Howard and GS Hope 1970; X = DH Ashton and RN Webb 1976; P = DC Pike and BA Fuhrer 1982; M = DA Meagher 1994-95

	Aneura alterniloba	VM		*Lepidozia laevifolia*	XM
n	*Anthoceros ?laevis*	M	x	*Lepidozia obtusiloba*	X
x	*Asterella drummondii*	P	n	*Lepidozia ulothrix* sp. agg.	M
n	*Balantiopsis diplophylla*	M	n	*Lethocolea pansa*	M
	Bazzania involuta	WPM	n	*Lophocolea ?biciliata*	M
	Cephaloziella exiliflora	XM	n	*Lophocolea gunniana*	M
n	*Chaetophyllopsis whiteleggei*	M	n	*Lophocolea* cf. *villosa*	M
n	*Cheilojeunea* sp.	M	n	*Lophocolea ?minor*	M
n	*Cheilolejeunea ?mimosa*	M	n	*Lophocolea muricata*	M
	Chiloscyphus sp.	H		*Lophocolea semiteres*	VBXM
	Chiloscyphus argutus	VM	n	*Lunularia cruciata*	M
n	*Chiloscyphus coalitus*	M		*Marchantia berteroana*	UGM
	Chiloscyphus echinellus	H	n	*Marsupidium surculosum*	M
	Chiloscyphus fissistipus	VM	n	*Megaceros gracilis*	M
n	*Chiloscyphus tridentatus*	HM	n	*Metzgeria decipiens*	M
	Cuspidatula monodon	VM		*Metzgeria furcata*	VM
n	*Diplasiolejeunea plicatiloba*	M	x	*Pallavicinia spinosa*	D
n	*Fossombronia intestinalis*	M		*Plagiochila fasciculata*	VHM
x	*Fossombronia alata*	P		*Radula buccinifera*	VM
n	*Frullania clavata*	M		*Riccardia* sp.	H
n	*Frullania deplanata*	M	n	*Riccardia aequicellularis*	M
	Frullania falciloba	VXM	n	*Riccardia crassa*	M
x	*Frullania pentapleura*	V	n	*Riccardia bipinnatifida*	M
	Frullania probosciphora	VM	x	*Riccardia multifida*	V
n	*Frullania monocera*	M	n	*Riccia* sp.	M
n	*Frullania rostrata*	M	x	*Schistochila lehmanniana*	VH
x	*Gackstroemia weindorferi*	VHX	n	*Siphonolejeunea nudipes*	M
n	*Goebelobryum unguiculatum*	M		*Symphogyna podophylla*	VHPM
	Hymenophyton flabellatum	VHM	n	*Telaranea centipes*	M
n	*Isotachis intortifolia*	M		*Tylimanthus* sp.	M
	Jamesoniella colorata	XM		*Tylimanthus tenellus*	H
	Kurzia compacta	XM	x	*Trichocolea mollissima*	VH
	Kurzia hippurioides	SM	n	*Zoopsis argentea*	M
n	*Lejeunea gunniana*	M	n	*Zoopsis leitgebiana*	M

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Arthur W. Thies
25 Davies Street, East Malvern, Victoria 3145

The Mosses and Liverworts of Rainforest in Tasmania and South-eastern Australia

by S. J. Jarman and B. A. Fuhrer

Publisher: *CSIRO 1995. 134 pages, RRP $24.95*

Those acquainted with the quality of Bruce Fuhrer's published colour photography of flowering plants, ferns, fungi and seaweeds will open this booklet with great expectations. They will not be disappointed by his photos of 50 mosses and 70 liverworts, mostly of species found also outside rainforest. The accompanying text by the co-author is of matching standard.

The aim of the book, quoting from its Introduction, is to provide a simple introduction to, and increase awareness of, the beautiful flora of mosses and liverworts, without scientific descriptions or identification keys.

Four general chapters fill the first 24 pages: 'A general introduction to bryophytes' describes structure, reproduction, life cycle, evolution and classification briefly and clearly without losing scientific accuracy. 'The Tasmanian bryophyte flora' is essentially an annotated list of literature for further reading. 'Bryophytes in Tasmanian rainforest' presents a brief survey of that forest's vegetation, and the distribution and ecological role of its bryophytes. 'Recognising bryophytes' is an excellent text on this non-trivial topic. It is well illustrated with black-and-white photos, and could help many field naturalists to tell a fern from a moss from a lichen from an alga.

The presentation of the various species is divided into three parts: mosses, thallose liverworts, and leafy liverworts. The text, with each species, comments on significant features, substrates and other relevant points. Detail is often presented in additional close-ups. The scientific names are given throughout - there are very few vernacular names anyway.

An appendix lists all species recorded in Tasmania's rainforests by their full botanical names, e.g. *Treubia lacunosa* (Col.) Prosk. A useful glossary of bryological and some general botanical terms follows. The explanations combine clarity with accuracy. Two pages then quote literature for further reading. Finally, there is an index of the species depicted.

So, of what benefit can the book be to a Victorian field naturalist, at least one with a strong bent to botany? Apart from what has been said before, anyone who can be lured into a closer study of the bryophytes will find the book helpful. The majority of the plants depicted can be found in Victoria, though often growing in different habitats, which affects both appearance and colour. Bryophytes tend to look quite different when they are wet and when they are dry, and *Thuidium furfurosum* e.g. (Fig. 50) ranges from deep green to orange according to habitat. Illumination in the forest presents formidable photographic problems. Fuhrer has generally solved them admirably. The obvious use of flash on *Lembophyllum* (Fig 23) e.g. has brought out well the characteristic branch tips, but occasionally, as with *Atrichum* (Fig 35), the appearance is not as I recall it.

The scientific names are very much up-to-date. Unfortunately so, for until the bryophyte volumes of the Flora of Australia come out, Scott, Stone and Rosser (1976) and Scott (1985) will remain the indispensable references of the serious amateur. The names used in these books could well have been added. The purely scientific literature recognises this, e.g. Vitt and Ramsay (1985). Also, flagging the Tasmanian endemics as such would have been helpful.

The book merits special commendation for giving equal weight to the liverworts and mosses, a rare feature in the popular literature. With the limitations stated, it will be a valuable addition to the field naturalist's library. One can only hope that it will encourage a few to take up the study of the bryophytes, where perhaps they can still contribute more than in any other branch of Botany.

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Founder Effects in Some Victorian Wild Rabbit *Oryctolagus cuniculus* L. Populations

Rosamond C.H. Shepherd[1] and J. W. Edmonds[2]

Abstract

The founding rabbits on most Victorian islands were domestic-types and the domestic characteristics can still be readily observed. Although Thomas Austin's releases of agouti rabbits at *Barwon Park* near Winchelsea were the main progenitors of the present wild rabbit populations, founder effects from other local releases can still be detected. Evidence for this is shown by genetic differences still observable in today's populations. These genetic differences were introduced with the original rabbit populations. (*The Victorian Naturalist* **113** (3)1996, 98–101)

Introduction

This study formed part of the background research into the myxomatosis/rabbit interaction continued over the period 1950–1985. This research was carried out by the staff of the Keith Turnbull Research Institute, Department of Crown Lands and Survey (with its various name changes), and one of its investigations was the genetic origin of the wild rabbit *Oryctolagus cuniculus* L. populations in Victoria.

Until about 1970 it was generally accepted that, although island populations of rabbits often had widely different characteristics, there was little variation within mainland populations. This was because their dominant progenitors, especially in Victorian populations, were a small number of wild-type rabbits from *Barwon Park* near Winchelsea (Fig. 1) (Rolls 1969). These wild-type rabbits (agouti, commonly called grey) were part of a consignment obtained from England by Thomas Austin which either escaped or were released in 1860 (Rolls 1969).

The persistence of characteristics of the original rabbits, ***founder effects***, can be readily observed in island populations, but there has been no detailed investigation in mainland populations. In this paper we discuss some island rabbit populations and consider some apparent founder effects in mainland populations and their possible origins.

Island Populations

The first recorded release of rabbits on a Victorian island was by Commander Stokes in H.M.S. Beagle in June 1842. About 12 rabbits were released on Deal Island (Fig. 1). Later releases were made on several other Bass Strait islands (Edmonds *et al.* 1976).

Descriptions of these island rabbits refer mainly to colour and size. A colony of about 20 black rabbits was founded on Doughboy Island before 1900, but was apparently wiped out by myxomatosis (J. Sparkes, Inspector, Department of Crown Lands and Survey *pers. comm.*). From Rabbit Island, Norman (1970) reported 3000-4000 long-eared, black-blue rabbits which were the size of domestic-rabbits, i.e. larger than mainland rabbits, and a few grey rabbits. Rabbits on Sunday Island were multi-coloured and also large; on Saint Margaret's Island, where the rabbits could travel to and from the mainland at low tide, there were some black and some orange rabbits amongst the mostly wild-type or agouti coloured population (D. Mitchell, Inspector, Department of Crown Lands and Survey *pers. comm.* 1975).

A Mr. Griffith may have released two agouti rabbits on Lady Julia Percy Island in 1848 (Fig. 1) (the late G.W. Douglas, Vermin and Noxious Weeds Destruction Board, *pers. comm.* 1980). However, Pescott (1965) reported that wild rabbits were introduced to Lady Julia Percy Island in 1868. Neither of these reports has been substantiated. The population on Mud Island in Port Phillip Bay was thought to have been founded by wild agouti rabbits introduced in about 1926 from the neighbouring mainland (D. Venn, Ranger, Department of Conservation and Environment *pers. comm.* 1982).

The Churchill Island population is a special case. Following a mortality rate greater than 99% from myxomatosis in 1952-1953, domestic-type rabbits were released and maintained as a feral population (Edmonds *et al.* 1981). The domestic characteristics of colour and large size persisted until eradication programs were carried out by the Department of Crown Lands and Survey during the 1980s.

Mainland rabbits

The first feral rabbits in Victoria were domestic-type escapees in Melbourne in 1837 (Stead 1935). It is believed that none of these survived for more than a short time.

[1] 6 Idon Avenue, Frankston, Victoria 3199.

[2] 515 Willowite Road, Moriac, Victoria 3240.

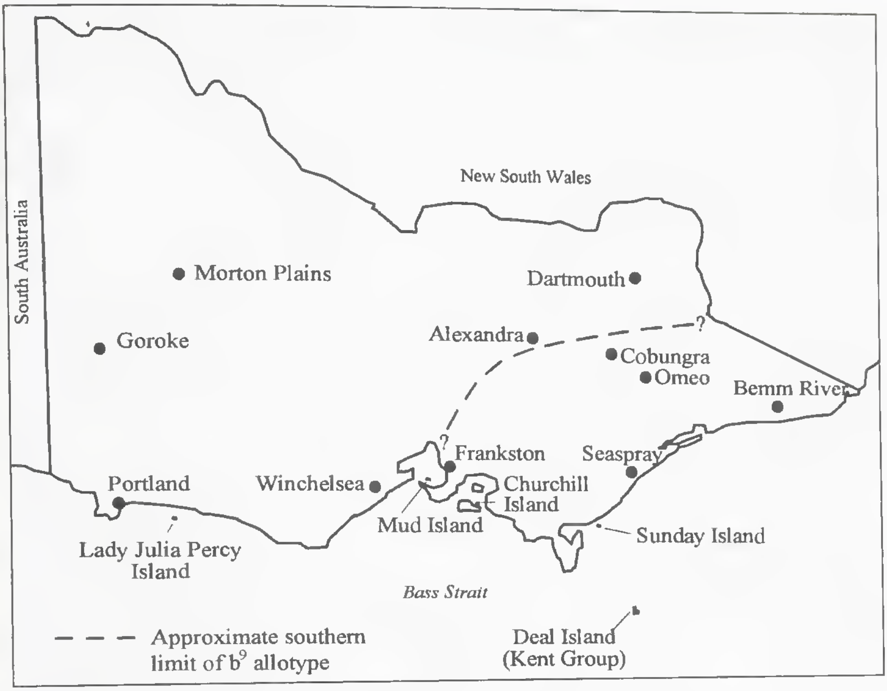

Fig. 1. Map of Victoria showing rabbit release and collection sites.

The first established population seems to have been in the coastal dunes between Portland and Port Fairy during the 1850s (Woodfield 1967). These rabbits were of unknown origin. Other recorded feral populations, which pre-dated the *Barwon Park* release, were on the central Victorian goldfields, at Morton Plains in the Mallee (Fig. 1) and in the southern Wimmera near Goroke (Fig. 1). The rapid spread of wild-type rabbits from *Barwon Park*, Winchelsea, apparently overwhelmed any pre-existing populations. Some of the spread from *Barwon Park* was deliberate for the first 3-4 years. The next deliberate release in that district was probably after the myxomatosis epizootics of the early 1950s when wild-type rabbits were released in order to maintain a population for historical reasons (Anon. *pers. comm.*). We have no evidence of any other organised releases on the mainland after 1875.

Data Collection

Coat colour was recorded in the field by both live observation and from shot samples. Rabbit size and weight (g) were recorded from shot samples as part of a wide ranging investigation of Victorian wild rabbit populations (Shepherd 1985, Shepherd and Edmonds 1976). A one year study (1979) in the Mallee (n=357) gave an average weight of 1470 g for mature rabbits i.e. >110 days old, whereas, mature domestic rabbits are in the 2000 g range.

Sera were collected for a study of structural differences in rabbit antibodies (immunoglobulins). They were tested for immunoglobulin (Ig) allotypes whose structure is controlled by co-dominant alleles (different forms of a gene) of immunoglobulin structural genes. The alleles tested for were the Aa locus alleles, a^1, a^2 and a^3 on the Ig heavy chain and the Ab locus alleles b^4, b^5 and b^9 on the Ig light chain. All tests were by antibody antigen reactions in gel as described by Herd and Edmonds (1977).

Results and Discussion

Although it is generally accepted that Austin's release of wild-type rabbits at Winchelsea provided the main founders for the present mainland populations (Rolls 1969), it is known that other releases have been significant contributors in some coastal areas and on some islands (Edmonds 1977; Edmonds *et al.* 1981; Herd and Edmonds 1977). Differences between island populations could be the result of either founder effects or differential selection effects on different islands. The rate of evolutionary change in the Australian wild rabbit has been sufficient to allow differences in colour and body conformation between temperate and arid zone rabbits, and also in rabbits under stress of high population density pressure (Myers 1966; Myers 1970); rabbits from the arid zone have yellowier coats (Stodart quoted in Myer 1970), and rabbits from warmer regions have significantly longer extremities, both ear length and foot length are longer in sub-tropical and arid zones than in the sub-alpine and Mediterranean zones (Myer 1970).

	Subtropical	Subalpine
Ear length (mm)	82.05	77.64
Foot length (mm)	92.01	89.38

In Victoria the most readily apparent example is selection for black colour in montane forest fringes, where black favours protection from predation. This colour was selected from the genetic pool available in the wild rabbit population (Edmonds *et al.* 1976). The possible occurrence of selection pressure must be allowed for in any consideration of founder effects (Shepherd and Edmonds *unpubl. data*).

The characteristics being considered, coat colour and size, may be under widely different selection pressures, even if the most severe pressure is thought to be predation by raptors and foxes. Founder effects for both colour and size have been recorded for several Gippsland populations including those on Churchill Island, St. Margaret's Island and Sunday Island and the coastal strip near these islands (Edmonds *et al.* 1976). We found no evidence that domestic-type genes for colour or for weight had spread far beyond the coastal strip. Populations sampled from agricultural land at Bemm River (n=23), Seaspray (n=233), Swifts Creek (n=55), Moe (n=53), Cobungra (n=104) and Negoura (n=64), and from Wilson's Promontory were wild-type in colour and size.

All rabbits from Lady Julia Percy Island (128) were agouti but mean weight (1080 g) was less than that for mainland wild rabbits. Grasses and other vegetation were sparse and dry at the time of collection. These rabbits were also smaller than the mainland rabbits. The smaller size could be either a selection or a founder effect. In either case the suggestion that the founding population was two agouti rabbits could be correct. Although the domestic rabbits available in the 1850s were large and mixed in colour they generally failed to establish in the wild (Rolls 1969). Perhaps Mr. Griffith was a percipient selector of rabbits and had collected his two agouti rabbits from the coastal dunes. It is, of course, possible that there were subsequent unacknowledged introductions of wild rabbits from the mainland.

Of a sample of 60 rabbits from Mud Island, 52 were agouti, six ginger and two black. These rabbits were within the weight range for mainland rabbits. The Mud Island population could have been founded by the release of rabbits from the mainland if these founders had been selected for colours with subsequent selection not being affected by terrestrial predators which tend to select out the more obvious colours. Genes for colour would then persist in the population.

The only evidence we have found for the survival of a probable domestic gene for colour in the agouti rabbits of the northern and western plains of Victoria, is from Morton Plains in the Mallee, where the occurrence of albinism is higher than in any other population we have observed. Although a shot collection is inevitably biased towards albinos our collection of 11% compares with 2.2% for rabbits collected near Donald (n=47) and 0.0004% in 6693 rabbits collected over 10 years in other north-western Victorian districts. There is no apparent reason why selection for albinism should have been greater at Morton Plains than elsewhere in north-western Victoria. It is likely that its high occurrence there is a founder effect from the domestic-type feral population established during the 1860s. We have found no evidence of any significant variation in the infrequent occurrence of colours other than agouti or albino in the northern or western plains rabbits.

In following up a survey of immunoglobulin allotypes (Edmonds 1977, Herd and Edmonds 1977) we have found that the order of frequencies of the Ab locus alleles on Lady Julia Percy Island, $b^9>b^5>b^4$, is unique in Australian rabbits and the b^9 frequency (0.40) is the highest recorded (Edmonds and Shepherd *in prep.*). Such an apparent founder effect could have occurred with a small number of agouti rabbits but it is most unlikely that they could have been taken by chance from a population resembling the present mainland population. If the founding date, which is believed locally to be 1848, is correct, then it is also unlikely that the island population was supplemented with any significant number of wild rabbits from the mainland after the Winchelsea rabbits. These have a high b^4 allele frequency, and established themselves across south-western Victoria. Only speculation on the origin of these rabbits is possible now.

A population sampled between Edenhope and Goroke could be distinguished from other Wimmera and neighbouring South Australian populations by a high b^5 frequency (0.52), the highest recorded on the mainland. The next highest b^5 frequency was 0.38 in a sample collected about 40 km east of Edenhope (Edmonds and Shepherd *in prep*.). The local belief that a wild rabbit population was established in about 1870 may be correct but its origins remain unknown. It could have been a small local release of Winchelsea rabbits which, by chance, had a high b^5 frequency.

The b^9 allele was not found in Gippsland (Herd and Edmonds 1977). We have attempted to determine the limits of the presence of the b^9 allele (Fig.1) which has not been found on the mainland east of Frankston and south of the Dividing Range. It is now present near Frankston, possibly as a result of the establishment of experimental rabbit colonies during the 1970s. It is also now present on Phillip Island, almost certainly by migration from Churchill Island across the causeway connecting the two islands.

Conclusions

There is no doubt that Thomas Austin's wild rabbits, released at *Barwon Park* and which included wild rabbits (Rolls 1969), were the main progenitors of Victoria's wild rabbit populations. The massive spread of rabbits began from there (Rolls 1969), since it is the only evidence for the release of wild rabbits in Western Victoria that could have contributed so greatly to the gene pool. There is no other supporting data for this massive spread, beyond the thousands of wild rabbits seen, and the initial spread reported from *Barwon Park*. However, some of the small releases of rabbits outside that area have made presistent contributions to the mainland gene pool.

Acknowledgments

We thank all the Technical staff of Keith Turnbull Research Institute, especially Mr Ivan F. Nolan, for their help in collecting and processing the rabbit samples. This work was partly funded by the International Wool Secretariat.

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Observations After a Fire in a Degraded Grassland

John Stewart[1]

Abstract
Following a fire, in December 1994, through Broadmeadows Valley Park, ca. 15 km north of Melbourne, Victoria, observations were made of the recovery of native flora, and then the introduced species, in one area of the park. This was carried out from June to November 1995.
(*The Victorian Naturalist* **113** (3) 1996, 102–106).

Broadmeadows Valley Park (Melways map nos. 6 and 179) is a linear open park, extending about 6 km from Johnstone Street, Broadmeadows in the south to Somerton Road, Coolaroo in the north. Set in the valley of the Yuroke Creek and its tributary gullies, it is a badly degraded grassland, having been used for agricultural purposes from the 1830's to the 1950's and is now surrounded by urban development. Before European settlement, judging by remnants in other parts of the park it was probably dominated by Kangaroo Grass *Themeda triandra* with many daisies, lilies and other small herbs. Although it has a long history of European settlement, 41 genera and 109 species of indigenous plants have been recorded throughout its area of over 170 ha (Carr *et al.* 1993; Arundell and Kern 1994).

On 7 December, 1994, a grassfire swept through part of the park and burnt an area that to the best of my knowledge had not been burnt for at least four years. This seemed a good opportunity to see what indigenous plants, if any, were present under the cover of the weeds. All plant names in this article follow Ross (1993) and Walsh and Entwistle (1994).

The area under study is a spur with a southerly aspect on the end of a gully entering the Yuroke Creek valley (Fig. 1). The angle of slope is approximately 15° and elevation 90-110 m. The soil is composed of elements of the underlying Silurian sediments and the late Tertiary basalt that forms the plateau above the valley with some boulders of sandstone conglomerate and quartzite strewn randomly over the slope.

Before the fire the slope to the north-west was covered with a thick mass of Chilean Needle Grass **Stipa neesiana* with a small area of dead Montpellier Broom **Genista monspessulana* that had been poisoned very early in the year. The north-easterly slope was a mixture of Canary Grass **Phalaris aquatica* and Artichoke Thistle**Cynara cardunculus.* On the very end there seemed to be a small area that was moister and had a lot more herbs including Ox Tongue **Helminthotheca echioides*, Cat's Ear **Hypochoeris radicata* and Ribwort **Plantago lanceolata* that kept most of the grasses out. There were a few patches of Kangaroo Grass *Themeda triandra* and Wattle Mat-rush *Lomandra filiformis* on the north-west slope a little past the area under study, and a patch of Common Raspwort *Gonocarpus tetragynus* on the point of the spur. These were the only indigenous plants evident to the casual eye.

Immediately after the fire on 10 December, 1995, I walked the area and found that all in the fire's path had been burnt and nothing had survived. There had been some very hot summer weather at this time, but then there was some rain: 19 mm on 22 December; 24 mm on 6 January; 18 mm on 9 January; 7 mm between 10-29 January, then a further 16 mm on 30 January; 25 mm fell in February; 91 mm in March, and 89 mm in April - a far better rainfall than was the case in 1994.

But to get back into sequence.

By 8 January (1995) new growth after the rain was quite evident and, from a low angle, the ground seemed almost green - blades of grass were about 60 mm long and seedlings of dicots were poking their leaves up everywhere.

By 22 January (1995) resprouts of Variable Glycine *Glycine tabacina* were scattered all over the slope with some plants almost in flower, patches of what looked like *Wahlenbergia* spp. in various places, and Bindweed *Convolvulus* sp.

[1] 19 Connell Street, Glenroy, Victoria 3046

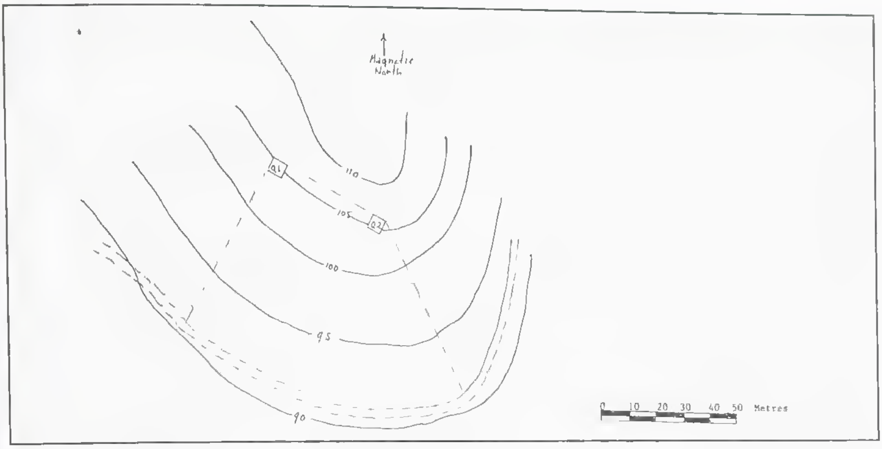

Fig.1. Plan of area under observation, Q1 and Q2 are quadrats. Numbers on lines are metres elevation

flowers were showing from small plants all over the lower slope. At one location on the point of the spur, *Solenogyne dominii* covered an area of $2m^2$ with their little radial leaves and rayless flowers. I had only seen this plant in one other part of the park, so this was a pleasant surprise.

Because of other commitments I did not make any further observations until 29 April, 1995. By then the Glycine had flowered, seeded and the pods opened. No seeds could be seen, taken away no doubt by the insects that always beat seed collectors, while snails or slugs were feeding on the leaves so that the plants were hard to see with only the stalks left amongst the grass. All snails in the area had been burnt in the fire, so these herbivores had either moved into the area from elsewhere or developed from eggs in the ground. Sweet Hound's Tongue *Cynoglossum suaveolens* were flowering over a wide area from small single plants. Patches of Small St. John's Wort *Hypericum gramineum* were also flowering, although it had now finished flowering in other parts of the park. Weeping Grass *Microlaena stipoides* was the only native grass to be seen and was not very common.

On 28 May, 1995, I decided that an area should be defined if these observations were to be of any use, so I set about it in the following way:-

The southern boundary was 100 m, measured along the fire track at the bottom of the spur, and the western side was a line up the slope on a bearing of 30^{o} for 60 m. The north side across the top was a bearing of 120^{o} for 45 m., while a bearing of 155^{o} down the slope picked up the south-eastern corner 65 m away, this was the east side. The whole contained arca was about 0.42 ha (Fig. 1).

On the north-west corner and the north-east corner quadrats of 5 x 5 m were marked out as data control bases, as these sites were the most weed infested before the fire. The north-west quadrat was covered with **Stipa neesiana* and the north-east one was a tangle of **Phalaris aquatica*, **Cynara cardunculus* and a scattering of Wild Sage **Salvia verbenaca*.

A survey of vegetation in these quadrats was made from May, when they were marked out, until 3 November, by which time the vegetation had become too thick for the survey to be of value (Table 1).

June - There were plenty of seedlings but far too small for identification. However, some Tall Wallaby Grass *Danthonia* sp. plants with the odd Weeping Grass *Microlaena stipoides* were evident. Although there was less bare ground than the previous month, only the old plants like thistles and tussocks really had shown real growth, also the Bluebells *Wahlenbergia* spp. and Sweet Hound's Tongue *Cynoglossum suaveolens* had finished flowering and were withering. Blue Devil *Eryngium ovinum* could be identi-

Table 1. Percent cover of species recorded in two quadrats, at various dates during the first year after burning.
'-' = not recorded, '+' = < 1% cover. '*' introduced species.

	Dates 1995					
Species	**28/5**	**24/6**	**22/7**	**20/8**	**6/10**	**4/11**
North-west Quadrat No. 1						
Acaena sp.	1%	2%	2%	5%	5%	2%
* *Aira caryophyllea*	-	-	-	-	-	2%
* *Avena fatua*	-	-	-	-	+	+
* *Briza maxima*	-	-	-	-	-	+
* *Briza minor*	-	-	-	-	5%	5%
* *Cerastium glomeratum*	-	-	-	-	+	+
* *Cynara cardunculus*	5%	5%	2%	2%	2%	2%
Dichelachne crinata	-	-	-	-	+	+
* *Galium aparine*	+	2%	1%	+	+	+
* *Helminthotheca echioides*	+	+	1%	+	+	+
* *Phalaris aquatica*	+	1%	2%	2%	2%	2%
* *Plantago lanceolata*	2%	2%	1%	+	+	+
* *Romulea rosea*	-	+	+	+	-	-
* *Rosa rubiginosa*	+	1%	1%	+	+	+
Rumex brownii	+	+	1%	2%	+	+
* *Sherardia arvensis*	+	+	1%	+	+	+
* *Sonchus oleraceus*	+	+	1%	2%	+	+
* *Stipa neesiana*	50%	70%	70%	70%	70%	70%
* *Trifolium* sp.	2%	3%	20%	25%	10%	10%
Bare ground	35%	15%	5%	+	-	-
North-west Quadrat No. 2						
Acaena sp.	5%	5%	5%	5%	2%	2%
* *Cerastium glomeratum*	-	+	2%	5%	2%	-
* *Cynara cardunculus*	20%	25%	25%	25%	25%	25%
* *Galium aparine*	2%	5%	+	+	+	-
* *Helminthotheca echioides*	+	+	+	+	-	-
* *Phalaris aquatica*	35%	30%	40%	40%	60%	80%
* *Plantago lanceolata*	+	+	+	+	+	+
* *Romulea rosea*	+	+	+	+	-	-
Rumex brownii	+	+	-	-	-	-
* *Salvia verbenaca*	10%	10%	5%	5%	2%	1%
* *Sonchus oleraceus*	-	-	+	-	-	-
* *Stipa neesiana*	20%	10%	10%	15%	5%	5%
* *Trifolium* sp.	-	+	2%	5%	5%	5%
Bare ground	10%	5%	5%	+	-	-

fied and also Common Woodruff *Asperula conferta*.

July - Bare ground had almost disappeared, trefoil seedlings were appearing but too small to identify. Mouse-ear Chickweed **Cerastium glomeratum* seemed to be growing more on the east side of the area than all over.

August - No bare ground now, the only bare spots were where the bedrock outcropped. Wall Fumitory **Fumaria murale* was seen with its pink and purple flowers peeping amongst the green grass and the bright pink stars of Onion Grass **Romulea rosea* were evident whenever the sun shone. The flowers of the Short-stem Sedge *Carex breviculmis* could be seen amongst its bright green grass-like leaves while a large patch of Small Riceflower *Pimelea humilis* was just coming into bloom with its tiny massed blooms putting on a great display. About halfway up the slope Field Woodrush *Luzula meridionalis* plants were blooming and the yellow and brown flowerheads could easily be seen. Thus, from having only one specimen previously recorded in the whole park, there must have been at least fifty plants here on the spur.

September - No observations made.

October - Most of the seedlings had grown big enough to be identified: Field

Madder **Sherardia arvensis*; Common Bartsia **Parentucellia latifolia*; Shivery Grass **Briza minor*, and probably French Catchfly **Silene gallica*. Flowers of the Pale Sundew *Drosera peltata* were now appearing, and flowerheads were also showing on the grasses, Common Tussock Grass *Poa labillardiera*, Soft Tussock Grass *Poa sieberiana*, Long-haired Plume Grass *Dichelachne crinata* and Quaking Grass *Briza maxima*. Sweet Hound's Tongue *Cynoglossum suaveolens* was coming into bloom again, although they had flowered in April and one of the trefoils could now be identified as Suckling Clover **Trifolium dubium*. However, the weeds were now starting to cover all the patches of native plants and it soon looked as it did before the fire.

November - The quadrats were so overgrown now that the weather was warmer that it was impractical to continue. The cycle had neared completion, for, by December, it would have been a year since the fire. The north-west quadrat had more than 70% cover by Chilean Needle Grass **Stipa neesiana* while other weeds made up the remaining 30% and the height of the grass was now over 50 cms. The north-east quadrat was no better, with the Canary Grass **Phalaris aquatica* and Artichoke Thistle **Cynara cardunculus* nearly 80 cms high, and in both quadrats *Trefoil species were now struggling for sunlight.

A few more plants could be identified, Salsify **Tragopogon porrifolius* and Hairy Pink **Petrorhagia velutina* , and at least three *Danthonia* spp. which were different from the Tall Wallaby Grass that had appeared in June. During the year there were areas that had a concentration of one native species (Table 2) and although there were other smaller patches, those mentioned in Table 2 stood out as places where, over the years, these plants had grown, flowered and dropped their seeds, so that with this opportunity after a fire, native plants could come back, even in such a badly degraded grassland.

Conclusion

As a result of this rough survey it could be seen that, although the area was covered with weeds, there were still traces of the original grassland herbs remaining. How to manage these exotic invaded areas is not clear, fire alone is not the answer. An article by Ian Lunt (1990) concluded with the following thoughts, 'Degraded, invaded and isolated remnants should not be managed solely by burning; burning should be integrated with other methods of vegetation control, such as weeding, poisoning and perhaps manipulated, seasonal grazing by native or introduced herbivores.'

Unfortunately interest in grasslands is not very high in the community, and therefore funds don't come easily. But to the few that know what an expanse of Kangaroo Grass or tall Spear Grass can look like, we would like everyone else to see and enjoy it.

Table 2. Native species which occupied areas greater than $1 m^2$ during the first year after fire.

Area	Species
5 x 2 m	*Acaena* sp.
$1 m^2$	*Cynoglossum suaveolens*
1 x 4 m	*Drosera peltata*
4 x 2 m	*Glycine tabacina*
4 x 2 m	*Hypericum gramineum*
4 x 4 and 3 x 2 m	*Hypericum gramineum*
10 x 3 and 4 x 3 m	*Gonocarpus tetragynus*
4 x 3 m	*Asperula conferta*
2 x 2 and 2 x 2 m	*Veronica gracilis*
6 x 4 and 2 x 1 m	*Wahlenbergia communis*
6 x 1 m	*Wahlenbergia luteola*

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Appendix. A species list of plants seen on the "Spur" since the fire. * introduced species.

MONOCOTYLEDONS	
Cyperaceae	
Carex breviculmis	Short-stem Sedge
Juncaceae	
Luzula meridionalis	Field Wood-rush
Iridaceae	
* *Romulea rosea var. australis*	Onion Grass
Liliaceae	
Tricoryne elatior	Yellow Rush Lily
Poaceae	
* *Aira carophyllea*	Silvery Hairgrass
* *Avena fatua*	Wild Oat
**Briza maxima*	QuakingGrass
**Briza minor*	Shivery Grass
Danthonia spp.	Wallaby Grasses
Dichelachne crinata	Long-haired Plume Grass
Microlaena stipoides	Weeping Grass
* *Nassella trichotoma*	Serrated Tussock Grass
* *Phalaris aquatica*	Canary Grass
Poa labillardieri	Common Tussock Grass
Poa sieberiana	Soft Tussock Grass
* *Stipa neesiana*	Chilean Needle Grass
Themeda triandra	Kangaroo Grass
DICOTYLEDONS	
Apiaceae	
Eryngium ovinum	Blue Devil
* *Foeniculum vulgare*	Fennel
Asteraceae	
* *Cynara cardunculus*	Artichoke Thistle
* *Helminthotheca echioides*	Ox Tongue
* *Hypochoeris radicata*	Cat's Ear
Senecio quadridentatus	Cotton Fireweed
Solenogyne dominii	Solenogyne
* *Sonchus oleraceus*	Common Sow Thistle
* *Tragopogon porrifolius*	Salsify
Boraginaceae	
Cynoglossum suaveolens	Sweet Hound's Tongue
Campanulaceae	
Wahlenbergia communis	Tufted Bluebell
Wahlenbergia luteola	Bluebell
Caryophyllaceae	
* *Cerastium glomeratum*	Mouse-ear Chickweed
* *Petrorhagia velutina*	Hairy Pink
* *Silene gallica*	French Catchfly
Clusiaceae	
Hypericum gramineum	Small St. John's Wort
Convolvulaceae	
Convolvulus remotus	Pink Bindweed
Convolvulus erubescens	Grassy Bindweed
Dichondra repens	Kidney Weed
Crassulaceae	
Crassula decumbens	Rufous Stonecrop
Droseraceae	
Drosera peltata	Pale Sundew
Fabaceae	
Bossiaea prostrata	Creeping Bossiaea
Glycine tabacina	Variable Glycine
* *Trifolium dubium*	Suckling Clover
* *Vicia hirsuta*	Tiny Vetch
* *Vicia sativa*	Common Vetch
Fumariaceae	
* *Fumaria murale*	Wall Fumitory
Geraniaceae	
Geranium retrorsum	Grassland Crane's bill
Haloragaceae	
Gonocarpus tetragynus	Common Raspwort
Lamiaceae	
* *Salvia verbenaca*	Wild Sage
Oxalidaceae	
Oxalis perennans	Yellow Wood-sorrel
Plantaginaceae	
* *Plantago lanceolata*	Ribwort
Polygonaceae	
* *Acetosella vulgaris*	Sheep Sorrel
Rumex dumosus	Wiry Dock
Rosaceae	
Acaena echinata	Sheep's Burr
Acaena ovina	Australian Sheep's Burr
* *Rosa rubiginosa*	
Rubiaceae	
Asperula conferta	Common Woodruf
* *Sherardia arvensis*	Field Madder
Scrophulariaceae	
* *Parentucellia latifolia*	Common Bartsia
Veronica gracilis	Slender Speedwell
Thymeleaceae	
Pimelea curviflora var. sericea	Curved Riceflower
Pimelea humilis	Small Riceflower

Back to the Heart of the Mallee

R.J. Fletcher[1]

The story of Wyperfeld National Park really begins with Edward John Eyre, who, in the process of droving sheep or cattle (there appears to be some doubt which it was) from New South Wales to the new settlement in Adelaide in 1838, 'rediscovered' the Wimmera River and traced it as far north as Lake Hindmarsh. This was named after Sir John Hindmarsh, the first Governor of South Australia. It would appear that he had attempted to reach the Murray River by way of what is now Pine Plains, but had to retrace his steps because of lack of water.

The aboriginal population had regularly travelled along the course of the Wimmera River and further north along Outlet Creek, and by 1847 Europeans had followed the same route to establish pastoral runs. Three of these runs occupied part of what is now the Wyperfeld National Park, namely 'Pine Plains', 'Cambacanya' and possibly part of 'Brimin'. The area was of considerable interest to early naturalists, and as early as 1861 William Lockhart Morton took botanical specimens to Baron Mueller for identification. Some fifty-six of these specimens are now housed in the National Herbarium in Melbourne (**Table 1**). Morton had spent June and most of July of 1861 carrying out a survey of the area. His chief interest was in finding suitable country for pastoral pursuits, but he made other valuable contributions to our knowledge of the area.

By the turn of the century this interest had stimulated a number of excursions and the accumulation of considerable knowledge of the local flora and fauna. One of the leading naturalists of the time, Arthur H.E. Mattingley, had made a study of the Malleefowl *Leipoa ocellata* (Mattingley 1909b), during 1907 at 'Pine Plains' as part of a more extensive study of the avifauna of the Mallee. It is the purpose of this paper to attempt to retrace the steps of Mattingley's 1907 September trip (Fig. 1).

It was very largely due to the efforts of Mattingley that in 1909, 3,900 ha were temporarily reserved as National Park. Nothing much happened after that for a while, partly because of the intervening war years, but in 1921 an additional 2600 ha were added and the Park was gazetted in October 1921. Additional areas were gazetted in succeeding years, notably 3000 ha in 1922 and 2600 ha in 1930. In more recent years, further large areas have been added extending west as far as the Murrayville-Yanac Road, making a total of 356 000 ha

Mattingley's paper, 'In The Heart Of The Mallee', was published in *The Victorian Naturalist* 26, 1909, and his observations began at Murtoa, which he described on 13 September, 1907 as one of a number of 'more or less dreary wayside stations', on the train journey to Hopetoun. The stop at Murtoa was of sufficient duration to go for a stroll to a clump of 'Buloke' *Allocasuarina luehmannii*, about a mile away, where nests were found containing young of the Black-backed Magpie (= Australian Magpie) *Gymnorhina tibicen*, Raven (= Australian Raven) *Corone australis* (= *Corvus coronoides*) and White-faced Xerophila (= Southern Whiteface) *Xerophila leucopsis* (= *Aphelocepha leucopsis*, while the Red-capped Robin *Petroeca goodenovii* (= *Petroica goodenovii*) and Yellow-rumped Tit (= Yellow-rumped Thornbill) *Acanthiza chrysorrhoa* were busy building their nests. Other birds observed in the immediate area were Wood Swallow (= Dusky Wood-swallow) *Artamus cyanopterus*, Galah *Cacatua roseicappilla*, White-fronted Chat *Epthianura albifrons*, Musk Lorikeet *Glossopsitta concinna*, Grass Parrakeet (= Red-rumped Parrot) *Psephotus haematonotus*, Ground-lark (= Richard's Pipit) *Anthus novaeseelandiae*, Noisy Minah (= Noisy Miner) *Manorina melanocephala*, Laughing Jackass (= Kookaburra) *Dacelo gigas* and the Kestrel (= Nankeen Kestrel) *Falco cenchroides*.

There is now no chance of finding Mattingley's 'clump of Buloke' within a mile of the station, and a current bird list

[1] 4/48 Newport Road, Clayton South, Victoria 3169

Table 1. Collections in the Melbourne Herbarium made by William Lockhart Morton between Lake Hindmarsh and Underbool, Victoria (including Wyperfeld and Pine Plains) during June and July, 1861. This plant list is after J.H.Willis, 'Notes of a Tour in the Wimmera District' 1861, W.L.Morton (published by National Parks Association,1966, where it appears as an alphabetical arrangement of species).

Species	Common Name	Spiecies	Common Name
Acacia brachybotria	Grey Mulga	*Grevillea huegelii*	Comb Grevillea
Acacia calamifolia	Wallowa	*Grevillea pterosperma*	Desert Grevillea
Acacia ligulata	Small Cooba	*Gyrostemon australasicus*	Wheel Fruit
Acacia lineata	Streaked Wattle	*Hakea leucoptera*	Silver Needlewood
Acacia oswaldi	Umbrella Wattle	*Hakea muelleriana*	Desert Hakea
Acacia rigens	Nealie	*Heterodendron oleifolium= Alectryon oleifolius* subsp. *canescens*	Cattle-bush
Acacia spinescens	Spiny Wattle	*Hibbertia virgata*	Guinea Flower
Acacia trineura	Three-veined Wattle	*Hunea pholidota = Haeckeria pholidota*	Scaly Haeckeria
Acacia wilhelmiana	Dwarf Nealie	*Kochia aphylla = Maireana aphylla*	Leafless Bluebush
Adriana hookeri	Mallee Bitterbush	*Lasiopetalum behrii*	Pink Velvet-bush
Allocasuarina muelleriana	Slaty She-Oak	*Leptospermum myrsinoides*	Silky Tea-tree
Arthrocnemum arbusculum= Sclerostegia arbuscula	Shrubby Glasswort	*Lomandra leucocephala* subsp. *robusta*	Woolly Mat-rush
Atriplex stipitata	Kidney Saltbush	*Melaleuca pubescens = M. lanceolata*	Moonah
Baeckea crassifolia	Desert Baeckea	*Melaleuca uncinata*	Broom Honeymyrtle
Banksia ornata	Desert Banksia	*Micromyrtus ciliata*	Heath-myrtle
Bertya mitchellii	Mitchell Bertya	*Olearia lepidophylla*	Club-moss Daisy-bush
Beyeria lechenaultii	Pale Turpentine-bush	*Olearia magniflora*	Splendid Daisy-bush
Beyeria opaca	Dark Turpentine Bush	*Olearia muelleri*	Mueller Daisy-bush
Callitris verrucosa	Scrub Cypress	*Olearia pimeleoides*	Pimelea Daisy-bush = Burrobunga
Calytrix tetragona	Fringe Myrtle	*Pimelea microcephala*	Mallee Riceflower
Cassia nemophila var. *platypoda = Senna artemesioides* subsp. *petiolaris*	Cassia	*Pimelea stricta*	Gaunt Riceflower
Codonocarpus continifolius	Bell-fruit Tree	*Santalum acuminatum*	Sweet Quandong
Conospermum patens	Smoke Bush	*Templetonia egena*	Round Templetonia bush
Dodonea attenuata = D. viscosa subsp. *angustissima*	Wedge-leaved Hop-bush	*Triodia irritans = T. scariosa* subsp. *scariosa*	Porcupine Grass
Dodonea bursariifolia	Small Hop-bush		
Eutaxia microphylla	Eutaxia		
Exocarpus sparteus	Broom Ballart		

would be much more modest. This author noted at the Murtoa stop, Little Wattlebird *Anthochaera chrysoptera*; New Holland Honeyeater *Phylidonyris novaehollandiae*, as well as two birds probably not there in 1907; the House Sparrow *Passer domesticus* and Common Starling *Sturnus vulgaris*.

A much more rewarding place for bird watching today would be the Murtoa Golf Course, some distance out of town and which is also full of botanical interest. (Fig. 2)

As a leading ornithologist, Mattingley's chief interest at Hopetoun was the birdlife on Lake Coorong, which contained ' excellent fresh water and was the town's water supply'. His observations around the lake included those listed in **Table 2**.

Lake Coorong is still a wonderland for birdlife, although no longer the town water supply which now comes to the man-made Lake Lascelles by channel from Lake Lonsdale. The channel that would have carried the water from the lake to the town in Mattingley's day is still there. Many of the birds noted by Mattingley were also seen by the author as well as the Great Egret *Ardea alba*, Black-winged Stilt *Himantopus himantopus*, White-necked Heron *Ardea pacifica*, Straw-necked Ibis *Threskiornis spinicollis*, Australian White Ibis *Threskiornis molucca*, Silver Gull *Larus novaehollandiae*, Noisy Miner *Manorina melanocephala*, and Red-rumped Parrot *Psephotus haematonotus*.

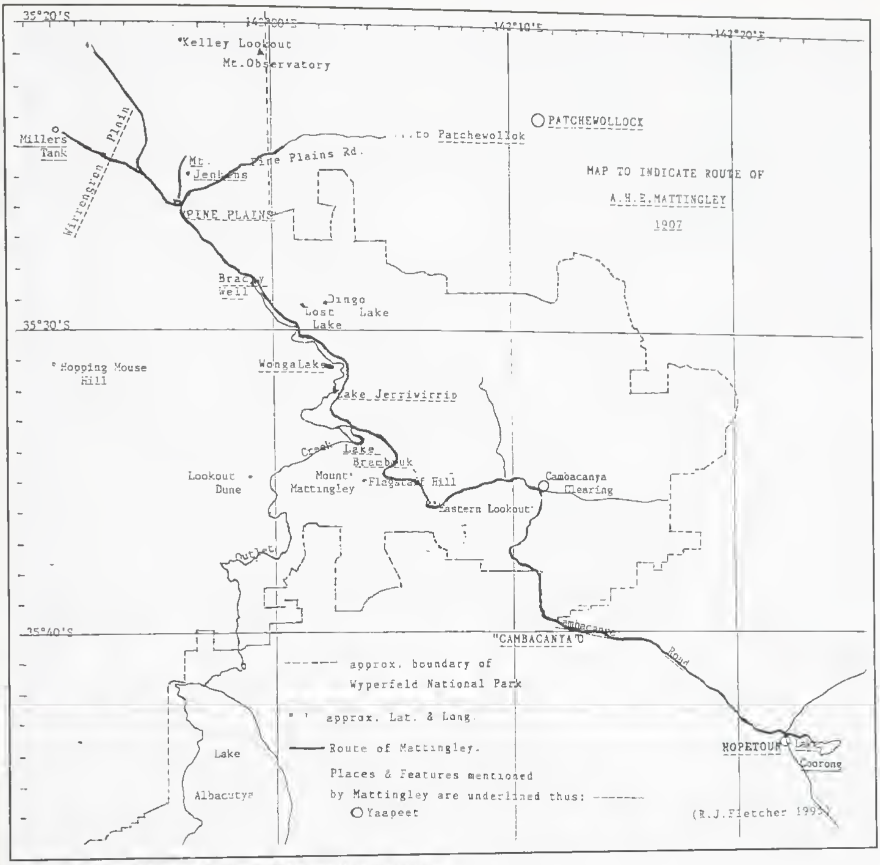

Fig. 1. Map of area showing Mattingley's route.

Fig. 2. *Caladenia xanthochila*, a rare and endangered species.

Bird-watching on Lake Coorong and its floodplain demands a good pair of binoculars. The lake is a very extensive sheet of water formed at the northern end of Yarriambiac Creek which rises some 120 km to the south, and is crossed many times on the road up from Murtoa. Also recommended, is a pair of waders!

The owner of Pine Plains Station in Mattingley's time was S. Poulton, a name still evident in the district. He provided Mattingley's party with a buggy and pair for the drive to Pine Plains via Cambacanya. Mattingley stated then that there was a 'first class road' from Hopetoun to Camba Canya (sic). It is now bitumen for most of the distance. He noted that the dense Mallee was being cleared in favour of wheat cropping and that the stock water from Lake Lonsdale had already arrived in the area. Apart from

Table 2. Birds observed by Mattingley in 1907 around Lake Coorong

Black Swan	*Cygnus atratus*
Black Duck = Pacific Black Duck	*Anas superciliosa*
Tippet Grebe = Great Crested Grebe	*Podiceps cristatus*
White-fronted Heron	*Notophoyx novaehollandiae* = *Egretta novaehollandiae*
Little Egret	*Egretta garzetta*
Whistling Eagle = Whistling Kite	*Haliastur sphenurus*
Wedge-tailed Eagle	*Uroaetus audax* = *Aquila audax*
Coot	*Fulica atra*
Black-fronted Dotterel	*Aegialitis melanops* = *Elseyornis melanops*
Marsh Tern = Whiskered Tern	*Chlidonias hybrida*
Spiny-cheeked Honeyeater	*Acanthochoera rufigularis* = *Acanthagenys rufogularis*
White-plumed Honeyeater	*Ptilotis penicillata* = *Lichenostomus penicillatus*
Harmonius Thrush = Grey Shrike-thrush	*Colluricincla harmonica*
Magpie-lark	*Grallina picata* = *Grallina cyanoleuca*
Fantail = Willie Wagtail	*Rhipidura tricolor* = *Rhipidura leucophrys*

roadside remnants there is no longer any 'mallee scrub', and this must have affected the birdlife. **Table 3** has been compiled from Mattingley's article and many of these birds were noted by the author in 1995, although by no means all. In addition, on the roadside near Cambeanya the Purple-gaped Honeyeater *Lichenostomus cratitius* was seen.

The most notable remnants of tree and shrubs along the verge include Buloke *Allocasuarina luehmannii* (much of it infested with Buloke Mistletoe *Amyema linophyllum* – a marvellous example of plant 'mimicry'), Umbrella Wattle *Acacia oswaldii*, and Desert Cassia *Senna artemesioides*.

On two of the dunes approaching Cambacanya were fine examples of Berrigan *Eremophila longifolia*, one in full flower and the other with very few flowers, but some fruit.

Cambacanya is a large and thriving concern based on wheat cropping, but the first impression is that of an extensive open cut gypsum mining project. The grandfather of the present owner took over the property during World War I. He said that the Poulton family had been hard hit by the drought of 1914. One year they had shorn 50 000 sheep but then the drought forced them to turn the animals loose into the scrub on a survival-of-the-fittest basis. The following year they had shorn 10 000! This means that 40 000 animals perished during the year and this loss was the end for the Poultons on Cambacanya. The stock watering system now in use would be an insurance against such a thing happening to that extent again.

One wonders if the ravages of the sheep at that time have resulted in the lack of vegetation in some areas to this day, especially the lack of an understorey in some of the Black Box areas.

Some of the original buildings still stand at Cambacanya (Fig. 3). At least one of the dwellings is the original where the limestone is clearly visible, although there are recent additions. Some outbuildings still stand, but in ruins, and are no longer used. But dominating the surroundings and made of more modern materials is the present main homestead and the extensive shedding used to house the machinery necessary for large-scale cropping and for operating the open-cut mine. Mattingley's vehicle 'bumped along fearfully' as he made his way towards what is now the south-eastern portion of the Wyperfeld National Park. Ours was a less hazardous trip, although there is no road as such. We learned that as long as you 'keep the fence on your right' you will eventually come out on what is now Webster's Road. Apart from some Mallee fringing the roads in the distance, as you cross Cambacanya the view is completely dominated by pad-

Fig. 3. Ruins of Cambacanya Station

Table 3. List of birds seen by Mattingley between Hopetoun and Cambacanya in 1907
= heard but not actually observed; @ = Not observed, but reputed to have been known to the Aboriginal population; * = Recorded as becoming very rare. NQ = likely to be a misidentification of a North Queensland species.

Brown Tree-creeper = Brown Treecreeper	*Climacteris scandens= Climacteris picumnus*
*Spotted Bowerbird	*Chlamydodera maculata= Chlamydera maculata*
Brown Fly-catcher= ? Jacky Winter	*Pseudogerygone=fusca Microeca- fascinans*
White-throated Thickhead= Golden Whistler	*Pachycephala pectoralis*
	Cinclorhamphus rufescens=
Rufous Song-lark = Rufous Songlark	*Cincloramphus mathewsi*
Red-throated Thickhead= Gilbert's Whistler	*Pacycephala gilberti= Pacycephala inornata*
Black-breasted Plover=Banded Lapwing	*Zonifer tricolor= Vanellus tricolor*
Chestnut-rumped Ground-Wren = Chestnut-rumped Heathwren	*Hylacola pyrrhopygia*
Mountain Duck= Australian Shelduck	*Casarca tadernoides= Tadorna tadernoides*
Crested Oreoica= Crested Bellbird	*Oreoica cristata= Oreoica gutturalis*
Pacific Heron= White-necked Heron	*Notophoyx pacifica= Ardea pacifica*
Scrub Robin= Southern Scrub-robin	*Drymaoedus brunneopygius= Drymodes brunneopygia*
White-eared Honey-eater	*Ptilotis leucotis= Lichenostomus leucotis*
Golden-rumped Pardalote= Spotted Pardalote	*Pardalotus xanthopygius = Pardalotus punctatus*
Chestnut-rumped Tit= Buff-rumped Thornbill	*Acanthiza reguloides*
Chestnut-backed Ground-bird=Cinnamon Quail-thrush	*Cinclosoma castanonotum= Cinclosoma castonotum*
Spiny-cheeked Honey-eater	*Acanthochoera rufigularis= Acanthagenys rufogularis*
Graceful Honeyeater (NQ).probably Yellow-plumed Honeyeater	*Meliphega gracilis* *Lichenostomus ornatus*
Emu	*Dromaius novaehollandiae*
Black-breasted Plover= Black-fronted Dotterel	*Charadrius melanops= Elseyornis melanops*
Pigeon= ? Crested Pigeon	*Ocyphaps lophotes*
Restless Flycatcher	*Sisura inquieta= Myiagra inquitea*
Sulphur-crested Cockatoo	*Cacatua galerita*
Red-capped Robin	*Petroeca goodenovii= Petroica goodenovii*
Galah	*Cacatua roseicapella*
Black-backed Wren= Splendid Fairy-wren	*Malurus melanotus= Malurus splendens*
Chough= White-winged Chough	*Corcorax melanoramphus*
Black Cockatoo = Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*
White-browed Babbler	*Pomatorhinus superciliosus=P omatostomus superciliosus*
Bronze-winged Pigeon=Common Bronzewing	*Phaps chalcoptera*
Wedge-tailed Eagle	*Uroaetus audax =Aquila audax*
Black-eared Cuckoo	*Misocalius osculans= Chrysococcyx osculans*
Blue Wren= Superb Fairy-wren	*Malurus cyaneus*
White-shouldered Caterpillar-eater = White-winged Triller	*Lalage sueurii*
Magpie= Australian Magpie	*Gymnorhina tibicen*
Bee-eater= Rainbow Bee-eater	*Merops ornata= Merops ornatus*
#Curlew= Bush Stone curlew	*Burhinus magnirostris= Burhinus grallarius*
Brown Hawk = Brown Falcon	*Hieracidia orientalis= Falco berigora*
#Delicate Owl= Barn Owl	*Strix delicatula= Tyto alba*
Kestrel= Nankeen Kestrel	*Falco cenchroides*
Mopoke, Boobook= Southern Boobook	*Nonox boobook= Ninox novaeseelandiae*
Owlet Nightjar= Australian Owlet-nightjar	*Aegotheles cristatus*
@Night Parrakeet= Night Parrot	*Geopsittacus occidentalis= Pexoporus occidentalis*
Red-rumped Parrakeet =Red-rumped Parrot	*Psephotus haematonotus*
Many-coloured Parakeet=Mulga Parrot	*Psephotus multicolor= Psephotus varius*
Mallee Parrakeet= Australian Ringneck	*Barnardius barnardi= Barbardius zonarius*
Major Mitchell's Cockatoo	*Cacatua leadbeateri*
Mallee Emu-wren	*Stipiturus mallee*
Orange-tipped Pardalote, Yellow-tipped Pardalote= Striated Pardalote	*Pardalotus affinis= Pardalotus striatus*
Mallee-Fowl=-Malleefowl	*Lipoa ocellata*
Tree Martin	*Cecropis nigricans = Hirundo nigricans*
White-faced Honey-eater=? White-fronted Honeyeater	*Phyliidonyris albifrons*

docks of wheat on the grand scale. The northern end of Websters Road is also the entrance to the Park, joining the end of Lowan Track at the locked gate. These tracks or their predecessors, would probably have been made by the traffic between Cambacanya and Pine Plains, and the problems with deep sand that Mattingley suffered in several parts can still occur today.

Mattingley made no particular emphasis on the plant life along the way, his chief interest being birds. However, in retracing what must be very close to his route along the northern part of Webster's Rd., Lowan Track and perhaps Cambcanya Track, there is a veritable garden awaiting the keen walker. Plants seen along Webster's Road, in the order noted, are listed in **Table 4** and those along the Lowan Track and Cambacanya Track are listed in **Table 5.** It was most noticeable that each specimen of *Thelymitra megacalyptra* seen along these tracks was growing out from a clump of *Triodia scariosa*! Mattingley passed along these tracks, or very close to them, and noted the changes in soil types from soft sand to harder flats, which account for the distribution of plants in the various areas. He certainly came to the area now known as the Wonga Hut Camping Areas adjacent to Lake Brimin, possibly from near where the Ranger Station is now situated. This would be a logical place to find 'elongated plains' and 'around their margins huge Red Gums, *Eucalyptus rostrata* (sic) rearing their umbrageous heads. We were in the ancient bed of the Wimmera River.'

There was an 'iron hut' here, which may well have been the one destroyed in the 1945 bush fires and replaced by the present similar structure. Unfortunately it would appear that the vegetation in this vicinity has suffered greatly from the ravages of grazing, fire, flood, rabbits, and people. It was the country near here that prompted Mattingley to comment that it 'would form an admirable national park without any further making.' To see what Mattingley saw, it is necessary to walk some of the routes designated in the Park literature or along any of the management tracks. The circuit from Lake Brimin to Eastern Lookout traverses most types of habitat found in the Park.

Table 4. Plants seen along Websters Track, listed in the order seen.

Acacia brachybotria	Grey Mulga
Acacia calamifolia	Wallowa
Cassytha melantha	Dodder Laurel
Cryptandra tomentosa	Prickly Cryptandra
Podolepis capillaris	Wiry Podolepis
Olearia tenuifolia	Cypress Daisy- bush
Callitris gracilis	Slender Cypress Pine
Eucalyptus oleosa	Acorn Mallee
Eucalyptus calycogona	Red Mallee
Eucalyptus. incrassata	Yellow Mallee
Leptospermum coriaceum	Green Tea-tree
Leptospermum myrsinoides	Silky Tea-tree
Zygophyllum apiculatum	Pointed Twin-leaf
Phebalium bullatum	Silvery Phebalium
Glischrocaryon behrii	Golden Pennants
Dianella revoluta var *revoluta*	Black Anther Flax-lily
Clematis microphylla	Small-leaved Clematis
Billardiera cymosa	Sweet Apple-berry
Melaleuca lanceolata	Moonah
Aotus ericifolia	Common Aotus

Table 5. Plants seen along the Lowan and Cambacanya Track, listed in the order seen.
* exotic plant

Baeckea behrii	Broom Baeckea
Adriana hookeri	Mallee Bitter-bush
Caladenia stricta	Upright Spider Orchid
Lasiopetalum behrii	Pink Velvet Bush
Lasiopetalum baueri	Slender Velvet Bush
Thelymitra megacalyptra	Scented Sun-orchid
Micromyrtus ciliata	Heath Myrtle
Beyeria lechenaultia	Pale Turpentine Bush
Calytrix tetragona	Fringe Myrtle
Calotis erinacea	Burr Daisy
Pittosporum phillyreoides	Weeping Pittosporum
Hakea vittata	Hooked Needlewood
Ajuga australis	Austral Bugle
Boronia caerulescens	Blue Boronia
Olearia pimeleoides	Pimelea Daisy-bush
Triodia scariosa	Porcupine Grass
Exocarpus sparteus	Broom Ballart
Eucalyptus largiflorens	Black Box
Eucalyptus camaldulensis	Red Gum
**Nicotiana glauca*	*Tree Tobacco
Westringia rigida	Stiff Westringia
Caladenia tensa	Rigid Spider Orchid
Acacia farinosa	Mealy Wattle
Millotia tenuifolia	Soft Millotia
Hibbertia stricta	Erect Guinea-flower
Hibbertia virgata	Twiggy Guinea flower

From the Wonga Hut on Lake Brimin, Mattingley's route basically followed Outlet Creek. The areas of open country, 'verdure clad bays forming the plains', the swales between the dunes, making a chain of 'lakes' along the course of Outlet Creek, impressed him as the grazing grounds of numerous emus and marsupials, and this is still so.

One item is sadly missing in any quantity, the nesting mounds of the Malleefowl *Leipoa ocellata*, which Mattingley found to be numerous in the mallee areas in this section of the Park. In another region a little further north, he examined forty-five mounds in a relatively small area.

Of course Mattingley's objective was the Pine Plains Station, still some distance away, and he proceeded up the Creek to Lake Brambruk, the destination of one of the Nature Walks - Lake Jerriwirrip, called 'Cherrywhip' by the locals at the time, and Wonga Lake. This route took him through some of the richest bird observing spots, and many of the species in his checklist were noted along here. It is only a matter of a few kilometres to walk this route, but folk doing so should have a good map and be able to make proper use of a compass. As is stated in the Park literature, any extensive walks should be discussed beforehand with the Rangers. It is not always easy to make out which is the bed of Outlet Creek, and there could be many false trails.

Perhaps it was fortunate that Mattingley and his party didn't divert a little to the west to try and avoid deep sand on the ridges between Jerriwirrip and Wonga. The depression in this area is Lake Plagianth, and on the occasion of this 1995 visit had, in its central area, an expanse of 'glutinous grey glug' which enhanced one's height by a centimetre or two at each step. If Mattingley's buggy and pair had entered they would have been in more trouble than with the deep sand up on the dunes.

Growing in this grey mud was a fascinating little plant, not seen before by the author, *Flax-leaf Alyssum *Alyssum linifolium*. This small crucifer is found in the drier parts of the state and in similar areas in other states. At this season it was in fruit, with the seeds visible in the tiny transparent 'spectacle' pods.

Mattingley must have had good information and also have been a good navigator. It was dark soon after they left Wonga Lake and it was still over six kilometres as the crow flies to his next reference point, Bracky Well. But of course the crow would have been stumbling along through the sand, or if following along the creek bed, tripping over fallen timber and becoming confused by the numerous side branches of the creek.

If the creek bed is followed from where it crosses the Nine Mile Square Track, one eventually comes across Emu Flat, and it is on the edge of this Flat that Bracky Well stood. There are the remains of a windmill lying on the ground, chiefly the tail-vane, and a couple of decayed logs, all that remains of the hut referred to by Mattingley.

Fortunately, somebody has erected a sign indicating Bracky Well, or it would be possible to walk past without noticing very much. From here it was only about four more kilometres across much easier ground, the southern bed of Lake Agnes, to Pine Plains Station.

Mattingley called this spot 'Bracke Well', and the local opinion at the moment is that 'Bracke' or 'Bracky' is an abbreviation of 'brackish', referring to the quality of the water provided.

Apparently the view from the current Pine Plains homestead, built by the late Tim O'Sullivan on the site of the original, hasn't changed much in nearly ninety years. There were then, as now, 'miles of country without a trace of mallee; large plains without a vestige of timber, evidently the dried up beds of ancient lakes, fringed with picturesque Red Gums: whilst the graceful Murray Pines grow profusely on the sand ridges.'

The principal 'large plain' is of course Wirrengren Plain, the ultimate destination of Outlet Creek. It is unusual for the Creek to run as far north as Lake Brambruk, and even more so for it to reach Pine Plains, but it is recorded that in very wet years it has done so. In 1853 Wirrengren Plain flooded to a depth of 12 feet (3.6 m), and in 1945 to 4 feet (1.2 m). It's very difficult to visualise such events (Fig. 4).

Mattingley spent the next three days

exploring around the area. The Lake Agnes perimeter is still timbered with Red Gum, Black Box and Cypress Pine, and bird life abounds. The dunes on the western side of Wirrengren Plain are timbered with several mallee and acacia species, and likewise abound in bird life. Mattingley's bird list between Hopetoun and Pine Plains included 50 species (**Table 3**) of the approximately 160 now on the list recorded for Wyperfeld National Park.

This author's list, though not having quite the same species as Mattingley, numbered fifty-seven, and included one not mentioned by Mattingley, the Peregrine Falcon *Falco peregrinus*. A pair were observed at nest (one that had been abandoned by an eagle), not far from Bracky Well. The nest was near the top of a Cypress Pine on the side of a sand dune. The male was particularly vocal in his displeasure at our presence, wheeling around and screaming. An hour or so later, on returning, the same reception was given. The female quietly left the nest and perched a little distance away, presumably returning when all was quiet. Mattingley doesn't specifically mention the Malleefowl being seen on the journey from Hopetoun to Pine Plains, although he mentions the sighting of several nests or mounds. However, the study of the 'Thermometer-Bird or Mallee-Fowl' was a major part of his work during this time. The details of this work were published in *Emu* 8, Jan.1909. There he describes the examination of 45 different mounds in the vicinity of Pine Plains, over a period of several months in 1907.

One current observation that would have surprised Mattingley, was that of a mob of camels, including a calf, on Wirrengren Plain (Fig. 5). These belong to the O'Sullivan family, and have been used since 1988 for safaris in various parts of the country. Another development, begun by Tim O'Sullivan, and being gradually completed by Susan O'Sullivan and family, is that of accommodation for visitors to the northern end of Wyperfeld, including that part which was previously included in Pine Plains. This should be a boon for folk who don't wish to camp.

So it is that Mattingley's dream of a National Park, the 'lungs of the city', has come to fruition, on an even grander scale than he imagined. It is possible, without much difficulty, to traverse most types of terrain in an ordinary vehicle or with day walks. For the more adventurous walker, there is very little limit to what can be done.

Adequate camping facilities are available in both the north and south sections of the Park, and unpowered sites are available for caravans. Unlike Mattingley's problems in deep sand with his 'buggy and pair', access to the major areas is by well-surfaced roads, including bitumen, from Rainbow or Hopetoun. Access from Patchewollock is by gravel road.

The western area of the Park, is accessible by way of the Yanac to Murrayville Track, but this is really only suitable for 4WD vehicles, and then only in dry weather. Unfortunately, some drivers feel the necessity to barrel along this track, with the result that it is very cut up in some sections. The motto of the four-wheel driver, 'tread lightly', has not always been observed in this area.

Fig. 4. Bed of Outlet Creek near Pine Plains Station.

Fig. 5. Camels on Wirrengren Plain

Acknowledgements
Thanks to: Damien Kerr, Principal Ranger, Wyperfeld National Park, and Staff; Bill Roberts, Hopetoun; Max Brown, 'Cambacanya'; and Susan O'Sullivan, 'Pine Plains'.

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Marine Invertebrates

Clarrie Handreck[1]

Introduction

This item complements Noel Schleiger's on 'Shell Collecting' in *The Victorian Naturalist* **112,** 105 (April 1995). His lists of activities, equipment, references and clubs are of course relevant here.

Most people's observations of marine invertebrates will be confined to intertidal and shallow subtidal areas. Keep in mind that the entire intertidal zone is exposed to human activity, with therefore widespread potential for deleterious effects from trampling, habitat disturbance, over-collecting, and exploitation for food and bait. There are *no* wilderness ('no-go') zones within current marine reserves (cf. terrestrial reserves where public access is mostly restricted to tracks).

Permits are required for collecting or research in all Victorian coastal and marine reserves.

Collecting live specimens outside reserves for non-research purposes is discouraged, too. Without immediate effective preservation, body tissue quickly decays. Many,including seastars and most nudibranchs, lose all colour when preserved.

Getting Started

The assistance available within a club can speed up your recognition of common species and the ability to assign specimens to appropriate taxonomic groups, and help you to develop an eye for the many very small or motionless or camouflaged animals.

Some Tips For Observing

Move slowly to minimise disturbance and turbidity.

In-situ observation of animals under stones or in rock pools, without handling them, often increases the range of behaviours seen.

If you do handle animals, please use discretion:

— Worms will often break, especially if pulled from tubes, holes, or from amongst the massed small white tube worm

— The legs of crabs and shrimps break off easily, especially if lively animals are restrained in the hand. Watch out, too, for 'soft' ones that have just moulted.

— Trying to remove sessile species, or those that cling tightly (limpets, etc.), is likely to cause damage or injury.

— Handling often increases life's problems for animals that drop limbs or discharge intestines to distract predators, e.g., brittle stars and some sea cucumbers, respectively.

— Use soft-action forceps or a small art brush if you need to handle soft-bodied animals.

In soft-sediment areas, distinguish species that live in various habitats: attached to sea-grasses or algae, on the surface, in the top few centimetres of sediment, or deeper and perhaps in burrows. Digging and sieving soft sediments inevitably causes considerable habitat disturbance.

In rocky-shore areas, turn and replace loose stones carefully to minimise the chance of animals being injured or washed off (our aim is to see them). Return each stone, right way up, to its original spot in the hope that the edges will quickly 'seal' again with sediment or shingle. If collecting dead shells, select those without things living on them (limpets, bryozoa, etc.) or inside them (especially hermit crabs, many of which are in very small shells).

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Jones, D. and Morgan, G. (1994): A Field Guide to Crustaceans of Australian Waters. Reed. ISBN 0 7301 0403 6. S/c. 216p.

In preparation

Edgar, G. A book for the general reader and naturalist on the marine life of southern Australia. Over 1000 species described and colour-illustrated. Due to be published by Reed in the first half of 1996.

Clubs and Societies

Marine Research Group of Victoria (MRGV*): Clarrie Handreck (03) 9870 3647.
Malacological Society of Australasia (Victorian Branch): Edna Tenner (03) 9478 1284.
Port Phillip Bay Shell Group: Christine Bunyard (03) 9439 2147.
Marine and Coastal Society of Victoria: Tim O'Hara (03) 9899 2509 Focus: marine environment management.
Aquatic Naturalists ('Aquanats'): Glenys Greenwood (03) 9560.6024. Focus: divers' natural history group.
Australian Marine Conservation Society (formerly Australian Littoral Society): Brisbane-based, branches in Qld. and NSW. Focus:research and management (07) 848 5235.
FNCV: Noel Schleiger (03) 9435 8408.

*Participants in MRGV activities can:

— help build a Victoria-wide database;
— assist with studies and reports on particular locations;
— support the work of specialist taxonomists;
— pursue their own interests or studies
— provide diver support for research (shore and boat opportunities arise)
— work as volunteers in Invertebrate Zoology, Museum of Victoria (Saturday and weekday options).

Lightning

G.L. Howie[1]

Since my letter headed 'Lightning Strikes Again' was published (Howie 1994), information has been printed which shows that the published facts, on the formation of thunderstorms and hence lightning, if not incorrect, do not show what really happens or indeed what forces are present.

Damage to trees shows the effect of the energy release pulses. While on a Field Naturalists' Society Botany Club excursion (10/12/95) to a native vegetation area within the Kuitpo Forest, which is otherwise mainly Radiata Pine *Pinus Radiata,* 30 km south of Adelaide, I noticed a *Eucalyptus obliqua* with a strip of bark removed from the full length of the main trunk, obviously due to lightning.

Splinters of wood and bark were strewn all around for a radius of about 15 m (about the height of the tree), the branch (60 mm diameter) that had been struck, complete with leaves which were dry after 2-3 months, was lodged in the fork of the main and dead trunk.

It appears that the current entered the branch via a dead stick which was probably wet and thus acted as a conductor. About 3 m of the branch was completely splintered, with one piece about a metre long stuck vertically in the soil directly below where it had grown. Down the main trunk the growing layer acted as the conductor and hence the strip of bark was blasted off.

Adelaide, on 17/12/95, experienced a severe electrical storm with most strokes apparently cloud to ground (the Electricity Corporation recording about 250 to main power lines in South Australia). About 110 flashes were recorded in the extended metropolitan area between 4.30 am and 12.30 pm by the Australia-wide radio detecting system now partly installed. The initial receivers are at Wagga Wagga, Cobar, Mildura and Mount Gambier. I have a copy of the print-out for 17/12/95, the first line being

'S 34.313 E 139.405 04:09:14.964 17-DEC-95 -32 KAMB'.

Times to 1 MS eastern standard. 116 flashes were recorded for the 'extended metropolitan Adelaide'.

It is hoped to be able to associate the tripping of power distribution circuit breakers (11KV and over) with the location of particular flashes so that insulators and conductors can be examined for damage when supply has not been interrupted.

Thanks to media publicity, I was able the next day to go and examine the remains of a Silky Oak *Grevillea robusta* which was struck. The trunk (30 cm diameter) 2-4 m above the ground was completely shattered with the bark totally removed from that and the section below. The discharge spreading out in three branches, one of which damaged a telephone cable abut two metres away. Unfortunately the trunk was cut up shortly after the incident.

On New Year's Eve, Adelaide experienced another severe thunderstorm which had apparently developed not far to the north. I was able to examine two houses that had been damaged by lightning. In one case about 35 roof tiles were broken and about 50 clay bricks in the upper part of a side wall were shattered. Most of the wiring in the house had to be replaced, not surprising as the discharge was seen as three sparks from ceiling to floor in three rooms.

The damage to the television, microwave oven, video recorder and washing machine motor which were plugged in, although not switched on, illustrates that all electrical appliances should be completely disconnected if a thunderstorm is imminent.

I was, therefore, not surprised to be told by a Field Naturalist member that two trees (*E. obliqua*) in the Society's reserve at Forest Range, 30 km north-east of Adelaide, had been struck by lightning on New Year's Eve 31/12/95.

This occurrence is of interest as it was found that the initial discharge was via one tree but the return stroke was via a nearby tree (butts 10 m apart, tops about 5 m

[1] 53 Gladys Street, Clarence Gardens, SA 5039

apart). The bark of both trees was blasted off along 6 cm strips right to the top and reduced to a mass of fibre resembling that from a coconut (Fig. 1), most of it still being attached to the remaining bark. The rest of the fibre and some splintered wood were spread about on trees, shrubs and ground for 10 m in all directions (Fig. 2).

As with the other cases, the foliage, because there was no evidence of burning, was obviously not part of the discharge paths. A few small twigs with leaves were apparently broken off by the force of the explosions and the condition of these indicated that the incident probably occurred on 17/12/95.

Another fact about lightning is also gaining publicity in the media. For many years I have been of the opinion that lightning often extended far above the thunderhead through the upper atmosphere and the night of the 2/1/95 provided further evidence. I was alone in the Cooltong Conservation Park, a mallee area with Bare Logania *Logania nuda*, Skeleton Fan Flower *Scaevola depauperata* and particularly *Stackhousia megaloptera* and dominated by Silver Mallee *Eucalyptus cyanophylla*, when an extremely severe thunderstorm came from the north-west.

Before the rain and high winds obscured my view , I was of the opinion that visible cloud-to-ground strokes were occurring at about 100 per minute. Subsequently it was clear that the thunderhead was very high, possibly 20-30 km, yet some ground strokes appeared to extend further upwards as a reddish glow. A short paragraph published about the same time, 'Gamma-Ray Thunderbolts' ('News Notes' 1995) subsequently convinced me that what I had seen as inverted triangles of light apparently reflection from below horizon thunderstorms, were, in fact, upper atmosphere extension of the lightning flashes, obviously involving potential differences much greater than that which could be caused by the thunderstorm alone.

I had, for over 20 years, been uncertain as to why light flashes were seen as distant triangles with the apex always pointing downwards, when, if they involved direct reflection of flashes, these should not be only inverted triangles. The explanation of the upper atmosphere glows has come in a number of publications since (Hill 1995; Davidson 1995; Muir 1995; Kerr 1994b, 1995; Lyons 1995; Holmes 1995).

Many cloud-to-ground strokes and/or the return strokes apparently extend up to 100 km above the earth in the form of inverted cones (seen as triangles) within volumes of up to 10, 000 km^3 of air. None of the published information has offered an explanation of the cause of 'Red Sprites' (salmon-red and carrot-shaped) and 'Blue Jets' (blue and fountain-shaped)(Fig. 3). One hypothesis is that they are formed from oxygen or nitrogen molecules excited by collisions with

Fig. 1. *Eucalyptus obliqua* Forest Range, South Australial Lower part of the trunk, bark shredded by lightning.

Fig. 2. Left, Butt tree of Fig. 1, right, bundle of dispersed fibre on *Acacia pycnantha*, 6 m away.

high energy electrons, somewhat similar to those produced in auroras (Kerr 1994; Lyons 1995; 'News Notes' 1995).

However, questions still arise:-

- Do charges resulting from solar activity accumulate on earth, and if so, do these charges subsequently escape into outer space with the assistance of thunderstorm activity and hence the 'Red Sprites', etc.? It appears that 'Red Sprites' are best observed from 200-250 km away from the thunderstorm (below the horizon) and, of course, well away from cities such as Melbourne.

- Do the charges accumulated in the capacitance formed by the earth, together with the insulating lower atmosphere (dielectric) and the conducting upper atmosphere, assist in the formation of thunderstorms and contribute to their intensity?

The result is a flash of light between cloud and earth, a damaged or demolished tree, a smashed power line insulator, a broken conductor, a damaged transformer or a bush fire (an essential for the existence of many Australian plant species), but what was the precursor high in the atmosphere and probably unnoticed by humans?

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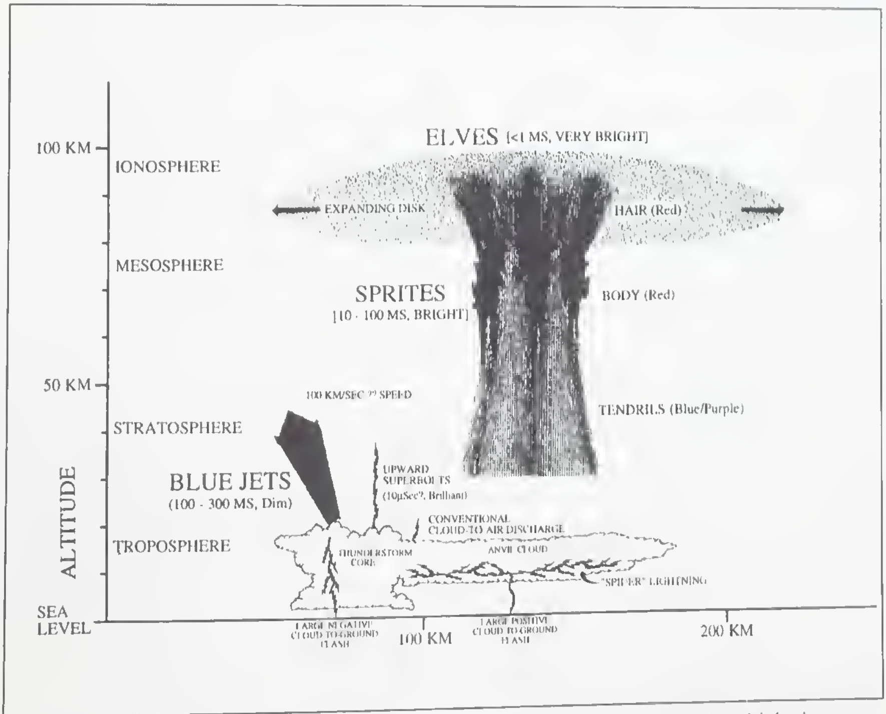

Fig. 3. Transient, Luminous Events in the Stratosphere and Mesosphere Induced by Lightning. Sprites - Elves - Blue Jets.Drawing courtesy Walter A. Lyons, ASTeR Inc., PO Box 466, Fort Collins, Colorado 80522, USA

A Field Guide to Australian Butterflies

by Robert Fisher

Publisher: *Surrey Beatty & Sons Pty Limited, Chipping Norton NSW. 1995. 254pp. RRP$29.95*

In recent years conservation attention to a number of rare butterflies, such as the Eltham Copper in Victoria, has seen an increase in public awareness of the need to learn more about our fauna. A modern field guide to assist identification of common species in the bush and home garden has become a must for the environmentally aware. This latest hand book, by a recognised authority on the South Australian fauna, is presumably directed to a lay or young audience. Just over 200 butterfly species of a national total exceeding 400 are illustrated. The book is hard bound, glossy covered and sturdy, and its slim shape makes it very portable.

The introductory section includes general information on nomenclature, life history, distribution, butterfly morphology, and a small component on how to use the guide in the field. The author recommends initial field classification to family level, but this would be difficult for the novice using only the information provided.

The bulk of the book comprises a family by family treatment of species in traditional arrangement. An outstanding feature is the high quality colour illustrations of early stages of some 45 species. Each family is separately introduced, and for each butterfly species, a description of the adult male and female, general distribution and some life history information is given along with illustrations of one or more museum specimens. To aid identification, wing measurements in millimetres are provided in the text. Very little on species biology is included, and more emphasis on this, rather than descriptions, would have enhanced the species accounts. There is a tendency towards technical language with emphasis on scientific rather than common names, but the inclusion of a three page glossary at the back of the book will assist the reader. The guide concludes with a bibliography and separate indexes of common and scientific names.

Although, perhaps of limited concern to the novice, the guide does contain a sprinkling of inaccuracies which butterfly specialists will detect. Occasionally, incorrect common names are applied; *Paralucia pyrodiscus lucida*, the famous 'Eltham Copper' is called the 'Dull Copper', a name applicable to the eastern subspecies only. Regrettably, there are at least 10 incorrectly identified adults in the guide (see appendix). Some illustrations of hesperiines involve at least two species under one name, sometimes comprising members of different genera. The female depicted for *Sabera dobboe* seems to be *Telicota anisodesma*, and the female of one lycaenid, *Candalides absimilis*, appears under four different names. For several species the sexes have been mistakenly given (eg. *Lampides boeticus*). The colour reproduction is generally accurate, however some of the field shots depict adults on unlikely ornamental flowers, and other 'live' butterflies appear deceased (eg. *Paralucia pyrodiscus*).

In places the work is up to 12 years out of date, although most of the new information is available in the journals cited in the bibliography. This has resulted in the use of some obsolete names (eg. *Danis hymetus* is a junior synonym of a New Guinea species, *Psychonotus caelius*). There are very few spelling errors. Those found pertained only to technical names, eg's. the mistletoe *Notothixos* (see p.102), also the butterfly *Tirumala hamata* (see pp.118-9). Some of the bibliographic details are vague, incomplete or erroneous (eg. McCubbin was not revised in 1985; this is a reprint of the 1971 edition). Distribution data has suffered the most and in some places is wrong - the rare Barrington Tops subspecies *Candalides heathi doddi* does not occur in the Blue Mountains. Errors are also present in the descriptions of adults, eg. the female of *Hypolimnas alimena lamina* is said to be without the blue band on the upperside - this is applicable only to the NT subspecies, *darwinensis*. The Australian life history of *Bindahara phocides*, published in 1983, is stated to be undescribed (p.210).

For me, these inadequacies are a concern, however the field guide will prove useful for those who wish to develop a casual interest in butterflies or are seeking general information in a readily accessible form for use in school projects. For this audience, the glossy presentation, brief text and simple structure diagrams will be a major attraction. Indeed, many common butterflies will be recognised using the clear colour plates, and for the more experienced enthusiast the first class photos of juvenile stages (mostly unavailable elsewhere) will be appreciated.

Kelvyn L. Dunn
15 Yackatoon Road
Upper Beaconsfield, Victoria 3808

Book Review Appendix:

Annotated list of the 10 mis-identified adult specimens and the juvenile stage referred to in this review.

Ocybadistes flavovittatus: (p.53).
Male is *Suniana sunias*, female is *O. walkeri*
(It is not possible to confirm the identity of the underside specimen - it could be either *O. walkeri* or *O. flavovittatus*)

O. hypomeloma: (p.55).
Male underside is *S. sunias*

Neohesperilla xiphiphora (p.40).
Female seems to be *N. crocea*

Sabera dobboe (p.65).
Female seems to be *Telicota anisodesma*

Elodina perdita (p.101).
Both sexes are *Elodina walkeri* (from NE Qld).
(Refer to generic revision by DeBaar & Hancock 1993).

Candalides margarita (p.213).
Female is *C. absimilis* (NQ form)

C. helenita (p.215).
Female is *C. absimilis* (NQ form)

C. consimilis (p.217).
Female upperside is *C. absimilis* (SE Qld-NSW form).
Female underside is *C. absimilis*

In addition, Lambkin (1995) stated the female *Pelopidas* illustrated is *P. agna dingo*. I am not convinced of this and judge this female to be a variant of *P. lyelli*. Some years back I examined similar ambiguous material from north-western Australia, and the female illustrated may even be the specimen from Derby in the SA Museum which I commented on in Dunn & Dunn (1991). Lambkin also pointed out that the illustration of *Cupha prosope prosope* seems to be *C.p. turneri* with which I agree.

Mis-identified juvenile stage:
Catopsilia gorgophone pupa (fig.13 p.89)
This is a female pupa of *C. pomona* (summer form) (see Dunn 1995).

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MEMBERSHIP

Members receive *The Victorian Naturalist* and the monthly Field Nat News free. The Club organises several monthly meetings (free to all) and excursions (transport costs may be charged). Research work, including both botanical and fauna surveys, is being done at a number of locations in Victoria, and all members are encouraged to participate.

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From our Naturalist in Residence, Glen Jameson

Middle Yarra Timelines

This is a season of growth and activity for the bushland and its creatures, there is not the shutting down procedures of the northern hemisphere's autumn. The dry Summer spell is broken with frequent rains from early March to May and there is a sense of renewal and replenishment, of gearing up for breeding and production. If it is to be a dry year with the affects of the El Nino Southern Oscillation bringing on drought, it will be in this season, Early Winter, that the effects will be first suggested.

Early Winter

On a rocky riparian escarpment overlooking the Yarra River is a stand of Black She-Oaks *Allocasuarina littoralis*. An uncommon plant along the Middle Yarra Valley, all these are males with pendulous golden flowers casting pollen to the winds in the hope of reaching the solitary female plant way downstream. It is a precarious existence and illustrative of the plight of many plants in this Riparian vegetation community, perhaps one of the most degraded in the Yarra Valley.

Also on this rocky escarpment above the rapids, grows Rock Correa *Correa glabra* covered in bright green bell-shaped flowers in which Eastern Spinebills *Acanthorhynchus tenuirostris* search for nectar with almost frenzied speed while Bell Miners *Manorina melanophrys*, with chicks in their nest, harass the Eastern Spinebill at every opportunity. At the base of the Rock Correa is the fungi *Psilocybe* sp. Under thickets of Burgan *Kunzea ericoides*, cryptogams such as *Hypnum cupressiforme*, *Marchantia foliosa* and *Cladia aggregata* have returned to an emerald green colour after substantial rains and illuminate the heavily shaded areas where Gnat Orchids *Acianthus pusillus* flower.

On the ground at the base of a Manna Gum *Eucalyptus viminalis*, in a hole large enough to fit your finger, is the larval case of a Goat Swift Moth, family Hepialidae. The first heavy showers soften the ground and send the Timelonic message for these huge Moths to emerge during that night in search of a reproductive partner.

Along the Jumping Creek in Warrandyte State Park and along ***bushland corridors***, many of the smaller birds including White-plumed Honeyeaters *Lichenostomus penicillatus*, Brown-headed Honeyeaters *Melithreptus brevirostris*, Yellow-faced Honeyeaters *Lichenostomus chrysops*, Grey Fantails *Rhipidura fuliginosa* and Golden Whistlers *Pachycephala pectoralis* will flock together and work the trees for invertebrates. Amongst the lower vegetation strata the same flocking behaviour occurs between Superb Fairy-wrens *Malurus cyaneus*, White-browed Scrubwrens *Sericornis frontalis*, Eastern Yellow Robins *Eopsaltria australis*, Yellow-rumped Thornbills *Acanthiza chrysorrhoa* and Grey Shrike-thrush *Colluricinca harmonica*.

Unseasonal major rains have swollen the river so that Mountain Tea-tree *Leptospermum grandifolium* and River Bottlebrush *Callistemon sieberi*, half submerged, drag in the fast flowing water, whilst the curse of the river system, Willow's *Salix* spp. leaves are turning yellow. The water is freezing cold so that the diversity of aquatic invertebrates is considerably lower than during the summer seasons. However, there are still *Chironomids*, Stoneflies *Plecoptera*, Mayflies *Ephemeroptera* and the Elmid Beetles, family Elmidae, indicators of good water quality, but many of the invertebrate populations and large amounts of organic matter have been swept away by the racing river to be dispersed right down to the lower reaches of the Yarra. This scouring of the food-rich riffle areas depletes the favoured feeding grounds of Platypus *Ornithorhynchus anatinus* and perhaps threatens the survival of dispersing juveniles.

Downstream, Bolin Bolin Billabong brims to the bank with flooding water and large emphemeral wetlands in the Yarra Flats Park are created, to much vocalized praise by the Common Froglet *Crinia signifera*, which have instantly appeared in their thousands to use the opportunity afforded by the flood and also during this season the Victorian Smooth Froglet *Geocrinia victoriana* is at its most vocal. Much of the invertebrate fauna and organic matter swept downstream spills onto the floodplains to enrich the wetland ecosystem and a large mob of Cattle Egrets *Ardea alba* feed on the sodden grassy areas of Banksia Park and Yarra Flats Park. River Red Gums *Eucalyptus camaldulensis* begin to shed their copious production of seed as the leaves are attacked by Lace Lerps family Psyllidae.

The frequent showers of Early Winter inject a new lease of life into the flora and fauna. In the morning Sun after a particularly heavy rain, the Bushlands appear drippingly fresh and clean. Even the heavily polluted air has been purified and the smells of the land are intoxicating. Eucalypts now put on large amounts of new growth with each species having its characteristic young leaf colour. Yellow Box *Eucalyptus meliodora* has a golden colour and Red Box *Eucalyptus polyanthemos* is tinged with red. Fungi is growing everywhere in response to the changed weather conditions.

Gullies and grassy valley slopes are full of the fruiting bodies of Fungi which are a major feature of the Winter seasons as the food chain of decay gains momentum. There are *Dermocybe* aff. *sanguinea* amongst leaf litter, *Armillaria luteobubalina* at the base of trees, the Yellow Staining Mushroom *Agaricus xanthodermus* which seems to have taken dominance over the much loved, collected and eaten Field Mushroom *Agaricus campestris*, huge boletes such as *Phlebopus marginatus* resembling garden settings and, under the introduced Monterey Pines *Pinus radiata*, an imported range of fungi, Fly Agaric *Amanita muscaria* and Saffron Milk Caps *Lactarius deliciosus*. Splashes of Pink Heath *Epacris impressa* adorn the bush under the increasingly overcast skies and Pink Robins *Petroica rodinogaster* which have moved down from mountain forests and gullies or across from Tasmania. enjoy the solitude of Andersons Creek along the Gold Memorial Gully. The usually solitary Black Swamp Wallaby *Wallabia bicolor* also a resident of quiet gullies and steeper slopes. gives birth through the winter seasons and may be occasionally observed with partners during this time. Pecking at the last heritage variety of apples on the trees at Petty's Orchard is a flock of the Tasmanian form of Silvereye *Zosterops lateralis lateralis* over for the Winter. Jacky Winters *Microeca fascinans* are observed although the last sightings of Dusky Woodswallows *Artamus cyanopterus* and Fairy Martins *Hirundo ariel* are made as they join the migration path northward.

In flight on the occasional sunny afternoon is the last of the Cabbage White *Pieris raphae*, Common Grass Blue *Zizina labradus*, and Imperial White *Delias* *harpalyce* Butterflies, although on small Black Wattles *Acacia mearnsii* Common Imperial Blue Butterflies *Jalmenus evagoras* are still emerging. Catching the mid-afternoon sun is a small mob of Eastern Grey Kangaroos *Macropus giganteus* laying in a clearing on a westerly facing slope of Laughing Waters Park. Amidst the tangle of a huge, long fallen branch, are plentiful juvenile Garden Skinks *Lampropholis guichenoti* which have just hatched and they too catch the sun for energy. Young Black Crickets *Teleogryllus commodus* are also plentiful, often finding their way into houses as does the introduced Black Millepede.

Distant views from the ridges and hilltops are often prevented as rain clouds cover the Kinglake, Dandenong and Healesville Ranges. On the dry ridges are found the early winter flowering forms of the Golden Wattle *Acacia pycnantha* and Spreading Wattle *Acacia genistifolia*, uncommon forms of plants which usually flower during Spring. Mistletoebirds *Dicaeum hirundinaceum* feed on the ripening fruits of the Drooping Mistletoe *Amyema pendulum* growing from a Red Box which is beginning to flower. Nearby Long-leaf Box *Eucalyptus goniocalyx* carries a heavy load of flowers as it tends to do every second year and at its base the Drooping Cassinia *Cassinia arcuata* is in flower in brown pendulous plumes. Overhead a pair of Wedge-tail Eagles *Aquila audax*, one carrying a European Rabbit *Oryctolagus cuniculus* plucked from the grassy slopes of Longridge Park, are out circling anti-clockwise with the high pressure air system to gain a vantage over the terrain. They scrutinize the forests carefully, for it is nest building time and secret gullies must be evaluated for their potential.

As dusk falls, we watch fifteen Gould's Wattled Bats *Chalinolobus gouldii* leave in succession from a nest box on a dry ridge in Yarra Valley Parklands. This organised exit, may help them avoid predation by Pied Butcherbirds *Cracticus nigrogularis*, Pied Currawongs *Strepera graculina* and Owls. Gould's Wattled Bats will copulate during the Winter seasons, as will most of the species of Bats that inhabit the Yarra Valley, although births will not take place until the Spring.

A staggering array of Moths are drawn to house lights, their eyes glowing golden orbs. After the first rains break the Summer dry, huge platoons of Southern Army Worm Moths *Persectania ewingii* appear. Beside them are Twin Emeralds *Chlorocoma dichloraria*, Tiger Moths *Spilosoma glatiguyi*, Heliotrope Moths *Utetheisa pulchelloides*, Urticating Anthelid Moths *Anthela nicothoe*, White Satin Moths *Thalaina selenaea* and, a favourite of the Warrandyte football team because it has a red "W" on each white wing (the team's colours), the Clara Satin Moth *Thalaina clara*. All of these invertebrates contribute to a rich harvest for the flocks of birds that glean the trees during the day and night hunters such as Sugar Gliders *Petaurus breviceps* and Feathertail Gliders *Acrobates pygmaeus*. Foraging in the dark, under the bark of trunks and large limbs of trees, or amongst leaf litter for arthropods, is the endangered Brush-tailed Phascogale *Phascogale tapoatafa*. Keenly alert and as agile as thought itself, this species will mate this season, after which all the males of the population die, to leave ecological room for the offspring.

Night skies are dominated by bright stars of Achernar, Sirius, Procyon, Pollux and Alderaran. Spurred on by the flush of new growth on the local Eucalypts, Brushtail Possums *Trichosurus vulpecula* show little decorum by creating copious amounts of noise as they copulate on tin roofs. The females will be giving birth this season and carry pouch young for the following four to five months. Ringtail Possums *Pseudocheirus peregrinus* also begin their breeding this season which is fortunate for the Powerful Owl *Ninox strenua* which depends largely on Ringtails for food. Carried across the valley, where saw-edged formations of mist mark the river like the vertebrae of an ancient creature, is the falsetto double hoot calls of the Southern Boohook Owls *Ninox novaeseelandiae*. They are in counterpoint to the deep, resonant double hoot of the Powerful Owl, which is more often heard as the largest bird of the Owl family contemplates the approaching breeding season.

Glen Jameson
PO Box 568, Templestowe, Victoria 3106

The Victorian Naturalist

Volume 113 (4) 1996 August

F.N.C.V.

Published by The Field Naturalists Club of Victoria
since 1884

Supported by the Department of Natural Resources and Environment

Department of NATURAL RESOURCES & ENVIRONMENT VICTORIA

From the Editors

Mueller and the FNCV

It is a measure of his greatness that Baron Ferdinand von Mueller found time in a busy and energetic life to encourage and be involved with the small group of amateur field naturalists who had recently formed The Field Naturalists Club of Victoria, as well as supplying articles to actively support the development of its journal, *The Victorian Naturalist*. We are sure that Mueller would be pleased to see that the club is still strong and vital and embarking on a new phase of growth and activity following the purchase of its own premises at Blackburn.

This edition of *The Victorian Naturalist* is to acknowledge and remember the Baron, and while it deals with the wider aspects of Mueller's involvement with natural history, the central issue is his association with the club, and we begin with three articles dealing with this aspect.

Thank you

The editors would like to thank all the authors who have given freely of their time to meet almost impossible deadlines in providing the material for the journal, and special thanks to Sara Maroske who helped to arrange and co-ordinate this issue, as well as check the printers page proofs. Behind the scenes the anonymous referees and proof readers have provided invaluable help with their conscientious efforts and timely comments. Our editorial team, Gill Earl, Ian Endersby, Ian Lunt, Ian Mansergh and Tom May, have provided support and given of their time, we are especially grateful for their checking of printers page proofs.

The success of the issue is entirely due to all the hard work of these people.

Aknowledgements

We gratefully acknowledge the substantial finacial assistance provided by **The Department of Natural Resources and Environment** towards the additional costs of this issue. Without their help we would not have been able to publish the numbers of papers or to cover such a wide range of topics.

Registered Office: FNCV, 1 Gardenia Street, Blackburn, Victoria 3130
Telephone/Fax: (03) 9877 9860
Mail: Locked Bag 3, PO Blackburn, Victoria 3130

ISSN 0042-5184

The Victorian Naturalist

'olume 113 (4) 1996 August

Editors: Ed and Pat Grey

Mueller Articles

ook reviews

'over: Baron Ferdinand von Mueller. The photo carries the inscription 'To the Rev Pastor churmann the most exalted of the Lutheran preachers in Australia. In kind remembrance from 'erd. von Mueller. March 1982.' Photo. courtesy Richard Schurmann.

Introduction

Sara Maroske[1]

At time of the death of Baron Ferdinand von Mueller on 10 October 1896 The Field Naturalists Club of Victoria (FNCV) placed a notice in the daily newspapers calling on Club members to join with other mourners in Mueller's funeral procession (French 1896). The Club subsequently bought the grave-plot adjoining the one donated to Mueller by the Trustees of the St Kilda Cemetery, thereby doubling the area that could be devoted to his memorial (Mezger, B. 1989, *pers. comm.*). It was Mueller's wish that this grave be tended (Mueller 1884 *unpubl.*), and over the years The Field Naturalists Club surrounded the memorial with Australian plants and kept it in order (e.g. Willis 1957). These actions placed the Club in a interesting position of intimacy with Mueller. No family member was nearly so involved in his funeral proceedings (Wehl 1896 *unpubl.*).

Mueller called himself one of the earliest naturalists in the colony. As such it is no surprise that he felt at home in the FNCV. He was one of the 'original' members and later a Patron of the Club. His was a familiar face at meetings where he exhibited extensively, and he also published numerous papers in *The Victorian Naturalist*. Many Club members had cause to feel grateful for the personal encouragement which Mueller gave them. As W.B. Spencer observed in an obituary in *The Victorian Naturalist*, probably every member of the Club had come into contact with Mueller. 'It is hard, indeed,' Spencer declared, 'to realize that a younger generation must arise to whom the presence of the Baron, so familiar to us, will only be a tradition.' (Spencer 1896).

Mueller, however, was no ordinary naturalist. As Government Botanist of Victoria and Director of the Botanic Garden, Melbourne he was internationally renowned for his knowledge of the Australian flora. First and foremost he was a botanical taxonomist but he also made significant contributions in the related fields of geography, agriculture, horticulture, forestry, palaeobotany and pharmacy. It is easy to feel overwhelmed and incredulous when attempting to summarize his achievements. His capacity for work was phenomenal. This special issue of *The Victorian Naturalist*, which commemorates the 100th anniversary of Mueller's death, conveys something of the richness of his endeavours in natural history, many of which in later life involved the FNCV.

In 'The Legacy of Mueller's Collections', Jim Ross provides a broad context for many of the other papers. As a fellow taxonomist, and one who uses materials accumulated by Mueller, Ross is in a good position to assess Mueller's botany. He points out that in order to undertake taxonomic work in Australia Mueller had to acquire the means to do so, which were not initially at hand. The Government provided Mueller with a salary and ever-diminishing grants for books, specimens and equipment. This he extended with his own funds, with the dedication of his small staff, and through the efforts of a large network of collectors. Even with these resources Mueller could not unravel all the taxonomic problems he encountered. Helen Aston's paper on *Villarsia* indicates that there is still plenty left for other botanists to do.

In his first decades in Australia, Mueller was able to make substantial plant collections himself and several papers explore aspects of what this involved. Ralph Grandison traces four excursions which Mueller carried out in the Murray scrub of South Australia, before he was appointed Government Botanist of Victoria. Helen Cohn's and Alan Parkin's papers detail Mueller's most ambitious journey as the botanist on the North Australian Exploring Expedition, 1855-6. Despite losing some specimens at sea Mueller was able to add numerous species to the Australian flora from this venture. David Albrecht's paper describes Mueller's botanizing in the

[1]National Herbarium, Birdwood Avenue, South Yarra, Victoria 3141

Twofold Bay/Genoa district and thereby reveals that while Mueller may have had obstacles to overcome in his travels, so do researchers trying to uncover his tracks.

Although he visited every Australian colony, Mueller relied on collectors to give him an overview of the entire country's flora. Thus as Ian Endersby's and Linden Gillbank's papers show, Mueller was able to make a contribution to the taxonomy of Lord Howe and Norfolk Islands, and central Australia without ever visiting these areas himself. Susan Martin reflects on the nature of the relationship between botanist and collector and suggests that, although it was mutually beneficial, it was also unequal, especially in respect of women, who had limited access to education and professions for most of the nineteenth century. Barbara Archer and Sara Maroske present a detailed case study of one individual woman collector, Sarah Brooks, who clearly got a great deal out of her relationship with Mueller even if it was not the same kind of thing as he did.

The scientific rewards to be reaped from the labours of Mueller's network were the discovery of new species, locality information which helped to set the geographical limits of species, and observations on plant biology. Several of the papers in this edition are preoccupied with the process of naming. Mueller named plants and geographical features after individuals variously to acknowledge a collector, a patron or a colleague, or simply to curry favour with a politician. Thomas Darragh has been able to identify instances in which this honour was returned to Mueller in names in zoology and palaeontology. Ruth Dwyer adds a race-horse and an insect to the list of Mueller's eponymy, Bernie Mace a giant specimen of *Eucalyptus regnans*, and Alan Parkin a medal which is awarded annually by ANZAAS.

Mueller's research on Australian plants is better known than his work on exotics. Nevertheless, as Ray Wallace demonstrates in 'The Baron and the Goldfield' Mueller's communication with many areas was on the subject of non-Australian plants. Carmel McPhee shows that this was also the case with individual families such as the Armytages whose Western District and Queensland properties benefited from Mueller's importation of pasture grasses such as *Panicum spectabile*. Australia's plants in turn become exotic when they were exported overseas. Alan Parkin sketches Mueller's very significant role in the acclimatization of Eucalypt species in countries like California and Italy where they were prized for their timber, oils and sanitary vapours.

Current assessment of these ventures is no longer unequivocally positive. Mueller's operations took place in a pre-ecology era where scientists were not fully cognizant of the inter-relatedness of species. In their articles on Thylacines and tall trees R.N. Paddle and Bernie Mace tease out some of the complexities of Mueller's environmental position. Paddle asserts that Mueller was not a 'hardline' acclimatizer because he was concerned about the extinction of native species and did not automatically favour exotics over natives. Mace laments what has been lost because Mueller's position on forestry was unpopular and indicates some of the problems in identifying truth in a subject where writers are rarely disinterested.

Mueller had many like-minded companions in the FNCV and he co-operated with the Club in its campaigns to preserve Wilsons Promontory and the Cabbage Palms (*Livistona australis*) of East Gippsland. The Club no doubt benefited from the prestige and authority Mueller's support gave to its activities. In return it supplied an interested audience and a record of Mueller's work. The papers of Tom May and Sara Maroske, and Sheila Houghton trace Mueller's use of Club exhibitions and *The Victorian Naturalist* to publicize and publish, with surprising speed, his new findings. Consequently the *Naturalist* is the place where the type descriptions of such exciting species like *Rhododendron lochae* and *Thismia rodwayi* are to be found.

It is interesting when surveying this volume to note how many individuals have been attracted to make a closer inspection of Mueller's life and work, and to submit a written contribution based on their research. Some authors call him with affection and familiarity 'the Baron' others make a more critical appraisal of his work. All are responding to an extraordinary individual. In her paper 'Baron von Mueller in The Field Naturalists Tradition', Angela Taylor argues that Mueller's relationship to the Club has been built into its folklore. It is a process in which the fact that Mueller was important in Club history has tended to be better remembered than the actual details of his involvement. While this volume continues to place Mueller in the centre of Club traditions, it does so in a way that illuminates as well as appreciates his contribution.

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Mueller Time-line

1825	Ferdinand Jakob Heinrich Müller is born on June 30th in Rostock in the German kingdom of Mecklenburg.
1847	Müller arrives in Adelaide on 16 December with his two sisters, Bertha and Clara. In this year he is also made a Doctor of Philosophy by the University of Kiel for a thesis on the flora of south-west Schleswig.
1848	In April, Mueller tours the Murray Scrub to Lake Alexandrina, SA with Carl Schedlich. In December he makes a second trip to the Murray Scrub and his first trip to the Murray River.
1849	Müller is naturalized in South Australia and changes the spelling of his surname to Mueller. Between February and March Mueller makes a second botanical trip to the Murray River, SA.
1851	In February, Mueller makes his third botanical excursion to the Murray River, SA. He also travels to the Flinders Ranges in this year.
1852	Following the discovery of gold Mueller moves to Victoria.
1853	On 26 January Mueller is appointed Government Botanist of Victoria by Lieut Governor Charles La Trobe. He leaves for his first major collecting trip in eastern Victoria on 29 January.
1855-6	Mueller accompanies the North Australian Exploring Expedition led by Augustus Gregory.
1857	On 13 August Mueller is appointed Director of the Botanic Garden, Melbourne. In this year Mueller is also made a Doctor of Medicine by the University of Rostock.
1858	The collections at Phytologic Museum of Melbourne (now National Herbarium of Victoria) number about 45,000 specimens.
1860	Mueller botanizes in the Twofold Bay/Genoa River district, NSW.
1861	Mueller is elected a fellow of the Royal Society, London.
1863-78	With Mueller's assistance, George Bentham publishes the seven volume work *Flora Australiensis.*
1865	Mueller donates his botanical library to the Government of Victoria.
1869	The King of Württemberg bestows on Mueller the title 'von'.
1871	The King of Württemberg raises Mueller to the hereditary title of Freiherr (Baron).
1873	Mueller is removed from the Directorship of the Botanic Garden, Melbourne.
1876	The first edition of Mueller's encyclopedic work, *Select Extra-Tropical Plants*, is published.
1879	Queen Victoria confers on Mueller the title of Knight Commander of the Most Distinguished Order of St Michael and St George (KCMG).
1880	Mueller joins the Field Naturalists' Club of Victoria (FNCV) as member number 36.
1884	Mueller has a paper in the first and January issue of *The Victorian Naturalist.*
1885-8	On the suggestion of FNCV President, Dr F. Dobson, Mueller publishes the *Key to the System of Victorian Plants* in two volumes.
1886	Mueller is made a patron of the FNCV.
1891	The collections at Phytologic Museum of Melbourne (now National Herbarium of Victoria) number about 750,000 specimens.
1896	On 10 October Mueller suffers a fatal stroke at his home in South Yarra. He is buried at the St Kilda Cemetery on 13 October.

Baron von Mueller in the Field Naturalists' Tradition

Angela Taylor[1]

Abstract

Baron Ferdinand von Mueller was an 'original' member (1880) and Patron (1886-96) of the Field Naturalists' Club of Victoria (FNCV), who valued his expertise, his familiar presence and the prestige his association lent the Club. After his death in 1896, the FNCV ritually commemorated Mueller as a pioneer of science on the main anniversaries of his death, birth and arrival in Australia. The high point of this tradition was reached in the inter-war years, when natural history had become marginalised by professional science. One outcome of FNCV tradition was that Mueller had his first published biography written by Charles Daley, an amateur naturalist-historian in the Club. Another outcome is that the lingering aura of tradition has clouded some perceptions of Mueller's historical relationship with the FNCV. (*The Victorian Naturalist* **113** (4), 1996,131-139)

Introduction

A.H.S. Lucas, the first editor of *The Victorian Naturalist* (1884-92) recalled in his autobiography how, on the *very afternoon* he landed in Melbourne in 1883, he was taken by his brother Dr T.P. Lucas (FNCV Vice-President 1880-81) to South Yarra to pay a visit.

> In a small cottage, in a room littered with books and papers and specimens, a short elderly gentleman, with grizzled hair, an ancient comforter about his neck, and a strong German accent, received us with an effusive welcome. It was the famous Baron Sir Ferdinand von Mueller, still, as we perceived, a most active Government Botanist (Lucas 1937).

Lucas' enthusiasm (indecent haste, perhaps) to meet the famous 'Baron' reflected the way amateur science was practised last century. Field naturalists saw themselves doing useful work for scientific specialists, in the hope of discovering something new, by making inductive observations in the field. Written almost fifty years later, Lucas' story is emblematic of the way the Field Naturalists' Club of Victoria (FNCV) has nurtured a sense of history, an awareness of continuity with a distinguished natural history past which Mueller exemplified.

In his obituary of the Baron, Professor Baldwin Spencer wrote, 'his name has been a household word amongst us ... It is hard, indeed, to realize that a younger generation must arise to whom the presence of the Baron, so familiar to us, will only be a tradition' (Spencer 1896). *Only* a tradition? FNCV tradition has commemorated Mueller - 'he *was* the pioneer botanist in its truest sense' (Willis 1949) - on every major anniversary of his death, birth and arrival in Australia. Through repetition of memorial practices over the past one hundred years, Mueller has become a hallowed symbol of the Club's links to the pioneers of science in Australia, a source of inspiration and example (Topp 1897).

An invented tradition is a set of ritual practices which, by repetition, seeks to inculcate certain values and implies continuity with an appropriate historic past. The problem is that such a tradition, as Hobsbawm and Ranger (1984) argue, can obscure our understanding of the past. The FNCV's enduring Mueller tradition has contributed to enhancing the history of the Baron's relationship with the FNCV. Thus, it is believed that Mueller was the founder (Grey 1996), that he was Patron from the Club's inception (Spencer 1896), and that he promoted the popularisation of natural science (Mueller 1885).

Mueller was an 'original' member, one of 56 'gentlemen' elected at the first two monthly meetings of the Club, not the founder. Before Mueller was elected Patron in 1886, on his own suggestion, his status in the Club is best described as *primus inter pares*, first among equals. A self-proclaimed prophet of the popularisation of the natural sciences, Mueller's contribution was constrained by the fact that he was a systematic botanist, not a teacher or a populariser (Mueller 1885; Spencer 1896). In the nineteenth century there were limits to the meaning of 'popularisation'. Specialist science and amateur natural history were not, in fact, sharply divided.

[1] Master of Arts in Public History student, History Department, Monash University, Clayton, Victoria 3168.

Tradition was first planted and ritually fertilised at Club conversaziones, meetings and Wild Flower exhibitions, and in obituaries, papers and historics published in *The Victorian Naturalist*. Commemoration followed the same forms with different expressions as each generation refurbished the past with a new duster of interests and values. Thus, in 'pilgrimages' to Mueller's St Kilda grave, the laying of wild flower wreaths in 1897 gave way to the memorial planting of Australian shrubs in 1938. For in 1931 the Wild Flower Protection Act, an FNCV initiative, had come into force, and commemorative tree planting became established on excursions during the years of the Great War. FNCV tradition was reinforced by the power of collective memory in the inter-war years. On commemorative occasions Club historians spoke about Mueller's possessions, quoted from his letters, shared anecdotes and wrote sketches of his life and work.

So strong had tradition become that Mueller, 'the prince of Australian botanists' (Pescott 1922) had his first biography written, not by a scientist or professional historian, but by an amateur historian and naturalist, a member of the FNCV. Charles Daley's *Baron Sir Ferdinand von Mueller, Botanist, Explorer, and Geographer* (1924) remained the only published biography of Mueller until 1949. In the decades when popular natural history was being nudged towards the margins of science (as amateur historians were being ignored by professionals), FNCV historians were memorialising Mueller as a Great Man of Science. This year's centenary is an appropriate occasion to place in historical perspective Mueller's relationship with the Club and its 'Mueller' tradition.

From *primus inter pares* to patron, 1880-96

The story of the FNCV's beginnings has been told by Club historians, Francis Barnard and Edward Pescott (Barnard 1906; Pescott 1940). It bears retelling, if only to dispel the misconception that Mueller was the founder.

The FNCV had its genesis in the informal gatherings of a small band of young field naturalists whose interests were entomological. Charles French Snr. (1842-1933), Dudley Best (1843-1928), David Kershaw (1844-1883), Francis Barnard (1857-1932) and J.E. Dixon (1852-1939) met frequently during the 1870s to talk about natural history and discuss the results of their weekend rambles in 'the scrub at Brighton, the bush at Sandringham, and the tree country at Kew' (Pescott 1933, 1940). They gathered on Sunday mornings at French's home inside the Royal Botanic Gardens, where he had worked since 1864 as propagator and manager of the glass-houses. It was here that they talked about establishing a natural history club (Pescott 1933).

It is not inconceivable that Charles French, who had worked closely with the Baron at the Gardens, discussed with Mueller the group's idea of starting a club. Had he done so, Mueller would have given his enthusiastic encouragement. He was, after all, one of Victoria's earliest field naturalists of the solitary kind. But there is no evidence that the original idea came from him.

The natural history field club was a transplanted British tradition. It was a hybrid which had grown by the mid nineteenth century from two distinct stocks: the informal sociable field clubs of Berwickshire, Ayrshire and the middle west of England and the rule-bound 'academic' natural history societies of the industrial cities (Allen 1976). In Melbourne the organisation of collective endeavour began on May 6 1880 when Charles French and Dudley Best called a preliminary meeting at the Athenaeum to form the Field Naturalists' Club of Victoria (FNCV Minutes 6.5.1880). Dr Thomas Lucas chaired this meeting and explained the aims and practices of a Field Naturalists' Club from his experience of such clubs in England (FNCV Minutes 6.5.1880; Barnard 1906). Growing up as the sons of a parson-naturalist who travelled the Wesleyan country circuits for 40 years, Thomas and Arthur Lucas had excellent opportunities for studying nature and learning of the operations of naturalists' clubs (Lucas 1937).

The FNCV was formally inaugurated on May 17 1880, when rules were adopted and office bearers elected (FNCV Minutes

17.5.1880). Entomology was the most popular branch of natural history among those present. This led to Frederick McCoy (1823-1899), Professor of Natural Science at Melbourne University being elected first president (1880-83). The FNCV minute book does not record either Mueller or McCoy being among the 30 or so 'gentlemen' present at the Athenaeum meetings of 6 and 17 May. Mueller was No. 36 on the 'Original Members' list of 56 gentlemen who were elected at the first two monthly meetings of the Club in June and July 1880, and who were afterwards termed 'original members' (FNCV Minutes 'Original Members' list 1880; Barnard 1906).

The support of Melbourne's two leading scientists Mueller and McCoy was a necessary but not sufficient condition to launch and sustain a successful club. By 1880 'Marvellous Melbourne' possessed the other essential conditions: strong public institutions of learning; a period of buoyant economic growth; a nucleus of knowledgeable and enthusiastic amateur naturalists, who included a number of Australian born; and, most importantly, the close proximity to the city of fairly open country, only a few miles by rail in any direction, where every branch of natural history could be studied (Cornwall 1889).

The FNCV was conceived as a popular scientific club, 'a body of people anxious to help one another study what lay around them' (Hall 1902). When Mueller praised the Club's progress at the 1885 annual conversazione, he recalled that in about 1860, while chairing a meeting of the Royal Society, 'he had prophesied the growth and increased popularity of the study of the Natural Sciences in the colony' (Mueller 1885). Exactly how he had expected his prophecy to be fulfilled, Mueller did not say. Popularising science would not have come about through a learned colonial society, such as the Royal Society of Victoria, which practised 'high' science. It had to wait upon the establishment of popular scientific clubs like the FNCV, which aimed to describe for Victorians, not scientists in London, the characteristics of their colony's natural history (Hall 1902). Nevertheless, the fact that in the 1880s and 90s the most dedicated naturalists in the FNCV perceived it as a 'learned society', and some were also members of the Royal and Microscopical Societies, indicated that there was still a mutually beneficial dialogue between specialist and popular science.

'Popularising' science generated lofty rhetoric more often than practical action. To the Rev. J.J. Halley, FNCV President (1884-87) and Congregational minister, popularisation meant the 'domestication of science' and the intelligent use of leisure in the open air. By studying a little natural science alongside their menfolk in the field, mothers and sisters could be the instruments of mental and moral improvement in 'happy homes', thereby weaning the youth of Melbourne from the glorification of cricket, football and rifle shooting (Halley 1885).

For Mueller, the 'domestication of science' embodied not just a moral but a religious imperative. He applauded Halley's rhetoric, just as he welcomed Halley and other 'divines' in the Club: 'for the more he and others worked amongst the wonders of Nature, the more impelled they were to recognise a First Great Cause' (Mueller 1885).

Rhetoric aside, Mueller welcomed women in the Club but would not have encouraged them to be anything more than collectors. By 1880 he already had an extensive network of women correspondents, most of whom collected for him (Maroske 1993). The 'hand-maiden of science' attitude must have irked Flora Campbell (1845-1923), an indefatigable collector of Victoria's macro-fungi for Kew, a self-taught vegetable pathologist, an investigator of the destructive hop 'spider' (an acarid) for the Department of Agriculture, and the entrepreneur for the colonial funding of Dr. M.C. Cooke's 1892 *Handbook of Australian Fungi* (Berkeley and Broome 1886; Pearson 1888, 1890). At the 'learned' end of the amateur spectrum, Campbell was the only female amateur in the FNCV to have her papers published in *The Victorian Naturalist* in the nineteenth century (Campbell 1886, 1887, 1895). As Mrs Flora Martin, her paper on 'Diseases of Plants' to the 1890 Australasian Association for the Advancement of

Science (AAAS) conference in Melbourne was also the first by a woman (Anon 1890).

Relations between Mueller and Campbell were strained. The Baron 'bitterly complained' of Campbell's daring to send fungi specimens for naming to *her* mentor, Queensland Government Botanist Frederick Manson Bailey, which she had been doing since 1879 (Campbell 1885). Mueller angered Bailey and Campbell by 'publishing as indigenous', without consulting Bailey, plants collected by Dr T.P. Lucas on 'a flying visit' to Queensland in 1885, plants which Bailey insisted were 'naturalized weeds or strays from the gardens' (Campbell 1885; Mueller 1885a). Campbell backed her loyal support of Bailey with the authority of Father Julian Tennison Woods (1832-1889), with whom she had travelled in Queensland in the 1870s and who had deeply regretted to her on several occasions the speed with which introduced plants spread (Campbell 1885). This was a skirmish between two people with strong opinions and forthright personalities about loyalty, expertise, and spheres of botanical influence.

If it were to be a popular scientific club, the FNCV needed to take practical steps to attract women. Although Halley boasted that the FNCV was the first of the 'learned' societies to admit women, the opening of the Club's doors to them happened by default (Halley 1885). The first woman joined in September 1881 because her husband wanted her to accompany him on excursions, 'if that is not against the rules' (Dobson 1881). Having elected the parliamentarian Dr F.S. Dobson in July 1881 without his prior knowledge, to lend the Club social prestige, the FNCV was hardly likely to refuse his request to admit Mrs Dobson (Dobson 1881; Evans 1982). In 1885 there were 20 'sisters of science' in the FNCV, compared to 140 men (Halley 1885; Barnard 1906).

Dr Frank Dobson, FNCV President in 1884, believed that more 'ladies' would join the Club to study botany if they had a handy field guide for identifying Victoria's plants. It was in this context that he urged the compilation of a 'Dichotomous Key', a handbook to the plants of Victoria, and suggested that Mueller undertake the work (Dobson 1884). He had in mind a key similar to the Rev. W. Spicer's *A handbook of the plants of Tasmania*. Dobson never took a walk in the bush in Victoria 'without my Spicer in my pocket' (Dobson 1884).

As a Member of Parliament, Dobson probably exerted some pressure on Mueller the Government Botanist to write the *Key to the System of Victorian Plants*, which resulted in two volumes, 1885, 1887-8 (Dobson 1884a; Barnard 1906a). Mueller did not relish the laborious task on which he expended much 'mental toil' (Mueller 1888a; Spencer 1896). Victoria's flora was 'doubly as rich in species' as Tasmania's, and the dichotomous method of Lamarck disrupted 'the chain of affinity' which linked the orders, genera and species naturally together (Mueller 1888).

Many aspiring field botanists in the Club found Mueller's *Key* 'more of a stumbling block than a help in elucidating the plants they had collected' (Barnard 1906). Baldwin Spencer conceded that as a field guide it was unsuccessful, partly because the Baron 'with his profound knowledge' was an investigator, not a teacher (Spencer 1896a). Many years later, Edward Pescott was more generous in his appraisal. In 1922 he asked, 'What student of to-day can say that it may be done without?' (Pescott 1922). Until the publication in 1931 of Professor Alfred Ewart's *The Flora of Victoria*, Mueller's pioneering *Key* of 1888 was the only descriptive Flora, albeit abridged, available for the amateur botanist (Sutton 1931). For almost a century after its publication, no botanist was able to improve on Mueller's seminal field guide.

Mueller the scientific botanist was no pedagogic populariser on the issue of vernacular names for plants. He believed 'these superfluous appellations... are vague, carry not beyond one language, and are almost useless burdens to the memory' (Sutton 1909). His *Key to the System of Victorian Plants* included a short list of some vernacular names, but many were 'almost as awkward as the scientific names' (Barnard 1906a).

Ten years after Mueller's death, the FNCV addressed the issue of the lack of popular names for native plants. Ornithologists (a select committee of the

AAAS) had already chosen vernacular names for Australian birds in 1898 (Anon 1898). The burgeoning nature study movement in schools in the 1900s provided the impetus for botanists in the Club to do the same for plants (Barnard 1906a). The laborious task of inventing popular names for Victoria's indigenous plants was entrusted to a Plant Names Committee of the FNCV in 1907. It took until 1923 to produce *A Census of the Plants of Victoria*, which listed all the known plants with their selected vernacular names (Anon 1923).

The FNCV's popular spring Wild Flower Shows, which began in 1885, gave Mueller the opportunity of bringing botany to a wider audience. A familiar figure at these annual shows, the Baron assisted enthusiastically in naming plants and securing exhibits from country friends (Anon 1896; Topp 1897). A down-to-earth comment from George Coghill (1864-1957), the Club's keenest collector of wild flowers and organiser of these shows, reveals that Mueller's enthusiasm could occasionally be irritating. At the 1886 Wild Flower Exhibition 'Baron von Mueller helped with the naming and his remarks on the flowers was [sic] most interesting though rather delaying to those who had a lot to do' (Coghill nd).

Mueller was offered but declined the Club presidency on five occasions between March 1883 and April 1886, citing either his many commitments or poor health (Mueller 1883, 1884, 1884a, 1885b, 1886). Perhaps not wanting to disappoint the FNCV, Mueller suggested in 1886 that he and McCoy be made Patrons of the Club, thereby representing 'the two great branches of animated natural history' (Mueller 1886). By his own rhetoric Mueller became the symbolic embodiment of botany.

The FNCV Committee passed a resolution to invite McCoy and Mueller to become Patrons. Mueller accepted and was elected in June 1886. McCoy either declined or failed to respond; FNCV records are silent on this point. Perhaps he was still smarting from the Club's criticism in 1885 of the National Museum (McCoy 1885). He was, however, elected as Patron in August 1889 to serve alongside Mueller, and accepted (FNCV Minutes 12.8.1889; McCoy 1889). When McCoy died in 1899, he received a conventional obituary in *The Victorian Naturalist* (Anon 1899). When Mueller died on 10 October 1896, the FNCV mourned him as an 'old friend', a 'familiar figure' and a 'beloved Patron' (Topp 1897).

From a household word to a tradition

The first move to establish the Mueller tradition was made quite decisively in October 1897, when the annual spring Wild Flower Exhibition was held over to commemorate the very first anniversary of the Baron's death (Anon 1897). Wild flower wreaths and native flowers sent from friends in Victoria, New South Wales and Western Australia were afterwards laid on Mueller's grave. Charles Topp's address urged the FNCV 'to treasure the fine example' Mueller set in his devotion to science for the benefit of his fellow colonists, and 'to cherish [his] memory' (Topp 1897).

Memory sustained the tradition for as long as there were field naturalists alive who remembered the Baron. The founding generations of the FNCV included botanists who had worked under Mueller at the Herbarium or the Royal Botanic Gardens, and for whom his name was, indeed, a household word. They shared vivid recollections. Charles French's first sight of Mueller riding his white pony along the Burwood road at the start of one of his botanical expeditions to Victoria's high country in the late 1850s or early 1860s became a treasured memory (Pescott 1933). Percy St John (1872-1944), FNCV President in 1929-30, who had regularly collected wild flowers as a young boy in the early 1880s for the 'benevolent Baron', attributed his lifelong study of eucalypts to Mueller's personal encouragement (Anon 1930). The death of James Audas in 1959 'snapped' the last personal link with Mueller and the former Melbourne Herbarium (Willis 1961).

Example and memory combined to strengthen tradition during the inter-war years as naturalists grew older and searched the past for sources of moral inspiration. Mueller was their exemplar. To commemorate the 25th anniversary of

Mueller's death, Club historians organised a 'Mueller evening'. Charles Daley (1859-1948) presented 'A Sketch of Mueller's Life', Edward Pescott (1872-1954) 'Notes on Mueller's Published Works' and Francis Barnard 'Mueller's Botanical Exploration of Victoria' (Anon 1921). Pescott's talk was published in *The Victorian Naturalist* as 'Notes on Mueller's Literary Work' (Pescott 1922). He asked, 'Are we ever to see a published biography and bibliography of the greatest botanist Australia has ever seen?'

Charles Daley (Club President 1922-4) accepted Pescott's challenge and wrote a memoir of the Baron's life for the Historical Society of Victoria and the FNCV. Daley's *Baron Sir Ferdinand von Mueller, Botanist, Explorer, and Geographer* (1924) was printed as a booklet in time to mark the centenary of Mueller's birth in 1925 (Daley 1924, 1927; Pescott 1948). The FNCV sold it at the Club's popular Wild Nature Shows in the 1930s for 1 shilling (Daley 1933). Thus, Mueller the 'prince of Australian botanists' (Pescott 1922) had his first biography written by an amateur historian. It long remained the standard work of reference and reached a popular audience (Pescott 1948).

Daley also wrote 'The History of Flora Australiensis' (the story of Mueller's collaboration with the Hookers, William and Joseph, and George Bentham at Kew), which first appeared in eight parts in *The Victorian Naturalist*, and was later republished as a booklet (Daley 1927-8; Pescott 1948). So vital a part of Daley's literary life had the Baron become that, even as he lay dying in hospital, Daley sent a letter drawing attention to his *Memoir* and his long correspondence with Mueller to the FNCV's centennial commemoration in 1947 of Mueller's arrival in Australia (Anon 1947).

For Victoria's Jubilee celebrations 1834-1934, the FNCV organised another 'Baron von Mueller' evening in March 1934 with the same cast. Daley reminisced on the Baron's life and work, Pescott spoke about some possessions of Mueller, Thomas Hart quoted from letters relating to the Baron, and Charles French followed with anecdotes (Anon 1934).

On this occasion the FNCV gave their Mueller tradition a fresh lease of life by establishing a fund to restore the Baron's neglected grave at St Kilda Cemetery (FNCV Minutes 27.2.1934). Edward Pescott also suggested that the Club erect a plaque in memory of the Baron in the new Herbarium (FNCV Minutes 27.2.1934). As a result of these FNCV initiatives, a memorial plaque to Mueller was erected in the entrance hall of the Herbarium in 1936, and the Baron's grave was put in order by 1938 (Anon 1936; Stewart 1938). At a commemorative pilgrimage to Mueller's restored grave in 1938, the FNCV was joined by representatives of the German Club in planting Australian shrubs at the base of Mueller's memorial. The Club also purchased a plot adjacent to the grave to plant with suitable species named after the Baron (Stewart 1938).

Charles Daley and Edward Pescott were, outside the FNCV, among the energetic leaders of patriotic local movements to Australianise the teaching of history, to preserve Australian flora and fauna, establish national parks and to erect monuments to Australian explorers (Davison 1988). Daley, by 1924 a retired school teacher, was a member of the Historical Memorials Committee of the Historical Society of Victoria, which inspired the erection of cairns and plaques to explorers around Victoria between 1910 and the early 1930s (Griffiths 1996). Pescott, formerly Principal of the Burnley School of Horticulture, led the FNCV campaign for legislative protection of Victoria's flora which resulted in the Wildflower Protection Act 1931. Through the Wattle League, he promoted the wattle as Australia's national flower (Hyam 1955). Both men wrote histories of Victorian places and pioneers.

The FNCV's Mueller tradition presents an apparent paradox. Daley and Pescott - amateurs engaged in the sociable co-operative practice of natural history - in their literary memorials to Mueller wrote popular history about a Great Man of Science. Their inspiration was, in part, a nostalgic looking back to the time when a mutually helpful dialogue took place between specialist scientists and amateur naturalists in the Club. The high water mark of the

FNCV's Mueller tradition was reached by the late 1940s, about the same time the amateur tradition found itself stranded in the shallows. By the mid 1950s the Club had fallen on lean times because, in the view of one prominent member, the professional scientists had no need, as in days gone by, to belong to a natural history club (Garnet 1955).

In the broader cultural context, Daley and Pescott were local history enthusiasts wanting to foster a patriotic sentiment towards Australia, her pioneers and her flora and fauna. They shared with others 'the antiquarian imagination' about which Tom Griffiths has written so eloquently (Griffiths 1996). Their curiosity about the past grew out of intimate knowledge and memory of places, the landscape and people. The 'pioneer-explorer' was central to their history: while looking forward to future progress, they searched the past for sources of inspiration and example (Davison 1988). Mueller, 'the last of the great botanical explorers' was one source (Pescott 1922). Science shares with Australian culture the legend of the 'pioneer'.

The late Dr Jim Willis, Victoria's distinguished botanist and most recent of FNCV historians made such a link between Australian and botanical pioneers when, in 1949, he disputed an historian's claim that 'there were *no* Australian pioneers after 1850' (Willis 1949). Such an arbitrary date-line would exclude 'the greatest pioneer' of Victorian botany - Baron Sir Ferdinand von Mueller. In his series on 'Botanical Pioneers in Victoria' for *The Victorian Naturalist*, Willis' portrait of Mueller exemplifies the 'Great Man of Science' approach:

> ...before he had been in Victoria three years, this amazing man had collected and named some 1,700 flowering species and about 800 cryptogams, too. In the same period he had travelled nearly 5,000 miles throughout the Colony--in Mallee deserts, heavy rain forests, remote and lofty mountains, jungles, and along the sea coasts. Papers on botanical subjects flowed from his facile pen, the published works exceeding 800 in number to the time of his death (Willis, 1949).

Willis went on to point out that, during Mueller's long term of office as Government Botanist (1852-96), he left surprisingly little for others to discover: 'most of the State's novelties introduced by subsequent workers have been rather the result of 'carving up' old species than in discovering entirely new entities which he missed' (Willis 1949).

In 1946, the 50th anniversary of Mueller's death, Willis had suggested a commemorative postage stamp with 'attractive floral motif' to mark the 1947 centenary of Mueller's arrival in Australia (Willis 1946). The FNCV and the Victorian Council of Scientific Societies supported the Government Botanist's request for a commemorative stamp to the Postmaster General (FNCV Minutes 28.1.1947; 25.2.1947; 25.3.1947; 29.4.1947). Although too late to mark the 1947 centenary, a twopence halfpenny stamp was issued on 13 September 1948 (Fig. 1). It featured Mueller's head and a sprig of gum leaves of 'that noble, useful tree *Eucalyptus Muelleriana* '[Yellow Stringybark *E. muelleriana*] (Willis 1949). A postage stamp was an appropriate tribute to a man who had been such a prolific correspondent. In 1893 alone Mueller claimed to have written 'by his own hand' about 6000 letters (Tadgell 1934). Mueller was

Fig. 1. The Mueller Commemorative Stamp, 1948.

thus commemorated in a popular philatelic form, perishable but collectable, like the plants he spent his life among.

During his lifetime the FNCV valued Mueller's expertise and the prestige bestowed by his association as an 'original' member, an enthusiastic participant and kindly Patron (1886-96). Such was the high esteem in which he was held that, after his death, the FNCV initiated a commemorative tradition which helped to invest Mueller with almost mythical stature. He became a symbol of the Club's links to the pioneers of science in Australia. His first biography was written by an amateur naturalist in the Club. The enduring tradition has, however, tended to obscure a clearer understanding of some important aspects of Mueller's relationship with the FNCV during his lifetime.

Acknowledgements

I wish to thank Sheila Houghton for her generous assistance with the FNCV Archives, and also Linden Gillbank and Sara Maroske for their comments.

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'Baron von Mueller' at Adelaide

At the Adelaide Racing Club's Meeting on the birthday of she who was not amused, 24 May 1881, a certain horse, apparently a chaffburner, was placed eighth in the Park Handicap. Heavy rains had fallen during the night; the rain clouds began to shift as morning broke, and by midday only fitful sunshine had broken through[1]. The horse was a chestnut colt recorded in The Australian Turf Register as being the property of Sir Thomas Elder, businessman, pastoralist, public benefactor and M.L.C.[2] It was a three-year-old, and in the Park handicap carried 6 st. 10 lbs. with Williams aboard. Mr W.E. Dakin was the trainer[3].

Baron Ferdinand von Mueller was delighted to have a quadrupedal namesake, 'I may go to the Races where I never was before all my life'[4].

If Dakin had followed the procedure used a little later, on another inclement occasion, and given the good Baron a stiff shot of whisky, the result in the Park Handicap may have been a win over the mile, and the 60 sovs. stake gained![5] With or without, as a four-year-old, the horse went on to sustain the fair name of his renomee. Baron von Mueller, by Gang Forward out of Hippona, continued racing in the distinctive colours of Dakin - black body, yellow sleeves and white cap. He first won The Suburban Plate, weight for age, and then The Yan Yean Stakes (Handicap) in Melbourne on Cup Day in 1881, The Grand Stand Stakes at Geelong, The Flying Handicap in Adelaide and The New Stand Handicap, another event of Adelaide Racing Club. The horse continued to race until the 1885/6 season, but ran unplaced[6]

Acknowledgement to Sara Maroske.

[1] Adelaide Advertiser. 25 May 1881, p 6. La Trobe Newspaper Collection, State Library of Victoria.
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Ruth Dwyer

75 Wattle Road, Hawthorn, Victoria 3122

Baron von Mueller and *The Victorian Naturalist*

Sheila Houghton[1]

At a meeting in December 1883 the Committee of The Field Naturalists Club of Victoria, having lost patience with the dilatoriness of Mr J. Wing in publishing the Club's proceedings in the *Southern Science Record*, decided to publish their own journal (FNCV Minutes 2.12.1883). They wasted no time in implementing this decision, and the first modest issue, of eight pages, appeared in January 1884. Two of the Club's most famous members contributed articles: Charles French, who supplied the first of his series of papers on Victorian orchids, and Baron Ferdinand von Mueller, with *Contributions to the Phytography of Australia*, dealing with *Podopetalum ormondi*, a species which he had dedicated 'to the honorable Francis Ormond, M.L.C., whose almost boundless munificence for raising ecclesiastic and educational institutions in this colony, was meriting a permanent token of appreciation also in botanical science' (Mueller 1884).

Mueller was an enthusiastic supporter of *The Victorian Naturalist*. In proposing a vote of thanks to the President and lecturers at the 5th Annual Conversazione in April 1885 he said 'that as one of the earliest naturalists in the colony, it gave him great pleasure to witness the advance and prosperity of the Field Club. A quarter of a century ago ... he had prophesied the growth and popularity of the study of Natural Sciences in the colony' (Mueller 1885a), and he evidently saw the Club's journal as one of the means to this end.

The Victorian Naturalist, price sixpence, was not intended primarily for members of the Club. It was to be sold through booksellers, and, if members wanted it, they had to subscribe to it, in addition to their Club subscription. The journal was soon in financial difficulties. In the annual report for 1884 the Hon. Secretary pointed out that the journal was not repaying the cost of printing, but that if members would subscribe this would easily be rectified, leaving a surplus which would enable them to increase the size from 8 to 16 pages, which was 'urgently desirable' (Barnard 1884). Members must have responded because the July issue contained 12 pages, and Mueller offered to pay for printing at the rate of 5/- (five shillings) per page (FNCV Minutes 4.8.1884). This apparently gave the Committee ideas, because at their September meeting they passed a resolution that authors whose papers had not been read before the Club would be charged 5/- per page for printing (FNCV Minutes 1.9.1884). The system evidently worked well. Two years later the Committee, no doubt as a mark of gratitude for past assistance, offered Mueller 'two pages free of cost in each number of the Naturalist for the publication of your descriptions of new plants, also one or two more as the Editor can spare them' (Barnard 1886). Pages in excess of this allowance were to be paid for. Mueller replied that he was 'much beholden to the Committee ... for the ample concessions made' (Mueller 1886a) and enclosed a cheque for £1 5/- for 5 of 7 pages in the previous number.

Mueller contributed 87 articles to *The Victorian Naturalist* between 1884 and 1896, varying in length from seven pages, *Observations on some Papuan and Polynesian Sterculiaceae*, in volume 3 August 1886, to which he referred in his letter, to a brief note on *Antholoma* which occupied a mere quarter of a page in volume 8 February 1892. Volume 1 contained six articles by Mueller, dealing mainly with plants from Papua and New Guinea, with two brief notes on species from Queensland and Western Australia. The series *Descriptions of New Australian Plants* began in volume 3 November 1886, and appeared monthly until April 1887. It was resumed in July 1890 and continued on a fairly regular basis for the rest of Mueller's life, the last article being included in volume 12, January 1896. After his death J.G. Luehmann (who succeeded Mueller as Government Botanist)

[1]12 Scenic Court, Gisborne, Victoria 3437.

continued the practice, reading four papers under the title *Reliquiae Muellerianae* to the Club, which were duly published in volume 13 1897. This series dealt with plants from all over Australia - as J.H. Maiden remarked Mueller was 'not a Victorian botanist, but an Australian one' (Willis 1949) - and included the discovery, which caused great excitement, of *Rhododendron lochae*, collected by W. Sayer and A. Davidson on the summit of Mount Bellenden-Ker. Mueller was particularly gratified by this collecting expedition, and his article in volume 3, April 1887, on *Hypsophila halleyana* (named after the Reverend J.J. Halley, President of the Club) is followed by a list of the plants which he exhibited at the March meeting, collected by Mr W. Sayer from Mount Bellenden-Ker, 'the ascent of which (particularly in the interest of the geography of plants) the Baron wished to be effected since many years ......' (Anon 1887).

Notes appeared on other new discoveries, a Victorian fern, *Adiantum diaphanum* (Mueller 1886b), the very localised, rare Flannel-flower *Actinotus schwarzii* from Central Australia, and the small slender daisy *Athrixia croniniana* from Western Australia, named for Miss Cronin, one of Mueller's lady collectors (Mueller 1888a). He was always very ready to examine and describe specimens provided by Club members: *Lepistemon lucae*, collected by Dr T.P. Lucas in north Queensland, while 'seeking restoration of his health' (Mueller 1885b); *Prasophyllum frenchii* (Maroon Leek Orchid), collected between the Yarra and the Dandenong Ranges by George French, and named by the Baron after this 'youthful collector, who has filially inhered from one of the principal founders of The Field Naturalists Club his ardour for forming, by searches of his own, ... phytologic collections' (Mueller 1889). If there was a long-winded way of putting things, the Baron was likely to employ it! In volume 7, Mueller published a note on another Victorian orchid, *Corysanthes unguiculata* (=*Corybas unguiculatus*, Small Helmet-orchid), 'this rare floral gem' discovered by Charles French, jnr, between Oakleigh and Cheltenham (Mueller 1890). He was also ready to supply lists of plants collected on major Club expeditions, that to the Kent Group Islands (Mueller 1891), and to the Furneaux Group (Mueller 1894).

While Mueller was keen to support *The Victorian Naturalist*, he also found it useful for his own purposes as evidenced by his explanation accompanying *A Supplementary List of Australian Lichens*, that it had been intended to be part of the *Fragmenta Phytographiae Australiae*, but as volume 12 could not be completed due to pressure of other literary work, he had offered it to the Editor of *The Victorian Naturalist* (Mueller 1887a). A similar situation applied to *Brief Notes on some New Papuan Plants* (Mueller 1892), and volume 5 contained a *Supplement to the Enumeration of Victorian Plants, comprising the species added since Part II of the Key to the System of our Native Vegetation was published* (Mueller 1888b). In the introduction to *Notes on Victorian Fungs* (sic) (Mueller 1885c) he said that this material also was intended for volume 12 of *Fragmenta Phytographiae Australiae*, but Mueller explains at length why he was unable to proceed with this publication, and the list of his commitments is formidable. There are undertones of professional sensitivity here, too. Mueller observes that Dr M.C. Cooke, 'the celebrated mycologist', had published 'an enumeration of all fungs (sic) from Australia known to him up to 1883' (Mueller 1885d), and hastens to point out that it was his Department which had supplied many of these plants (Mueller 1885d). There follows a list of the Victorian fungi, and Mueller hoped to publish an Australian list in the next number of *The Victorian Naturalist*. This did not happen.

It is not entirely clear how many of Mueller's papers were read before the Club. Those on the fern *Adiantum diaphanum* and the rare Victorian fungi *Cyttaria gunnii* and *Cordyceps taylori* certainly were. One of the series *Descriptions of New Australian Plants* was read by J.G. Luehmann in July 1890, but it seems that none of the others were. The agenda for the October 1887 meeting lists a paper by Baron von Mueller, K.C.M.G. *Notes on a*

Remarkable Fungus from the Wimmera, but is was not published, nor was it reported that it was read. Perhaps the Baron was unable to attend, or perhaps by the time Flora Campbell had finished her paper on a variety of parasitic fungi, members felt that the evening had been sufficiently 'fungaceous'.

In the distribution lists Mueller acknowledged various collectors. When describing species he typically supplied details of the history and nomenclature. Some of these plants received the collector's name but Mueller also used this means of paying tribute to people. *Rhododendron lochae* was dedicated to Lady Loch, wife of the Governor, in 'special recognition of the patronage given by her to Victorian horticulture' (Mueller 1887b), not to the intrepid Mr Sayer who endured so much in its collection. He was, however, acknowledged in *Helicia sayeriana* (family Proteaceae) and *Dracophyllum sayeri* (family Epacridaceae). Similarly, the cycad collected by Will E. Armit, the 'emissary of the Argus for itinerations in New Guinea' (Mueller 1885e), was named *Cycas scratchleyana*, after the first ruler of British New Guinea, General Scratchley (Mueller 1885f).

An example of Mueller's extensive interests appeared in *The Victorian Naturalist* volume 4 , December 1887, where the Editor printed a letter from Sir Richard Owen thanking the Baron for an embryo of *Ornithorrhyncus* (=*O. anatinus*, Playtpus), which had convinced him that the Monotremes were ovo-viviparous. The ensuing comments indicate that Mueller had been of the same view for some years, his opinion being reinforced by this specimen before he dispatched it (Mueller 1887c).

Baldwin Spencer, in his obituary of Mueller, referred to his 'quaintness of speech and manner' (Spencer 1896). As an active member of The Field Naturalists Club of Victoria and as its patron, Mueller was frequently called upon to make speeches. In his articles his notes were generally 'succinct' as he described them, but in speaking Mueller gave full rein to his rotund and stately periods. The two eulogies which he gave on Alphonse de Candolle (Mueller 1893) and Louis Pasteur (Mueller 1895) are splendid examples of his rhetorical style, and one can imagine his audience being elevated to a plane of reverential emotion. Though his style was naturally influenced by the custom of the time, he combined a flair for invention with the exact use of the English language, using words which, though unfamiliar today, had, in some cases, been in use for centuries.

Although it is evident that as the Club increased in numbers and adventurousness, and there were more discoveries and expeditions to report, the early Editors of *The Victorian Naturalist* did not want for material, they still had reason to be grateful to the Baron for his cooperation and generosity, both financial and literary.

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Ferdinand von Mueller, Exhibitioner Extraordinaire

Tom May[1] and Sara Maroske[2]

Abstract

Exhibits of natural history specimens were a feature of meetings of The Field Naturalist's Club of Victoria in the nineteenth century. The exhibits provided by Baron Ferdinand von Mueller are typical of those of the time. He used exhibits to illustrate his current activities, often soon after discoveries had been made. Exhibits also served as a way of recognising the contribution of Mueller's network of collectors. Various other information can be gleaned from the reports of exhibits, including the time of introduction of exotic plants and the date of publication of Mueller's works. (*The Victorian Naturalist* **113**, (4) 1996, 143-145)

Exhibits of natural history specimens and other objects were a feature of clubs and learned societies in the nineteenth century. The Field Naturalists' Club of Victoria excelled in this regard. Novel, unusual or bizarre exhibits were a prominent part of its meetings and on any evening could include insects, birds and other animals, fungi, plants, wood sections, rocks, fossils, books, paintings and Aboriginal artefacts. Some exhibits were illustrative of papers read to the meetings, but others were by Club members for whom such presentations were their only public participation in Club activities. Lists of the exhibits were provided in the reports of the Club meetings printed in each monthly issue of *The Victorian Naturalist*. Under the name of the exhibitor the 'principal' exhibits were given. Each 'exhibit' could itself consist of numerous individual items. Exhibits were also a prominent feature of the yearly Conversazione and were integral to the annual wildflower show.

The centre piece at the Conversazione of 1887, at which 750 people were present, was a 250 lb giant clam shell from Singapore, provided by D. Le Souëf, who also showed a tiger (dead) and a diamond snake (alive). Among the other numerous animal, vegetable and mineral specimens (only the 'more important' were listed) were 'a large case containing lyre birds, with nests, ground thrush, robins, etc.' (A.J. Campbell); 'an orang-outang, a red wallaby, a platypus, an alligator' (A. Coles); 'some fine walking-stick insects' (C. French); 'Victorian crabs, star-fish and sea-eggs (A.H.S. Lucas); 'slides of transverse sections of the petioles of Eucalypts, under microscope' (D. McAlpine); and 'rare African and American mosses; foreign micro-fungi; European algae (mostly fresh-water)' (F. Reader) (*Victorian Naturalist* **4**, 17-18, 28-31). There were also 750 at the 1888 Conversazione, where those attending would have seen 'a wedge tailed eagle killing rabbit' and 'a laughing-jackass killing snake' (A.W. Coles); 'a collection of about 100 species of dried plants from King Island' (C. French Jnr); 'specimens of insect architecture, also geological specimens, and, under microscopes a variety of interesting objects' (P.H. Anderson); and numerous others of which Baron Ferdinand von Mueller, Patron of the Club, remarked that it 'seemed a pity that' 'exhibits so skilfully brought together by the members of the Club should only be on view for the one evening.' (*The Victorian Naturalist* **5**, 20-22).

Mueller himself was a prolific exhibitor at meetings and other activities of the FNCV especially after he became Club Patron in 1886. In the reports of the monthly meetings of the Club in *The Victorian Naturalist* Mueller was noted as providing exhibits at 87 of the 152 meetings held between January 1884 and September 1896, and at only 19 of the 92 meetings during the period from January 1889 to September 1896 did Mueller not provide exhibits. It is sometimes evident from the reports that Mueller was present at the meetings because he was noted as having made comments on papers read, or having presented a paper himself or introduced a visitor. There are only a handful of occasions where Mueller was noted as

[1] National Herbarium of Victoria, Birdwood Avenue, South Yarra, Victoria 3141.
[2] Mueller Correspondence Project, Department of History & Philosophy of Science, University of Melbourne, Parkville, Victoria 3052.

present at a meeting but did not exhibit. Mueller presumably attended most of the meetings at which he did exhibit, although in some cases his exhibits may have been presented by others in the Club. He certainly made some effort to attend Club meetings. In January 1894 it is recorded that he 'attended at considerable risk, suffering as he was from indisposition' (*The Victorian Naturalist* **10**, 151), and in October 1895 Mueller managed to deliver an address on the late Louis Pasteur despite having 'been detained by another engagement' (*The Victorian Naturalist* **12**, 74).

Principally Mueller exhibited examples of new or interesting plants. These served the purpose of illustrating plants in an age where photography was still little used. In addition, the plants exhibited had often recently been received from one of Mueller's Australia-wide network of collectors - whose contribution was thereby acknowledged in a more accessible and immediate way than through his scientific monographs. For example, at the December 1893 meeting of the Club Mueller exhibited 'a specimen of the extremely rare *Isopogon Fletcheri*, recently discovered by J. Fletcher, Esq., on the Blue Mountains', New South Wales (*The Victorian Naturalist* **10**, 134). At the following meeting Mueller exhibited also from New South Wales a variety of *Grevillea asplenifolia* 'from Cole River, near Jervis Bay, where it was discovered by a son of Mr P. L. C. Shepherd' along with a new species of *Helipterum* commemorating the collector J. D. Batt from near Lake Lefroy, Western Australia and the first record of the exotic *Soliva sessilis* collected by J. B. Williamson from near Port Fairy, Victoria (*The Victorian Naturalist* **10**, 151).

The information mentioned in the reports of exhibits may supplement that provided with the formal description. For instance, *Helipterum fitzgibbonii* was described by Mueller (1890a) from various localities including 'Nullarbor-Plains; J. Batt', but is more specifically noted as having been 'collected about 100 miles north of Eucla, W.A., by Mr. J.D. Batt' in the list of exhibits for the meeting of June 1890 (*The Victorian Naturalist* **7**, 31). Whereas novel Australian species would be formally published elsewhere, mention of the newly recorded exotic plants often occurs only in the reports of exhibits.

When Mueller published new species in *The Victorian Naturalist* it is often remarkable how little time elapsed between the collection of the new species, its exhibition and formal description. George French collected a novel orchid on the 9th November 1889 at Dandenong, and the species was also observed on the Club excursion to Tooradin on the same day (*The Victorian Naturalist* **6**, 121). On the following Monday, two days later, French exhibited the orchid at the FNCV monthly meeting (*The Victorian Naturalist* **6**, 122), and Mueller formally described it as *Prasophyllum frenchii* in the December issue of the *Naturalist*, the very issue in which the exhibit was noted (Mueller 1889).

The same sense of immediacy occurred when Mueller and others dealt with the results of explorations further afield. On Mueller's suggestion W.A. Sayer climbed Mt Bellenden-Ker in Queensland and collected plant specimens. These were exhibited by Mueller at the March 1887 meeting of the Club (*The Victorian Naturalist* **3**, 162 and 169-170) and described, mostly in *The Victorian Naturalist*, at about the same time (Mueller 1887a, 1887b). Sayer's narrative of the arduous expedition was read before the April 1887 meeting of the Club (Sayer 1887). Plants described by Mueller from Bellenden-Ker included *Rhododendron lochae* which commemorated Lady Loch (who knitted his muffler). Not only was it the sole *Rhododendron* known from Australia at that time, but also a species which Mueller had predicted would be found on Mt Bellenden-Ker when he sailed by that locality en route to northern Australia in 1855 (Mueller 1887a). Also described from from Bellenden-Ker was the new genus and species *Hypsophila halleyana* of which Mueller wrote: 'I have connected with this tree - one from the highest mountain of tropical Australia - the name of the Rev. J. J. Halley, who, as President of the Victorian Field-Naturalists' Club, has amidst the onerous duties of his ecclesiastic position, still also advanced energetically the studies of living nature among us.' (Mueller 1887b).

As Mueller worked on his multifarious publications he often kept the FNCV informed of progress by exhibiting various works, sometimes at the proof stage. Thus in July 1889 he showed advance proofs of a new edition of his *Census of Australian Plants* (*The Victorian Naturalist* **6**, 74) and in April 1893 he placed before the club proof plates of thistles drawn by Mr Ashley (*The Victorian Naturalist* **10**, 3), which later appeared in *Illustrated Description of Thistles ...*, a pamphlet brought out by the Department of Agriculture (Mueller 1893). When recently published works were displayed, the reports of exhibits give a definite date by which the book or part thereof must have been published, as is the case for the fourth decade of the *Iconography of Australian Salsolaceous Plants* (Mueller 1890b) which was exhibited at the Club meeting of October 13th 1890 (*The Victorian Naturalist* **7**, 102). This is useful for taxonomic works where date priority is of importance. The list of books received for the Club library is another source of information on publication dates.

Mueller occasionally brought to Club meetings books by other authors, and the records of these exhibits help to establish a picture of the development of Mueller's library. He also occasionally shared with the Club interesting letters from his voluminous correspondence with fellow savants.

The exhibits provided by Mueller at the last Club meeting which he attended (September 14th 1896) are a typical mix of the new and the interesting, and were recorded as follows: '*Galium murale*, as an introduced plant from South Europe; *Cryptandra bifida*, new for Victoria, collected at the Wimmera by Mr. F. Reader; *Cyrtostylis reniformis*, with green flowers, collected by Mr. J. Paul at Grantville; also the following plants as new for extra tropic Western Australia:- *Bassia divaricata*, from near Coolgardie, collected by Mr. F. Wehl; *Perotis rara*, traced by Mr. J. Cusack towards Shark's Bay, where he also collected *Lythrum hissopifolia* and *Vallisneria spiralis*.' (*The Victorian Naturalist* **13**, 71). A list of these exhibits also exists in Mueller's handwriting (Royal Botanic Gardens, Melbourne, RB MSS M76) with a few minor differences. It would have been one of the last things that Mueller wrote for the Club, because he died on the 10th October, although he did contribute flowers to the annual exhibition of wild flowers on the 28th September, obtained through 'country friends' St Eloy D'Alton of Nhill and Miss Wise of Sale (*The Victorian Naturalist* **13**, 86).

The records of Mueller's exhibits and those of numerous other members serve not only to help us understand what being a field naturalist encompassed, but also conjure up the atmosphere of past meetings. Mueller's regular presence must have brought a sense of excitement at the sharing of recent discoveries, and he no doubt commented on the botanical exhibits of other members. In Mueller's case the records of exhibits also provide important details of his professional scientific work.

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The Legacy of Mueller's Collections

J. H. Ross[1]

Abstract
The National Herbarium of Victoria dates from the appointment of Baron Ferdinand von Mueller as first Government Botanist for Victoria on 26 January 1853. Mueller worked tirelessly until his death on 10 October 1896 to build a world-class collection of herbarium specimens and a botanical library. The means by which he did so are outlined and an assessment is made of his contribution and the legacy he left for future generations. (*The Victorian Naturalist* **113**,(4) 1996, 146-150).

Introduction

One of the tasks assigned to Baron Ferdinand von Mueller when he took up his appointment as Victoria's first Government Botanist on 26 January 1853 was a survey of the botanical resources of the colony. Although more than sixty years had passed since the first European settlement in Australia, the flora of Victoria was very poorly known, this knowledge being based on opportunistic collections gathered by visitors during brief landfalls or overland travels. However, few, if any, of these specimens remained in the colony. As was customary at the time, early collections invariably went to institutions or private collections in Europe. On taking up his appointment, there was no nucleus of a collection for Mueller to build on, apart from his own private collection of specimens from Europe and South Australia and a small personal library.

Charles Moore, Director of the Gardens in Sydney, was confronted with a similar situation. Despite the activities of collectors such as Allan Cunningham, Charles Fraser, Franz Sieber and others, Moore reported in 1855 that until 1853 the Garden lacked a herbarium and 'there was not a single specimen' (Gilbert, 1986).

Building the Collections

Mueller had to start from scratch in building a collection of specimens and books. This was a challenge that Mueller enjoyed and he worked tirelessly to this end. Within days of his appointment, he set off on his first collecting trip to parts of eastern Victoria during which he travelled some 2500 kilometres (Mueller, 1853a). On 5 September 1853, in his First General Report of the Government Botanist, Mueller wrote: 'In accordance with His Excellency's instructions, a collection of dried specimens of plants has been commenced for the Government. This Herbarium will be at all times accessible to the public.' The National Herbarium of Victoria (MEL), or, as Mueller called it, the 'Phytologic Museum of Melbourne' had been founded. After fifteen months Mueller had covered 6,400 kilometres and collected 1,459 species not previously recorded for Victoria, many of them undescribed (Mueller, 1854). Not only had Mueller plans to document the flora of the colony of Victoria, but his ambition was to write what he termed 'an universal Australian Flora' (Mueller, 1853b). In 1855/56 Mueller participated in the North Australia Expedition under the command of Augustus Gregory during which he collected 2000 species, 800 of them new to science or new records for Australia (Willis, 1949).

Mueller was conscious of his isolation from other professional botanists and the need to establish contacts. In October 1853 in a letter to Sir William Hooker, Director of the Royal Botanic Gardens, Kew, England, he wrote: '... I confidently hope that I shall enjoy the indulgence of the botanists, as I stand here perfectly alone, without any aid, only scantily provided with books, without access to authentic specimens and even without a magnifying glass, powerful enough to examine the anther appendices of Angianthea.' (Mueller, 1853c).

Mueller knew that to carry out his job efficiently he had to familiarise himself with the current state of knowledge of the Australian flora. He knew that the means

[1]National Herbarium of Victoria, Birdwood Avenue, South Yarra, Victoria, 3141

to accomplish this was to have access to the published work of those who had gone before him and of contemporaries who had described native species, and access to a comprehensive herbarium containing authentically named specimens for comparative purposes (Lucas, 1995). Many of the early descriptions were insufficiently diagnostic to enable the species in question to be identified with certainty from the description alone. Details of Mueller's books and his endeavours to build his library are well documented (Maroske et al, 1992; Cohn, 1995). He expended a substantial portion of his own money on purchasing books and in 1865 donated the library that he had established to the government (Mueller, 1865).

Mueller devoted much of his energies to building the collection of specimens through a combination of his own collecting activities, encouraging others to collect on his behalf, exchange with other herbaria, and the purchase of private herbaria. He knew that one of the best means to acquire authenticated material for comparative purposes was to purchase existing herbaria. Duplicates of some of Robert Brown's Australian collections were obtained from Sir William and Sir Joseph Hooker of Kew. Mueller was very adept at harnessing the energy of countless collectors and he established a network of collectors around the country. Among these collectors were a number of women such as Anne McHard of Blackwood River, and Sarah Brooks of Israelite Bay, both of Western Australia, who made important contributions. Mueller paid some collectors out of his own pocket but others were pleased to donate specimens and many were rewarded by having species named in their honour.

Mueller was one of the most fervent and eloquent advocates of exploration that the country has known (Ericksen, 1978). Mueller sponsored some of the early expeditions of Ernest Giles to Central Australia (Barker and Barker, 1990), was an active member of the committee that organised the Burke and Wills Expedition in 1860, sent out relief expeditions the following year, and was chairman of the Ladies' Leichhardt Search Expedition of 1865. To varying degrees he was associated with all of the exploration activities of the 1870s. He did this out of his interest in exploration but the prospect of more specimens from remote parts of the continent for his herbarium was always in his mind.

Mueller's endeavours to purchase herbaria are well documented (Short, 1990). The National Herbarium of Victoria library possesses an account book covering the period 1868-1872. From this book we learn that Mueller purchased specimens from numerous collectors including Joseph Nernst from Queensland, George Maxwell from Western Australia, Samuel Hannaford from Tasmania, and J.P. Fullager from Lord Howe Island. A complete list is reproduced by Short (1990). Amongst the most important private established herbaria purchased by Mueller were those of Joachim Steetz and Otto Sonder (Short and Sinkora, 1988, Short 1990). Mueller received the Steetz herbarium in December 1863 and the contents of this herbarium are detailed by Short and Sinkora (1988).

The number of specimens in Steetz's herbarium is not known but Mueller noted that it consisted of 15 large packing cases (Mueller, 1863b). The Steetz herbarium was the first large private herbarium from Europe purchased by Mueller and its importance to Mueller cannot be over emphasised. The herbarium contained many specimens gathered by early collectors in Australia that had been returned to Europe, among them specimens collected by Franz Wilhelm Sieber in eastern Australia. Of particular interest to Mueller was the good set of specimens collected by Johann Ludwig Preiss in Western Australia. These supplemented the set of specimens collected by James Drummond to which Mueller (1867) made reference, the 'late meritorious James Drummond, from whose enlightened son the Melbourne botanical museum received the whole normal collection of plants secured by his father during a long series of years in West Australia, many of the plants being solely contained as yet in this collection.' Mueller acquired more Drummond specimens in the Steetz herbarium (Short, 1990).

By far the largest herbarium purchased for the Melbourne herbarium was the Otto Wilhelm Sonder herbarium. The Sonder herbarium probably contained in excess of 250,000 specimens. Mueller (1859) claimed that the Sonder herbarium was 'the richest of all private botanical collections in existence.' Details of its contents and purchase are discussed by Short (1990). Suffice it to say that it took more than twenty years for Mueller to pursuade the government to provide the necessary funds to purchase this important herbarium. Mueller was at pains to point out to the government the benefits of acquiring the herbarium: '....I pointed out that such acquisition, altho' in first instance a costly one, would save the expense of time and money in accumulating gradually such herbarium, whilst the possession of such is after all everuseful, ...'(Mueller, 1859). Mueller (1888) pointed out that 'Through Sonder's herbarium, original specimens from the collections of several disciples of Linnaeus were obtained, coming from Professor Lehmann's herbarium.' The significance of the acquisition of the Steetz and Sonder herbaria was that they contained authentically named material and many type specimens collected by early European collectors to visit Australia. These specimens became available in Australia for the first time and were of inestimable value to Mueller. Unfortunately, Mueller's attempts to purchase the Lindley herbarium were thwarted by Government indifference.

Mueller's herbarium grew in size rapidly. He was the focal point of botany in Australia for almost forty years and material poured in from every corner of the continent. In 1858 he estimated that the herbarium consisted of 45,000 specimens: 'It comprises one of the most important series of Australian plants anywhere in existence, which will probably be consulted centuries hereafter, and which amounts to about 6,000 well-marked species in very numerous varieties' (Mueller, 1858). By September 1868 Mueller estimated the collection at approximately 350,000 (Mueller, 1869). In 1888 half a million specimens were said to be present (Mueller, 1888) and in 1891 Mueller noted that the collection contained 750,000 specimens (Mueller, 1891).

Assessment of Mueller's contributions

Any assessment of Mueller's contributions must take into account the circumstances that prevailed at that time. This was about a hundred years before the era of instant gratification conferred by such facilities as the facsimile machine, computers and e-mail. Communications were poor. To send a letter to Europe and receive a response took at least three months. Field work was very demanding and in parts of Australia often dangerous. Transport was by means of ship from one coastal point to another and overland it was often by horse or on foot. There was no possibility of pulling into a motel or a caravan park at the end of a day, enjoying a good meal, the comfort of a good night's sleep, and certainly no fast food. Distances that we to-day easily accomplish in one day in a vehicle took Mueller weeks; air travel was unknown. Specimens had to be carried on a pack horse, often for weeks on end, during which time they were often damaged. Paper for pressing specimens in the field was always in short supply.

During Mueller's years the herbarium lacked sufficient funds or staff to cope with many of the basic curatorial activities. None of the specimens was mounted. This was unfortunate because of the ease with which a label may become separated from the specimen to which it belongs. Two possible outcomes of this are that the wrong label becomes associated with a specimen or that a specimen ends up without any label. In either eventuality, the specimen has practically no utility. Although mounting of specimens has been underway at the herbarium for over forty years, Mueller's acquisitions policy was so successful that a century after his death it is estimated that almost half a million specimens are still waiting to be mounted, many of them collected by Mueller himself. This is an unfortunate legacy which Mueller could not prevent.

Mueller did not number his collections as did other early collectors such as J. Drummond, L. Preiss and F.W. Sieber.

The reason given by Mueller is that he used names, many of them manuscript names, rather than numbers because of the potential for inaccuracies when using numbers. In a letter to William Hooker written on 5 April 1855 Mueller wrote: 'It is sad to me also, to see against all my remonstrations, nearly all of my old apellations now in print: most of these names have been years ago replaced by more correct ones; they were originated mostly when I was very inexperienced here and much more in want of books than now and should only serve instead of numbers which by a slight inaccuracy lead at once into mistakes.' (Mueller, 1855). It is a matter of regret that Mueller did not use collecting numbers as it would have obviated a great deal of confusion and prevented the publication of countless manuscript names. In particular, had the specimens been numbered it would have made it far easier to trace the type specimens of many of the taxa Mueller described. Mueller had a tendency, no doubt occasioned by the lack of time and any mechanical means of copying labels, to abbreviate label data on duplicates and sometimes to use different wording. Mueller's handwriting is sometimes scarcely legible which does not help matters! A consequence of this is that it is often difficult to determine whether a specimen in another herbarium is a duplicate of a sheet in MEL or whether the sheet in another herbarium is unique. As Mueller did not number his own collections, it is difficult to estimate the number that he collected himself. It seems probable that he collected between 10,000 and 20,000 specimens.

Mueller surrendered his ambition to write a universal flora of Australia in favour of George Bentham who produced the 7-volume *Flora Australiensis* (1863-1878). Nevertheless, Mueller assisted Bentham to the extent of sending to Kew, family by family, the entire holdings of the Australian material in the herbarium. Two enduring benefits accrued to Australian botanists from this arrangement. Firstly, Bentham saw a wider range of material than would otherwise have been possible and cited many of the Melbourne specimens in the *Flora*, thus enabling one to gain a better appreciation of his taxonomic concepts. Secondly, the verso of the label of each specimen that was sent to Kew was marked with a 'B' on its return to Melbourne to indicate that it had been examined by Bentham (Ross, 1995). This greatly enhanced the utility of these specimens to later generations of botanists.

Mueller was very liberal with his specimens and dispersed many to other herbaria around the world. Indeed, there is scarcely a major herbarium in the world that does not possess some of Mueller's specimens. J.H. Maiden, in a letter to Alfred Ewart on 4 May 1917 wrote: 'I know of Mueller's feverish idea to get rid of his duplicates. He used to tell me that he would distribute his duplicates during his own lifetime and leave no man to do it after he was dead. The consequence has been, in the present case (*Acacia delibrata* and *A. oligoneura*), that crucial specimens have disappeared from the Melbourne Herbarium.' (Maiden, 1917). Of course this dispersal occurred prior to the type concept as we know it to-day, but one of the legacies of Mueller's generosity or enthusiasm to disperse his collections partly explains why many types that one would expect to find here are not here. This is most unfortunate. Undoubtedly many of the alleged duplicates would in fact not have been duplicates in the strict sense as we use the term today but specimens of taxa of which Mueller had other examples in his collection.

One means of evaluating Mueller's contribution is to examine what happened to the herbarium in the years subsequent to his death in 1896. When Mueller was alive he dominated the herbarium to the extent that there was no natural successor of equivalent scientific calibre. Mueller's death left a vacuum and almost immediately the herbarium ran out of impetus and a decline set in. The flood of new material that had poured in to Mueller for naming from around the country dried up and material tended to be sent instead to other botanists such as F.M. Bailey in Brisbane or J.H. Maiden in Sydney. Mueller was succeeded in the position of Government Botanist by J.G. Luehmann who in turn was succeeded by W. Laidlaw and A.J. Ewart. A.J. Ewart was part-time Government Botanist, his duties as Professor of Botany at The University of Melbourne occupying most of his energies. By and large the herbarium languished for about fifty years following Mueller's death and only after the second world war did a new vitality appear. It is doubtful whether the number of specimens in the collection has increased by more than 200,000 during the hundred years since Mueller's death.

It is remarkable that despite all of the difficulties, Mueller succeeded in building such a rich collection that ranks in importance with some of the great herbaria of Europe and North America. The collections are worldwide in their coverage and all plant groups and fungi are represented. It says much about Mueller's tenacity of purpose. Mueller left a wonderful resource from which subsequent generations have derived, and continue to derive, enormous benefits. His legacy is overwhelmingly positive.

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Villarsia - One of Mueller's Puzzles

Helen I. Aston[1]

In December 1856, J.F. Carl Wilhelmi collected material of *Villarsia*, Marsh-flower, from 'Banks of the Wannon' in south-western Victoria. His collection was lodged with Baron Ferdinand von Mueller and today is still extant in the National Herbarium of Victoria. It is one of the many specimens gathered by early explorers and collectors which proved puzzling to the botanists of the era, and which have had to wait until more recent times for satisfactory taxonomic placement. Mueller was a great botanist, with a fine observational eye, but even he was limited by the often meagre material on which he had to found his judgements. I offer this little story as an example.

Mueller was obviously puzzled by Wilhelmi's material and was uncertain of it's identity. Herbarium annotations indicate that he first allied it with *V. parnassifolia* of Western Australia, but later he placed it under the widespread and common south-eastern Australian species *V. reniformis*. In each case he noted significant differences from the usual collections of the species concerned. Thus in his *Fragmenta Phytographiae Australia* **6**, 140 (1868), under *V. reniformis*, he was referring to Wilhelmi's collection when he wrote 'A fluvio Wannon habeo plantam seminibus minoribus ovatis turgentibus estrophiolatis asperis saltem a forma legitima diversam.' That is, he noted the different seed characters of the Wannon material and considered that, although he was placing it under *V. reniformis*, he thought it was worthy at least of being considered a distinct form of that species.

Current day botanists will appreciate Mueller's dilemma. With only one collection showing those puzzling seeds available to him in 1868, he was wise to be conservative in his approach. The elucidation of such taxonomic puzzles requires more data from more collections and preferably also personal observations of plants in the field. In 1868 Mueller could not simply hop in a car and whizz off on a quick trip to the Wannon area. He necessarily left his puzzle unresolved.

There the matter rested for almost 100 years until 1965, when my attention focussed on plants of *Villarsia* growing in a swamp at Cranbourne, south-east of Melbourne. There were two distinctly different species present although Victorian botanists were then recognising the presence of only one species within the State. Feeling somewhat elated at this chance discovery, I returned to the National Herbarium of Victoria and examined the *Villarsia* collections it held. As I sorted all of the Victorian specimens I became aware of Mueller's puzzle of long ago. All except the Wannon collection and one from the 'Lower Glenelg River', into which the Wannon River runs, were readily sorted into two groups corresponding to the two species seen at Cranbourne. Victoria therefore had not only two good species (which later proved to be the real *V. reniformis* and *V. exaltata*), but also the Wannon/Glenelg exception to be accounted for.

Mueller's puzzle thus passed on to myself. It became part of field and herbarium studies which resulted in a full revision of the genus *Villarsia* within Australia, published in *Muelleria* 2,1-63 (1969). In this, the differences which Mueller had noticed were confirmed and the Wannon material proved to be the first Victorian collection of a new species *V. umbricola*.

Poor Mueller! In this example he had to wait almost 113 years for the entity which he tentatively felt was distinct to be given formal specific recognition. Is that a sigh of satisfaction I hear Mueller? Or are you sighing for other puzzles of yours which still remain unresolved?

[1] c/o National Herbarium of Victoria, Birdwood Avenue, South Yarra 3141

Mueller's Excursions in the Murray Scrub 1848-1851

R. Grandison[1]

Abstract
This paper outlines four botanical excursions carried out by Mueller and associates in the Murray Scrub of South Australia between 1848 and 1851. The account is supplemented by three appendices covering 'Where is Dr. Schulzen?' 'People and Places' and S.T.Gill's second visit to Moorundie.
(*The Victorian Naturalist* **113**, (4) 1996, 152-162

Fig. 1. Mueller's Hut, Wistow, near Mt. Barker (October 1995).

Introduction

On 16th December 1847, a twenty one year old Dr. Ferdinand Mueller with two younger sisters Clara and Bertha arrived off Largs Bay, South Australia, on the barque *Hermann von Beckerath*. Almost immediately Mueller began to collect plants, an activity which dominated his 4 1/2 year stay in S.A. He wasted no time in covering the botanical novelties close to Adelaide and in the Mt. Lofty Ranges, particularly near Macclesfield. Nearby at Wistow he soon purchased land and in a small hut (which still stands) he set up a base for further explorations (Fig.1). His zeal for collecting was matched by an outward gregarious nature in befriending a host of settlers or new-comers, whether English or German. By early April of 1848 he had expanded botanical operations to the Barossa Valley and made a trip to Kapunda. All of this was quite an achievement considering his short residence in the colony and that most excursions were on foot. During the same month he decided to make a short exploratory trip to Lake Alexandrina, a view of which he had looking to the S.E.

[1] R.Grandison, 44 Mataro Road, Hope Valley. S. A. 5090.

from the elevated position of his hut.

Mueller left an account of some of his travels in the Murray Scrub in the newspaper, *Süd australische Zeitung* pt.9, p.1 of 6/6/1850 with an article titled, '*Der Murray Scrub, botanisch skizziert*'. Unfortunately, as Sinkora in Churchill *et. al.* (1978) points out, 'No copies of the references to publications in Australian newspapers listed (below) exist in Australian libraries today. These references were obtained from various published and unpublished sources, and their accuracy cannot be guaranteed'. Since that time the status of the above reference does not seem to have changed. Verification of dates, places and sometimes clear identification of plants (due to nomenclatural change) can frequently be difficult where limited sources of information may be dispensed in the literature and perhaps even then quite imprecise. Some clues to the botanical conduct of these trips by Mueller can be gleamed from the inclusive work of others such as Miquel (1856). Here is mentioned the occasional specific place name (often with variant spelling) or the name of a person. Herbarium sheets such as those at MEL can provide useful fragments of information which taken together may finally approach a reasonably reliable and sequential account. The similarly-placed travels of Mueller's associates who did leave a record of one kind or another for the area, have been helpful in providing supportive background of the frontier where one cultural group was investigating or using the natural resources of another group.

In this paper, the Murray Scrub under consideration is that area of country east of the Mt.Lofty Ranges to the River Murray, bound in the north by the overland track between Truro and McBean Pound. The southern boundary is taken to be the northern most limit of Lake Alexandrina (Fig. 2).

First Trip through the Murray Scrub - A Hike to the Lake, late April 1848

About 1900, Carl Gustav (Gus) Schedlich, a man then aged in his late seventies, recorded his memoirs as a young emigrant from Bremen having arrived in S.A. late in December 1847, only a week after Mueller. In his reminiscences, (Schedlich c.1900) it is stated by the author that he left Bremen on 20/7/1847 and that the ship was at Cape Borda (Kangaroo Island) on 18/12/1847. The follow up voyage to Port Adelaide therefore corresponds to the arrival of the *Gellert* (Sexton 1990) about four days later. Interestingly amongst the other 250 passengers aboard the ship *Gellert* was a young surgeon named Dr. Ludwig Schulzen. Schedlich says Mueller was present to welcome them to S.A. so it would appear perhaps a case of renewing acquaintances.

Late in April 1848, Schedlich accompanied Muller to Lake Alexandrina (then called Lake Victoria) and it is through his latter-day reminiscences that we have an account of the trip.

> 'At this time I made an excursion with Baron von Müller to the lakes and we came the first night as far as Strathalbyn where we stayed at Mr. Donald Gallons, (Gollan) who kept the public house. Mr. Gallons never forgot Baron von Müller who was not satisfied with the accommodation compared with that to which he had been accustomed at home, and when afterwards saw Mr. Gallons he always asked me how the Baron was. Baron Müller was delighted with the Australian flora which was perfectly new to him.
>
> The second night we slept at a station of Mr. Gilbert, (south-east) from there to the lake where Langhornes Creek enters the lake, had a bath and returned by way of Langhornes Creek, the Baron being delighted with a variety of water plants. [see Wood (1972) p.36 where there is a reference to the collection in 1848 by Mueller of the branched alga *Chara baueri* at Lake Victoria].
>
> Instead of going to Strathalbyn we went via Tinpot. The Baron was sure we were wrong and I had to climb a tree when I convinced myself we were right as I could see Mt. Barker hill quite plainly, also the Bugle Ranges. He would insist on being

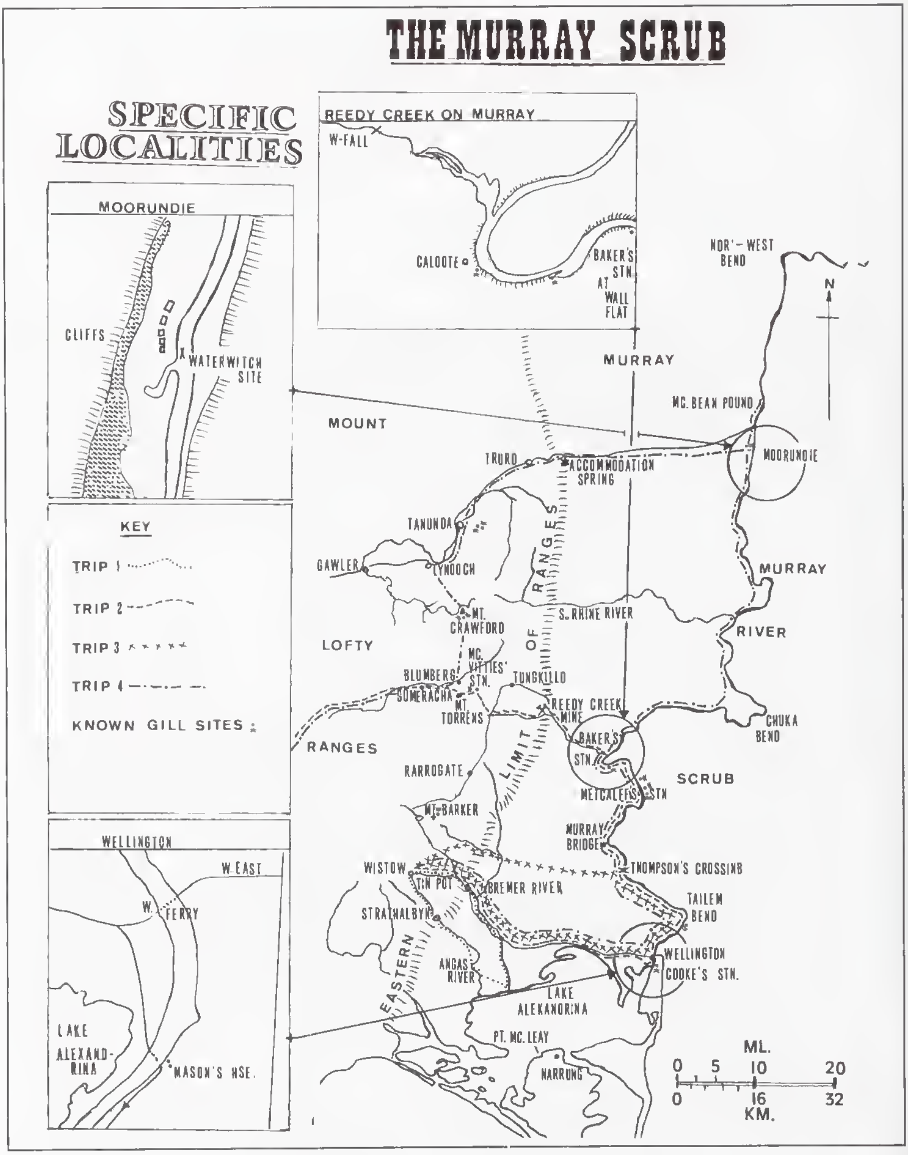

Fig. 2. Map showing Mueller's routes and locations mentioned in text.

right and as I was quite sure I was quite right he left me just where now the Morning Star public house is situated. He soon found himself to be on the wrong road and come back to me, when in a very short time came to the section then occupied by old Mr. John Hall and were regaled by Mr. John Hall with a cup of tea and a snuff, enjoying the tea after the long walk and were regaled by Mr. John Hall with a cup of tea and a snuff, enjoying the tea after the long walk. We were soon at home now and rested from our adventures.'

Second Trip through the Murray Scrub - First Trip to the Murray River - December 1848

Mueller had been in S.A. just one year yet had already carried out numerous collecting expeditions in the Mt. Lofty Ranges from Tanunda to Macclesfield in the south, along with a lengthy hike to the shores of Lake Alexandrina with Gus Schedlich (Schedlich c.1900). During October of the same year he spent several weeks on Samuel Davenport's property at Rivoli Bay seeking a plant cause for what today is known as Coastal Disease (Glen c.1900).

This time, Mueller's route may have originated at Klemzig from where he travelled to Hope Valley. There he intercepted the bullock track from Reedy Creek Mine which passed down Grand Junction Road to the Yatala Smelter at Rosewater. The track led up Anstey Hill through the Chain of Ponds settlement (old Morning Star Hotel) then to the S.A. Company's Ludlow House. It then weaved about until the Mt. Torrens Inn could be reached.(Sketched by Walter Light). This was a well known bullocky staging point for the teams. Judging from the siting of a Gill painting of McVitties' Station bearing a contemporary signature style, a slight detour may have been made to the NE of Mt. Torrens. As pointed out by Butler (1993), McVittie had a well-established merino stud sheep farm. In association with the South Australian Company John Baker imported large numbers of sheep from his former home colony of Tasmania, in order to improve herd quality (Pastoral Pioneers Vol 1) This is the most likely source of McVittie's stud Merinos and is suggestive of business dealings between the men. The circumstance is enhanced by Gill's painting of the station displaying the sheep. From the station, a trek to the SE soon would cause the party to pick up the bullock track to Reedy Creek Mine. Baker not only had his own Terlinga Station at nearby Tungkillo, but was one of the local directors for the Australian Mining Company's operations at Reedy Creek Mine (Butler 1993). Nearing the scarp face the hilltops are followed to the last, before the track drops steeply into the copper mining complex nestled amongst the enclosing hills.

Nearby on a creek of the same name, which periodically manages to flow to the Murray River, Mueller collected *Cassia culliantha* (syn. *C. vittata*). At this point the River Murray is as close as it gets to the Mt.Lofty Ranges and the 15 km along the Reedy Creek to Caloote and Baker's Station on the Murray could be easily accomplished (Fig. 1). The trip, following the nearby cattle track from the station, allowed an inspection of the Murray Scrub without the usual concerns over the lack of surface water. Baker's Station, like a number of other stations about the Murray River, was an area held by a tenure of an annual occupation licence from the Crown. Botanical collections at this time are also evident in Willis' List of Mueller collections held at MEL which relate to this time. Whether by arrangement or chance, it would appear from associative paintings done at the time by Gill, (Figs. 3 and 4) that the party may have accompanied Baker in his boat downstream towards the lakes. Baker had another station on the southern side of Lake Alexandrina near the channel that links it to Lake Albert. One of the paintings showing a river bank with an outcropping rock is labelled as being on Cooke's Station, about 3km south of Wellington near Mason's house (Fig. 5). At this point it would be convenient to leave the river in order to return to Wistow rather than sail on across the lake to Baker's other station.

Fig. 3. S.T. Gill's painting site for *Camp Site, River Murray* close to Baker's Station and viewed to the west of north where Reedy Creek joins the Murray. Caloote landing in mid foreground. (July 1996).

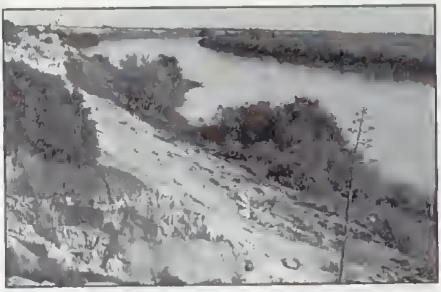

Fig. 4. S.T. Gill's painting site for *River Murray Scene*, about 1km south of Tailem Bend. (May 1996).

Second Trip to the Murray River, February- March 1849

This trip appears to have had its origins at Wistow and followed the deeply incised Mt. Barker Creek down to its confluence with the Bremer River. Mueller was accompanied by his friend and neighbour Ludwig Fischer. Mueller attributed the collection of the small dark blue flowered *Eremophila gibbifolia (syn. Duttonia gibbifolia)* to Fischer from the Mt. Barker Creek area. The genus *Duttonia*, named after the Colonial Secretary, Francis Dutton, was established by this plant name being published in the German botanical journal, *Linnaea* xxv, 409 of 1851. One specimen, MEL 77670 has been designated the holotype, and another, MEL 77671 isotype.

Alongside the Mt. Barker Creek, Mueller is listed by Miquel (1856) to have collected *Melaleuca pubescens*. Near the junction of Mt. Barker Creek with the Bremer River, Fischer collected *Acacia rupicola* (*Flora Australiensis* II, 333*)*. As indicated by Whibley(1980), this collection is close to the northern extent of the species in the Murray Scrub.

Once across the Bremer River and out of the hills it was only about a 30 km walk through the Murray Scrub to Samuel Davenport's Station on the Murray. On this march they passed to the north of the present Ferris-McDonald Conservation Park but collected *Exocarpos sparteus*, dated February 1849 but its locality was merely listed as 'Murray', MEL 1606. Davenport's Station held by occupational licence from the Crown, had an area of about 70 square miles and extended from about present day Murray Bridge to south of Tailem Bend. In charge of the station was Davenport's young (step) brother-in-law, Thomas Glen (Baldwin 1980). It was Mueller's second visit in less than two months. On this previous trip. S.T.Gill made a painting of the downstream view of the Murray River from an elevated spot just south of present day Tailem Bend, showing a portion of Davenport's holding (Fig. 3).

From the station Mueller and Fischer turned downstream to reach Wellington. For the 1st March, the Willis List records a collection at Wellington. The circuit was completed by skirting Lake Alexandria through familiar country to Wistow.

Third Trip to the Murray February 1851

During his second visit to South Australia Dr. Hans Behr botanically explored the eastern side of the Mt. Lofty Ranges out from Truro and into part of the Murray Scrub late in 1848 (Kraehenbuehl 1981). He most likely had been staying at the home of August Fiedler,(Grandison 1985, 1990) a prominent settler at Tanunda. During March of the following year he ventured from Truro across the Murray Scrub to Moorundie on the River Murray. In his subsequent letter to Professor Kuntze in Leipzig, quoted at length by (Kraehenbuehl 1981), Behr related ' the tortures of thirst' and the 'desolate flats' but left a good description of the Murray Scrub landscape and many of its plants. About October 1849 Behr left South Australia but his influence on Mueller appears to have remained. During February of 1851, as suggested by the Willis List and specimens observed at MEL, Mueller organised another trip to the Murray River. From Tanunda he passed through Truro to the old overlander's track through the Murray Scrub, rather south of the present highway to Moorundie on the river. This was, up to this point, a copy of Behr's trip of two years before.

It is likely that Mueller was accompanied by travelling companions, but at this stage their presence is indicated by circumstance. At Moorundie, by this time abandoned, S.T.Gill made a number of paintings, several features of which

Fig. 5 S.T. Gill's painting of *On the River Murray at Mr. Cooke's Station* (Private Collection).

suggest a date of 1851.

At about this time, an associate of Mueller's, a Dr. Ludwig Schulzen, by somewhat mysterious means, was absent without leave from his medical post at Robe and may have travelled with him (Appendix 1). A few known collections of this time outline the route. From the Willis List come place names such as the Wheal Barton (Mine near Truro). From sheet MEL.1610 an undated specimen of *Exocarpos sparteus* labelled, 'Murray Scrub, Mr Irwin' supplies another clue to his whereabouts (Appendix 2). Another specimen, MEL 2541 *Santalum acuminatum* (Quandong) dated February 1851, has a locality of, 'Low hills towards the Murray'. This locality is taken to be the rise from the flats not long before the river is reached. Another specimen of the same plant MEL 2519 was described as taken at 'Morunda' (Moorundie), also in February 1851. Yet a third specimen MEL 2533, carries the Aboriginal name 'Weria' and Murray Scrub, though it is not dated. A mixed sheet, MEL 1677 of *Exocarpos aphylla* lists the collection from, 'near Morundie, February 1851'. The Willis List also mentions a collection at McBean's Pound near present day Blanchetown.

Not a great deal is known directly of Mueller's downstream trip along the River Murray from Moorundie to Wellington, however another German botanist proceeded him by about 3 weeks. This adventurer was Carl Wilhelmi, who with a friend made the trip on foot from Tanunda to Moorundie, then downstream to Wellington. In a series of articles published in newspaper *Der Kosmopolit* in September 1859, Wilhelmi related a number of interesting aspects of his journey and this gives an understanding of what Mueller may have faced. Like Behr before him, Wilhelmi discovered the perils of summer travel in a waterless landscape.

> 'On the third day, equipped with water and provisions, they (search party) followed his (Sievers) track, found first of all his gun leaning against a bush and him lying unconscious under a thick scrub, when they were just about to search further. After the searchers moistened his face and chest with water and also poured some in his mouth, he recovered again. Since no drop of water is to be found in this scrub, which extends occasionally 40 to 50 miles on both

'sides of the Murray, we provided ourselves with a water flask and set off on our way, warned by many on no account to pass the night in the scrub'.

'In the night, however, such a thirst overcame me that I gently took away the flask from my friend, who had the custody of it and took a hearty swig out of it'.

At Moorundie he described the place as,

'This township consisted of five houses, namely an accommodation house, a half-fallen in stone house for the police and three huts without roofs'.

This circumstance relates well to Gill's painting of the same scene (Appendix 3). The travel downstream from Moorundie was sometimes anything but a stroll along the river.

'Soon the river on both sides became so enclosed by the high vertically rising cliffs, that we were compelled to climb them, which for my somewhat heavy companion was no slight task'.

'Still following the Murray straight on, we found our way barred by a large lagoon densely covered with reeds in a right bend of the river, so that we had to make a large detour. After many fruitless attempts to penetrate through it, we found at last a place where the ground was able to bear us and with great exertion we forced through the 6 to 8 foot high reeds'.

The Mueller party eventually made its way to Baker's Station previously visited back in December 1848. According to the Wilhelmi account, the station was about to be deserted, and this may well have been the case upon Mueller's arrival several weeks later.

'On our arrival of the cattle station of Mr. Baker, the people were just occupied in loading an old, defective boat with cooking utensils, cattle branding irons and so forth, to send these objects 50 miles down the Murray by five Aboriginals, because there was no more feed for the cattle on this station and the latter were also to be driven there'.

At nearby Taylor's Station there was already a ferry for crossing the river.

'Reached Taylor's Ferry-Station in good time, where we remained the next day and did the washing'.

'The following day we made an excursion in the neighbourhood of the station and I was so fortunate to find a new species of the genus *Acacia*, which Dr Mueller was so kind to name after me'.

From this vicinity on Metcalfe's Station, Gill, produced a painting entitled '*King's Hut Cattle Station of the Lower Murray*' (Fig. 6). This run had been held for several years by Henry Metcalfe on occupational licence. From a site located across the river from Mypolonga, Gill once more set to work and produced 2 paintings simply called 'Metcalfe's Station, River Murray'. From here the remaining downstream area was known and presumably quickly covered until Thompson's Station was reached (previously Davenport's Station). Wilhelmi says of it, 'Mr. Thompson was away, but we were heartily welcomed by his overseer and his German stockrider'.It is possible the Mueller party made a similar contact, before making its way to Wellington, where Schulzen may well have continued southwards and returned to Robe! (Appendix 1).

Summary of Mueller's Travels in the Murray Scrub

Mueller's excursions in the Murray Scrub represent a phase in his energetic phytogeographical travels in South Australia, later to be developed in Victoria and other parts of Australia. It was a time too when he developed associations with many people, some of whom became long

Fig. 6. S.T. Gill's painting site for *King's Hut Cattle Station of the Lower Murray*, about 10km S.S.E. of Mannum.(May 1996).

standing friends. Names such as Samuel Davenport (later Sir), Charles Stuart, Carl Wilhelmi, August Fiedler, S.T. Gill, William Blandowski, Ludwig Schulzen belong to this group. The Murray Scrub was an area of risk to the traveller, especially in the northern sector eastwards of Truro, due to the general absence of surface water. Here overlanders leaving the Murray River near Blanchetown had to drove their stock for several waterless days until they arrived at Accommodation Spring on the eastern flanks of the ranges. The supply of water, whether the source was considered in the ranges or at the Murray River, dictated that the scrub east of Truro was to be traversed smartly rather than loitered in. It's rather interesting to note that this route was covered by Dr. Behr, then Carl Wilhelmi who was followed by Mueller, all travelling during the summer months. If the Murray Scrub was a challenge then the area about Moorundie was an attraction. The artists S.T. Gill (Appleyard 1986), George French Angas (Angas 1846) and von Guerard (Carroll and Tregenza 1986) all visited the area (along with others) and recorded their impressions. Additionally Angas (1861) investigated the Hairy Nosed Wombat, *Lasiorhinus latifrons* (Owen 1845) and Alfred Sievers almost lost his life there in collecting birds for Sturt.

From this it can be gauged that Mueller was not the only scientific investigator in this region. He may well have been influenced by Behr to try the track to Moorundie, after all Kraehenbuehl (1981) pointed out the unfulfilled desire of Behr to investigate the upper Spencer Gulf area, which was subsequently achieved by Mueller in company with Gill (Grandison 1996 *in press)* in October of 1851.

Without any direct list of collections in the Murray Scrub by Mueller, it is difficult to be exhaustive about what was collected. Investigations into listings mentioned throughout the volumes of *Flora Australiensis* and known collections by Behr, act as a starting point to accumulate information from selected specimens held at MEL. Doubtlessly other specimens probably exist at Kew and other localities. In a few cases specimens collected by Behr near Moorundie carry a Mueller name as well, but this may be due to a rendering of the Sonder collection as there is no evidence to suggest they were at this site together. Perhaps due to the time of the year of his travels in the Murray Scrub, little material appears as a novelty. A new species of *Acacia* collected near the river south of Mannum was named in honour of his friend Carl Wilhelmi.

These excursions to the Murray Scrub represent a deepening resolve to widen at every opportunity his phytogeographical terms of reference to the flora of his adopted land, taken with a young man's sense of adventure concerning risks involved and the stamina required.

Acknowledgments

The author wishes to record his thanks to the following persons who have supported this project. Mr. Keith Borrow of Erindale South Australia who has assisted with aspects concerning the works of S.T. Gill and Walter Light along with valuable discussions about collateral issues. Dr. Thomas Darragh of Melbourne who supplied me with a translated copy of Wilhelmi's narrative published in *Der Kosmopolit* 18-25/9/1857, Darrell Kraehenbuehl for data obtained by his gleanings at MEL. The staff at MEL past and present who assisted in my search through the collection. The late Dr. J.H. Willis, a friend and mentor who sowed the seeds of Mueller's collecting places and dates he had noted in his time at MEL. Mrs. Vick of Wistow South Australia for allowing me access to Mueller's Hut. Freda Grant who transformed a script into a final typed manuscript.

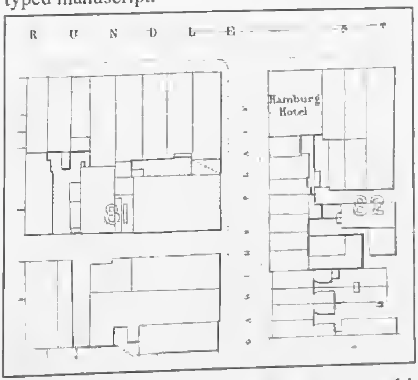

Fig. 7. 'The only community where you could have interaction with intelligent people was the German coffee place of Pohlman's (Hamburg Hotel) at Rundle Street where well educated Germans found a kind of club and where under the leadership of Herr Linger you could hear some good singing'. (Schedlich c.1900).

Appendix 1 'Where is Dr.Schulzen?'

Dr. Ludwig Schulzen arrived in South Australia aboard the ship *Gellert* on 23/12/1847 from Bremen. From an address on a letter there is some evidence that he may have resided at Pohlman's Hotel on the corner of Gawler Place and Rundle Street. This locality was well known as a cultural spot (Fig.7) and was also mentioned in these terms by Schedlich in his reminiscences. In a letter dated 7/8/1848 (P.R.O. Adelaide) from the Colonial Secretary's Office, Schulzen was appointed medical officer at Guichen Bay (Robe). He was directed to the Government Resident, through whom he was instructed he should direct all communications. His appointment was considered provisional on the basis he produced his Diploma within 18 months. The pay was 50 Pounds per annum and he was to report to the Government Resident, Capt. Butler at Robe as soon as possible.

By December 1848, not long after his arrival, he applied for leave of absence in order to travel to Adelaide. He was directed that his absence would be without pay unless he could organise a replacement! During October 1848 Mueller had visited nearby Mayura Station of Samuel Davenport for about three weeks, and probably called in on Schulzen at Guichen Bay. Subsequent collections made by Schulzen and forwarded to Mueller include (Kraehenbuehl 1995 *pers. comm.) Leptomeria aphylla* from Guichen Bay, near end of 1848, *Brunonia australis* also from Guichen Bay', and dated December 1848, and *Pimelia humilis* listed as from Guichen Bay and Cape Jaffa and dated February/March 1849. Another interesting collection by Schulzen noted by Kraehenbuehl (1995) was *Lomandra effusa* MEL 20848 from the town of Mt. Gambier, June 1849. The date coincides with the arrival in the town of Dr. Wehl, Mueller's future brother-in-law. In another letter dated Robe 18/10/1850, Schulzen applied through the new Government Resident Chas Brewer for another leave of absence in order to travel to Adelaide for 'health reasons!' This time the leave was enacted. Schulzen may have spent some time at the German and British Hospital in Adelaide as in late March of 1851 he applied for a remission of fees (P.R.O. Adelaide). In this letter he made reference to his limited salary. Altogether he doesn't appear to have been very happy about the job, its salary or location.

In a letter dated 24/1/1851, (P.R.O. Adelaide) from the Government Resident, Brewer to the Colonial Secretary, Charles Sturt, it was reported that Schulzen was overdue on his overland journey from Adelaide to Robe. Sturt alerted the police, but a report of 5/3/1851 still showed no sign of Schulzen. Where was Schulzen? If in Adelaide the question would not have arisen as he would have been sighted, so what was he doing for 3 1/2 months? The suggestion is that he possibly travelled to the Barossa Valley to the home of August Fiedler at Tanunda. (Grandison 1985). Here in the Barossa Valley he could enjoy a cultural respite while the authorities in Adelaide and Robe pondered his whereabouts or fate. As the police were making enquiries about him, this news probably made him aware that it would be unwise to return to Adelaide. As events were to unfold, Mueller was already preparing a trip from the Barossa Valley to Moorundie on the Murray, then downstream to Wellington. This was the opportunity Schulzen required, and accordingly in the new year he accompanied Mueller to the Murray, eventually leaving the party at Wellington in order to travel along the Coorong back to Robe. Using this route would avoid returning to Adelaide and being recognised. The return to Robe meant travel along the Coorong. Once again he would pass Cantara Station, south of Salt Creek where it is known he collected for Mueller in July 1850 (Kraehenbuehl 1995 *pers.comm.*). A number of undated and unlocated specimens from the same site and listed in *Flora Australiensis*, hint at the possibility that he may have once again collected for Mueller. An apparently gratefully Mueller named *Lasiopetalum schulzenii* after its collector.

It is not known what excuses Schulzen offered for his apparent disappearance, but he didn't last long at the job for in the following August he resigned. From here he seems to have spent some time with Dr.Wehl at Mt.Gambier before joining the exodus to the goldfields at Mt. Alexander. (Bowden 1974)

Appendix 2. People and Places

Accommodation Spring A critical watering place located on the eastern flank of Mt. Lofty Ranges, east of Truro. Discovered by E.J. Eyre 1839.

Baker's Station John Baker arrived in South Australia during 1838. He imported stock into Adelaide from V.D.L. Properties were acquired along the Lower Murray River near Caloote and Murray Bridge, as well as the southern flank of Lake Alexandrina. A small portion of the latter eventually became the Pt. McLeay Mission Station of Taplin.

Dr. Hans Behr Born 18/8/1818 Koethen in Saxony-Anhalt died 6/3/1904 San Francisco U.S.A. Paid two visits to South Australia, one in 1844-45 (pre Mueller) the other 1848-49. Made extensive botanical and entomological collections. Frequented the home of August Fiedler. Made an excursion through the Murray Scrub from Truro to Moorundie in the summer of 1848-49.

August Fiedler Born 21/2/1796, Kleinzig, Brandenberg Prussia, died Langmeil South Australia 19/9/1880. Arrived onboard *Prince George* 26/12/1838. Veteran of Waterloo, orchardist winegrower, whose home acted as a centre of early Barossan art and science. Head layman of the Lutheran Church under Pastor Kaval.

Ludwig Fischer Born 14/3/1809 in Holstein. Worked in a number of Botanic Gardens. As such he met Mueller at the University of Kiel. Emigrated to South Australia in 1848 and settled in Bugle Ranges where once again he was botanically associated with Mueller.

Gilberts's Station Located on the lower reaches of the Angas River within few km. of Lake Alexandrina.

S.T. Gill (1818-1880) As an artist he frequently portrayed an accurate record of the colonial frontier, especially in South Australia where he accompanied Mueller on several expeditions.

John Hall's Sections John Hall, a tennant farmer on sections 2895, 2896 of Macclesfield Special Survey taken out by Samuel Davenport. Located about 2 km. east of Wistow close to Mt. Barker creek.

Thomas Irwin Arrived in Sydney by the ship *Royal Saxon* in 1844. Probably joined an overlanding group to South Australia, being subsequently employed on the station of the Disher Brothers or Lachlan McBean in the Murray Scrub adjacent to Accommodation Springs. Mentioned on a herbarium label MEL 1610 for *Exocarpos sparteus* as collected in the Murray Scrub.

Langhorne Creek Name of a locality on the lower reaches of the Bremer River which flows into Lake Alexandrina.

Walter Light with brother Arnold, arrived in South Australia on board the *William Hyde* from Plymouth in May 1849. Arnold was an architect. Walter later returned permanently to England.

Ludlow House Is one of the oldest surviving houses in South Australia. Its building commenced in 1840 for the South Australian Company which had extensive pastoral interests in the area. Until 1852 the main track between Gumeracha and Chain of Ponds passed by this substantial building.

McVitties Station William McVittie had a Merino stud sheep station a few km. south east of Mt. Torrens between 1846 to mid 1851. A station scene was painted by S.T. Gill in the summer of 1848/49 period.

Mt. Torrens Inn Existed as of 1848. Sketched by Walter Light in the following year. On the copper road from Reedy Creek Mine.

Metcalfe's Station Henry Metcalfe held an area on the River Murray flanking both banks by occupational licence until July 1851. The station boundary south of present day Caloote, extended downstream towards Murray Bridge.

Moorundie An Aboriginal Station established by E.J. Eyre in October of 1841 at a site on the River Murray about 5 km. south of present day Blanchetown, following clashes between Overlanders and Tribesmen at the Rufus River anabranch. Eyre departed in November 1844.

Morning Star Inn Chain of Ponds (Timnath). Existed 1847 to late 1978 when demolished.

Murray Scrub a name variously applied to a region between the Mt. Lofty Ranges and the River Murray. It is characterised by being underlaid by limestone and where there is a scarcity of surface waters.

Reedy Creek Mine Operations began in 1847 after the purchase of a Special Survey in the previous year by the Australian Mining Company. After a revival of the mine in the 1860's the company surveyed the nearby town of Palmer, naming it after Colonel Palmer the Chairman of Directors of the company.

Carl Gustav 'Gus' Schedlich born Dresden, Germany 22/4/1821 died Mannum South Australia 8/8/1847. Associate of Mueller and for a time engaged to his sister Bertha.

Dr.Ludwig Schulzen MD from Leipzig who arrived in South Australian onboard the *Gellert* 23/12/1847 from Bremen. Appointed MO Robe in August 1848, resigned position August 1851. Collected for Mueller along the Coorong. At the Mt.Alexander Goldfields for 2 1/2 years until early 1855.

Taylor's Station located between Mannum and Chuka Bend on River Murray. Mentioned by Wilhelmi (Feb. 1851) that David Taylor operated a ferry across the river.

Thompson's Station Located between Murray Bridge and Tailem Bend on the River Murray. Also known for a stock crossing of the river at the present site of the Swansport Bridge.

Tin Pot A small settlement about midway between Wistow and Wellington. Now known as Woodchester. Originally a part of the Angas Special Survey of 1841 when the name Tin Pot was already in use.

Wheal Barton Mine A copper mine started in 1849 a few km. south east of Truro, along with a township named Barton.

Appendix 3. A possible date for S.T. Gill's painting titled, Old Police Station of Morunda held by AGSA and illustrated in Appleyard *et al.* (1986).

Gill appears to have visited Moorundie a couple of times. Dr. Tregenza in one of his compilation folders about S.T. Gill, held by the Mortlock Library, Adelaide states, Gill visited Eyre at Moorundie in February 1842. At this time the Government cutter *Waterwitch* was tied up to the riverbank (Fig. 1) and portrayed as such in one of his contemporary paintings (Appleyard *et al* 1986). In January 1842 the Police Station was built, (Eyre Letters) thus if Gill visited the place in 1843 it could hardly be described as 'old'. In December 1842 the *Waterwitch* sank at her moorings with the upper masthead left showing. The 1843 date inscribed on the front of the painting must therefore be in doubt as accurate, as it does not show the mast.

As outlined by Appleyard *et al.*. (1986), Gill periodically changed his signature style. The style shown on the lower left of the painting is identical to that of another painting called *Arrival of the Geelong Mail at Ballarat* dated 1855. This signature on the Moorundie painting is suggestive of a subsequent completion, perhaps with a lapse of accuracy for the inscribed date. As Gill left S.A. early in 1852 and there are 1851 signature styles on his paintings of *Metcalfe's Station*, it is suggested a probability exists for considering that the Moorundie painting mentioned above was made in 1851 while in the company of Mueller and associates. From Wilhelmi's description of 1851 (see text) the Police Station could hy then be described as 'old' and 'run down'.

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Botanical Researches in Intertropical Australia: Ferdinand Mueller and the North Australian Exploring Expedition

Helen M. Cohn[1]

On 17 July 1855 Baron Ferdinand von Mueller sailed out of the harbour of Sydney on board *Monarch*. He was embarking on an exploration of the unknown, an expedition into the centre of the Australian continent where no European had been before. His companions on this great adventure included A.C. Gregory, the expedition's leader, and his brother Henry, both experienced explorers and bushmen. Artist Thomas Baines, having endured the rigours of the South African bush, was about to get his first taste of the Australian outback. The complement of scientific personnel included J.R. Elsey, surgeon and naturalist, J.S. Wilson, geologist and J. Flood, collector and preserver. Stockmen, a farrier, a harnessmaker and a carpenter completed the expedition's membership. Horses and sheep were taken on board in Brisbane. The North Australian Exploring Expedition was under way (Cumpston 1972; Birman 1979).

Embarkation

Mueller's appointment as botanist to the expedition was made almost at the last minute and his decision to join caused him some anguish. In the early part of 1855 Mueller found his position of Government Botanist in Victoria increasingly precarious. The colony was sinking further into the depths of a depression such that the government was obliged to make drastic reductions in expenditure. Mueller expected to hear at any time that he was without a job since, as he reported to William Hooker at Kew, 'the abolishment of the scientific institutions' had been decided upon, and retrenchments were being made in every direction (Mueller to Hooker, 5 April 1855). In May approval of the budget for his department gave Mueller hope that he would escape the fate of his colleagues in the Geological Survey (Darragh 1987). However, the blow fell the next month. On instructions from the Governor, Charles Hotham, the Colonial Secretary informed Mueller that 'the reduced state of the finances of the Colony will compel His Excellency to abolish the office of Government Botanist at the end of the present month' (Moore to Mueller, 13 June 1855).

Mueller had determined that if this fate awaited him he would pursue his dream of preparing a 'universal flora of Australia' by travelling, using only his own slender resources, in various regions of the eastern part of the continent. A more congenial alternative presented itself, however. Unexpectedly, he received a letter from A.C. Gregory who was at that time in the last stages of preparation for an extended expedition into the unexplored regions of north Australia. William Hooker's nominee for the position of botanist, the elderly James Drummond of Perth, had declined, much to Gregory's relief. He needed strong young men who could withstand the rigours of travel in unknown territory. It was at the instigation of William Harvey, an Irish botanist then making a botanical tour of the colonies, that Gregory wrote to Mueller indicating that an application from him to join the party would be given immediate consideration (Gregory to Mueller, 11 May 1855).

Without waiting for Mueller's reply, Gregory recommended to the Governor General, William Denison, 'the expediency of accepting the services of Dr Mueller in the capacity of Botanist to the Expedition, as I imagine that the position he now holds as Government Botanist in the Colony of Victoria, added to the strong recommendation of Professor Harvey, are a sufficient guarantee of his ability to perform the duties required' (Gregory to Thompson, 24 May 1855).

[1] Royal Botanic Gardens, Melbourne

Mueller was delighted that Harvey, with whom he had scoured the shores of Port Philip Bay for algae, had put his name forward (Mueller to Gregory, 13 May 1855). Here was an unsurpassed opportunity for him to study the flora in areas where no botanical collections had previously been made. He wavered, however. 'I ought not to embark in a dangerous enterprise', he remarked to Gregory, 'in which my constitution may be brok [sic] altogether, and to return perhaps breadless home' (Mueller to Gregory, 26 May 1855). The dreadful fates of the last two expeditions, those of Edmund Kennedy and Ludwig Leichhardt, preyed on his mind. He feared that a prolonged absence would materially affect his prospects for re-employment with the Victorian government, unless 'the elaboration of any discovered plants as the reward for my labours would be entrusted to myself' (Mueller to Hooker, 11 January 1857).

Mueller sought the unprecedented concession of being able to retain part of his collections for his own study and evaluation. On other such expeditions all collections, journals and notes were deemed to be government property, not permitted to be published without official sanction. 'I alone could reconceal [sic] myself to the manyfold dangers', he wrote to Gregory, 'which we have to brave in such a country as we intend to explore, by having the reward of publishing my own botanical discoveries from the collected material; as I otherwise would sink to the position of a mere collector' (Mueller to Gregory, 4 June 1855).

Ultimately Mueller sought Gregory's support in applying for leave of absence from the Victorian Government. This being granted, Mueller travelled to Sydney in July intending to consult Gregory and Denison, 'whether my physical strength will be sufficient to participate in the general duties of the exploration' before actually accepting the position of botanist with the expedition (Mueller to Gregory, 23 June 1855). Mueller embarked in Sydney without receiving any assurances with regard to his retaining a duplicate set of his collections, his enthusiasm for studying the northern flora outweighing the fears he held on other grounds.

On the trail

The expeditionary party reached the mouth of the Victoria River in northern Australia in September 1855. Here the real work began. The party worked its way upstream, some by river in the schooner *Tom Tough*, while Gregory led a small group, including Mueller, by an overland route reconnoitring as they went. A depot camp was established on the river in October, the place being determined in part because the schooner had run aground and resisted all efforts at refloating. The surrounding country offered plentiful grass for the horses and sheep but presented a somewhat dreary aspect. It was, wrote Gregory in his journal, 'very rough and stony, thinly timbered with white gum eucalyptus of small size, and nearly destitute of leaves; and though the whole country was grassy, it was so much parched by the intense heat that it presented a very sterile aspect.' (Gregory 1884). The stony ground proved difficult for the horses and caused them to go lame. Drying grass presented a further problem. A grass fire broke out from 'want of due precaution in clearing the grass around the fire at the camp, though the cook had been cautioned on the subject'. The party lost a night's sleep in trying to prevent the fire consuming all the grass for the animals (Gregory 1884).

From here, on January 3 1856, Gregory set off towards the inland accompanied by his brother Henry, Mueller, Baines, Flood, overseer G. Phibbs, farrier R. Bowman, harness-maker C. Dean and stockman J. Fahey. This was towards the end of the wet season and the men daily noted the drying of the countryside. Rivers that in the wet would run in torrents became mud flats deeply fissured by the scorching rays of a tropical sun. Gregory deemed much of the country through which they passed quite worthless and noted that the surface of the ground was often covered with a thin crust of salt.

Mueller, in writing to William Hooker, painted a vivid picture of the daily routine for the men on the expedition.

'We were roused precisely at four o cl. a.m. by the last sentry on watch, finished our simple breakfast in ¼ of an hour, went at once in search of our horses, and managed generally to have them caught, driven in saddled and packed a little past sunrise. We travelled hardly ever less than 8 hours, often 10, at the rate of about 3 miles an hour, but when grass or water was not conveniently found sometimes considerably longer. Unloading, going through our little domestic duties, repair of cloaths and saddlery, attendance to our noble animals, [without] which we would have been helpless beings in the wilderness, pitching our calico-sheets and refreshing ourselfes by a hasty meal would occupy us for less than an hour, the rest of the day, about 2 hours at the average, was allotted to the special duties of our respective departments. I would employ myself examining the plants round our camp, in attending to the specimens and seeds snatched up on the way or writing botanical notes. At night we stretched ourselfes on our blanket, and generally in full cloaths, to be ready for defence at a seconds notice, the gun alongside us, the revolver under our head.' (Mueller to Hooker, 11 January 1857).

For two months they travelled in a south and westerly direction, following a watercourse Gregory named Sturts Creek, for nearly 300 miles. In doing so they penetrated far into the level tract of country which Gregory termed the Great Australian Desert. Hopes that the Creek would lead to some important outlet to the waters of the Australian interior came to nothing. Gregory knew the signs of impending drought and decided to retreat to the Victoria River 'while it was practicable, as the rapid evaporation and increasing saltiness of the water in this arid and inhospitable region warned us that each day we delayed increased the difficulty of the return, and it was possible that we were cut off from any communication with the party at the depot by an impassable tract of dry country' (Gregory 1884).

The heat proved a trial. Gregory frequently recorded midday temperatures of over 100°F. When on the move, the party often stopped travelling in the middle of the day and resumed later in the afternoon when the sun had lost some of its strength. A thermometer was lost when the heat caused the scale to warp and the tube broke. Flies were a persistent bother, especially to the horses, getting in their eyes and making them restless. On returning to the depot camp Gregory found that the salt pork had reduced to ¼ its original weight, the heat having melted the fat. It became, said Mueller, 'rancid and indigestible' (Mueller to Hooker, 11 January 1857). Gregory found an alternative by making 'experiments in the preparation of meat biscuits by mixing the preserved fresh beef with flour in equal proportions, with satisfactory results.' (Gregory 1884).

Some provisions were in short supply, having been water-damaged in landing from *Tom Tough*. Rats and white ants attacked the food stored under cover at the camp. To supplement their diet the men shot game whenever possible. Emu, ducks, catfish and even a tortoise found their way into the pot. They also made use of the local plants. Among the most important of these was *Portulaca oleracea* which very easy to gather and required no cooking (Mueller to Hooker, 11 January 1857). It was to this widespread anitscorbutic plant that Mueller ascribed the continued good health of the party. The Australian spinach, *Chenopodium erosum*, was of similar benefit but more time-consuming to prepare. The roots of both the giant water-lily and *Typha*, a small kind of cucumber, a species of rose-apple, the tender parts of the stem of the orchid *Cymbidium canaliculatum*, the clustered fig, a native mulberry and the yam all provided variety in an otherwise very restricted diet. Palm-cabbage was obtained from several species of *Livistona* and *Pandanus*, although even after boiling the taste was still acidic. Mueller noted in particular the berries of Leichhardt's breadtree, a species of *Gardenia*, and Leichhardt's nonda fruit (Mueller to Hooker, 20 May 1857).

Not all the native plants were edible,

however. Some of the horses died from a virulently poisonous plant. Mueller was unable to determine which plant caused the damage, although he thought it probably akin to *Gompholobium*. The expedition could not afford to loose any of its horses. Yet these animals showed a remarkable propensity for straying from camp even up to 10 miles distance. Much manpower was spent rounding them up. It was not only the horses that strayed. 'Dr Müller having wandered away into the rocky hills and lost himself', Gregory noted, 'I halted at the first convenient spot, having detached several of the party to search for him, but it was not until 4 p.m. that the Doctor reached the camp' (Gregory 1884). It was a 'frequent occurrence' that, absorbed in collecting plants, Mueller became detached from the rest of the party.

Perhaps the most extraordinary part of the expedition was the overland journey. Leaving Baines in charge of the depot party with instructions regarding supplies and the carriage of letters and Mueller's precious inland specimens, Gregory set out on 21 June. He was accompanied by Henry Gregory, Mueller, Elsey, Bowman, Dean and Melville. They marched across Arnhem Land to the Gulf of Carpentaria, then followed the Gilbert and Burdekin Rivers to cross the Great Dividing Range, returning to Brisbane on 16 December 1856. In all the party had travelled 5000 miles by land (Waterson 1972). They were greeted as heroes.

Not a mere collector

For Mueller, of course, the most important aspect of the long and arduous journey was the botanical collections he made. It was, after all, 'for the sake of the plants *alone*' that he ever wanted to join the expedition (Mueller to Gregory, 23 June 1855). Mueller took every chance that offered to collect as much as he could, and paid tribute to Gregory for affording him every possible opportunity to pursue his collecting (Mueller 1858a). Indeed, between Mueller and Gregory there was obviously a great deal of mutual respect. Gregory might have twitted Mueller on wearing out more horses than anyone else, but had Mueller not been a competent bushman he would not have been chosen as a member of the overland party. For his part Mueller stated that the success of the expedition was due entirely to Gregory's incomparable experience, unabating exertions and unwearied attention to all aspects of the expedition (Mueller to Gregory, 4 June 1857).

Mueller's specimens did not reach the herbaria at Kew and Melbourne without difficulty. The necessity of carrying as much food as possible greatly limited the amount of drying paper Mueller could carry into the inland or on the overland section. Everything had to be carried on horseback. With high temperatures and being jolted over distances of hundreds of miles 'many of my specimens have suffered frightfully, particularly such brittle kinds as Eucalyptus, Loranthus, Capparis &c. of which I was obliged in many instances to place the remaining fragments into paper capsules.' (Mueller to Hooker, 6 March 1857).

The onset of the rainy season brought different problems. 'I lost many specimens or damaged them in drying', he wrote to William Hooker, 'a process which after our long daily stages was in the humid evening air not easily accomplished, particularly as we could not load our poor packanimals in such a climate with large heavy tents at the outset from the Victoria River' (Mueller to Hooker, 11 January 1857). As the party approached the east coast, Mueller found 'the plants increased to such a number for the collection, that I was unable to describe from fresh specimens at all, but during the earlier part of this section of the expedition, I found particularly on Sundays time for writing detailed descriptions of the more interesting plants, which as regards the gay colours of Hibiscus, the tender flowers of Stylidium and Mitrasacme, or the easily forgotten habitual characters of Eucalypti, was, I think, of some importance' (Mueller to Hooker, 11 January 1857).

It was impossible for Mueller to carry overland with him to Moreton Bay the collections from the inland section of the of the expedition. Being the first botanical collections made in this remote and inaccessible region, they included a great number of rare and unknown plants. Instead they were placed in the care of Thomas Baines for transportation by sea, and finally reached Sydney in April 1857 four months after the return of the overland party. To Mueller's dismay they were damaged. In some distress Mueller reported to Gregory that 'one of the most valuable parts of the botanical collections obtained principally in Central Australia and the Upper part of the Victoria River, arrived by Messenger, has been destroyed by water to the amount of nearly 3000 specimens and from 2-300 kinds of seeds' (Mueller to Gregory, 6 April 1857).

Baines ascribed the damage to one of two possibilities: either to a mishap in trans-shipment of cargo in Java from the derelict *Tom Tough* to *Mermaid*; or to the long continuance of hot dry weather which caused the deck seams to leak into the hold where Mueller's specimens had been stowed (Baines to Gregory, 7 April 1857). Mueller, in his disappointment, found neither possibility compensation for his loss (Mueller to Hooker, 6 April 1857). He began the task of unpacking the damaged plants with a heavy heart. With these specimens now remaining only in fragmentary form, Mueller remarked to William Hooker that the notes made at the time of collection would render this mishap a not irretrievable loss (Mueller to Hooker, 6 April 1857).

Flora of tropical Australia

Mueller did not know when he left Sydney in July 1855 whether he would be permitted to retain for his own purposes a duplicate set of the specimens. Throughout the expedition he collected and wrote his notes in the hope that this would be the case. It was not until the party returned to Sydney in December 1856 that Mueller learned that William Hooker's representations on his behalf to the Secretary of State for the Colonies had been successful (Hooker to Labouchere, 18 December 1855). His dearest wish with regard to the North Australian Exploring Expedition had been granted.

Mueller spent from January to May 1857 sorting, labelling, naming and describing the collections, and packing the best specimens for shipment to Kew. When Elsey returned to London in March he took with him Mueller's first consignment of 1500 specimens comprising 300 species from the overland section of the trip (Mueller to Hooker, 13 March 1857). By the middle of May Mueller had finished his sorting and packing. Five cases with approximately 6000 specimens awaited shipment, while notes relating to 400 rare or undescribed plants were to be sent separately to ensure against loss at sea (Gregory to Thompson, 15 May 1857).

In his report to Gregory on the botanical results of the expedition, (Mueller 1858a). Mueller estimated that he had observed nearly 2000 species in 160 natural orders and 900 genera. He summarised his observations on the predominant families and most numerous genera, and the relative distribution of families in different geographic areas. These areas he categorised as: dense coast forests, Brigalow scrub, open downs, desert, sandstone tableland, sea coast, and banks and valleys of rivers. The collections from the Victoria River and Arnhem Land represented, he believed, a 'nearly perfect flora' of those areas. In particular he noted the plants which had proved edible or of some other benefit to the expedition members.

Mueller's letters to William Hooker during the course of the expedition, in which he made tentative identifications and recorded his observations to date, were edited by Hooker for publication (Mueller 1856a, 1856b, 1856c). As Mueller steadily worked through the collections in Sydney his letters to Hooker continued to include detailed discussions of the plants he examined. Ultimately Mueller's descriptions and notes of the *Eucalyptus* and *Acacia* species from the expedition were published in London with the help of the botanists at Kew (Mueller 1858b, 1859). Mueller preferred, however, to publish his results in Australia and many can be found in the early volumes of his *Fragmenta Phytographiae Australiae.*

The North Australian Exploring Expedition was among the most successful expeditions mounted in Australia. Mueller certainly made the most of his opportunity. In his comprehensive collecting, detailed descriptions of the plants and wide-ranging botanical observations Mueller was indeed no mere collector. The expedition, in Mueller's estimation, was one 'which in its wise arrangements, in the rapidity of its movements and in its multitude of detail[ed] discoveries will ever stand unparalleled in the history of Australia Geography' (Mueller to Gregory, 4 June 1857).

Postscript

In April 1996, as part of the celebrations marking the centenary of the death of Ferdinand Mueller, the Royal Botanic Gardens, Melbourne in conjunction with the Darwin Herbarium, organised a collecting trip to revisit some of the sites where Mueller collected in 1856. The party concentrated its efforts in the Gregory National Park which straddles the Victoria River. In less than two weeks, 2500 specimens were collected in duplicate. This was accomplished with the aid of modern equipment such as helicopters, satellite navigators which give accurate latitude and longitude readings, portable gas plant driers, and refrigerators for storing food and drinking water. The party was not afflicted with drought, did not sleep with guns at hand, and reported feeling the presence of Mueller's spirit at the depot camp.

Acknowledgements

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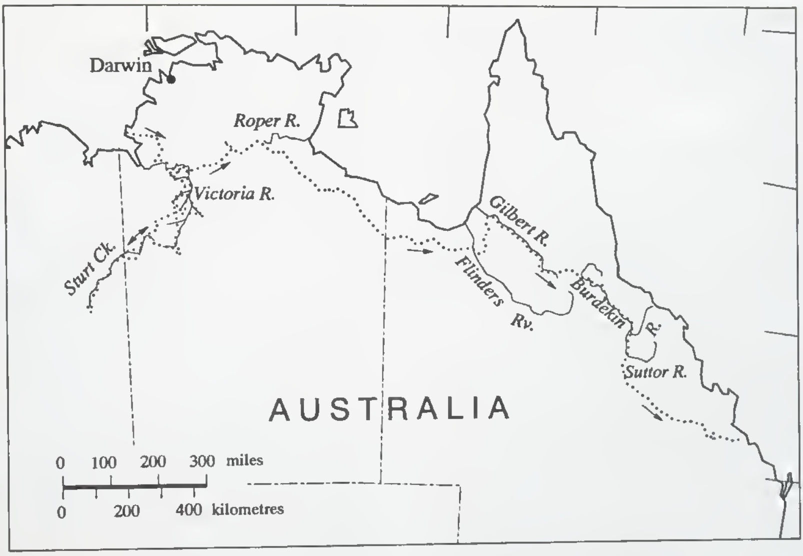

Route of the North Australia Expedition (extracted from R.Eriksen, 'Ernest Giles:Explorer and Traveller'. Heineman, 1978

Mueller and the North Australia Expedition

This extraordinary adventure with the Gregory brothers (A.C. and H.T.) commenced with embarkation from Sydney on 18 July 1855, sailing in the *Monarch* and *Tom Tough* via Brisbane to an initial landing at Pt. Pearce at the northern extremity of the Victoria Estuary two months later. For added excitement, include the grounding and near loss of the *Monarch* on a reef just out of Darwin (28 Aug), with the loss of some horses, plus the subsequent grounding and holing of *Tom Tough* near Entrance Island (27 Sept), entailing water damage to a significant part of the stores, loss of many sheep and many months of repairs (*Tom Tough* being their lifeline to the world after the departure of *Monarch*).

There followed a period of four months (in what is not normally regarded as the northern tourist season) of base camp establishment a little below Timber Creek, and repairs to the *Tom Tough*. In this time, we read of Baron Ferdinand von Mueller's involvement in herding sheep (of which only 40 out of 200 reached base camp) and in the search for suitable timber for ship repairs (mainly the River Paperbark, *Melaleuca leucadendron*), as well as his participation with the Gregorys in a 3 week reconnaissance up valley as far as the Baines River.

Serious exploration began (3 Jan) with a three month foray to the head of the Victoria River and down the full length of Sturt Creek to its termination in Lake Gregory, taking advantage of the 'wet' season. Their route also passed Mt Mueller (one of *four* in Australia, others being in Arnhem Land, Baw Baw Plateau and SW Tasmania*). The return in late March (following the Wickham River through Victoria River Downs) was already quite dodgy in respect of water. Only then (21 June) did the main act begin, travelling via Mataranka (surgeon/naturalist J R Elsey leaving his famous name behind) to Albert River on the Gulf of Carpentaria (now Burketown). The planned rendezvous with *Tom Tough* (and a relief party under Baines) failed to eventuate for reasons not recorded. Leaving the Albert River a few days later (3 Sept), the party of 5 continued via Croydon and Charters Towers (Burdekin Valley) to a first encounter with civilization on the Dawson River, near Rockhampton, in late November 1856. Even from here, it was still another three weeks ride to Brisbane

(16 Dec). During the course of this journey, they succeeded in finding two of Ludwig Leichhardt's camps, one on the Elsey River and another on reaching the Burdekin.

If Mueller was not already a horseman, he must have learnt something after 16 months nearly every day in the saddle. However, Gregory records on 29 July, from somewhere in the region of Borroloola:

'About three miles before we reached camp, Dr Mueller had fallen some distance behind the party; but as this was a frequent occurrence in collecting botanical specimens, it was not observed until we reached the creek, when he was out of sight; after unsaddling the pack-horses I was preparing to send in search of him, when he came up to the camp, the cause of his delay being that his horse had knocked up (sic). This was unfortunate, as the load of one of the pack-horses had to be distributed among the others in order to remount the doctor, who requires stronger horses than any other person in the party, having knocked up four since January, while not one of the other riding horses had failed, though carrying heavier weights.'

Only a week earlier, two of the pack-horses had cracked up and died, probably from eating a poisonous plant, giving Elsey and Mueller the joy of conducting a post-mortem! Mueller, however, was perhaps fortunate not to be present with Gregory on a reconnaissance foray to the east of the Victoria when he records (on 12 April):

'The water (Victoria River) was running strong twenty yards, and one to two feet deep; in examining the ford my horse trod on the back of a large alligator, which seemed to be equally astonished as the horse at this unexpected meeting.'

Nevertheless, he was a member of the party that overlanded the horses from Pt Pearce to base, over the Macadam Range and Fitzmaurice River, where crocodiles mauled three horses in the night.

We also find recorded, on only the second day out from base on the Sturt Creek tour (4 Jan):

'Started at 7 am and followed up the creek; but Dr Mueller having wandered away into the rocky hills and lost himself, I halted at the first convenient spot, having despatched several of the party to search for him, but it was not until 4 pm that the Doctor reached camp.'

It is perhaps notable that Mueller managed to be present on nearly every journey undertaken, and even undertook his own private excursion (with Wilson the geologist, and Elsey) by longboat up the Baines River. This continued into a lifelong rapport with the Gregorys. In contrast, Wilson, who seemed to have personality clashes, was ultimately sacked from the expedition and Flood (the collecter/preserver) also fell from grace, while Baines (the artist) mostly ended up as base commander and missed the main action. Surprisingly, the Gregory journal makes negligible reference to Mueller's activities (such as his doubtless excitment at discoveries such as *Eucalyptus ptychocarpa* and *E. phoenicea)*, despite being meticulous in its descriptions of route and countryside, nor is there an appendix as with so many other explorations. Mueller's own report, involving observations on 3000 species from 800 genera, is to be found in the Journal of the Linnean Society of 1858 and in Vol. 2 of his *Fragmenta* (for those who read Latin). It should hardly surprise that Mueller retained an intense interest in exploration activities thereafter and that his name is linked to very many of them. Amazingly, Mueller was obliged to take 18 months unpaid leave from the Victorian Government for the purpose of this journey.

This article draws on the journals of the Gregory Expedition.

*There might have been yet another, as bestowed in 1873 by Ernest Giles on what he beheld as one of the most remarkable mountains on earth, in honour of the patron and a major financier of his expedition (and featured on the cover of his journal). Mueller, however, promptly renamed it Mt. Olga, which it remains to this day.

Alan K Parkin
2 Hazel Drive, Templestowe, Victoria 3107.

Eden Revisited - Following the Scent of Mueller's 1860 Journey through the Twofold Bay-Genoa District.

D.E. Albrecht[1]

Abstract
Ferdinand von Mueller travelled through the Twofold Bay - Genoa River area (south-eastern New South Wales/ far east Gippsland, Victoria) in September 1860, collecting many plant species, some 20 new to science. Mueller's route is described in detail, and plants collected at the localities visited by Mueller are discussed. A list is provided of species based on types collected by Mueller on this journey. (*The Victorian Naturalist* **113**, (4) 1996, 171-180)

Introduction

In the mid 1980's I was among a small group of botanists who were involved in extensive field work in south-eastern New South Wales and far east Gippsland. My surprise at finding a number of undescribed taxa and disjunct populations raised a number of questions about the history of collecting in the region. Had collectors simply missed some of the particularly interesting areas or was the area poorly collected generally? Not surprisingly, Baron Ferdinand von Mueller is a prominent figure in the history of botanical exploration in the region. Allan Cunningham had collected specimens from the coastal vegetation of Twofold Bay (centred on present day Eden) as early as 1818, but Mueller was the first botanist to penetrate the hinterland of this region.

On his journey through the region, which lasted for most of September 1860, Mueller travelled some 300 miles and collected in excess of 250 taxa. Regrettably there is no surviving journal of his expedition and it is only in the official government reports that Mueller mentions the course of his journey. The most informative account is found in his *Annual Report of the Government Botanist* ... for 1860-61:

'During the month of September I was engaged in elucidating the vegetation along the south eastern frontiers of the colony, crossing the country from Twofold Bay to the Genoa, along which river I travelled to the coast, deviating to Cape Howe and to the adjoining freshwater lake, and ascended again the Genoa River to near its sources, examining the adjacent elevated country and the Nungatta mountains on my way ...' (Mueller 1861).

The late Norman Wakefield published three articles (Wakefield 1952; 1958; 1969) that mention, albeit briefly, aspects of Mueller's September 1860 expedition. This contribution, in the form of a potted chronology, aims to supplement Wakefield's work, particularly with regard to Mueller's route, collecting localities and the significance of the expedition.

The locality data accompanying Mueller's specimens, though often very imprecise, are a major source of information for establishing his route (Fig. 1). Many of the specimens collected on the expedition are housed at the National Herbarium of Victoria (MEL); a number are also cited in *Flora Australiensis* (Bentham 1863-1878). The task of finding all specimens from the expedition in MEL and extracting the locality data accompanying each specimen is physically an enormous task. I began this task, searching at least those species known to have a restricted distribution in the region, but finally became frustrated by the enormity of the undertaking. When all of the collections at MEL are finally databased, which at current projections may take well over a decade, we may be in a position to conclude with more certainty the finer details of his route. Fig. 2 shows the localities discussed in the following text. An annotated list of type collections made on the expedition is presented in Appendix 1.

[1]Northern Territory Herbarium, Parks and Wildlife Commission of the Northern Territory, P.O. Box 1046, Alice Springs, N.T. 0871. Australia.

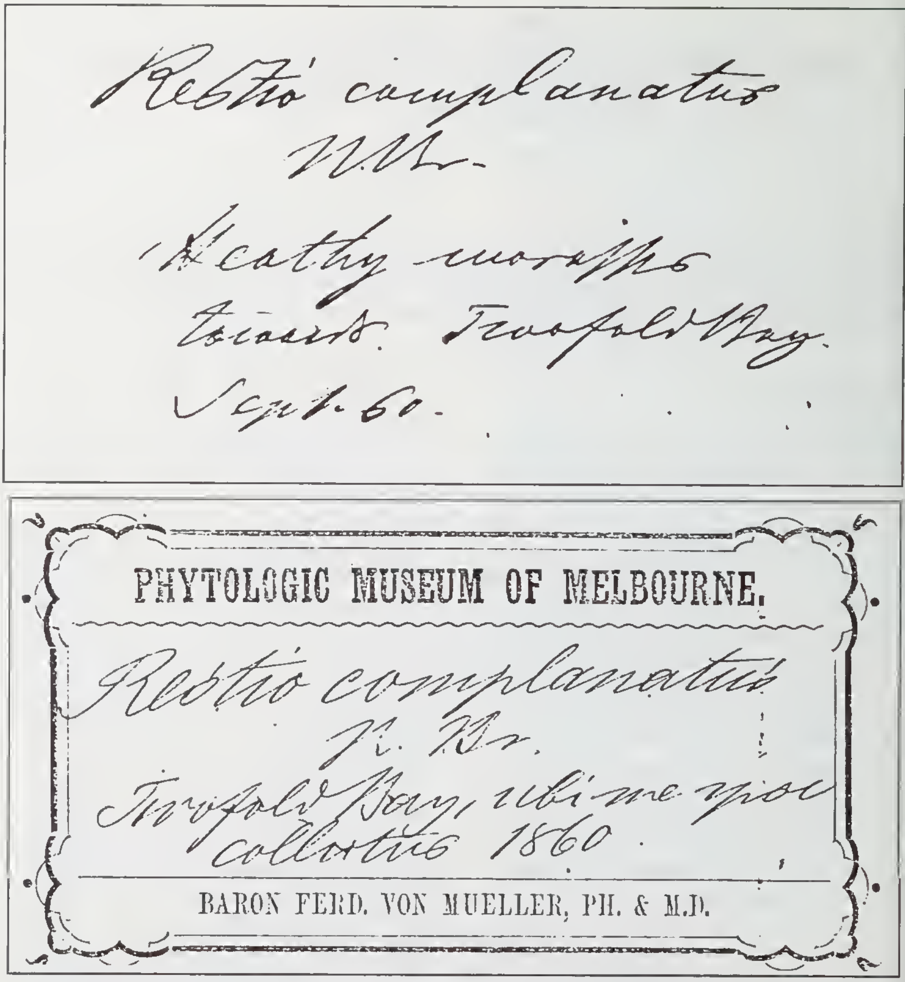

Fig. 1. Two kinds of labels commonly accompanying Mueller's September 1860 specimens. Labels are in Mueller's hand.

A preliminary list of taxa collected during the journey is housed in the library of the National Herbarium of Victoria. Nomenclature follows Ross (1993) and Harden (1990-1993)

The expedition

Mueller departed from Melbourne on the 6th September 1860 on the steam ship *Rangatira*, arriving at Snug Cove, Twofold Bay the following day. His arrival was noted in the local tabloid newspaper *The Twofold Bay and Maneroo Telegraph* on the 11th of September: 'An old friend, andthe friend of science and mankind Dr. Mueller, the curator of the Botanical Gardens in Melbourne, arrived here on Saturday (7th) last in the Rangatira, and on Sunday (8th) morning left this town on an expedition overland to the west of Cape Howe. Unlike the crowd of people who are rushing in the face of commerce, his persuit is amidst the regions of science. His object is to procure the best botanical knowledge of this unexplored district.'

When Mueller arrived at Eden the town was prospering. Gold was discovered at Kiandra in November, 1859 and hundreds of prospectors came by sea, disembarking at Eden and making their way westwards

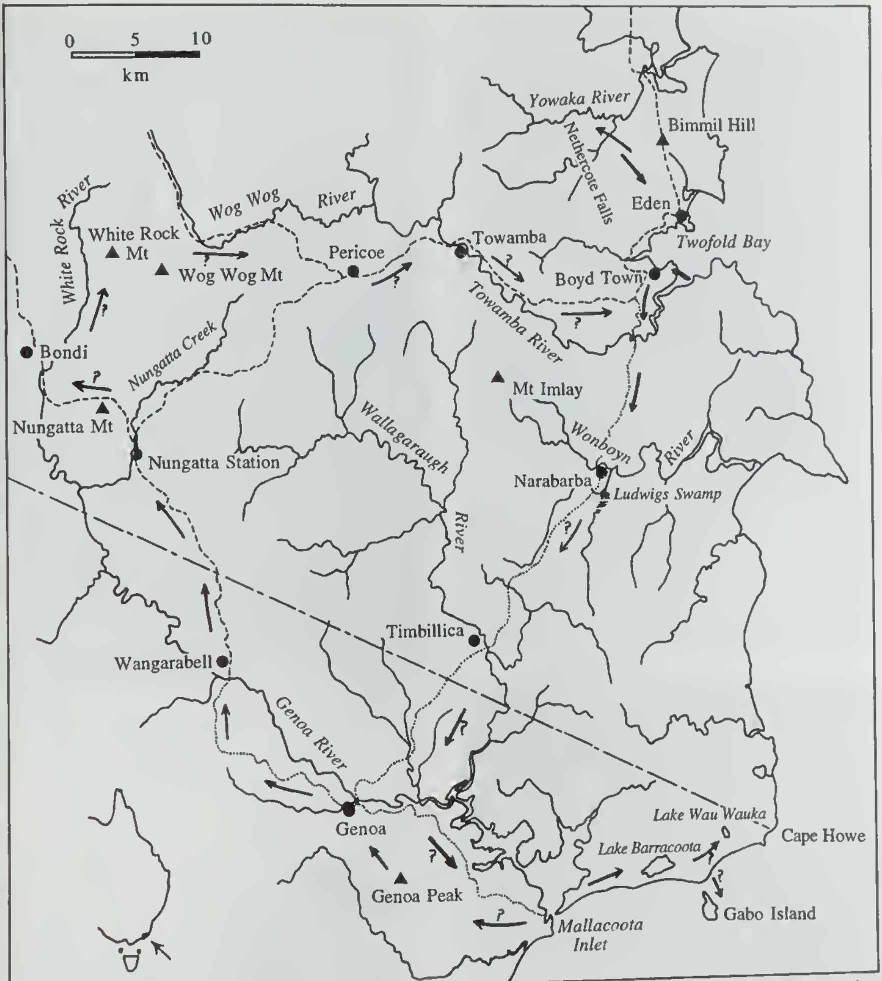

Fig. 2. Collecting localities and probable route of Mueller's September 1860 botanical exploration of the Twofold Bay-Genoa district. Dashed line: tracks as shown on maps c. 1860. Dotted line: presence of track probable but route not accurate. Arrows: probable route of Meuller. ?: route uncertain

to the goldfields. In a letter to William Hooker (Royal Botanic Gardens, Kew) from the Genoa River on the 17th September 1860 (Hooker 1860 *unpub.*), Mueller indicated that from Eden he proceeded southward towards the Genoa River.

A considerable proportion of Mueller's collections from the expedition were gathered in the vicinity of Twofold Bay. On the coastal dunes, sedimentary coastal cliffs and adjoining headlands of Twofold Bay he collected characteristic species such as *Alyxia buxifolia*, *Senecio lautus*, *Zieria cytisoides*, *Apium prostratum*, *Westringea fruiticosa* and *Banksia integrifolia* (Fig. 3). In the near-coastal ridge forest he collected common species such as *Eucalyptus gummifera*, *E. sieberi*, *E. longifolia*, *Patersonia sericea*, *Leptomeria acida*, *Pultenaea daphnoides*, *Platylobium formosum* and *Pimelea linifolia*.

The views from the higher ridges near Eden would have enabled Mueller to survey the country to the south. From this vantage point Mt Imlay is a prominent landmark, and one we would expect to have been alluring to Mueller. Although several of his collections are labelled Mt Imlay, they are all relatively widespread species that were probably gathered on the lower slopes of the mountain or further east. The species with restricted distributions known to occur in the vicinity of the summit, namely *Eucalyptus imlayensis*, *Hibbertia saligna*, *Eriostemon virgatus*, *Prostanthera walteri*, *Tetratheca subaphylla* and *Persoonia brevifolia* were not collected by Mueller and it is unlikely that he explored the summit of this interesting mountain.

The two Mt Imlay collections of *Elaeocarpus holopetalus*, a species restricted to sheltered gully heads towards the summit of the mountain (Fig. 4), are somewhat confusing, as both Mueller's and Lockhart Morton's name appear on the labels, which are undated. As Mueller described this species in 1861 and did not cite a specimen from Mt Imlay, one assumes that the material was not collected by Mueller as he did not revisit the area subsequent to his 1860 trip. Morton collected *Oxylobium ellipticum*, *Hibbertia saligna* and *Actinotus helianthi* from the summit of Mt Imlay and it seems logical to suppose that he also collected *Elaeocarpus holopetalus* sometime after 1861. Morton collected several other interesting taxa near Twofold Bay, namely *Pomaderris brogoensis* and *Boronia anemonifolia* var. *variablis*. Unfortunately no dates are given on his labels. Mueller sent Morton's Twofold Bay-Mt Imlay collections to Bentham and they appear in his *Flora Australiensis*, volume 4 onwards. Morton's collections of taxa treated in volume 3 (published in Jan. 1867) are not cited, and assuming they would have been cited by Bentham had he examined them, it is probable that Morton visited the area sometime between the publication of volumes 3 and 4. A Mr Morton is listed in the *Argus* dated April 23rd 1867 as arriving in Melbourne on the steamship *City of Melbourne* from Sydney (via Twofold Bay). This date corresponds with the phenological state of his specimens, however, in the absence of a christian name the evidence is not conclusive (Fig. 5).

As Mueller progressed southwards he collected in several vegetation communities between the Towamba and Womboyn Rivers. In the dry sclerophyll woodlands dominated by *Eucalyptus sieberi* he collected a number of heathy understorey plants including *Poranthera corymbosa*, *Phebalium diosmeum*, *Xanthosia pilosa*,

Fig. 3. *Senecio lautus* in full bloom on the rocky coastline surrounding Twofold Bay.

Fig. 4 View into a patch of cool temperate rainforest below the summit of Mt Imlay. It is here that Morton collected specimens of *Elaeocarpus holopetalus*.

Fig. 5. Portrait of W Lockhart Morton. He collected specimens from Twofold Bay and Mt Imlay c. 1867.

Fig. 6. Understorey vegetation in forests dominated by Eucalyptus sieberi between the Towamba and Womboyn Rivers

Platysace lanceolata, *Hakea dactyloides*, *Coopernookia barbata* and *Bossiaea heterophylla* (Fig. 6). It is difficult to pinpoint from his collections exactly where they were gathered as most species are widely distributed. Similarly it is difficult to pinpoint where he collected species such as *Gymnoschoenus sphaerocephalus*, *Schoenus lepidosperma*, *Restio complanatus*, *Baeckea linifolia* and *Pultenaea paludosa*, as they are all characteristic species of the lowland swamps in this vicinity (Fig. 7). The label accompanying *Pultenaea paludosa* reads 'moory heaths near the Womboyn', which suggests that he may have collected near Ludwigs Swamp.

Mueller made several collections from 'granite rocks on the Womboyn'. Although there is no granite on the Womboyn River, the river passes through an area of rhyolite to the east of Narabarba, and it is probable that Mueller included rhyolite in his concept of granite.

His collections of *Dodonaea triquetra*, *Crowea exalata*, *Schoenus imberbis*, *Chrysocephalum baxteri* and *Pseudanthus divaricatissimus* are likely to have come from the shrubland that occurs on the more exposed rhyolite. It is perhaps surprising that Mueller did not collect the endemic *Acacia constablei* that grows in the vicinity.

Mueller's route from the Womboyn River to the Genoa River is uncertain and, to date, specimens have not provided any clarification. There are conflicting stories

Fig. 7. Lowland swamp vegetation south of the Towamba River.

regarding the existence of a track between the Towamba and Genoa Rivers. Similarly it is debatable whether a track existed between Timbillica and Mallacoota (which at that time was situated on the north side of the Genoa River). According to C. Allen (*pers. comm.*) and Alan Piesley (*pers. comm.*), both descendants of early settlers in the region, the open forest vegetation was lightly stocked with trees and had an open understorey, which made travel by horse feasible in the absence of a track. Unfortunately this section of his journey remains a mystery. At Mallacoota Inlet he collected a suite of specimens including *Correa alba*, *Phylloglossum drummondii* and *Spyridium cinereum*.

Travelling north from the mouth of the Genoa River Mueller collected *Chorizandra australis* from the fresh water lake near Cape Howe. Whether he was referring to Lake Barracoota or Lake Wau Wauka is at present uncertain. The vegetation through this area is dense and it is likely that he travelled principally on the consolidated beach sands. Wakefield (1969) mentioned two of Mueller's specimens from 'abreast Gabo', namely *Conospermum taxifolium* and *Helichrysum elatum*. Apparently there was sporadic access to the island by means of a sand bar. The only collection made by Mueller from Gabo Island cited in *Flora Australiensis* is referred to *Pterostylis mutica*. This collection is not housed at MEL and it would be worth searching further herbaria to ascertain whether the *Pterostylis* specimen is correctly attributed to Mueller. The specimen may have been collected by Maplestone, who made a number of collections on Gabo Island in 1861. Although Mueller claims to have visited Cape Howe I have yet to encounter a specimen supporting this claim.

Returning to the northern side of Mallacoota Inlet, Mueller may have crossed to the southern side of the Genoa River by boat, which means of transport was apparently much used in that location at the time. Alternatively he may have forded the Genoa River upstream of Mallacoota Inlet at Goodwin Sands and the Narrows. Once on the southern side of the Genoa River, he probably followed a horse track towards Genoa. Wakefield (1969) mentioned that the Genoa-Mallacoota track passed over the shoulder of Genoa Peak. However, I been unable to determine the exact alignment of this track. Mueller probably deviated from the track to the summit of Genoa Peak (Fig. 8) where he collected *Dendrobium striolatum*, *Lycopodium varium*, *Pomaderris lanigera*, *Dodonaea triquetra*, *Prostanthera hirtula* var. *angustifolia* and several other species.

From Genoa Peak he returned to Genoa and ascended the Genoa River valley along the Old Wangarabell track. Mueller collected a considerable number of specimens labelled 'Genoa River'. Wakefield (1969) suggested that many of the collections thus labelled were collected about the mouth of the granitic gorge about two miles upstream from the present township of Genoa, at the point where the Old Wangarabell track swung westerly away from the river. Many of these species were probably also collected near Wangarabell, where the track crossed the Genoa River (Fig. 9). It was either at Wangarabell or further along the Wangarabell track at Nungatta Station that Mueller commenced a letter to William Hooker. This was dated the 17th September, only nine days after setting out from Eden.

From Wangarabell Mueller travelled north to Nungatta Station homestead (Fig. 10), at that time occupied by Alexander Weatherhead. The original description of *Telopea oreades* indicated that Mueller was accompanied in the field by Weatherhead when the type collection was gathered. In his letter to Hooker, Mueller referred the Nungatta populations to the

Fig. 8. The view from Genoa Peak over the Howe Range, lower Genoa River, Mallacoota Inlet and Gabo Island.

Tasmanian *Telopea truncata*, but at that time he had not seen good flowering material. Mueller collected in the riparian environments of Nungatta and Nina creeks (on the east side of Nungatta Mountain) where he discovered *Elaeocarpus holopetalus* in cool temperate rainforest. Other species collected in this environment were *Scutellaria mollis* and *Adiantum hispidulum*. The locality data on his specimens of *Persoonia brevifolia* reads 'common on the summit of Nungatta Mountains and White Rock Mountain' and 'granite declivities of the upper Genoa River'. A brief search for this species around the sandstone summit of Nungatta Mountain was unsuccessful. Doug Binns (*pers comm.*) has also looked on the Nungatta Range without success. It is probable that Mueller's specimens were all gathered on the granite outcrops on White Rock Mountain.

Fig. 9. Riparian vegetation on the Genoa River near Wangarabell.

From Nungatta Mueller travelled north to White Rock Mountain. His specimen locality data are vague for this tract of country and it is presently uncertain whether his route was via Bondi homestead. Localities mentioned on specimen labels typically read 'sources of the Genoa River' or 'upper Genoa River'. A collection of *Eucalyptus stellulata* has such a label. This species presently occurs in the vicinity of the old Nungatta-Bondi track, just south of the former Bondi homestead. I have not observed *E. stellulata* growing further east and, although it is tempting to argue that this evidence indicates that he would have visited Bondi homestead, the species may have occurred further east on Nungatta Station prior to extensive clearing.

On the summit of White Rock Mountain Mueller collected *Epacris robusta* (Fig. 11), *Oxylobium arborescens*, *Persoonia confertifolia*, *P. silvatica*, *P. brevifolia*, *Eucalyptus sieberi*, *Kunzea ericoides* and *Tetratheca subaphylla*. The Nalbaugh plateau between White Rock Mountain and Wog Wog Mountain to the east supports a number of species with regionally restricted distributions. Several of these species, such as *Acacia costiniana*, occur

Fig. 10. The original 'Nungatta' (or 'Nangutta') homestead. Mueller is likely to have spent at least one night here.

quite abundantly on the plateau, and one would assume that Mueller would have collected these species had he crossed Nalbaugh Plateau.

The route by which he returned to Eden is uncertain. It seems logical that he would have proceeded from White Rock Mountain eastward to Pericoe via the track that follows the upper part of the Wog Wog River. From Pericoe the track would be followed to Towamba, Boyd Town and finally Eden. This was a well established route. Unfortunately the only specimens that perhaps support at least part of this route are those he gathered on the Towamba River viz *Dodonaea truncatiales*, *Melaleuca armillaris*, *Pomaderris intermedia* and *Westringea eremicola*. However, these species may have been collected when he first crossed the Towamba River on the way southwards towards the Genoa River.

Prior to sailing for Melbourne, Mueller collected to the north of Eden. In the moist, sheltered gullies around Bimmil Hill he collected warm temperate rainforest species including *Acmena smithii*, *Pittosporum undulatum*, *Ficus coronata*, *Marsdenia rostrata*, *Rapanea howittiana*, *Cissus hypoglauca*, *Pteris umbrosa* and a host of other species. It was probably here that he discovered *Prostanthera incisa* var. *pubescens* and *Polyscias murrayi*. The latter species was named in honour of Patrick Murray, the chief magistrate of the district, who apparently assisted Mueller with some of the logistic aspects of the expedition. This aid was doubtlessly in the form of 'local' knowledge regarding tracks, accommodation and assistance in procuring horses for his expedition.

Fig. 11. *Epacris robusta* growing in shrubland on large granite expanses near the summit of White Rock Mountain.

Mueller also collected specimens from the Yowaka River, probably near, or downstream of, Nethercote Falls. The geology here is rhyolite and a characteristic scrub or shrubland develops on areas of exposed rock (Fig. 12). *Phebalium ralstonii*, *Lasiopetalum ferrugineum*, *Muehlenbeckia rhyticaryia*, *Crowea exalata*, *Pseudanthus divaricatissimus*, *Rulingia dasyphylla*, *Hibbertia monogyna* and *Dodonaea truncatiales* are all characteristic species of this vegetation type that he collected. Rhyolite shrubland occurs in scattered patches further west than Nethercote Falls but, in considering the species Mueller collected and did not collect, it is likely that he travelled no further west than approximately Nethercote Falls.

Mueller returned to Eden and boarded the steam ship *Wonga Wonga* on the 30th of September. His arrival at Hobsons Bay, Melbourne was reported in the *Argus* on the 2nd October 1860.

Conclusion

Mueller's expedition was the first significant botanical collecting trip within the south-eastern New South Wales-far east Gippsland region. He collected a respectable number of specimens (currently estimated to be about 20% of the known flora of the region) and discovered about 20 species previously unknown to science. His collections provided useful material for his work on the flora of Victoria and were used extensively by Bentham during his preparation of *Flora Australiensis*.

Considering the short duration of the expedition and the considerable distance traversed, Mueller managed to sample from a surprisingly large percentage of the habitats present in the region. He collected in a number of botanical 'hot spots' and came remarkably close to several others (e.g. Mt Imlay summit and Nalbaugh plateau). No doubt it was with considerable reluctance that he had to pass by some of these interesting-looking sites. The gratification of future generations of botanists was probably the last thing on this mind when deciding whether to botanise a particular area.

Fig. 12. Shrubland on rhyolite outcropping near the Yowaka River. *Acacia subtilinervis* (dominant) and *Phebalium ralstonii* were discovered by Mueller in this area.

Acknowledgments

The following are sincerely thanked for their help, particularly with historical information and distribution data - Ed Mitchell, Tom May, Margaret Parris, David Keith, Doug Binns, Carole Helman, Phil Gilmour, C. Allen and Alan Piesley, along with staff of the State Library of Victoria, and the library, Royal Botanic Gardens, Melbourne.

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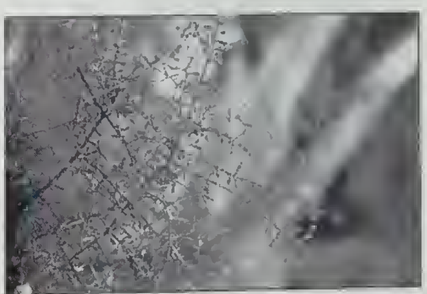

Fig. 13. *Pseudanthus divaricatissimus.* Mueller collected this along the Womboyn and Yowaka Rivers.

Appendix 1

List of TYPES collected by Mueller in the Twofold Bay-Genoa District, September 1860.

1.Taxa described by Mueller

Acacia subtilinervis F.Muell., *Pl. Victoria* 2: 32 (1863). Type: On granite declivities around Mt Imlay. *A. subtilinervis* has never been relocated on Mt Imlay despite quite extensive searching. The geology of Mt Imlay is of sedimentary origin and likely *A. subtilinervis* habitat appears to be absent on Mt Imlay. The nearest known populations to Mt Imlay occur in the vicinity of the Yowaka River near Nethercote, an area collected over by Mueller. The geology of this area has been mapped as rhyolite, which appears to have included within Mueller's concept of granite. Unless *A. subtilinervis* is discovered closer to Mt Imlay, the Yowaka River should be considered the type locality of this species.

Dodonaea truncatiales F.Muell., *Fragm.* 2: 143 (1861). Syntypes: In wooded valleys and gravelly banks of the Towamba, Yowaka and Genoa Rivers.

Elaeocarpus holopetalus F.Muell., *Fragm.* 2: 143 (1861). Syntypes: In wooded valleys of the Nungatta Mountains and headwaters of Nina Creek.

Eriostemon ralstonii F.Muell., *Fragm.* 2: 101 (1861). Type: On granite rocks against the Yowaka River, towards Twofold Bay. Current name: *Phebalium ralstonii* (F.Muell.) Benth., *Fl. Austral.* 1: 339 (1863)

Ionidium vernonii F.Muell., *Pl. Victoria* 1: 223 (1862). Syntypes: On barren plains and ridges near the Genoa River; also near Twofold Bay. Current name: *Hybanthus vernonii* (F.Muell.) F.Muell., *Fragm.* 10: 81 (1871)

Panax murrayi F.Muell., *Fragm.* 2: 106 (1861). Type: In valleys of wooded ranges towards Twofold Bay. Current name: *Polyscias murrayi* (F.Muell.) Harms, *Nat. Pflanzenfam.* 3(8): 47 (1898).

Telopea oreades F.Muell., *Fragm.* 2: 170 (1861). Type: Towards the headwaters of Nungatta Creek in the alpine tract behind the Nungatta Mountains. Weatherhead and Mueller.

Tetratheca ericifolia var. *aphylla* F.Muell., *Pl. Victoria* 1: 183 (1862). Syntypes: Granite rocks at the White Rock Hill, 3000'; sources of the Genoa River. Current name: *T. subaphylla* Benth., *Fl. Austral.* 1: 132 (1863)

2.Taxa described by botanists other than Mueller

Correa lawrenciana var. *genoensis* Paul G.Wilson, *Trans. Roy. Soc. South Australia* 85: 50 (1961). Type: Flooded banks of the lower Genoa River.

Epacris robusta Benth., *Fl. Austral.* 4: 237 (1868). Type: Granite rocks at the summit of White Peak Mountain, at the head of the Genoa River.

Grevillea victoriae var. *leptoneura* Benth., *Fl. Austral.* 5: 468 (1870). Type: Sources of the Genoa River.

Isopogon anemonifolius var. *tenuifolius* F.Muell. ex Benth., *Fl. Austral.* 5: 347 (1870). Type: Twofold Bay. Current name: *I. prostratus* McGill., *Telopea* 1: 32 (1975)

Persoonia myrtilloides var. *brevifolia* Benth., *Flora Austral.* 5: 401 (1870). Syntypes: Upper Genoa River; Nungatta Mountains. Current name: *P. brevifolia* (Benth.) L.A.S.Johnson & P.H.Weston, *Telopea* 4: 275 (1991).

Pomaderris cinerea Benth., *Fl. Austral.* 1: 420 (1863). Type: Mt Imlay, Twofold Bay.

Prostanthera hirtula var. *angustifolia* Benth., *Fl. Austral.* 5: 97 (1870). Type: Genoa Peak.

Prostanthera incisa var. *pubescens* F.Muell. ex Benth., *Fl. Austral.* 5: 96 (1870). Type: Forest rivulets near Twofold Bay.

Pseudanthus divaricatissimus var. *orbiculare* Benth., *Fl. Austral.* 6: 60 (1873). Syntype: Granite rocks on the Yowaka River.

Pultenaea altissima F.Muell. ex Benth., *Fl. Austral.* 2: 123 (1864). Syntypes: Genoa River; Twofold Bay and Genoa River.

Pultenaea benthamii var. *elatior* F.Muell. ex Benth., *Fl. Austral.* 2: 114 (1864). Syntype: Yowaka River.

Pultenaea viscosa R.Br. ex Benth., *Fl. Austral.* 2: 127 (1864). Syntype: Womboyn Range.

Mueller's Oceanic Island Plants

Ian D. Endersby[1]

Abstract

Ferdinand von Mueller never visited any of the oceanic islands to which Australia lays claim but he was associated with the naming of plants from some of those localities. His major contribution was the description of endemic species from Lord Howe Island collected by staff from Sydney and Melbourne Botanic Gardens. He also revised genera that included species named by Endlicher from Norfolk Island and named species in Australia and New Guinea which were subsequently introduced to Norfolk and Christmas Islands and the Coral Seas Island Territory. *Taeniophyllum muelleri* (Orchidaceae) from Norfolk Island was named after him. (*The Victorian Naturalist* **113**, (4) 1996, 181-184).

Introduction

Although Baron von Mueller never visited Lord Howe or Norfolk Islands he played a substantial role in the naming of their plants, particularly those of Lord Howe Island.

These two islands are both of volcanic origin occurring on submarine ridges in the western Pacific Ocean. Each has a flora with a high degree of endemism and a subsequent history of degradation and the introduction of alien plants. Table 1, according to Green (1994), shows the current status of the floras.

Table 1. Current status of the floras

	Norfolk Island	Lord Howe Island
Endemic species	47	105
Indigenous species	124	136
Naturalised species	274	218
TOTAL species	445	459

Australia also lays claim to a number of other Oceanic Islands: Christmas; Cocos (Keeling); Ashmore Reef and Cartier; Coral Sea Islands Territory; Macquarie; Heard and McDonald Islands. Mueller's name is also associated with plants from two of these.

Early Collectors

Norfolk Island was discovered by Captain James Cook on his second Pacific voyage and was settled as a penal colony in 1788 - a satellite to the First Fleet settlement at Sydney Cove. Cook's complement included Johann Forster and his son Georg as naturalists, and they collected some plants (Forster 1777: 586-587). However, their visit was short and the first major collection was made by Ferdinand Bauer during his visit in 1804-1805 (Norst 1989). He lodged his collection and sketches with the Natural History Museum in Vienna and provided specimens to the German botanist Stephan Endlicher enabling him to prepare the first comprehensive account of the flora of the island in his *Prodromus Florae Norfolkicae*.(Endlicher 1883). Allan Cunningham collected extensively on Norfolk Island in 1830 during which expedition he was marooned on nearby Philip Island by escaping convicts (Daley 1926), and J.H. Maiden, while director of the Sydney Botanic Gardens visited the island in 1902 and published the next flora (Maiden 1904).

Lord Howe Island was sighted during the voyage of H.M.S *Supply* to establish the settlement on Norfolk Island (Fidlon & Ryan 1980: 41), and Lieutenant Ball landed and took possession of it on the return journey. Settlement occurred gradually from 1833 as whalers and others established homes and gardens and sought to grow sufficient food for their own needs and to barter with passing ships. Botanical collections were made by naturalists MacGillivray and Milne, from the H.M.S. *Herald*, in 1854 and submitted to George Bentham for naming. However, it was Charles Moore, Director of the Sydney Botanic Gardens, who visited the island in 1869 and provided the first of the endemics to be classified by Mueller (Hill 1870), some of which they jointly named (see Table 1). In 1873 and 1874, J.P.

[1] 56 Looker Road, Montmorency , Victoria 3094

Fullagar, the plant collector from the Melbourne Botanic Gardens added to the earlier collections of Moore and it is predominantly these two collections which Mueller (1875) used to list the Island's flora.

Mueller described and named plants that occur on Norfolk, Lord Howe, and Christmas Islands and the Coral Sea Islands Territory. His major contribution was to the flora of Lord Howe Island.

Lord Howe Island

Mueller was involved in the naming of 37 of the 105 endemic species currently listed for Lord Howe Island, predominantly from the collections made by Moore and Fullagar (Table 1). He and Moore also named the Island Pine *Panax cissodendron* (which was later transferred to *Polyscias*) from a Lord Howe specimen, a species which is native to New Caledonia and Vanuatu as well. His other contribution was to transfer the Norfolk Island Hoya *Hybanthera biglandulosa* from the genus *Tylophora* which Endlicher had used when he named the type from Norfolk Island; it, also, is known from New Caledonia, Vanuatu and Fiji.

Of the 38 species which were initially named by Mueller, 19 were described in conjunction with Charles Moore, in fact Moore was the senior author, publishing in Mueller's *Fragmenta*. The nomenclature of 21 of their species has survived to the present day.

Norfolk Island

Endlicher had named *Hybanthera biglandulosa* (Asclepiadaceae), Devil's Guts *Busbeckia nobilis* (Capparaceae) and Sia's Backbone *Morus pendulinus* (Moraceae) from specimens that Bauer collected on Norfolk Island. In subsequent revisions Mueller moved them to the genera *Tylophora, Capparis* and *Streblus* respectively.

Mueller does have one Norfolk Island species to his credit: Crispy Bird's Nest Fern *Asplenium robinsonii* collected by a Sydney Botanic Gardens' resident agent, Isaac Robinson, and published in the *Journal of Botany* in 1884 (**22**: 289). It was relegated to *Asplenium australasicum* f. *robinsonii* by P.S. Green in 1988.

Mueller also named the Broad-leaved Ironbark *Eucalyptus fibrosa* which he collected himself from a locality on the Brisbane River, Queensland. This has since been introduced to Norfolk Island and is reproducing itself in a limited area. As a recently planted species perhaps this is a somewhat spurious Mueller association but is included for completeness as it appears in the island's flora (Green 1994).

While all of the species discussed so far have been named or revised by Mueller, one of his contemporaries, John Lindley, named the Minute Orchid *Taeniophyllum muelleri* in his honour (ex Benth. *Fl. Austral.* **6**: 291, 1873). This is a rare and local epiphyte found growing on the undersides of the branches of the Norfolk Island Pine. It is poignant that it was also in 1873 that Mueller was dismissed from the directorship of the Melbourne Botanic Gardens.

Christmas Island

D'Albertis' Creeper *Mucuna albertisii* (Fabaceae) was named by Mueller from a specimen collected on the Fly River, New Guinea, by L.M. d'Albertis in 1876. While listed for the Christmas Island flora it has been found at only one place and is assumed to have been introduced through cultivation. Another species found only in areas of cultivation is *Lindernia crustacea* (Scrophulariaceae) which was originally named by Linnaeus from a specimen collected in China. Mueller's contribution was to transfer it from the genus *Capraria* to *Lindernia*.

Coral Sea Islands Territory

Comb Finger Grass *Digitaria ctenantha* was collected by Mueller from the Sturt and Hooker Creeks in the Northern Territory and originally described by him in the genus *Panicum*. This species is widespread across tropical Australia and is listed for two cays in the Coral Sea Islands.

Summary

Mueller has his name associated with the botanical nomenclature of 47 species that are found on the oceanic islands to which Australia lays claim. One of these was named after him, with 42 of them he was sole or joint author, and four were revisions to the prior work of others. Except for one subspecies of fern on Norfolk Island the species from islands other than Lord Howe were introductions or references to revised genera. It was Lord Howe Island which was the foremost locality and this occurred because Mueller's collectors and contemporaries were involved.

In the centenary anniversary of his death it is of interest to collate Mueller's contribution to our offshore islands; a contribution perhaps overshadowed by his own extensive terrestrial expeditions.

Acknowledgments

This note benefited greatly from the comments of an anonymous referee.

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Almost all of the information in this review came from Volumes 49 and 50 of the *Flora of Australia*, the two volumes covering the Oceanic Islands [Volume 49 (1994) and Volume 50 (1993), Australian Govemment Publishing Service, Canberra]. Table 2 was extracted from the work of P.S. Green (1994) in volume 49.

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Table 2. Mueller's Lord Howe Island Plants. e = endemic; 1 = original genus; 2 = collector.

SPECIES	1	2
MONOCOTYLEDONAE		
ARECACEAE		
e *Howea belmoreana* (**C. Moore & F. Muell.**) Becc.	*Kentia*	C . Moore & W. Carron
e *Howea forsteriana* (**C. Moore & F. Muell.**) Becc.	*Kentia*	C . Moore
e *Hedyscape canterburyana* (**C. Moore & F. Muell.**) H. Wendl. & Drude	*Kentia*	C. Moore & R.D.Fitzgerald
e *Lepidorrachis mooreana* (**F. Muell.**) O.F. Cook	*Kentia*	C. Moore
CYPERACEAE		
e *Uncinia debilior* **F. Muell.**		J.P. Fullagar & Lind
IRIDACEAE		
e *Dietes robinsoniana* (**C. Moore & F. Muell.**) Klatt	*Iris*	C. Moore
ORCHIDACEAE		
e *Dendrobium moorei* **F. Muell.**		C. Moore
PANDANACEAE		
e *Pandanus forsteri* **C. Moore & F. Muell.**		C. Moore & J.P. Fullagar
BLECHNACEAE		
e *Blechnum fullagarii* (**F. Muell.**) C. Chr.	*Lomaria*	Lind & J.P. Fullagar
CYATHEACEAE		
e *Cyathea macarthurii* (**F. Muell.**) Baker	*Hemitelia*	W. Carron & C. Moore

Table 2. cont.

SPECIES	1	2
DICOTYLEDONAE		
APOCYNACEAE		
e *Alyxia lindii* **F. Muell.**		Lind & J.P. Fullagar
e *Alyxia squamulosa* **C. Moore & F. Muell.**		C. Moore
ARALIACEAE		
Polyscias cissodendron **(C. Moore & F. Muell.)** Harms	*Panax*	?C. Moore
ASCLEPIADACEAE		
e *Marsdenia tubulosa* **F. Muell.**		J.P. Fullagar
Tylophora biglandulosa **(Endl.)** F. Muell.		Bauer (Norfolk Island)
ASTERACEAE		
e *Brachyscome segmentosa* **C. Moore & F. Muell.**		C. Moore; J.P. Fullagar & Lind
e *Olearia ballii* **(F. Muell.)** Hemsl.	*Aster*	J.P. Fullagar & Lind
e *Olearia mooneyi* **(F. Muell.)** Hemsl.	*Aster*	Lind & J.P. Fullagar
EPACRIDACEAE		
e *Dracophyllum fiztgeraldii* **C. Moore & F. Muell.**		R.D. Fitzgerald
FABACEAE		
e *Carmichaelia exsul* **F. Muell.**		C. Moore
GESNERIACEAE		
e *Negria rhabdothamnoides* **F. Muell.**		C. Moore
GROSSULARIACEAE		
e *Corokia carpodetoides*	*Colmeiroa*	C. Moore
LOGANIACEAE		
e *Geniostoma petiolosum* **C. Moore & F. Muell.**		C . Moore
MYRSINACEAE		
e *Rapanea platystigma* **(F. Muell.)** Mez	*Myrsine*	J .P. Fullagar & Lind
MYRTACEAE		
e *Cleistocalyx fullagarii* **(F. Muell.)** Merr. & L.M. Perry	*Acicalyptus*	C.Moore; J.P. Fullagar & Lind
e *Metrosideros nervulosa* **C. Moore & F. Muell.**		J.P. Fullagar & Lind
OLEACEAE		
e *Chionanthus quadristamineus* **F. Muell.**		C.Moore; Lind &J.P. Fullagar
PITTOSPORACEAE		
e *Pittosporum erioloma* **C. Moore & F. Muell.**		not designated
RUBIACEAE		
e *Atractocarpus stipularis* **(F. Muell.)** Puttock	*Randia*	C. Moore
e *Coprosma lanceolaris* **F. Muell.**		Lind & J.P. Fullagar
e *Coprosma putida* **C. Moore & F. Muell.**		C. Moore & W. Carron
e *Psychotria carronis* **C. Moore & F. Muell.**		C. Moore & W. Carron
RUTACEAE		
e *Melicope contermina* **C. Moore & F. Muell.**		C. Moore
e *Melicope polybotrya* **(C. Moore & F. Muell.)** T.G. Hartley	*Euodia*	C. Moore & W. Carron
SANTALACEAE		
e *Exocarpus homalocladus* **C. Moore & F. Muell.**		C. Moore
THYMELEACEAE		
e *Pimelea congesta* **C. Moore & F. Muell.**		C. Moore
ULMACEAE		
e *Celtis conferta* subsp. *amblyphylla* **(F. Muell.)** P.S. Green	*C. amblyphylla*	C. Moore & J.P.Fullagar
URTICACEAE		
Boehmeria calophleba **C. Moore & F. Muell.**		C. Moore
WINTERACEAE		
e *Zygogynum howeanum* **(F. Muell.)** Vink	*Drimys*	C. Moore

Baron Ferdinand von Mueller and his 'Lady' Correspondents

Susan K. Martin*

Abstract
There were many women in nineteenth-century Australia involved in botany. Almost all were amateurs, though some took their study very seriously. Their correspondence with Baron F. von Mueller reveals some interesting issues, particularly around the amateur status of women in this and other sciences. (*The Victorian Naturalist* **113**, (4) 1996, 185-187)

By the nineteenth century, botany was regarded as an acceptable 'accomplishment' for young ladies of the middle and upper classes, along with embroidery, music and flower painting. Many young women took a professional and systematic approach to their study, often in resistance to the trivialisation that might be implied by 'accomplishment' and sometimes using those very notions of genteel leisure as a smokescreen for a serious and passionate pursuit. Nevertheless the increasing professionalisation of botany across the nineteenth century tended to relegate more serious 'lady' botanists to amateur status whether they liked it or not, until the very end of the century.

In Australia, as in some other colonies of the period, the division between professional and amateur, serious student and accomplished lady was more blurred because of the special access to species and whole botanical zones formerly inaccessible to Europeans yet now available to some early women settlers (and some of their male counterparts). Georgiana Molloy's work in collecting and sorting seeds and specimens for James Mangles in Britain is an example of this (Hasluck 1990; Lines 1994).

For many women botanists later in the century Baron Ferdinand von Mueller was an invaluable resource. The women benefited from Mueller's expertise and his willingness to correspond, and to take their endeavours seriously. Mueller benefited by adding a number of women to his considerable network of amateur and professional collectors. With the notable exception of Amalie Dietrich, most of the women botanists with whom Mueller corresponded were from the middle and upper classes - women with the leisure and opportunity to study botany, collect plants, to buy books and participate in amateur societies. It is notable that in Australia some of these societies, such as the Royal Society of South Australia (Kraehenbuehl 1981) and the Royal Society of Tasmania (Rae-Ellis 1979), were open to women in the nineteenth century, while their most prestigious British counterparts, the Royal Society and the Linnean Society, did not allow women members until well into the twentieth century (Allen 1980).

Louisa Atkinson, in New South Wales, and Louisa Meredith, in Tasmania, both corresponded and associated with Mueller as Director of the Melbourne Botanic Garden and compiler of the First Census and Second Census of Australian plants. Mueller's Census and some of his correspondence, illustrate the vexed position most of these women botanists still occupied - partaking of some of the Imperial power of European science, but still disempowered by the status of women in the nineteenth century.

Mueller was fastidious in his replies to correspondents (Robertson 1986), but some of his replies to women seem a little double-edged in the way that they reposition his collectors as amateurs, whose true profession lies elsewhere. To Louisa Hussey he wrote in 1896: 'My pride is to demonstrate for all classes of Australian plants the geographical distribution; but if you incurred special toil for that it would disturb your happiness and might withdraw you from filial and domestic duties' (Kraehenbuehl 1981: letter from Mueller 25 June 1896, published in *Garden and Field* November 1896 Melbourne). This solicitude does not fully accord with Mueller's other correspondence with Hussey: 'Kindly send some seeds of any of the Droseras later in the season'.

*School of English, La Trobe University, Bundoora, Victoria 3083.

Veronica Distans: 'Has this any scent? What is its greatest height? Are the flowers always white?' (Kraehenbuehl 1981). In the former letter Mueller positions Hussey's professional interest and practice of botany as an aside to primary domesticity, and by publishing the letter in *Garden and Field* spreads the message clearly to other young lady botanists. At the same time his avuncular tone might be taken to imply that collecting is part of their filial duty, which again removes it from the public sphere.

Hussey may have had the last word in this exchange, however, it is impossible to know, as Hussey's letters to Mueller, along with correspondence from a number of other women botanists, including Amalie Dietrich, were blithely recycled for the war effort by the Director of the National Herbarium of Victoria in the 1940s (Kraehenbuehl 1981; Moyal 1981).

Less personally Mueller's 'Census' demonstrates the way in which the contributions of 'amateurs', male and female, of whatever class, could be obscured by the very structures of their discipline. Though to all intents and purposes some of these 'lady botanists' engaged in the practices and demonstrated the skills of professional botanists, they did not have access to one of the quintessential features of the Colonial botanist in the nineteenth century - the power of naming[1]. While Mueller's 'Types' - the dried herbaria samples which serve as guarantee for the identification of a species - generally note the name of the collector and the site of collection as well as the genus and species attribution, his 'Census', which for the nineteenth century was literally the last word on the naming of Australian plants, lists, not the discoverer or preparer of the species or specimen, but the publisher of the official name and description, and the place of publication[2].

That at least some of the women botanists were frustrated by this lack of access to the language of their science, is evident in their writing. Concerns about naming surface in Louisa Atkinson's first newspaper column, 'A Voice from the Country', which appeared in the *Sydney Morning Herald* in the 1860s. She discusses the importance of common names, as opposed to Latin ones, in establishing familiarity with plants, and proposes to list or even invent vernacular names for the flora she describes in the column (Atkinson 1978).

Amalie Dietrich, who was a paid collector of botanical and other natural history specimens in northern Australia from 1863-73, was a notable exception to the majority of Australian lady botanists. She was acknowledged as a professional and colleague in a number of ways not extended to them by such men as Mueller (Moyal 1981). As a woman of working-class background, and a foreigner whose English was poor, she travelled freely around Australia, collecting for her European employer. Sara Mills argues that women travellers in the nineteenth century could behave eccentrically, even 'being treated as honorary men' (Mills 1994). Dietrich is also in a different class from the other lady botanists described here because she was able to obtain a paid position as a collector - a fact described as 'bizarre' by Moyal. But like the other women here, and because she was employed as a collector, had a working class background and a limited education, she did not publish or name her collected specimens.

A number of women botanists, including Dietrich, though deprived of the power of naming, had species, and in Louisa Atkinson's case a genus (*Atkinsonia ligustrina* named by Mueller 1858) named after them. While this was, of course, both honour and acknowledgment, there is some level of objectification and memorialising potentially involved in it.

Louisa Meredith expressed gratitude at having a species named after her: 'My esteemed friend of many years, the eminent Australian botanist, Baron F. Von Mueller, has done me the honour of giving to the small 'immortelle' found on Mount Olympus, in Tasmania, my name as its specific title' (Meredith 1891). This gratitude reads differently in the light of her comments on her status in 1878: 'I believe that no other woman resident in the colonies has done so much in art, science and literature for her adopted country, and

I think forty years of active work deserve their reward'(Rae-Ellis 1979). She seems to have relished the £100 pension she eventually extorted from the Tasmanian government more than the 'small' remembrance offered by von Mueller (Rae-Ellis 1979). She was probably right in this, as along with a great number of plants named after women in the nineteenth-century, the so called 'imortelle' has disappeared from the current 'Census of Australian Vascular Plants' [3].

[1] I have so far been unable to locate an Australian plant named by a woman in the nineteenth century. I would be grateful to hear from anyone who has information to the contrary. For information on nineteenth-century plant taxonomy see Lumley and Spencer (1990).

[2] This remains current practise.

[3] The most likely reason for this would be reclassification, but it is not listed even as a previous species name.

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Sarah Theresa Brooks - Plant collector for Ferdinand Mueller

Barbara Archer[1] and Sara Maroske[2]

The Brooks family were pioneers of the Israelite Bay and Mt Ragged region in Western Australia. They were like other European pioneers in that they were willing and able to endure great hardships in pursuit of their dreams for a better life, but the Brooks were set apart from their peers by the fact that at least one member of the family, Sarah, made time, amid what must have been arduous and demanding daily chores, to collect plants. She was in fact a member of the great network of collectors established around Australia in the last century by the Government Botanist of Victoria, Baron Ferdinand von Mueller. This detail is barely if ever mentioned in accounts of Brooks's life, and yet surely it makes her story as a pioneer all the more remarkable.

Sarah Theresa Brooks was born in the ship *Harpley*, while it was tied up at Plymouth Harbour, England. The date was 19 September 1850, just days before the *Harpley's* departure for Australia on 24 September. On board were Sarah's parents, Henry Ferby Brooks and Emily Henrietta née Donovan, and her brother John Paul who was nearly three. They were also accompanied by Mrs Brooks, sister, Mary Jane Donovan (Willis. n.d.a *unpubl.*, *South Australian Register* 1851).

The *Harpley* arrived at Melbourne (via Adelaide) on 31 January 1851 (Syme 1987). The family settled at Geelong and Mr Brooks travelled to Melbourne to present letters of introduction in order to gain employment. Unfortunately he contracted malignant typhoid on this journey and died at the age of 24 in April 1851 leaving his young widow with two children to support. Mrs Brooks's sister married in 1854 shrinking the family circle still further (Oldham 1974).

Undaunted, Mrs Brooks opened a day school in Pakington Street, Geelong, and Sarah herself commenced classes there on 10 August 1855. Later the school was conducted at 39 Skene Street, Geelong in partnership with a Mrs Edgar. It may have been in the classrooms of this school that Sarah's interest in botany was first awakened. Her brother, John, attended Geelong Grammar School when it first occupied its central Geelong site in 1863. The earlier site was in Skene Street opposite the Brooks's family home. John may have attended a private school prior to that date. Sarah also attended drawing lessons with Edmund Sasse the art master of Geelong Grammar School for a number of years (Oldham 1974).

After an unsuccessful dairy-farm venture near Lilydale east of Melbourne the family moved to Western Australia in 1873. They were influenced in their decision by the generous land offers made in this year by the Western Australian Government which was eager to attract new settlers. John Brooks had also heard from a sailor that the land about Esperance was 'beautiful, grassy country' and unoccupied (Canberra 1927).

From an initial base at Albany, John Brooks applied for a free lease of 100,000 acres at Esperance Bay in March 1874 (Erickson 1978, Rintoul 1964). He and his family then determined to set out for their new home by foot. It was such a remarkable proposition, even for the tough days of early European settlement, that it received notice in the *Albany Herald*:

> 'A somewhat extraordinary expedition left here lately with the intention of making the overland journey to Esperance Bay. The party consisted of a man named Brooks with his mother and sister. ... The women and the man intend walking the whole distance - about 300 miles - with an occasional lift in the cart. ... It is hoped they may succeed in accomplishing their undertaking, but I should not be surprised to learn of a police party sent to search for and succour them.' (*Albany Herald*

[1]POB 1030, Esperance, WA 6450.
[2]Department of History & Philosophy of Science, The University of Melbourne, Parkville, Vic. 3052.

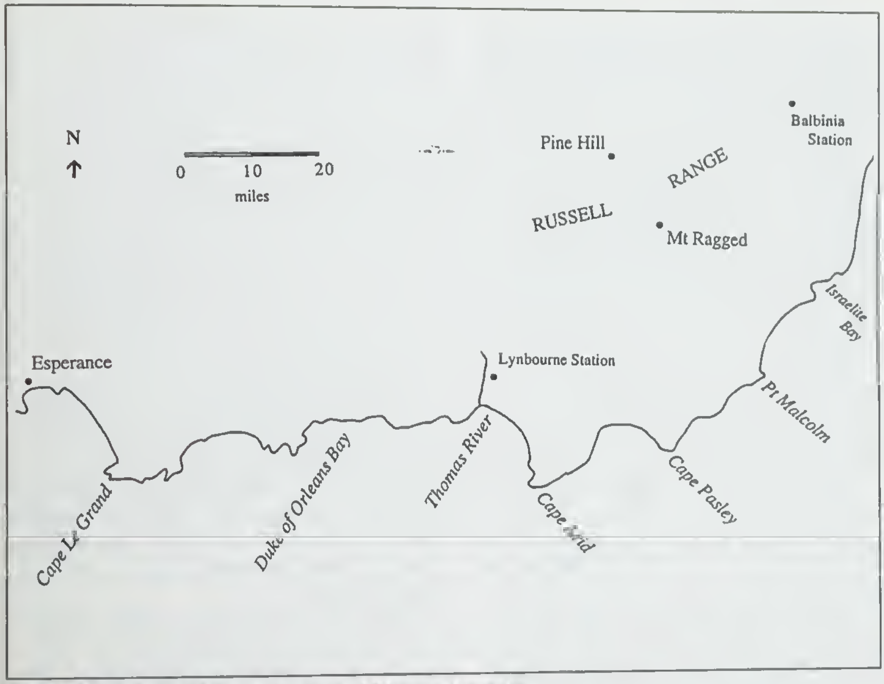


Fig. 1. Map of part of the south coast of Western Australia.

1874).

The Brooks family successfully reached Esperance Bay in early May and walked along the coast to Thomas River. The two women rested near Campbell Taylor's home station, Lynbourne, while John took a small party and walked on to Eucla. He found the Muir family already established on pastoral leases and returned, disappointed in his venture, to Lynbourne Station. Later in 1874 the Brooks moved on to Point Malcolm where they settled and built 'Marlburnup' a few miles west of Point Malcolm (Fig.1) (Oldham 1975, Esperance Municipal Museum n.d. *unpubl.*).

In 1877 John became the first lineman at the Israelite Bay Telegraph Station and the family relinquished its pastoral leases. They moved into a stone house named Waratah which was built at Israelite Bay and lived there until 1883 when John and Mrs Brooks moved to Balbinia Station which they had taken up a year earlier (Dimer 1989, Esperance Municipal Museum n.d. *unpubl.*, Stevens 1933). Balbinia was a watering place 97 km (60 miles) inland at which Alexander Forrest had bivouacked during his exploring expedition of the Hampton Plains in 1871 (Fig. 2) (Forrest 1872, Brooks 1888, Esperance Municipal Museum n.d. *unpubl.*).

Sarah remained at the Israelite Bay settlement, a popular figure with the Telegraph Station officials and their wives. She painted landscapes, played the piano and sang. She is also reputed to have been fluent in seven languages which may have been deduced from the fact that she painted a prayer scroll in oils giving

Fig. 2. Balbinia station ruins, remains of fireplace.

the Lord's Prayer in this number of languages (Brooks n.d. *unpubl.*). Mr Karl Dimer (formerly of Nanambinia Station) recalled that her journal was written in either Greek or Hebrew. Unfortunately this journal was mislaid in the early 1950s (Dimer, K. 1996 *pers. comm.* 29 February). With youth and such talents on her side she must have been attractive to the young men of the district and she evidently received several proposals of marriage, but declined to accept any of them (Esperance Municipal Museum n.d. *unpubl.*).

In 1883 Sarah happened upon an offer in the *West Australian* which she was happy to accept. It was an appeal by Baron Ferdinand von Mueller to settlers in outlying districts to assist in his botanical researches. The *West Australian* felt it could do no better than to print the Baron's own words, which begged the newspaper to:

> 'urge inland and northern and far eastern settlers to induce the natives to bring, in baskets, specimens of *all sorts* of plants, to be dried at the stations and forwarded to me by post. The small expenditure required for barter articles I would gladly refund. The minutest annuals should not be overlooked on such occasions. Perhaps I may not live many years to carry on my investigations and I should like so much to give the finishing stroke for the elaboration of the rich and varied flora of Western Australia before I pass away.' (*West Australian* 1883).

Mueller was the Government Botanist of Victoria but his true field of endeavour was the whole of Australia. He made extensive collecting trips himself, including two visits to Western Australia in 1867, 1877-8, but relied heavily on collectors to be his eyes and hands in remote areas (Willis 1949). Mueller placed a number of advertisements in Western Australian newspapers (Hamersley 1981) and through these and other means was successful in building up a substantial network of Western Australian collectors. Mueller's women collectors in Western Australia included; Mary Wilkins née Adams (1873-1931), Ellen Best (1842-1918), Diana Bunbury (1811-98), Mary Walter née Cronin (1871-1971), Nellie Davey, Louisa Clarke née Franklyn, Mrs Gale, Clara Ryan née Graham, Margaret Forrest née Hamersley (1844-1929), Mary McHard née Jones (1826-1912), Ann Knight née McKail (1840-1904), Amelia (Mildred) Bunbury née Pries (1863-1956), Geraldine Sewell (1861-1900), Julia Sewell (1847-1914), Miss Toll, Alice Heal née Eaton (1870-1932), Martha Heal née Eaton (1868-1941), and Mary Rogers née Warburton b. 1851 (Pearson and Davis n.d. *unpubl.*).

Sarah's interest must have been pricked by Mueller's words in the *West Australian*, and his plea was given urgency by the sense he had of imminent demise (as it happened he lived for another 13 years). As Sarah read on, however, she could have been forgiven for thinking that the *West Australian* had her in mind when it added:

> 'There are already many ladies living in these far distant parts of the colony, bereft, to a great extent, of those intellectual resources to which many of them have been accustomed. And upon these ladies, in particular, we would impress the interest they might derive from actively aiding our great Australian botanist in his valuable scientific researches. Much has been done in this way by the ladies in the settled districts and a still larger field for similar work is opened for those who have followed husbands and brothers into the remote and less known portions of this vast territory.' (*West Australian* 1883).

Mueller's advertisement was timed to coincide with the start of Spring flowering and Sarah was able to begin collecting immediately. On 5 November she had enough specimens prepared to send a batch to Mueller. Her letter was a brief almost terse document, and oddly stilted by being written in the third person. Perhaps she lacked confidence in how her efforts would be received.

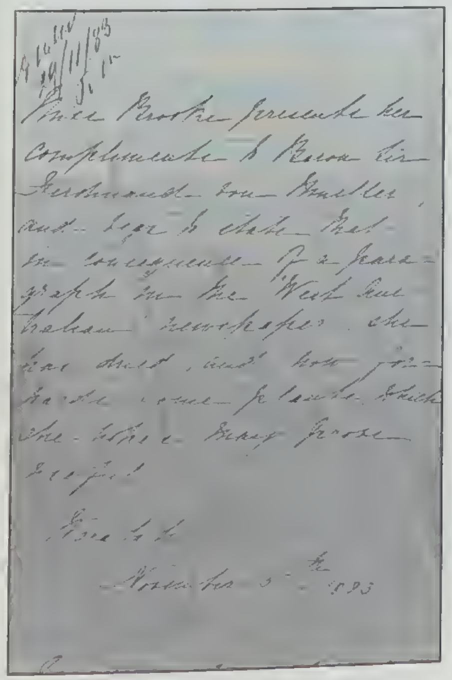
> 'Miss Brooks presents her compliments to Baron Sir Ferdinand von Mueller and begs to state that in consequence of a paragraph in the *West Australian* newspaper she has dried

and now forwards some plants she hoped may prove useful.' (Brooks 1883 *unpubl.*).

Mueller replied in person on 9 November and judging by the number of collections at the National Herbarium of Victoria (see Appendix) this letter was the first in what must have been a long and regular correspondence with Sarah. Unfortunately her initial letter is the only part of it known to survive.

From 1883 Sarah collected plants (incuding algae), and fungi in the region of Israelite Bay and Russell Range (Mt Ragged) of far SE Western Australia (see Appendix). The old labels on her specimens at the National Herbarium of Victoria mis-spell her name as 'Brooke', an understandable error given the appearance of the 's' she formed at the end of words (Fig. 3).

The value which Mueller placed on Sarah's work is in part revealed by the fact that he named two plants for her. The first was *Scaevola brooksiana* F.Muell. which Sarah discovered in the vicinity of Israelite Bay. Mueller called it a 'pretty and remarkable plant' (Fig. 4.,Mueller


Miss Brooks presents her compliments to Baron Sir Ferdinand von Mueller, and begs to state that in consequence of a paragraph in the 'West Australian' newspaper she has dried, and now forwards some plants which she hopes may prove useful.

November 5th 1883

Fig. 3. Sarah Brooks's letter to Baron Ferdinand von Mueller, 5 November 1883.

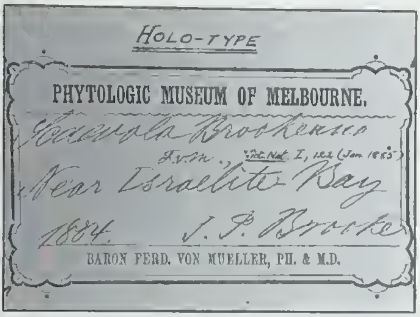


Fig. 4. *Scaevola brooksiana* specimen label (Royal Botanic Gardens, Melbourne).

1884). The second was *Hakea brooksiana* F.Muell. which Sarah found at or towards Mt Ragged (Fig. 5, Mueller 1886). Mueller sent Sarah's algae collections to the famous Swedish phycologist J.G. Agardh and he named *Rhodophyllis brooksiana* J.Agardh in her honour (Agardh 1890). The mis-spelling of Sarah's name on herbarium labels was repeated in the original spelling of the specific epithets erected in her honour (i.e. 'brookeana').

Like-minded companions must have been few for Sarah in the remote Israelite Bay region, but in her brother and mother she had at least two people to share her scientific curiosity. Both Mrs Brooks and John seem to have collected plants for Mueller although not in the same quantities as Sarah. Some of the specimen labels at the National Herbarium of Victoria des-

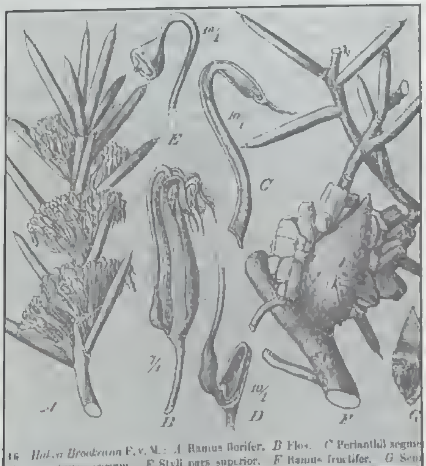


Fig. 5. *Hakea brooksiana* (Diels and Pitzel 1904).

ignate 'Mrs Brooks' as the collector rather than 'Miss Brooks' (e.g. Lander 1988).

John also made a number of exploratory sorties in the SW of Western Australia, ostensibly in search of grazing country, but also clearly with his eyes open to scientific phenomenona. In 1875 he travelled inland from Israelite Bay to Mt Brooks and eventually beyond Lake Roe. This journey was accomplished with the aid only of a pocket compass and the company of a local farmer, Stephen Ponton, and an aboriginal guide, Black Ben. According to Sarah, Ernest Giles came upon their tracks when crossing the WA desert in 1875 (Brooks 1888, Hamersley 1981). A comparison of the routes of John and Giles indicates that their paths must have crossed somewhere between Victoria Spring and Lake Roe (Fig. 1.) (Giles 1889, Brooks 1888, Hamersley 1981).

In 1886 Sarah joined John on an expedition. It was a remarkable feat for her because since arriving in the district she 'had not journeyed further than Mt Ragged'. The brother and sister team set out from Israelite Bay towards a peak in the Hampton Range known as 'The Cliffs', noting the abundance of poison plants all the way up to the top of the hill. From here they headed to Mt Ragged which the local Aborigines never climbed for fear of being struck down by invisible spirits. After being told of the Brooks' successful ascent the Aborigines explained it by saying that the spirits would only attack black people. From Mt Ragged Sarah and John travelled to Pine Hill, then eastward through Eucalypt woodland to Balbinia, and north through increasingly arid country, finally ending in flat salt-bush country broken up with only occasional specimens of *Pittosporum phylliraeoides* (Brooks 1888, Hamersley 1981).

Sarah's observations on this and John's earlier 1875 trip were published along with a detailed map in *Petermann's Geographische Mitteilungen*, a German geographical magazine (Brooks 1888, Hamersley 1981). August Petermann was a long-time correspondent of Mueller and no doubt Mueller facilitated the publication and possibly even translated Sarah's account into German.

John was also clearly a competent author, and in 1894 he wrote a very long and detailed letter to Mueller on the natural features of Israelite Bay 'I have,' he declared, 'through Miss Brooke [sic], 'your assurance that this spot has special interest to the botanist, and I have my own conviction that it must have an equal interest to the geologist, the meteorologist, and perhaps the geographer.' Mueller submitted the letter to the sixth meeting of the Australasian Association for the Advancement of Science held in Brisbane in 1895, and it was published as part of the proceedings for Section on Geography (of which Mueller was the President) (Brooks 1895).

Like many of Mueller's collectors, Sarah seems to have ceased collecting plants after his death in 1896. It is a testimony to Mueller's energy and enthusiasm that no one was able to take his place in managing the network of his collectors.

In 1898 fire destroyed Waratah and Sarah moved to Balbinia Station. She shared a limestone cottage with her mother while John lived nearby in a granite home. Mrs Brooks died in 1911 after being confined to a sofa for many years and was buried in the orchard (Dimer 1989).

Sarah continued to express her interest in plants into old age (Fig. 6). In a record of her impressions on a trip to Perth in 1927 she observed:

Fig. 6. Sarah Theresa Brooks, n.d. (Esperance Municipal Museum).

'Coming baek to civilisation after 50 years I was frequently asked what struek me most and I always replied, the beauty of the flowers. We first met them along the railway as we app-roaehed Perth the lovely blue lace flowers and the gorgeous orange plumes of the Christmas trees.' (Brooks 1928).

She suffered a stroke in 1928 and was hospitalized in Norseman. On a visit to the district, Premier Collier ealled in to see her and was met with the remark, 'Well, I suppose you have eome to see the last of the dinothoriums'. She died on 23 September 1928 aged 78 and was buried in the Norseman Cemetery. In 1974 a Memorial Tablet was placed on her grave by the Royal Western Australian Historieal Society and the Norseman Historieal and Geological Museum.

John lived to 20 May 1930 when he died of exposure after being found in the bush a eouple of kilometres from his home. He was buried in the orehard at Balbinia. In 1975 the Lions Club of Esperanee restored and marked his resting plaee.

The Dimer family won the tender for John's stoek, equipment and possessions. Many of these items have been earefully preserved. Some of the furniture is used to this day. Balbinia was abandoned and reverted to the erown. In 1975 a bronze memorial was placed on the homestead by the Royal Western Australian Historieal Society and the Esperance Munieipal Museum (Dimer 1989).

Mrs Croeker of Balladonia Station has written 'Miss Brooks eame to the district as a charming and aecomplished young woman and truly wasted her sweetness on the desert air' (Croeker 1954). This statement eould only be taken as true if Sarah's collecting was eompletely disregarded. Sarah was a woman of wide interests and talents which made her reeeptive to Mueller's request for assistanee in his botanieal research. She in faet beeame one of his most prolific plant colleetors in Western Australia, and her eollections made a lasting contribution to knowledge of the Western Australian flora. Mueller was not in a position to pay for more than the small expenses of a eollector like Sarah but he eould and did honour her in plant names, and possibly, as he did with other eolleetors, also made her gifts of garden seeds (Hamersley 1981). Remnants of the orchard at Balbinia include a fig and mulberry tree, and the Brooks's rose 'Konigen von Denmark' still flourishes.

Acknowledgments

We thank Jim Ross for encouraging us to undertake this project and for providing information on the Brooks specimens at the National Herbarium of Victoria. Dorothy André (Curator Esperance Municipal Museum) assisted us with Brooks records and photographs. The Esperance Shire Council granted us permission to use the photographs and notes. Karl Dimer generously shared his knowledge about the Brooks family and gave permission to photograph material in his possession. Susan Mildred (Mortlock Library, Adelaide), and Fred Atherton provided information on the *Harpley*. Thanks also to William Archer for the use of photographs and visits to Balbinia Station, and to Tom May for his encouragement and comments on various drafts.

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Appendix: A select list of Sarah Brooks' plant and fungi collections at the National Herbarium of Victoria (MEL), based on (Willis n.d.b *unpubl.*) with additions.

Plants

Acacia osswaldii F.Muell.
Acacia 'salicina' Lindl. Israelite Bay.
Athrixia multiceps (A.Gray) Benth. Israelite Bay.
Atriplex cinerea Poir. Israelite Bay.
Atriplex stipitata Benth. Half-way between Mt Ragged and Victoria Spring, 1886 (MEL 608065).
Atriplex vesicaria Benth. Half-way between Mt Ragged and Victoria Spring, 1886 (MEL 608112, MEL 608113).
Atriplex vesicaria Heward ex Benth. ssp *variabilis* Parr-Smith. Half-way between Mt Ragged and Victoria Spring, 1886 (MEL 608130, MEL 608133).
Bossiaea preissii Meisn. Israelite Bay, Dec. 1884, 1885, 1893. Near Israelite Bay, Dec. 1884 (MEL).
Callitris drummondii (Parl.) F.Muell. NW base of Mt Ragged, Israelite Bay, 1894 (MEL 226799, 226800).
Callitris roei (Endl.) F.Muell. Israelite Bay.
Codonocarpus cotinifolius (Desf.) F.Muell. N of Mt Ragged.
Conospermun distichum R.Br. Israelite Bay (Mueller & Tate [1896]).
Darwinia diosmoides (DC) Benth. Israelite Bay (Mueller & Tate [1996]).
Dodonaea ceratocarpa Endl. Mt Ragged.
Dodonaea lobulata F.Muell. Beyond Mt Ragged.
Eucalyptus angulosa Schauer. Israelite Bay, 1885 (MEL 1607395).
Eucalyptus angustissima F.Muell. Israelite Bay, 1885 (MEL 1607517).
Eucalyptus eremophila (Diels) Maiden. North of Mt Ragged, 1889 (MEL 1613484).
Eucalyptus kruseana F.Muell. Hampton Plains, 1890 (MEL 708038).
Eucalyptus litorea Brooker & Hopper. Israelite Bay, 1884 (MEL 1607276).
Eucalyptus scyphocalyx (F.Muell. ex Benth.) Maiden & Blakely. N of Mt Ragged, 1889 (MEL 1008919).
Eucalyptus tetraptera Turcz. Israelite Bay, 1884 (MEL 706096).
Eucalyptus uncinata Turcz. Israelite Bay, 1885 (MEL 705705).
Gonocarpus pycnostachys (F.Muell.) Orch. Near Israelite Bay. Type collection (Orchard 1993).
Goodia medicaginea F.Muell. N of Mt Ragged, 1889 (MEL 1058265), near Mt Ragged, 1890 (MEL 1058272).
Hakea brookseana F.Muell (Mueller 1886).
Helipterum hyalospermum F.Muell. ex Benth. Mt Ragged.
**Lawrencia glomerata* Hook. Israelite Bay, 1883, 1884.
**Lawrencia squamata* Nees ex Miq. Israelite Bay, 1885.
Nematolepis phebalioides Turcz. Near Mt Ragged.
Neurachne alopecuroidea R.Br. Israelite Bay.
Microlepidium pilosulum F.Muell. Israelite Bay, 1885 (MEL 10936).
Millotia tenuifolia Cass. Near Israelite Bay.
Phebalium lepidotum (Turcz). NW base of Mt Ragged.
Podolepis capillaris (Steetz) Diels. Half-way between Mt Ragged and Victoria Spring.
Scaevola brookseana F.Muell. (Mueller 1884).
Swainsona oliveri F.Muell. Half-way between Mt Ragged and Victoria Spring.
Templetonia battii F.Muell. N of Mt Ragged, 1889 (MEL).
Vittadinia blackii N.Burb. Half-way between Mt Ragged and Victoria Spring.

Fungi

Polyporus basilapiloides (McAlpine & Tepper) Lloyd. Eyre Botanical District, Israelite Bay, 1893 (MEL 2015815).

* Collections of Sarah Brooks from the National Herbarium of Victoria, which were destroyed by fire in a road accident in 1984 (Lander 1987).

Mueller and Personal Names in Zoology and Palaeontology

Thomas A. Darragh[1]

Abstract
This paper discusses the naming of species after Ferdinand Mueller in zoology and palaeontology and Mueller's role in naming fossil plants. (*The Victorian Naturalist* **113**, 1996,195-197)

The use of personal names in botanical and zoological nomenclature goes back to the beginnings of the naming of animals and plants. Species have been named after persons for all kinds of reasons. It is traditional to name a species after its collector, or to honour some other scientist, particularly one who has made substantial contributions in that particular discipline. Sometimes names are given to species to honour one's friends. In many cases, the recipient of such an honour reciprocated when the chance came. Though it is frowned upon as lacking in taste, some egoists have even named species after themselves. Some taxonomists have used names for political purposes to enhance their own status or position. In this, Baron Ferdinand von Mueller was no exception. As a taxonomist describing new species he was in a position to dispense honours through naming and, of course, he was in a position to receive them through others naming species after him. The epithet *muelleri* is a common one, so tracking down all those that pertain to Mueller is not an easy task. This brief survey has covered most of the Australian sources but the species mentioned here are certainly not all that bear his name.

Zoology

Though Mueller was a very famous scientist in his time and in contact with many non-botanical taxonomists, there are few species outside botany described by Australian scientists which bear his name. Long after Mueller's death, William M. Bale, a fellow member of The Field Naturalists Club of Victoria, named a living hydroid, *Sertullaria muelleri*, which Mueller had collected at Encounter Bay, South Australia, and gave to Bale (Bale 1913). In 1889, Professor Ralph Tate of the University of Adelaide, a talented botanist as well as a palaeontologist, after whom Mueller named seven plants, dedicated *Semicassis muelleri*, a gastropod from the Lower Pliocene of Victoria, to 'Baron Sir F. von Mueller as a public mark of recognition of his contributions to the phytology of the Australian Tertiary Period' (Tate 1889). Mueller appreciated 'most highly the honor of your connecting my name now with conchology' and ' most gratefully recognize the sentiments which induced this dedication' (Mueller 1889). Mueller's phytological contributions will be mentioned below. This seems to be the only example of a mollusc, either fossil or living, named after him, and the only other invertebrate named for Mueller seem to be the insect described by P. Dattari in 1886, *Phalacrognathus muelleri* (see Dwyer this volume), perhaps because he did not himself collect anything new or because he made no contributions in other disciplines. Possibly his fellow scientists, though respecting him, did not particularly like him. For instance, his colleague Professor Frederick McCoy, who named many fossils, including fossil plants, after collectors and other scientific colleagues, did not so honour Mueller, even though Mueller named a fossil fruit after him.

In one instance Mueller is alleged to have collected an important mollusc specimen but the name it received from McCoy was not Mueller's. The circumstances surrounding the origin of this specimen, named *Voluta roadnightae*, are unusual and worthy of remark. In 1881 McCoy named *Voluta roadnightae*, which was 'found by Mrs Roadnight, to whom I have had the pleasure of dedicating it, three years ago,... it somewhat resembles the fossil *Voluta Hannafordi*, McCoy, a fact which did not escape Mrs Roadnight's notice' (McCoy 1881). No mention of Mueller here, yet in 1899, Mrs Agnes Kenyon recorded:

[1] Museum of Victoria, Box 666E Melbourne, Victoria 3001.

> 'The first and type specimen of this rare and beautiful Volute came to light in a very curious and unexpected manner, as it was discovered by chance by the late Baron Sir Ferdinand von Mueller, the Government Botanist for Victoria, who, when holiday-making at the Lake's Entrance, Gippsland, south coast of Victoria, happened to notice a shell which was being used for the purpose of propping up his bedroom window at the hotel. Although in a broken and mutilated condition it appeared new to him, and he therefore obtained possession of it, and ascertained that it had been found by Mrs. Roadnight, the landlord's mother, some years previously, in the vicinity of Red Bluff on the Ninety-mile beach. Upon his return to Melbourne, he placed the shell in the hands of the late Sir Frederick McCoy,...' (Kenyon 1899).

If one can judge from the errors in the article (Spencer 1901) and in the localities from which Mrs Kenyon, a shell collector, alleged some of her shells came, this story may have been exaggerated or erroneous and it does not agree with McCoy's remarks (McCoy 1881). It is extremely unlikely that Mueller would have recognised the shell as new, though he may very well have conveyed it to Melbourne for Mrs Roadnight. Unfortunately there are no records in the Museum concerning its acquisition which throw light on its origin, except that they show McCoy himself was in Gippsland at The Narrows on the Gippsland Lakes in November 1878 and could have been given the shell during his visit.

In July 1891, an attempt by Mueller's fellow Club members and associates, Charles French and J.G. Luehmann, to honour Mueller by naming a new species of the Tree Kangaroo *Dendrolagus* failed. The skin was exhibited and a brief note with the name mentioned was read at the meeting of The Field Naturalists Club of Victoria held on 13 July 1891 and reported in the *Argus* next day (page 6). Mueller proudly informed Edward Ramsay of the Australian Museum that 'They generously named the animal after me... Nevertheless it may only be a variety of D. Lumholtzii... You will see the full notes in the next issue of the Victorian Naturalist' (Mueller 1891). Alas for Mueller! The specimen must have proved to be of the existing species because when the report of the meeting was published in September in *The Victorian Naturalist* (vol. 8, no. 5, p. 66) the note including the name was omitted and it was merely reported that the note was read and the skin exhibited.

It is not surprising that German speaking scientists were among those who named species for Mueller, particularly because he sent so much zoological material to German museums. As part of his efforts to secure his Wurtemberg titles, Mueller sent enormous collections to the Stuttgart Natural History Museum. At least three species of Australian fish (*Pseudorhombus muelleri* Klunzinger 1872; *Synaptura muelleri* Steindachner 1879; *Leptobrama muelleri* Steindachner 1878) and three species of reptiles (*Phaneropis muelleri* Fischer 1881; *Hoplocephalus muelleri* Fischer 1885; *Hinulia muelleri* Fischer 1882) from these collections were named after him.

Palaeobotany

In the field of palaeobotany, there are several species that bear Mueller's name. R.M. Johnston (1885) named a rather problematic fossil which he alleged to be a cone of *Lepidodendron* as *Lepidostrobus muelleri*, and
Henry Deane (1902a, b) named *Sterculia muelleri*, *Mollinedia muelleri*, *Eucalyptus muelleri* and *Tristenites muelleri* in papers in which he honoured a number of palaeontologists and geologists. Both these workers had their names used for plants by Mueller.

The Austrian palaeobotanist, Constantin Ettingshausen, who monographed the Tertiary plants of New South Wales, named three taxa, *Elaeocarpus muelleri*, *Fagus muelleri* and *Anomozamites muelleri* (Ettingshausen 1888). He also named *Alnus muelleri* (1883), and in turn, Mueller named a Gentian after

Ettingshausen. August Schenk of Leipzig University described *Phyllocladus muelleri* from specimens of fossil wood sent to him by Mueller (Schenk in Schimper and Schenk 1890). The collector of the wood, Ferdinand Krause of Ballarat, was not mentioned or honoured.

Mueller was not a palaeontologist, nevertheless, when large collections of fossil fruits were found in the deep leads of the Haddon district near Ballarat, at Chiltern, Beechworth and Tanjil, and sent to the Mining Department, Robert Brough Smyth, Secretary for Mines turned to Mueller to describe them. They were described in a series of papers published in the *Reports of the Mining Surveyors and Registrars* from 1871 to 1874 and then in a collected work in 1874, *Observations on new vegetable fossils of the Auriferous Drifts*, using the same plates. A further series of papers dealing with Victorian and New South Wales fossil fruits appeared from 1875 to 1879 and were republished using the same plates in 1883 as Decade 2 of the previous title (Mueller 1874, 1883).

Of the 16 names given in the 1873 publication, one was for R.B. Smyth, and four were for politicians who had occupied the office of Minister of Mines. In the 1883 publication, there were 15 names, one of which was for the then Secretary of Mines, Thomas Couchman, and one for the then Minister of Mines, W. Collard Smith. When dedicating *Trematocaryon mclellani*, Mueller (1873) wrote that it was dedicated to :

> 'the Honorable William McLellan, M.L.A., for several years Minister of the Mining Department, under whose authority this unpretensive essay has passed to publicity. This dedication is also intended as a public mark of recognition of the support, which this respected gentleman in his legislative position has always accorded to the labours of the writer.'

Mueller's dedications to other the Ministers were equally obsequious. As these publications were written just before and just after Mueller's removal as Director of the Botanic Gardens in 1873, it is possible that he made the dedications to shore up his position as Government Botanist or, at least, to curry favour and support for his activities.

Acknowledgments

I thank Sara Maroske, Helen Cohn and David Holloway for commenting on the manuscript, and John Coventry for providing reptile references.

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Mueller - Champion of Victoria's Giant trees

Bernard Mace[1]

In the year 1895, botanist A. D. Hardy (Hardy 1921) accompanied by the famous photographer J. M. Lindt led a party of people to the location of an enormous specimen of Australia's tallest tree, the Mountain Ash *Eucalyptus regnans*, on Mount Monda near Healesville. The party consisted mainly of members of the Geographical Society, and world famous botanist Baron Ferdinand von Mueller. Hardy respectfully named it the 'Mueller Tree' in honour of his colleague, even though 'the Baron' had wandered off on his own private botanical excursion and was not present to witness the occasion.

This magnificent tree was later measured accurately - 64 feet (19.7 metres) circumference at 6 feet (1.8 metres) above ground level, and height of 307 feet (94.5 metres). In the 1930s this same tree was 'rediscovered' by Mr Harold Furmston, an employee of the Melbourne and Metropolitan Board of Works, and was renamed the 'Furmston Tree' by the Healesville Progress Association. The same tree is still standing and very much alive today, although now reduced in height by decay and wind damage. Nevertheless, it exudes an atmosphere of mystery and silent dignity, reflecting its great age, immense proportions and moss-covered convolutions of its buttressed root system, thus remaining a fitting tribute to the great botanist after whom it was originally named.

In his work on the identification and classification of the flora of Victoria, Mueller made a particular study of the Mountain Ash and was responsible for naming and classifying the species. In his 'Second Census of Australian Plants' (Mueller 1870), he gives the following description:

> '*Eucalyptus amygdalina*, Lindl. - In our sheltered springy (containing water springs) forest glens attaining not rarely a height of over 400 feet, there forming a smooth stem and broad leaves, producing a foliage different to the ordinary state of Euc. amygdalina as occurs in more open country. This species or variety, which might be called *Euc. regnans*, represents the loftiest tree in the British territory, and ranks next to the *Sequoia Wellingtonia* in size anywhere on the globe.'

Later events persuaded him to revise this size ranking and to claim giant specimens of the Mountain Ash to be the tallest trees in the world. Mueller was an unabashed enthusiast for the giant Mountain Ash, but he was also acutely aware that they were a rapidly disappearing feature of the Australian landscape. The plight of the forests in general was already a cause for concern in the late 1800s.

From the earliest days of European settlement in Victoria, the forests were exploited with unprecedented energy and indecent haste. This was particularly true of those tall eucalypt forests that clothed the hills in close proximity to Melbourne, such as the Dandenongs and Kinglake Ranges which are now known collectively as the 'Central Highlands'. The early explorers commented on the extraordinary height of the 'tall gums' that grew in these areas, but very few had the botanical training or interest to realise the significance of what they were observing. The Mountain Ash *Eucalyptus regnans*, which is the tallest of the eucalypts, predominates throughout most of this region, and until the end of the 19th century, the tallest specimens in specific locations providing ideal conditions, may well have been the tallest trees in the world. However, this was not recognised until it was too late, and the exploitation proceeded unrelentingly, with very little consideration that the forests were being robbed of their crowning glory, the giants of the old growth forest.

The first wave of destruction resulted from the activities of the 'paling splitters' who scoured 'the scrub' to find the tallest and straightest timber, that, once felled with axe and cross-cut saw, would split cleanly and easily, yielding huge volumes of palings and shingles. These were items

[1]785 Myers Creek Road, Toolangi, 3777

desperately needed and essential to the development of housing in the new colony. It was lucrative business for these forerunners of the timber industry and a popular occupation amongst pioneers.

This rapidly became a competitive business, and the 'splitters' searched far and wide for the biggest trees that would yield the highest returns for the hard work of cutting them down. Thus it was that stories began to filter through to the community about the huge size of some of the trees.

There was precious little interest, and the scantest of records from the early 1800s, but a few scientists began to take reports seriously of exceptionally tall trees. The appointment of Mueller as State Botanist of Victoria in 1853, and later as Director of the Botanic Gardens, placed him in the ideal position to review reports of these enormous trees and he was probably the first to fully recognise their majesty and botanical significance. He enthusiastically embraced the process of documenting evidence of the colossal size of the largest specimens of eucalypts. Mueller soon perceived that a precarious situation had arisen. He was receiving sawmillers and surveyors accounts of giant Mountain Ash of immense proportions, while at the same time the universal preoccupation of the timber workers was to seek out and fell the largest trees they could find. Consequently, it was evident that a wonder of nature was being destroyed at the same time that its existence was beginning to be validated.

In 1866 Mueller (Mueller 1866-7) wrote:-

> 'In a philosophical contemplation of the nature of any country and the history of its creation, our attention is likely to be in the first instance engaged in a survey of the constituents of its pristine forests. Greatly is to be feared that in ages hence, when much of the woods will have sunk under ruthless axes, the deductions of advanced knowledge thereon will have to be based solely on evidence early placed on record.
>
> The marvellous height of some of the Australian, and especially Victorian trees, has become the subject of closer investigation since of late, particularly through the miners' tracks, easier access has been afforded to the back-gullies of our mountain system. Some astounding data, supported by actual measurements are now on record. The highest tree previously known was a Karri (*Eucalyptus colossea*) measured by Mr Pemberton Walcott in one of the delightful glens of the Warren River of Western Australia, where it rises to approximately 400 feet high. Into the hollow trunk of this Karri three riders with an additional packhorse, could enter and turn in it without dismounting. On the desire of the writer of these pages, Mr D. Boyle measured a fallen tree of *Eucalyptus amygdalina* (now known as *E. regnans* - mountain ash) in the deep recesses of Dandenong, and obtained for it the length of 420 feet, with proportions indicated in a design of a monumental structure placed in the exhibition; while Mr G. Clein took the measurement of a Eucalyptus on the Blacks' Spur, 10 miles from Healesville, 480 feet high!'

This information is highly significant, coming from the botanist who classified *Eucalyptus regnans* and spent so much time studying and documenting these magnificent trees. It should be noted that Mueller was a meticulous and indefatigable scientist whose collecting expeditions traversed the length and breadth of Victoria. By 1868, his collections in the Herbarium reportedly exceeded 300,000 specimens, many of which were new to science (Willis and Cohn 1993). He became deeply concerned about the fate of the few remaining giant examples of Mountain Ash in our forests, and sought to highlight their importance by comparing them to the giant sequoias of California. As the evidence accumulated, he came to believe that the Mountain Ash, particularly those growing in parts of Victoria, were in fact the tallest trees in the world, sometimes attaining the astonishing height of 500 feet (154 metres), and thus exceeding the greatest height ever claimed for the giant sequoias by at least 100 feet (around 30 metres). This assertion was well founded, being based primarily on professional surveyors reports, although anecdotal evidence no

`Mueller' Tree , early 1900's.

'Mueller' Tree today. Photo courtesy Ern Mainka.

doubt played a part. Sometimes standing trees were measured using a theodolite or clinometer, but even more convincingly, some enormous specimens were accurately measured by 'tape line' on the ground, where they had either fallen by chance or been felled by the axeman.

Contemplating an explanation for the superior size of Mountain Ash found in Victoria, compared to interstate locations, Mueller wrote (Mueller 1866-7):

> 'The enormous height attained by not isolated, but vast masses of our timber trees in the rich diluvial deposits of sheltered depressions within Victorian ranges, finds its principal explanation, perhaps in the circumstances that the richness of the soil is combined with the humid geniality of the climate, never sinking to the colder temperature of Tasmania, nor rising to a warmth less favourable to the strong development of these trees in New South Wales.'

In other words, Victoria had the unique combination of climatic and environmental factors that enabled the forest giants to reach their full potential after centuries of development. Largely because of Mueller's dedicated investigative work, considerable efforts were made to find and record the largest surviving specimens in the late 1800s. Surveyors, forestry workers and timber mill operators measured and recorded the largest trees they encountered and submitted their records to the Herbarium. Several prominent photographers travelled far and wide to secure photographic records of the most impressive specimens they could find. Nicholas Caire (Caire 1905), in particular, became devoted to the quest for images of the rapidly disappearing giants, to confirm their existence for future generations. Unfortunately the extraordinary giants amongst the Mountain Ash were the first to be eliminated.

It is not surprising that claims of *Eucalyptus regnans* attaining such stupendous heights were vigorously challenged from various quarters. For instance, in 1888 a reward of £600 was offered to anyone who could prove the existence of a tree 400 feet or more in height. The desired affirmative result was intended to be highlighted at the Centennial International Exhibition in Melbourne. The size claimed had to be validated by a qualified surveyor, but this proved to be a tall order in more ways than one. The fact that strenuous efforts to produce the evidence that would reap the reward failed, is often quoted as evidence that Mueller's claims were invalid. In fact a professional photographer, J. Duncan Pierce and a surveyor, C. R. Cunningham were employed to photograph and measure as many of the known giant trees as possible before the 1888 exhibition. The largest tree they could find was 'The Neerim Giant' which stood 326 feet high (100 metres) and 48 feet (14.8 metres) girth at chest height. Located on a spur of Mt Baw Baw, this was undeniably a huge tree as the photographic records show, but it was still 75 feet short of the desired 400 foot mark. However, E. J. Dowey (Hardy 1923), the timber cutter who led the party to this tree, reported that freezing conditions and the poor health of Pierce, meant that rather than search out the largest tree in the area, they had merely located the closest large specimen and measured it alone before returning quickly to civilisation. He also asserted that he had found and cut down much larger trees in the same area some time afterwards! The record of the search, in the lead up to the 1888 exhibition can be found in 'Giant Trees Of Australia,' (Anon 1888), the superb compilation of photographs with minimal text that resulted from the efforts of Pierce and Cunningham.

It is easy to criticise an assertion that stretches the limits of our credulity or imagination, but there was little justification for claims that Mueller was prone to exaggerate. He was not alone in reporting the extraordinary height of Victoria's Mountain Ash. Botanist A. D. Hardy also documented accounts of giant examples of the species, sometimes without embarking on exhaustive analysis of the reports (Hardy 1921). Most of the tallest trees recorded by Mueller were measured by surveyors, and although there were some notable inconsistencies, there is no justification for doubting the veracity of all reports. None the less, criticisms did arise, and one polite detractor was the State Botanist of New South Wales, J. H. Maiden who took the more conservative view point. In *The Forest Flora of New South Wales*, No. 72, (Maiden 1904-25), he wrote:

> *Eucalyptus regnans* F. V. M. 'The Giant Gum Tree
>
> A large tree, the largest indeed in Australia, though inferior in size to the Redwood, *Sequoia sempervirens* and the 'Big Tree' *Sequoia Wellingtonia* of Western America. Trees about 300 feet high are known in Victoria..'

Later in the same publication he referred to Mueller as follows:

> 'The greatest claims to possess the tallest trees of the world have been made on behalf of Victoria, most of them from Gippsland. In 1862 Mueller wrote to the Seaman's Journal of Botany that Mr. D. Boyle, of Nunawading, near Melbourne, has measured a fallen tree in the recesses of Dandenong and found it to be 420 feet.'

Surveyor Boyle was apparently discredited at a later date after a tree he measured at 466 feet was allegedly remeasured at 219 feet. This might have been good fuel for the sceptics and reflected badly on Mueller, but it defies comprehension that a qualified surveyor could produce an error of more than 100 percent in a simple measurement. Even an amateur could expect to get within 10 percent with a clinometer. Perhaps they remeasured the wrong tree? Maiden sought to discredit Mueller by highlighting conflicting claims of extraordinary heights which appeared to relate to the same trees. Obviously disagreeing with Mueller, he rather disparagingly quoted him as saying (Mueller 1885):

> 'the tallest tree of the globe, surpassing even the renowned California Sequoia and Wellington pines in height, reaching to 400 feet and even more.'

Maiden called for constructive action to settle the argument (Maiden 1904-25.): '*It will be best, if possible, to take a standing tree, measured by a surveyor, and we should have at least two independent measurements.*' A sound proposal, but by the early 1900s it was apparently already too late. He expressed doubts about the size claimed for the 'Neerim Giant', 326 feet high, and made dismissive comments about an even bigger specimen that came to be known as the 'Thorpdale Tree,' measured by Government certified surveyor George Cornthwaite in 1880. This giant from South Gippsland was measured with a theodolite at 370 feet high, and then shortly after was cut down by Cornthwaite's pastoralist brother and more accurately remeasured with a tape line on the ground. The result was 375 feet confirmed. This was reported in *The Victorian Naturalist*, July 1918. Currently this vanquished monarch is remembered with a pathetic pole, topped with a sign reading 'THE WORLD'S TALLEST TREE.' This tree has been referred to in the *Guinness Book of Records* (erroneously) as the tallest hardwood tree in the world at 115 metres (375 feet) high. If it was still standing, it would be at least 4 metres higher than the largest Redwood still standing in California. The tallest currently accepted record of a Californian Redwood *Sequoia sempervirens* is 368 feet (113 metres) and 66 feet (20 metres) girth at chest height. This fine tree fell during a storm in 1992.

Significantly, there was a giant Mountain Ash produced for the 1888 Exhibition in Melbourne, 'obtained through the kindness of Mr S. Willis of Prahran,' (Hardy 1912, 1921) and its enormous butt was displayed for all to see. The tree was provided by a sawmiller from Menzies Creek, and was claimed to have been measured with a tape line by the mill owner prior to being sectioned. It was reported to be 400 feet long, but was not confirmed by a licensed surveyor, so it did not warrant payment of the £600 reward. However the butt was laboriously sectioned into thirteen pieces, each approximately fifteen feet high, transported to the Exhibition Building grounds and reassembled into a stunning exhibit. It was reported to be 72 feet (22 metres) in circumference at ground level.

Despite the opposition to the notion that Victoria once harboured the tallest trees on earth, 'the Baron' was finally vindicated. One of his contemporaries by the name of William Ferguson, who was a licensed surveyor and in fact the 'Inspector of State Forests of Victoria', was assigned the task of assessing the timber reserves of the Watts River catchment near Healesville and to report on its suitability for proclamation as a State Forest. Ferguson investigated *'areas that had not been penetrated by the timber splitter or the wood cutter.'*, and reported to Mr Clement Hodgkinson, Assistant Commissioner of State Forests in 1872, (Simpfendorfer 1982) that....

'Some places, where the trees are fewer and at a lower altitude, the timber is much larger in diameter, averaging from 6 to 10 feet and frequently trees to 15 feet in diameter are met with on alluvial flats near the river. These trees average about ten per acre; their size, sometimes, is enormous. Many of the trees that have fallen through decay and by bush fires measure 350 feet in length, with girth in proportion. In one instance I measured with the tape line one huge specimen that lay prostrate across a tributary of the Watts and found it to be **435 feet from its roots to the top of its trunk. At 5 feet from the ground it measures 18 feet in diameter. At the extreme end where it has broken in its fall, it (the trunk) is 3 feet in diameter. This tree has been much burnt by fire, and I fully believe that before it fell it must have been more than 500 feet high.** As it now lies it forms a complete bridge across a deep ravine.'

This, the 'Ferguson Tree,' may well have been the tallest tree ever accurately recorded by mankind. Ferguson's report was secreted away in Government files for many years and apparently never came to the notice of Mueller. This record has recently been investigated by Dr A. C. Carder, a retired forester from Canada who has investigated tall tree records world wide, and it is currently listed in the *Guinness Book of Records*. The biggest girth ever recorded in Australia was the 'Bulga Stump' a Mountain Ash from the Tarra Bulga region of South Gippsland. It measured 111 feet (34 metres) girth at chest height, and its hollow interior could 'comfortably' house 11 horses.

The 'Bulga Stump'. The largest girth ever measured in Australia.

Photographed in 1888, it was already dead and broken off, so we can only speculate how tall it may have been in its prime, and unfortunately, it was burned soon after.

On balance, it appears that official efforts to confirm the existence of Mountain Ash upwards of 400 feet tall, in the latter part of the 19th century, were poorly executed and perhaps 20 to 30 years too late. The evidence shows that Mueller was correct in his assertions and well aware of the environmental factors that enabled Mountain Ash to reach exceptional heights in Victoria. He and some of his contemporaries were of the opinion that most of the great trees had already been destroyed by the paling splitters, or by the fires that followed European settlement, by as early as 1860 (Mueller 1885). Subsequent timber harvesting practices and policies gave neither recognition nor protection to the tallest trees in the world. Even those giants that may have survived in protected water catchments were probably destroyed by bushfires, which increased in frequency and intensity as a consequence of human activities and modifications to the environment. Consequently, the most magnificent botanical feature of Australia's wilderness was effectively lost by the turn of the century. The present status of that formerly ideal forest ecosystem is now so greatly modified that the grandeur of the past may never be seen again. Thankfully, the published notes of Mueller and a few other dedicated individuals were preserved to inform us of the extraordinary tall trees that once characterised Victoria's Mountain Ash forests.

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FOREST CONSERVATION

I regard the forest as an heritage given to us by nature, not for spoil or to devastate, but to be wisely used, reverently honoured, and carefully maintained. I regard the forests as a gift, instrusted [sic] to any of us only for transient care during a short space of time, to be surrendered to posterity again as an unimpaired property, with increased riches and augmented blessings, to pass as a sacred patrimony from generation to generation.

F. Mueller (1871).

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Tabulation Of The World's Largest Trees

Past Records - Mountain Ash *Eucalyptus regnans*

Name	Location	Height	Girth	Measurement Details
Ferguson Tree	Healesville	Over 500ft	56.5ft	Measured by Surveyor William (154m +) (17.5m) Ferguson. Fallen tree 435 feet to top (broken by fall). 3 feet thick at break. Recorded in 1872
Not named	Mt Baw Baw	470 ft	N.A.	Measured by Surveyor (145m) G.W.Robinson. Prior to 1889
Centennial Exhibition Tree	Menzies Creek	400 ft (123 m)	72 ft (22 m)	Measured by sawmiller after felling. Prior to 1888
Not named	Dandenongs	392 ft (120 m)	N. A.	Fallen tree measured by Surveyor David Boyle in 1862. He added 30 ft for its broken top giving a total height of 420 ft.
Thorpdale tree	Thorpdale (South Gippsland)	375 ft (115 m)	N.A.	Accurately measured by surveyor, G. Cornthwaite. Felled, 1880
Gerraty Tree	Toorongo	348 ft	N. A.	Fallen tree measured by Inspector Forest, Noojee (107 m) of Forests, F. G. Gerraty, 1939
Olongolah Tree	Beech Forest	347 ft	N.A.	Felled tree, measured by Colac Otways (107 m) Shire Engineer (before 1900)
Neerim Giant	Mt Baw Baw	325 ft (100 m)	48 ft (14.7 m)	Measured by Government Surveyor. Broken top. Destroyed by fire early this century.
Girth measurements only				
Bulga Stump	Bulga South Gippsland	N. A.	111 ft (34 m)	Photographed pre-1888, later destroyed by fire.
King Edward VII	Cumberland Valley	N. A.	88 ft (27 m)	Photographed in 1904 by Nicholas Caire. Destroyed by fire.
Existing Trees - Mountain Ash *Eucalyptus regnans*				
Mueller Tree. by Also known as Furmston's Tree. (Broken at top)	Mt Monda	60 m (195ft)	19.7 m (64ft)	First found by botanist A. D. Hardy, in 1902 (then over 300 feet high). In 1935 rediscovered Furmston and remeasured at 287 feet (88 m).
Mr Jessop	Wallaby Creek Catchment	91 m (295 ft)	8.5 m (27.6 ft)	Probably Victoria's tallest living tree. Named after former Chairman, Board of Works
The Big Tree	Cumberland Tall Trees Reserve	84 m (275 ft)	6.3 m (20.5 ft)	Previously 92 m (301 ft). Top broken by wind storm in 1959. Officially still listed as Victoria's tallest tree.

Ada Tree	Powelltown Forest	76 m (247ft)	15.6 m (51ft)	Recent measurements. Currently standing
Mt Fatigue Tree	South Gippsland	45 m (150 ft)	21 m (68 ft)	Recently measured by Brett Mifsud. Broken top. Largest girth known in living *E. regnans*.
Big Tree	Melba Gully Otway Ranges	50 m (approx.)	15.5 m (50 ft)	Hollow shell and broken top. Hybrid Mountain Ash- Messmate *E. obliqua*
Big Tree gum	The Hermitage	65 m (211 ft)	14 m (46 ft)	Registered by the National Trust. (Mountain Grey Gum) (Black Spur) Very large for a grey :-*E. cypellocarpa*
Bellamy Tree Errinundra vicinity	Ellery Creek	50 m (162 ft)	15.4 m (50 ft)`	Recently visited by Prof. Bellamy. (Broken top). Giant Messmate *E. obliqua*. (In a coup currently destined for woodchipping)
Tasmanian Trees				
Not named	Jacques Road (Tas) (Florentine Valley)	100 m+ (325 ft)	N.A.	Recently reported stand of trees. To be confirmed.
Big Tree	Styx Valley Tasmania	92 m (300 ft)	9 m (29 ft)	Generally recognised as Australia's tallest tree.
Geeveston Tree (Broken at top)	Geeveston Tasmania	87 m (283 ft)	21 m (68 ft)	Much visited tourist attraction. Measurements - recent.
American Trees - Present and Past				
Californian Redwood *Sequoia sempervirens*	Coastal regions	368 ft (113m)	66 ft (20m)	Fell in 1992.
Howard Libby Tree	Humbolt County California	360 ft (111 m)		Largest known tree still standing in the world.
Wellington Pine *Sequoiadendron giganteum*	Central Calif	347 ft (107m)	83 ft (26.6m)	Past specimen (Ref. Dr A.C. Carder) .
Douglas Fir *Pseudotsuga menziesii*	Oregon	400 ft (123m)	53 ft (16.4m)	Past specimen (Ref. Dr A.C. Carder)
New Zealand Trees				
Kauri	Tane Mahuta Ngahere Waipoua Forest	51 m (166 ft)	14 m (45.5 ft)	Still living, over 1200 years old. Largest living Kauri.

To Honour a Noted Botanist

Ruth Dwyer*

Baron Ferdinand von Mueller was honoured in many ways, noble titles, decorations and through living species being named after him. Most of these were botanical, but as Darragh shows in this issue there were also fossils and insects. One of the more spectacular is the King Stag Beetle, *Phalacrognathus muelleri*. On the 14 June 1886, The Field Naturalists Club of Victoria held their monthly meeting, as usual, at the Royal Society's hall. A relevant paper was read by Mr. Paolo Dattari[1].

Dattari presented his paper, 'Notes on the new Australian beetle,' outlined the history of 'this splendid insect' and in distributing the paper, illustrated with enlarged coloured drawings, expressed his opinion that the specimens exhibited would probably be found to be more than one species. Lithographic plates of the beetle were also distributed. It was found to be a new genus, and was named *Phalacrognathus muelleri* in honour of his friend and mentor, the Government Botanist, Baron Sir Ferdinand Jakob Heinrich von Mueller. A copy of the paper, with coloured plate, was presented to the library of The Field Naturalists Club [2]. It cannot now be found. However another copy was located in the collection of the National Museum of Victoria.

Paolo Dattari, a cultured Italian gentleman, had emigrated from London in 1877 as an unassisted passenger aboard the *Somersetshire*[3]. Dattari, born c1850 in Leghorn near Florence, the son of Luigi Dattari, gentleman, and Enrichetta, formerly Maneschit, was professionally an architect[4]. Unfortunately no buildings in Victoria can be attributed to him, but evidences of his involvement in associated disciplines are varied. He contributed two pen-and-ink drawings to the Adelaide Exhibition of 1881, one being an allegory for Punch, the other a frontispiece for a scientific publication. Both were well designed and delicately executed[5]. The handsome and costly gold and silver presentation casket of 1880 for Captain Standish, Chief Commissioner of Police in Victoria, was of Dattari's manufacture[6]. and showed a distinct Italianate influence. Dattari was also to apply for the registration of at least two patents in Victoria, the first being in 1882 for a Parallel Ruler combining ruler, protractor and scale, and the other in 1883, in conjunction with J.E.Edwards, an Electro 'Control'[7]. His interest in the scientific is further evidenced by the existence of a letter from Professor McCoy (7 August 1886) identifying a species of fish found locally[8].

In June 1880, Dattari had been elected to The Field Naturalists Club of Victoria, one of the original members, and remained as such until 1886, after which time there is an inexplicable absence until his re-admission on 13 July 1891[9]. A letter from Mueller (7 September 1886) enclosed a map of New Guinea possibly indicating a field trip by Dattari to that northern area[10].The birth of a son, Paolo, to Dattari and his wife, the former Margaret Elizabeth Victoria Yeomans, indicates a possible presence in Carlton in 1887[11]. The last Sands and McDougall directory entry is for Station Street, North Carlton in 1888. It is believed that Dattari returned to the Florentine area some time after 1891.

Baron von Mueller had presented to Dattari a copy of his 'Description and illustrations of the myoporinous plants of Australia, vol. 2,' inscribed 'To P. Dattari Esqr & c with regardful remembrance from his sincere friend Ferd. von Mueller. Sept. 1886'[12]. Other relevant correspondence, including advice on the terminology to be used when documenting botanical specimens,[13] is held at the library of the National Herbarium of Victoria and by The Field Naturalists Club of Victoria.

Acknowledgements

Dr. Thomas A. Darragh, National Museum of Victoria, for assistance including the location of the McCoy letter. Sara Maroske, Joint Editor of The von Mueller Project, for provision of transcripts of letters from The Correspondence of Ferdinand von Mueller.

* 75 Wattle Road, Hawthorn, Victoria 3122.

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The Mueller Memorial Medal

Alan K. Parkin[1]

Soon after Baron Ferdinand von Mueller's death, we read in *The Victorian Naturalist* (**14**, 8) that

> 'a fund has been started to establish a permanent national memorial to the late Baron von Mueller. An influential general committee, with the Mayor of Melbourne as its chairman, and an executive committee, under the chairmanship of Sir John Madden, have been formed, while Professor Spencer (then Past President, FNCV) and Mr. W. Wiesbaden have consented to act as joint hon. secretaries',

with the then secretary, Mr G. Coghill, soliciting support from Club members. This initiative is similarly recorded in the *Australian Journal of Pharmacy*, which indicates that the thinking was to fund a 'statue or scholarship which should keep his memory green always', and that a sum of 55 pounds was subscribed at the inaugural meeting.

The matter appears to have languished a little until being taken up at the 7th Congress of the Australasian Association for the Advancement of Science (January 1898), where the Baron von Mueller Memorial Fund Committee was established and soon accumulated 450 pounds to invest. This was considered sufficient to fund the award of a Medal biennially

> 'to the author of the most important contribution, or series of contributions, to natural knowledge, published originally within His Majesty's Dominions, within a period of not more than five years or less than one year of the date of the award, preference to be given to work referring to Australia. The portion of the interest remaining after the purchase of the medal was to be awarded as a prize to accompany the medal.'

to be administered by AAAS (*The Victorian Naturalist* **17,** 11). The Medal, as illustrated by Daley (Victorian History Magazine, 2, 1924), was designed by J.T. Fryer of Melbourne and cast, at least initially, in Paris in silvered bronze. It shows on one side the Baron, who was AAAS (now ANZAAS) President in 1890, at work with a specimen, and on the other a Waratah (presumably *Telopea oreades* FvM) with inscription.

The list of recipients of the Mueller Memorial Medal below (largely from M.Willis, *By Their Fruits*) will contain many names familiar to Club members:

1904	Howitt, A. W. (VN* **20**, 128)
1907	Hill, Prof. J. P.
1909	David, Prof. T.W.E.
1911	Etheridge, R.
1913	Howchin, Rev. W.
1921	Baker, R.T. & Chilton, Prof. C. (2 awards)
1923	Maiden, J.H.
1924	Maitland, A.G.
1926	Wood-Jones, Prof. F.
1928	Cockayne, L.
1930	Mawson, Sir D.
1932	Black, J.M.

[1] 2 Hazel Drive, Templestowe, Victoria 3107.

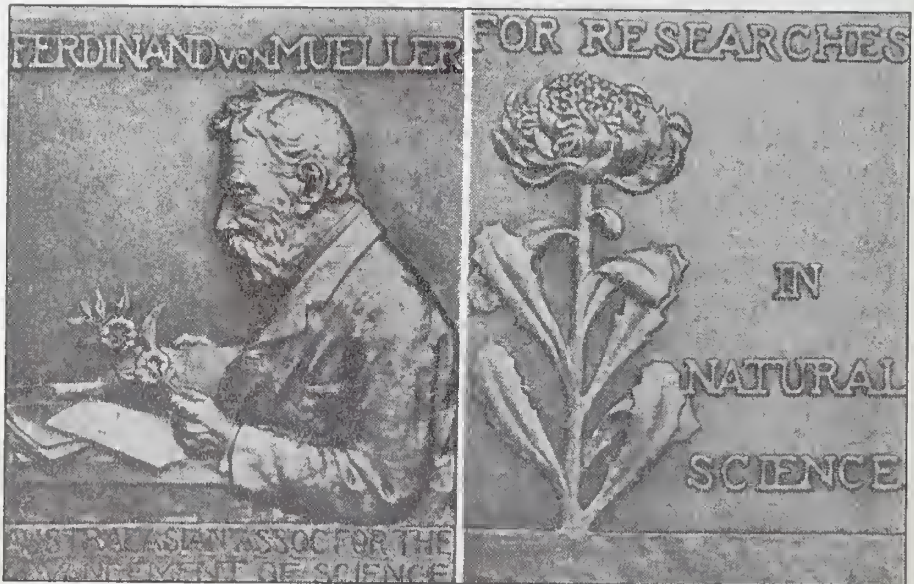
1935	Tillyard, R.J.
1937	Skeats, Prof. E.W.
1939	Johnston, Prof. T.H.
1946	White, C.T. & Andrews, E.C. (2 awards, VN **63**,164)
1949	Dakin, Prof. W.J. (VN **65**, 262)

Strangely, very few of these awards gain a mention in *The Victorian Naturalist*, with no further references after 1949. Around this time, the award conditions appear to have been broadened by ANZAAS, such that the Medal has become somewhat overshadowed by the Australian Natural History Medallion, at least as far as this Club is concerned. It may be of interest that C.T. White was the grandson of F.M. Bailey, whom he succeeded as Government Botanist of Queensland. The first presentation to A.W. Howitt (*The Victorian Naturalist* **21**, 4) was made by Prof. Baldwin Spencer at a joint meeting of FNCV and the Royal Society of Victoria, of which he was then President.

Awards made by ANZAAS, subsequent to 1950, are listed below:

1951	Benson, W.N.
1952	Longman, H.A.
1954	Prescott, Prof. J.A.
1955	Bull, L.B.
1957	Elkin, Prof. P.E.
1958	Marston, H.R.
1959	Browne, W.R.
1961	McKerras, I.M.
1962	Burnet, Sir F. McF.
1964	Fenner, Prof. F.J.
1965	White, Prof. M.J.D.
1967	Hill, Prof. Dorothy
1968	Taylor, N.H.
1969	Beauglehole, J.C.
1970	Robertson, Sir R.N.
1971	Stanner, Prof. W.E.H.
1972	Waterhouse, D.F.
1973	Moir, Prof. R.J.
1975	Ringwood, Prof. A.E.
1976	Pryor, Prof. L.D.
1977	McIntyre, Prof. A.K.
1979	McFarlane, Prof. W.V.
1980	Waring, Prof. J.H.
1981	Sprent, Prof J.F.A.
1982	Bennett, Isobel
1983	Webb, L.J.
1983	Webb, L.J.
1984	Johnson, L.A.S.
1985	Woodall, R.
1987	Womersley, H.B.S.
1988	Quirk, Prof. J.P.
1990	Main, Prof. A.R.
1991	Mitchell, Prof. G. F.
1992	Clarke, Prof. Adrienne E.
1993	Twidale, Prof. C.R.
1994	Archer, Prof. M.
1995	Curtis, Winifred

* *The Victorian Naturalist.*



The Mueller Medal. From *The Victorian Naturalist* **21**, 5, on the occasion of the presentation to Mr A.H. Howitt, F.G.S. 1904.

The Baron and the Goldfield

Ray Wallace[1]

The great Bendigo goldfield eventually matured into a fine provincial city. Prominent towns such as Inglewood and Castlemaine, both within thirty miles of Bendigo, had enjoyed the bonanza of their own gold production and Bendigo's neighbour and erstwhile rival, Eaglehawk, was also founded on gold. Civic pride was high and by the 1870s botanical and public gardens were well established in the aforementioned towns.

If the botanical gardens were underpinned by the philosophy of the Enlightenment then the movement and the time, in Victoria, was ripe for someone of Baron Ferdinand von Mueller's stamp. Enlightenment thought was based on the belief that, as scientific knowledge expanded and truth was revealed, society would correspondingly progress, as exemplified by the Industrial Revolution.

This type of thinking led to the concept of the botanical garden being a place where the marriage of genteel learning and utility took place. One could observe the wonders of nature with the aim of unravelling its secrets.

The four gardens in the towns mentioned above, although perhaps unknown to the majority of their councillors, were in a way trial grounds for Mueller, here his conifers could be subject to empirical observation and experimentation. One of the Baron's primary focuses was the search for suitable species for the establishment of a softwood timber industry and naturally conifers were a prominent part of his distributions (Almond 1996). The botanical gardens at White Hills (Bendigo) and Castlemaine and the public gardens of Eaglehawk and Inglewood certainly give testimony to the wider state picture, while the cemeteries of Eaglehawk and White Hills are rich in superb specimens of coniferous species as well, and were established in that period when Mueller was distributing huge numbers of plants throughout Victoria.

His legacy is found even in the small Canterbury Park, Eaglehawk, public gardens which holds lovely specimens of Bunya Bunya Pine *Araucaria bidwillii*, Hoop Pine *Araucaria cunninghamii*, Canary Island Pine *Pinus canariensis*, Deodar Cedar *Cedrus deodara* and Western Yellow Pine *Pinus ponderosa*.

In the same area at the Eaglehawk cemetery, as well some of the above species, there are specimens of the sombre Monterey Cypress *Cupressus macrocarpa*, along with Monterey Pine *Pinus radiata* and Norfolk Island Pine *Araucaria heterophylla*.

At White Hills gardens too is the rare Soledad Pine *Pinus torreyana* which is included on the National Trust Register of Significant Trees, also at White Hills gardens, and on the Register, is a superb specimen of African acacia, Karoo Thorn *Acacia karoo*.

A lot of Mueller's distributions in the Bendigo gardens reflect his involvement with the Zoological and Acclimatisation Society of Victoria of which he was a board member. A man of boundless energy, Mueller, with contacts throughout the world which must have numbered hundreds if not thousands, actively sought more work. In the 1860s he was writing to the Borough of Eaglehawk offering his services.

Council records of the then Borough of Sandhurst (Bendigo) note that in the 1860s and 1870s Mueller was supplying seeds and plants along with advice to the public gardens in Bendigo.

As well, in a letter dated 7 May 1872, Mueller was recommending a fellow German, Mr Homeyer, as a very suitable man to take over the curatorship of the botanical gardens at White Hills upon the retirement of Curator Fletcher. The Baron's petition was unsuccessful, however, for soon after the name of Curator Gadd appears in the records and indeed appeared for many years to follow.

In 1873 Mueller was supplying aquatic plants for the Eaglehawk Borough Council and that same year the Botanical Gardens

[1]19 Haggar Street, Eaglehawk, Victoria 3556

Fig. 1. Karoo Thorn *Acacia karoo* at White Hills Botanical Gardens

were supplying the Eaglehawk gardens with trees. However, Mueller was not Eaglehawk's sole source of plant material for in 1873 the Council was also purchasing plants from Joseph Harris's South Yarra nursery a month before Mueller was replaced as Director of the Botanical Gardens. Trees for the White Hills Botanical Gardens were also purchased from B. and S. Johnson at Preston. Curator Fletcher was also inquiring for *Araucaria* seeds from Law Sumner and Co., Melbourne.

So prominent a role did Mueller play in the supplying of free plants to regional gardens that there is strong evidence that the professional nursery lobby had some influence in his dismissal as Director of the Botanical Gardens (*Daily Telegraph* 1872).

It seems, however, that this did not stop Mueller from performing what he obviously saw as a public duty for he was still supplying the Castlemaine Botanical Gardens with plants as late as 1880, a practice he had established in 1860.

Perhaps an indirect influence of Mueller on the Bendigo and district gardens, through his involvement with the Acclimatisation Society, was the establishment of aviaries in places such as the Eaglehawk and White Hills gardens, and shortly after the artificial Lake Neangar at Eaglehawk was completed in 1883, the Acclimatisation Society offered to stock it with fish.

A striking example of Mueller's indefatigable attention to detail was illustrated in his capacity as Government Botanist. As a man who must have written possibly thousands of letters a year in a voluminous correspondence he found time to write to the committee of the Eaglehawk Mechanics Institute inquiring if they had a complete collection of his works and if not he would donate those the library lacked. The Eaglehawk Mechanics Institute was a substantial edifice and serviced a population of some 8,000 people (Minute Book 1877a).

Even more striking is the fact that he made the same offer to the little California Gully Mechanics Institute, situated between Eaglehawk and Bendigo, and servicing some few hundred people. Such was the Baron's zeal (Minute Book 1877b).

Whilst Mueller had much to do with Bendigo, and its surrounding areas, as Government Botanist and Director of the

Botanic Garden through his vast correspondence, surprisingly, he seemed to do little botanical work in such places as the floristically rich Bendigo Whipstick or the equally interesting box-ironbark forest country around Inglewood.

Walter Bissill from Big Hill, a science graduate from the University of Melbourne and pioneer naturalist, had done extensive work in the southern areas of Bendigo but little to the north, but as far as I am aware there is little evidence of much communication between Mueller and him and Richard Nancarrow at Neilborough, another pioneer naturalist, although Bissill did send Mueller specimens and had *Hannafordia bissillii* named for him.

The Victorian Field Naturalists visited the Whipstick quite often prior to 1920 but little systematic work was carried out before the pioneering efforts of Charles Daley, David Paton and Alfred Tadgell.

One early Bendigo naturalist that Mueller did have extensive contacts with was Walter Froggatt who had spent his childhood in Eaglehawk and later became Government Entomologist for New South Wales. His early development as a naturalist had been nurtured by Richard Nancarrow. As a young man, Froggatt collected plants on the Flinders River, Queensland, and sent material to Mueller.

Not one to forget either slight or favour, the Baron used his influence in 1885 to have Froggatt appointed special zoological collector and assistant zoologist for the New South Wales branch of the (Royal) Geographical Society of Australasia's expedition to New Guinea. Froggatt performed his duties so well that his career prospered, thanks to the initial impetus supplied by the Baron.

Thus the influence of the Baron is still tangible and seen, even today, through Bendigo and district's gardens and his philosophy is made concrete through the superb conifers that adorn them.

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Minute Book 1877b. Minute Book California Gully Mechanics Institute Public Library, 20 October 1877.

Mueller, Acclimatiser and Seed Merchant

It could well be said that Baron von Mueller's principal interest lay in the genus *Eucalyptus*, and he lavished praise on these remarkable trees throughout his writings. Not least, he extolled their sanitary virtues by dint of his own training with a PhD in botany from Kiel (where he first encountered *Euc globulus* in the University garden), and because eucalyptus oil was already well established in medicinal use*. He it was who persuaded a Richmond chemist, Joseph Bosisto, to commence commercial production of eucalyptus oil in 1853.

From his appointment as Government Botanist in that year, Mueller engaged in prodigious correspondence with botanists around the world (and it is said that it needed two postmen to deliver his mail). One of the most noteable correspondents was Elwood Cooper of Santa Barbara College, California, who received seed of some 50 species of *Eucalyptus* from the Baron and planted more than 50,000 trees on some 100 hectares of the College Campus. From here, and another experimental planting by Abbot Kinney at Rustic Canyon, Blue Gum in particular has come to be synonomous with the landscape of southern California, even to spawn the 'Eucalyptus School' of painting (focussed around Hanson Duvall Puthuff). Cooper ultimately published his book '*Forest Culture and Eucalyptus Trees*' in 1876, consisting mostly of reprinted lectures of Mueller's - and in one edition even reprinting the whole of '*Select Extra Tropical Plants*', in what has been termed an outrageous act of plagarism (Pescott 1922). However, there is no indication that Mueller was ever unduly perturbed by this.

Mueller, of course, received a vast quantity of seed in exchange - much of which went into the development of our Royal Botanic Gardens, including an experimental patch of opium. It is well known that he took Blackberry seed, *Rubus fruticosus,* wherever he went on his travels in Victoria - to sustain weary travellers of the future! (Wakefield 1959; 1961). In one of his lectures, he relates taking Dewberry (*Rubus canadensis*) seed on a journey up the Yarra to Mt. Baw Baw, scattering it in the alpine bogs. In fact, his dreams for acclimatisation of plants and animals (alpacas roaming the High Plains, etc.), as espoused lyrically in his various lectures, would horrify many of us today.

Mueller was not the first to send seed overseas. Maiden (1903) records that Messmate *Euc. obliqua* was planted in the botanic garden of the Count of Camalduli, near Naples, some time before 1829, under curator Frederick Dehnhardt. Red Gum seeds must have arrived also around the same time, which resulted in this species acquiring the quite inappropriate name of *Euc. camaldulensis* (Dehn).

In discussions with the then Catholic Archbishop of Melbourne, Dr Goold (as recorded by J S Duke, Melbourne *Argus* 22.8.31), Mueller learnt something of the problems of the malaria ridden swamps of the Campagna di Roma. His solution was to plant *Euc globulus*, not only to lower the water table, but also to clarify the air and disinfect the soil from the falling leaves. Dr. Goold duly left for the Vatican Council of 1869 with a packet of seed from the Baron, who passed it to the Superior of the Trappist monks at the Tre Fontane Monastery, in the heart of the fever stricken region. The monks then undertook the raising of some 55000 trees, planted out in regular early morning forays (perhaps when the air was deemed to be fresh) over some years. The transformation was evidently profound, ultimately enabling farming operations to be established. When Mueller was advised of this in an1879 letter from Dr Goold, he was so flattered that the whole of his Lordships letter was quoted in *Eucalyptographia* (6th Decade), with his own extravagant comments on the solution of a problem that had defied all the rulers of Rome from Appius Claudius to the present.**

Blue Gum seed went to many lands, and established itself so well that in some (such as Portugal) it has virtually displaced much of the natural vegetation. Mueller sent *Acacia dealbata* and *A. mollissima* to South Africa where they flourished so well away from the copper butterfly that we were soon importing wattle bark from there. Saltbush (*Atriplex*) species went to California and Arizona, and in return he received Marram Grass (*Psamma arenaria*), first planted at Port Fairy, and Monterey Pine *Pinus radiata*, a tree recorded by Ewart (Handbook of Forest Trees... 1925) as being not abundant, nor of any real commercial significance, in California. Early reports of the Royal Botanic Gardens contain lengthy lists (pages!) of seed donors but little specific detail on what they sent.

* Mueller's sensitvity to such matters was undoubtedly hightened by losing both his parents to TB, and his own brush with the disease. He always remained something of a hypochondriac and was noted for muffling his neck with a scarf, even at important social gatherings.
** R.F.Zacharin *Emigrant Eucalypts* p 58 records an entirely different story, wherein the seed originated from Alfred Howitt, responding to his father William who retired to Rome in 1870.

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Alan Parkin

2 Hazel Drive, Templestowe, Victoria 3107.

Mueller's Magpies and Marsupial Wolves: A Window into 'What Might Have Been'.

R.N. Paddle[1]

Abstract.
Mueller is most often associated with the development of the science of botany in Victoria. However, he had an active interest in the development of Melbourne Zoo and a far-sighted view of Australian ecology. His concern and actions over the problem of foreign introductions (the European magpie) and the extinction of the native fauna (the Thylacine), indicate that Mueller was amongst the first scientists to appreciate the threat to the Australian environment from European settlement. (*The Victorian Naturalist* **113**, (4) 1996, 215-218)

At the request of Victoria's Chief Secretary, Baron Ferdinand von Mueller convened the first meeting of the Committee appointed to administer Melbourne's proposed Zoological Gardens on 24th July 1858 and was duly elected Secretary (Jenkins 1977). The position of 'Secretary' was the title confirmed upon the curator of the zoo, until the designated position of 'Director' was established in 1882 (Zoological and Acclimatisation Society 1884). An initial land grant of 33 acres for the Zoological Gardens was situated on the north side of the Yarra river, but these 'Richmond Paddocks' proved to be too swampy and the collection was moved across the river to within the Botanical Gardens. The early zoological collection consisted of Victorian native mammals and birds, together with deer and camels and representatives of other more unusual domesticated ruminant species, foreign songbirds and a few monkeys. As curator, Mueller effectively ran the zoo for the first four years of its existence. He not only concerned himself with daily care, he organised the international exchange of animals, building up the zoo's display through exchanging specimens with zoological, botanical and acclimatisation societies in Calcutta, Cologne, Copenhagen, Java, London and Paris (de Courcy 1995).

In 1861 the English Magpies (*Pica pica*) imported by the zoo committee member Thomas Embling escaped from their cage in the Botanical Gardens. Unable to effect their capture, Mueller kept his eye on the escapees. He noticed how very destructive they were to the smaller native bird species, so, in order to prevent the Magpies from reproducing and spreading beyond the gardens, he shot them. Even though the objects of the Acclimatisation Society - the designated body then in control of the development of the zoo - were only meant to be for 'the introduction, acclimatisation and domestification of innoxious animals' (Acclimatisation Society minutes, August 1861, cited in Jenkins 1977, p61), and the English Magpies had proved themselves, on the contrary, quite noxious, Embling was incensed and his acclimatisation colleagues on the zoo committee turned against Mueller. From their perspective, the real reason for the importation of English Magpies was to acclimatise, breed and then release them in large numbers to replace the unwanted native birds as quickly as possible. Animosity towards, and rumour against, Mueller was spread by the hard-line acclimatisers on the zoo committee (de Courcy 1995). The animal collection was removed from the Botanical Gardens, and an attempt made to re-establish the zoo on the 'Richmond Paddocks' site. But this again proved unsuccessful and, after some political agitation, the granting of a replacement 55 acres at Royal Park in 1862 saw the Zoological Gardens, under W.G. Sprigg as secretary-curator, finally separated from their botanical counterpart.

Melbourne Zoo did not exhibit a Thylacine or Marsupial Wolf (*Thylacinus cynocephalus*) until after it had moved to the Royal Park site. The Thylacine was obtained from an unknown Tasmanian source on 4th November 1864. The

[1] Psychology Department, Australian Catholic University, Christ Campus.

specimen adapted well to captivity and survived until 12th January 1869. Shortly after its arrival Mueller, in the course of his usual botanical correspondence with the Launceston naturalist Ronald Campbell Gunn [FRS], wrote inquiring about the possibility of obtaining Thylacine specimens.

Gunn had kept Thylacines as pets and supplied specimens to different institutions for zoological display. He had successfully sent a pair of Thylacines to the Zoological Society of London in 1849, for display at Regent's Park Zoo (Gunn 1850). Intrigued by the species' behaviour and potential he set out - as others had before him - to domesticate a specimen. In 1851 he had noted: 'My living Thylacine is becoming tamer: it seems very far from being a vicious animal at its worst, and the name Tiger or Hyæna gives a most unjust idea of its fierceness' (Gunn 1851). In 1854 he provided a Thylacine for Richard Propsting's animal collection on public display in Hobart (Propsting 1854), and he despatched a family of four Thylacines to Regent's Park Zoo in 1863. Only two of these specimens survived the voyage and they were to be the last Thylacines to enter London Zoo for 21 years (Gunn 1863; Sclater 1884; Zoological Society of London 1872). Gunn may also have been the unidentified source supplying Melbourne Zoo's 1864 specimen.

In May 1865 Gunn wrote to Mueller, offering him a family of Thylacines, a mother with three young. Mueller gratefully accepted the offer on the 20th May (1865a) and received the specimens on the 16th June:

> I received your very kind letter of the 14th together with the 4 Thylacini in excellent health. It is indeed a precious gift and I trust to fulfil now the wish of the Parisian Savants, who were so eager to secure this rare creature for the Jardin des Plantes. I shall not fail to render known who is the real donor. (1865b)

Mueller recognised the increasing rarity of the species, and the value of the donation, expressing the hope that :'As these animals most probably would breed in not too confined a state, the species, ere long perhaps extinct, might be kept up in menageries from your importation' (1865b). Mueller's prediction of the future for the species was well placed: the last known Thylacine died in Hobart Zoo on 7th September 1936. Unfortunately the conditions for successful Thylacine breeding in captivity - the isolation of an unrelated adult pair - were rarely met; the only confirmed instance of captive breeding took place at Melbourne Zoo in 1899.

Concerned about the loss on board ship of half the Thylacines Gunn sent to London in 1863, Mueller questioned Gunn as to whether the young should be separated from their mother (1865a). The family was kept together but the decision was made to overwinter the Thylacines in the botanical gardens.

> The weather is now too cold to send the animals around Cape Horn. I shall probably wait til spring when the *Yorkshire* goes & when I can place them together with the sheep on board under the care of a very trustworthy man. (1865b)

In a further letter to Gunn, Mueller noted that 'The Thylacini...continue in good health' (1865c).

The *Yorkshire* duly set sail for London on 14th November 1865. How the Thylacine family fared on the journey, how many survived and where they went to on arrival in 1866 are, at present, unknown.

Examination of the historical records of the Jardin des Plantes has failed to locate details of the arrival of their first Thylacine specimen on display. Heinz Moeller who has published extensively on Thylacine anatomy and records of Thylacines in European zoos, notes that two or more Thylacine specimens were held in the Jardin des Plantes. The last known specimen died in 1891. Details of the very first specimen remain, at present, unknown (Claude 1996; Moeller 1993), but could conceivably date from 1866.

It is also possible that members of the family were separated on their arrival, and donated to other learned individuals and institutions. Mueller may therefore have been responsible for the only live Thylacine presently known from continental Europe at this time. When the Berlin Zoo received a second Thylacine in 1871 (it received its first in July 1864 but it had lived only four months) the next edition of the zoo guide suggested it was the only Thylacine now alive in Europe as the Vienna animal had died in 1866 ['das Wiener Tier war 1866 gestorben'], (cited in Klös 1988). This casually mentioned Thylacine living in Vienna in 1866 may well have originated from Mueller.

Mueller began supplying the Stuttgart Natural History Museum with zoological and botanical specimens in the 1860's. His vertebrate donations alone totalled 2,269 specimens, covering 837 species, one of which was a Thylacine (Köning 1991). However, the registration date for this specimen - a whole skin mount plus skull - (Fig 1) is recorded as September 1889 (Joan Dixon, *pers. comm*), and its most likely provenance was from deceased stock at Melbourne Zoo, which is known to have purchased six Thylacine specimens from northern Tasmania between 1883 and 1886.

It is difficult to imagine how Mueller could have filled his life with any additional professional responsibilities and activities. But his presentation of Thylacine specimens, both alive and dead, to European scientific institutions is merely one expression of his zoological interests; the depth of which may be gauged by the extent of his donations to the Stuttgart Natural History Museum. His prediction of extinction for the Thylacine and concern over the introduction and release of exotic species demonstrates how finely attuned he was to the entirety of Australian ecological relationships. Were it not for internal acclimatisation politics within the committee overseeing the zoo, he would, in all likelihood, have continued as curator. Mueller's environmental concerns were denigrated by the economic rationalists of his time, the acclimatisers who saw little of tangible value in the Australian environment and sought, with the concept of 'progress' in mind, to alter its unfamiliar wildness as rapidly as possible, and replace it with economic productivity and familiar faces. Having removed Mueller as curator, the Acclimatisation Society of Victoria went on to play its pre-eminent role in the destruction of the

Fig. 1. The whole skin mount of an adult male Thylacine in the Stüttgart Natural History Museum, donated by Mueller in 1889.

Australian environment. For example, members of the Association helped spread Rabbits, release Foxes, import and release Hares, five species of Deer, two species of Sparrow, Starlings, Blackbirds, Pigeons, Doves, Indian Mynas, European Waterfowl and Californian Quail all of which became established within Victoria. They also supplied specimens for release by individuals and societies in other Australasian colonies (Jenkins 1977; Rolls 1984).

How great has been the environmental destruction in the 100 years since Mueller's death, and how significant the decrease in Australian biodiversity! One is forced to contemplate how different the Australian environment would be today if only Mueller had been retained as curator of the Melbourne Zoological Gardens.

Acknowledgments

Thanks are expressed to Prof. A.M. Lucas, King's College, University of London, for his continuing attempts to locate European-based records of Mueller's Thylacines in 1866; to Dr Wirth of the Stuttgart Natural History Museum for the photograph, to Joan Dixon, Museum of Victoria, for access to her personally obtained records of Thylacines held in overseas museums, and to John Lowe for his services as translator. The professional advice and assistance from archivists and librarians at the Mitchell Library, Sydney, Public Records Office, Melbourne, and Museum of Victoria was invaluable, as well as the assistance provided by Chris Larcombe, Chief Executive Officer at Melbourne Zoo. The continuing encouragement and support of Prof. Rod Home, University of Melbourne and Prof. Graham Mitchell, Commonwealth Serum Laboratories is also appreciated.

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Mueller's naming of Places and Plants In Central Australia - Victorian Eponyms

Linden Gillbank[1]

Abstract
Mueller was largely responsible for determining the shape of European botanical knowledge of inland Australia during the second half of the nineteenth century. In naming inland plants and physiographic features, Mueller honoured fellow Victorians including explorers, doctors and politicians (*The Victorian Naturalist* **113**,1996, 219-226).

Introduction

Floral and physiographic features of the arid interior of Australia bear the names of nineteenth century residents of the colony of Victoria. Some names are well-known: for example Victoria's governor La Trobe and government astronomer Ellery - whose names are attached to a species of *Eremophila* and a tributary of the Finke River. Other names are of less well-known Victorians. The person who was largely responsible for these names was Baron Ferdinand von Mueller. As Victoria's government botanist from the begining of 1853 until his death in 1896, he provided names for places as well as plants in central Australia, many of them commemorating fellow Victorians.

This paper describes how Victoria's Government Botanist wielded such extra-colonial naming power over part of the Australian landscape which was never part of Victoria and which he never visited; and reveals some of the Victorians whom Mueller chose for phytological and physiographical commemoration. **Mueller's plant names are presented as he recorded them - with specific names commemorating people begining with capital letters, as was the custom in the nineteenth century.**

Mueller and Exploration

Exploration was an integral part of Mueller's early botanical work. During the 1850s he trekked extensively across the Australian landscape in search of plants. His first substantial floral foray in Australia - from Adelaide along the Flinders Ranges in 1851 - introduced Mueller to Australia's desert flora in the wild. Following his appointment as Victoria's Government Botanist in January 1853, Mueller carried out extensive botanical expeditions in Victoria and participated in the British government's North Australian Exploring Expedition led by Augustus Gregory (Cohn, this volume). With Gregory, Mueller used the Victoria River and Sturt Creek as he had used the Flinders ranges four years earlier - to explore and botanize into the undocumented interior of the continent (Gillbank and Maroske 1996). As botanist to the North Australian Exploring Expedition, the young Mueller enhanced his skills and reputation in both exploration and botany.

Mueller never reached the arid centre of Australia but maintained a continuing interest in its exploration and botany. After Gregory's expedition, Mueller increasingly enjoyed the role of Australian botanical authority, and plants collected during several waves of inland exploration were sent to him to document - including expeditions led by Babbage, Stuart, Burke and Giles (Gillbank and Maroske 1996). Mueller documented many of these plants in Latin in his journal *Fragmenta Phytographiae Australiae* [*Fragments of Australian Botany*], and in English in *The Victorian Naturalist* (after its establishment in 1884).

Mueller did not sit idly waiting for plant specimens to reach him. He argued publicly for further exploration of the interior, helped initiate the expedition now known as the Burke and Wills expedition, and helped Giles plan, publicize and fund his expeditions.

Desert Lovers

Mueller was fascinated by the remarkable flora of the arid interior, commenting in 1858 that:

[1]History and Philosophy of Science Department, University of Melbourne, Parkville, Victoria 3052.

> 'A traveller in the extensive desert-tracts of Australia is often well rewarded for his toils and privations by the enjoyment which the sight of the varied works of the Creator must ever cause to contemplative minds; more especially when it is observed that, with the increase of the country's barrenness, variety and beauty in the vegetation increase in proportion.' (Mueller 1860)

He was particularly impressed with the diverse beauty of plants whose generic name *Eremophila* means desert-loving:

> 'Prominent amongst the attractive plants to be met with in the solitudes of the interior are those of the Myoporinous order ... [including the genus] *Eremophila*, ... comprising forms exquisitely ornamental.' (Mueller 1860)

Mueller received the plants collected during Benjamin Herschel Babbage's 1858 exploration north of Lake Torrens, South Australia. In his botanical report Mueller (1859) suggested that

> 'the most interesting and certainly the most ornamental portion of the vegetation in the territory lately explored is constituted by the numerous and gorgeous species of Eremophila. The additions to this genus now obtained induced me to review once more all the species with which I am acquainted'.

In reviewing the genus *Eremophila* R.Br., Mueller honoured Victoria's first governor, Charles Joseph La Trobe, who had created the position of Government Botanist and appointed Mueller to it. While trekking down Sturt Creek with Gregory, Mueller had collected a 'magnificent' *Eremophila* which he wanted to name after La Trobe, whose 'unlimited kindness' was 'in the desert vividly retained' in his mind, hoping that it would 'never sink in oblivion' (Mueller to Hooker, April 6, 1857). Mueller (1858-9; 1859) expressed his indebtedness to La Trobe by naming and describing *Eremophila Latrobei* in the first volume of his *Fragmenta* and in his botanical report of the Babbage expedition. Mueller (1859) noted that this 'noble species' was

> 'well worthy of bearing the name of the excellent Charl. Jos. La Trobe, a great patron of Botany, and to whose love for science the botanical department under my administration owes its origin.'

Mueller did provide a lasting botanical memorial to La Trobe. That attractive desert lover, with its bright-red pendulous floral bells, still carries his name - both its formal scientific name, *E. latrobei*, and its common name, Latrobe's Desert Fuchsia.

Of explorers, living and dead

In the 1860s Mueller named many plants collected in the arid interior during several expeditions - John McDouall Stuart's expeditions, the Victorian Exploring Expedition and its subsequent relief expeditions.

Mueller was an active and enthusiastic proponent of a plan for the Philosophical Institute of Victoria (later the Royal Society of Victoria) to send a Victorian scientific expedition across Australia. A foundation member of its Exploration Committee, Mueller supported the committee's eventual choice of route but not leader (Bonyhady 1991). On the Victorian Exploring Expedition, which was renamed the Burke and Wills Expedition, and two relief expeditions, three medical officers - Beckler, Wheeler, and Murray - doubled as plant collectors and sent specimens to Mueller. In the early 1860s Mueller used specimens they collected to botanically commemorate people connected with the expedition and several other Victorians. Their specimens are type specimens which are still housed in Melbourne's National Herbarium.

The main expedition's medical officer and botanist, Dr Hermann Beckler, who had previously collected plants for Mueller, was the only expedition member to collect plants. However he did not accompany Burke and Wills north of the depot camp on the Darling River (near Menindie), but remained in charge of that camp. From December 1860 to June 1861, while caring for the sick, Beckler collected plants in the north-west corner of NSW and just across the border into Queensland (Bonyhady 1991; Willis 1962). At the Royal Society's monthly meeting in May 1861 Mueller exhibited several plant specimens which Beckler had collected near the Darling River while searching for two members of Burke's exploring party (*Argus* 28 May, 1861).

Although Mueller had previously received plant specimens from the vicinity of the Darling River, Beckler's collection contained many plants still awaiting scientific names. In naming them in the second and third volumes of his *Fragmenta*, Mueller commemorated people who had supported the expedition and his Botanic Garden (Table 1). They included three Victorian residents - Hopwood, Docker and Greeves - all of whom Mueller acknowledged in his annual reports as donors of plant material - seeds, living plants, and dried herbarium specimens.

Mueller (1860-1) named *Anthocercis Hopwoodii* in honour of Henry Hopwood, former convict, entrepreneur and founder of the town of Echuca, who donated £100 in return for being accepted as a member of the Philosophical Institute - the most enthusiastic response to the Institute's appeal for £2000 (Bonyhady 1991). Mueller later transferred this alkaloid-rich 'Pituri' plant to the genus *Duboisia*. Mueller (1860-1) named *Acanthocladium Dockeri* to commemorate the Reverend Joseph Docker of 'Bontharambo' on the Ovens River (near Wangaratta), who donated £100 to the Victorian Exploring Expedition so that he would not seem lacking in either public spirit or gratitude to his 'adopted country' (Bonyhady 1991). Later Mueller (1862-3) named a woolly herb which Beckler collected near the Barrier Range *Millotia Greevesii* (Fig.1), after the multifaceted Augustus Greeves, M.L.A., surgeon, politician, businessman and former Mayor of Melbourne.

When Burke and his three companions did not return to Melbourne, relief expeditions were sent out in search of the missing explorers. Alfred Howitt's first relief party reached the depot camp in August 1861. Their medical officer, Walter Frank Wheeler, later collected plants beyond Beckler's most northerly collections - between Stokes Range and Cooper's Creek (Willis 1963). Wheeler is commemorated in the names of two plants he sent Mueller. One was among the herbarium specimens of Australian legumes which Mueller sent to George Bentham to determine. In his *Flora Australiensis* Bentham (1864 II) described and named *Isotropis Wheeleri*. Mueller sent his collection of Australian members of the Euphorbiaceae to the French botanist, H. Baillon, for taxonomic enumeration. Baillon (1866,p.286) named one *Euphorbia Wheeleri* after its collector.

The surgeon and plant collector on Howitt's second relief expedition, James Patrick Murray, on leave from the Melbourne Hospital, relieved Wheeler on New Year's Day 1862 at the depot camp on the Darling River. From March to October 1862 Murray collected extensively in the vicinity of Cooper's Creek. A July trek across Sturt's Stony Desert to the Diamantina River yielded many 'new' species for Mueller to name (Willis 1962). In naming two of them *Ptilotus Murrayi*

Table 1. Plants collected during inland expeditions in the early 1860s, which Mueller named (or sent to others to name) to commemorate Victorians.

Original name	Current name [APNI]
Acacia Murrayana	*Acacia murrayana* Benth.
Acanthocladium Dockerii	*Acanthocladium dockeri* F.Muell.
Anthocercis Hopwoodii	*Duboisia hopwoodii* (F.Muell.)F.Muell.
Elachopappus Rudallii	*Myriocephalus rudallii* (F.Muell.) Benth.
Eremophila Willsii	*Eremophila willsii* F.Muell.
Euphorbia Wheeleri	*Euphorbia wheeleri* Baillon
Eurybia Ferresii	*Olearia ferresii* (F.Muell.)Benth.
Isotropis Wheeleri	*Isotropis wheeleri* Benth.
Millotia Greevesii	*Millotia greevesii* F.Muell.
Ptilotus Murrayi	*Ptilotus murrayi* F.Muell.
Swainsona Burkei	*Swainsona burkei* Benth.
Zygophyllum Howittii	*Zygophyllum howittii* F.Muell.

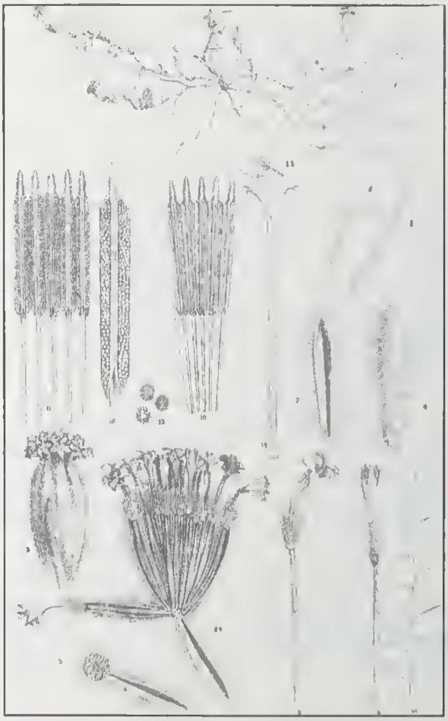

Fig. 1. Illustration accompanying Mueller's description of *Millotia Greevesii* [*Fragmenta* **3**: plate 19]

and *Zygophyllum Howittii* Mueller (1862-3) botanically commemorated Murray and Howitt. Among the specimens which Mueller sent Bentham was a wattle whose flowers Murray had collected near Cooper's Creek. In his *Flora Australiensis* Bentham (1864, II) named it *Acacia Murrayana* to commemorate its collector.

Mueller used a small daisy which Murray collected near Cooper's Creek to commemorate another early Melbourne medical man - James Thomas Rudall. Mueller (1862-3) named it *Elachopappus Rudallii* the year before Rudall named his baby son James Ferdinand.

It is a sad irony that two plants collected during Stuart's successful expeditions allowed Mueller to commemorate Burke and Wills who, unlike Stuart, died during their transcontinental expedition. Both plants have purple flowers. After Howitt's news of their death reached Melbourne, Mueller (1862-3) named an *Eremophila* with striking lilac-purple flowers, which Stuart collected near the Finke river, *Eremophila Willsii* (Fig. 2) to commemorate the young William Wills. Its common names include Sandhill Native Fuchsia and Wills' Desert Fuchsia. Robert O'Hara Burke is commemorated in the name of a legume which Stuart collected and Mueller forwarded to Bentham. In his *Flora Australiensis* Bentham (1864 II) described and named *Swainsona Burkei.*

Mueller also used a daisy collected during Stuart's expedition to commemorate Victoria's Government Printer, John Ferres. His name appears on Mueller's annual reports and other publications some of which were in Latin. Mueller was pleased to have them printed at the Government Printing Office where 'men of classical knowledge are engaged as readers and compositors' (Cavanagh 1988). Mueller (1862-3) named a sticky, scented, shrub with large daisy flowers which Stuart collected on Brinkley's Bluff in the MacDonnell Ranges *Eurybia Ferresii* (Fig.3). He also dedicated early

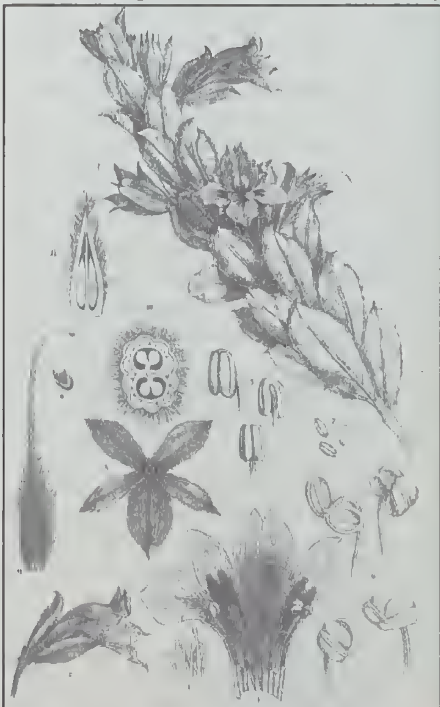

Fig. 2. Illustration accompanying Mueller's description of *Ermophila Willsii* [*Fragmenta* **3**: plate 20]

volumes of his *Fragmenta* to 'Joannis Ferres'.

Mueller and Giles

During the 1870s, the overland telegraph line stretched northward across the continent. Its telegraph stations greatly facilitated European access to the interior on both sides of the telegraph line, prompting a new wave of exploration still driven by the hope of finding water, pastures and minerals. Mueller anticipated new botanical wealth from this wave, and was keen to support Ernest Giles and other explorers. As he explained in his introduction to Giles' *Geographic Travels in Central Australia*, which he also edited, Mueller publicized Giles' expeditions and sought and provided financial support. He helped plan Giles' expeditions and provided maps. Giles (1875) mentioned 'a small German map of Australia, given me amongst numerous others by my kind and generous patron, the Baron von Mueller'.

In 1872 Giles applied many European names to physiographic features in central Australia. Some were the names of Mueller's European correspondents, colleagues and patrons. In the published report of his first expedition, Giles (1875) recorded some of these - peaks in the MacDonnell Ranges named after Dr Otto Sonder, Count Zeil and Baron von Heuglin; ranges after Baron Justus von Liebig and Professor Ehrenberg; a bluff after Dr Haast; a watercourse after Professor Augustus Petermann; Kata Tjuta after Olga, Queen of Wuerttemberg (the year after Mueller received the hereditary title of Freiherr from the King of Wuerttemberg); and a salt-lake after another patron of science - Amadeus, King of Spain.

Victorians were also commemorated. Giles (1875) named 'a charming little oasis' Glen Edith after his Melbourne niece, and a range after her father, Giles' brother-in-law, George Gill, who, like Mueller, had provided funds for the expedition. Two tributaries of the Finke River were named after Mueller's associates. Giles (1875) named 'Ellery's Creek' after Mueller's fellow public servant, 'our well-known and esteemed astronomer, Mr.

Fig. 3. Illustration accompanying Mueller's description of *Eurybia Ferresii* [*Fragmenta* **3**: plate 18]

Ellery, F.R.S.', and 'Rudall's Creek' 'in honour of an eminent surgeon and promoter of science in the Victorian metropolis, and a friend of Baron Mueller' - James Rudall. This was a decade after Mueller had attatched his name to the small Poached Egg Daisy, and several years after Mueller had helped him translate a German book on mental health for publication in English in Melbourne.

To enable Giles to undertake a second expedition westward from the overland telegraph, Mueller sought financial support by offering an eponymic inducement. For the privilege of being 'one of 25 Gentlemen' each subscribing £10, the donor 'shall be honored by his name being given to some new geographic locality' (Mueller to Mackinnon, 7 Jan. 1873). Mueller also arranged for William Tietkens to gain botanical experience before joining Giles' second expedition in 1873 (Hardy 1906).

Some features were still named in honour of foreign dignitaries. At Mueller's request Giles 'bestowed the names of H.R.H. Prince Alfred (the Duke of Edinburgh) and of her Imperial Highness the Princess Marie' on two mountains he 'discovered' about the time of their marriage (Mueller to Bowen, Sept.5, 1874). Mueller also botanically commemorated the princess by naming the palm, whose leaves Giles had collected in the Finke gorge, *Livistona Mariae* (Mueller 1878-81,p.54). This was one of the plants Giles collected during his first and second expeditions many of which Mueller named in volume 8 of his *Fragmenta* (Table 2). One was another beautiful 'desert-lover' with purple bell-shaped flowers which Mueller named to commemorate the explorer: Mueller (1872-4) named an undocumented *Eremophila,* which Giles collected in the MacDonnell Ranges, *E. Gilesii.* It is sometimes called Giles' Desert Fuchsia. Mueller subsequently named other plants after Giles and Tietkens.

Mueller used plants collected during Giles' first two expeditions to commemorate four Melbourne medical men - Wilkie, Farrage, Thomson and Lewellin. Mueller (1872-4) named a mintbush *Prostanthera Wilkieana* to honour the Melbourne physician and politician, David Wilkie M.D.. Wilkie shared Mueller's interest in natural history, and like Mueller had given time, ideas and money to help initiate the Philosophical Institute's expedition, served on the Exploration Committee, and was very critical of the Burke and Wills' expedition (Bonyhady, passim.). Mueller (1872-4) named an *Hibiscus*-like shrub from the MacDonnell Ranges *Hibiscus Farragei* after Dr William Farrage. Its purple flower resembles Sturt's Desert Rose (*Gossypium sturtianum*), but because its style differs from that of both *Hibiscus* and *Gossypium*, it has been transferred to the genus *Radyera*, but is still known commonly as Bush Hibiscus. Mueller (1872-4) named a small pale perennial daisy growing in rocky crevices in the MacDonnell Ranges after Dr William Thomson, an energetic advocate of the contagionist doctrine and Darwinian ideas (Gandevia 1976). *Helichrysum thomsonii* is commonly called Thomson's Daisy. *Dicrastylis lewellini* commemorates John Henry Hill Lewellin, M.D.. Mueller (1872-4) named it *Chloanthes Lewellini* and later transferred it to the genus *Dicrastylis.* Mueller gave Lewellin a copy of *Fragmenta* volume 8 which contained his description of *Chloanthes Lewellini* and inscribed it to his 'friend Henry Lewellin, a most skillful physician'. This volume is in the library of Victoria's National Herbarium (*pers. comm.* Helen Cohn, May 1996)

Several other species of *Dicrastylis* commemorate people. As well as naming one after Giles, Mueller (1872-4) named a yellow woolly flowered one *Dicrastyles Beveridgei* after Peter Beveridge of 'Tyntynder' on the Murray River (near Swan Hill), who had donated plants and seeds to Mueller's Botanic Garden.

A yellow-flowered herb which Giles collected near Lake Amadeus commemorates a botanical artist, Fanny Anne Charsley, who painted local wildflowers during her decade domiciled in Melbourne. On her return to England in 1866, thirteen of her water colour paintings, 'large quarto lithograph (or zincograph) plates of excellent drawings of the flowers, coloured with perfect accuracy' were published in a book, *The Wildflowers*

Table 2. Plants collected during Giles' expeditions which Mueller named to commemorate Victorians.

Mueller's name	**Current name [APNI]**
Chloanthes Lewellini	*Dicrastylis lewellinii* (F.Muell.) F.Muell.
Dicrastyles Beveridgei	*Dicrastylis beveridgei* F.Muell.
Hannafordia Bissillii	*Hannafordia bissillii* F.Muell.
Helichrysum Thomsoni	*Helichrysum thomsonii* F.Muell.
Helipterum Charsleyae	*Helipterum charsleyae* F.Muell.
Hibiscus Farragei	*Radyera farragei* (F.Muell.) Fryxell & Hashmi
Phyllota Luehmanni	*Phyllota luehmannii* F.Muell.
Prostanthera Wilkieana	*Prostanthera wilkieana* F.Muell.
Wrixonia prostantheroides	*Wrixonia prostantheroides* F.Muell.

around Melbourne, which she dedicated to Mueller who had provided taxonomic details (Cavanagh 19831). It was possibly the first 'popular' illustrated book on the Victorian flora. In response Mueller (1872-4) named a daisy which Giles collected near Lake Amadeus - *Helipterum Charsleyae. H. charsleyae* is not, as it is sometimes called, 'Charles Daisy'. There is no misspelling in the specific name.

In volume 10 of his *Fragmenta* Mueller continued to name plants collected during Giles' expeditions between the overland telegraph and the western coast of Australia in the mid-1870s (Table 2). Mueller (1876-7) named *Hannafordia Bissillii* after Walter Bissill of 'Belvoir Park' at Ravenswood (between Castlemaine and Bendigo), who wrote about local wildflowers and sent seeds and specimens to Mueller.

A generic name also commemorates a Victorian. In naming a relative of *Prostanthera* collected during Giles' 1875 westward expedition, *Wrixonia prostantheroides*, Mueller (1876-7) established the genus *Wrixonia* and commended Henry John Wrixon, M.L.A., a barrister and politician, for his support of science.

1890s

Mueller continued to botanically commemorate people into the 1890s. He wished to honour Melbourne's Town Clerk, Edmund Gerald FitzGibbon, who donated plants to the Botanic Garden and whose voluminous correspondence with Mueller related to various aspects of the Botanic Garden. Mueller had received several specimens of an everlasting from other collectors, and on receipt of a specimen collected during Tietkens' 1889 expedition, Mueller (1890a and b) published the name and description of *Helipterum Fitzgibboni* first in *The Victorian Naturalist* and later in the *Transactions and Proceedings of the Royal Society of South Australia*. Mueller (1890a) explained that:

> 'The specific name of this exceedingly pretty 'Everlasting' was chosen already some years ago in honour of E.G. Fitzgibbon Esq., who through a third of a century so dignifiedly held the onerous office of Melbourne town-clerk, and who with genial and enlightened circumspectness has also constantly promoted science-researches in the greatest of southern cities.'

A common name of *Helipterum fitzgibbonii* is Fitzgibbon's Daisy.

Long after commemorating his assistant, George Luehmann, in naming a legume collected during Giles' 1875 expedition *Phyllota Luehmanni* (Mueller 1876-7), he named a chenopod collected by Rev. Schwarz from Hermannsburg Lutheran Mission on the Finke River, *Bassia Luehmanni*. Mueller (1890a) dedicated it to

> 'G. Luehmann, Esq., F.L.S., First Assistant in the Phytologic Department here, who during many years has zealously aided the researches of its founder'.

Now included in the genus *Maireana, M. luehmannii* still commemorates Mueller's assistant.

During the last years of his life Mueller helped Professor Ralph Tate of the University of Adelaide, determine plants collected during the 1891 Elder Scientific Exploring Expedition and the 1894 Horn Scientific Expedition (Gillbank and Maroske, 1996). In 1896, the year of Mueller's death, *Darwinia Luehmanni* was also dedicated to Luehmann in recognition of his taxonomic help with plants collected during the Elder expedition (Mueller and Tate, 1896,p.353).

Eponymous Echoes

Although taxonomic changes have erased some of Mueller's plant names, enough survive for his commemoration of fellow Victorians to remain etched in the flora and physiography of the arid interior of Australia. Many plants still carry the names of Mueller's Victorian colleagues and contributors, and other Victorians who shared his passionate interest in plants and exploration. They include explorers, collectors, doctors, politicians and a female botanical artist.

Acknowledgements

I wish to thank Sara Maroske of the Mueller Correspondence Project and

Helen Cohn at the Library of Victoria's National Herbarium, for generous provision of information and comments.

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Meuller's privately expressed disappointment at not writing *Flora Australiensis* is poignantly expressed in a letter to Professor Oliver, Christmas 1863 '...The effect of the existing arrangement has been greatly to disturb my plan of life, to bend my spirit to proceed on my path, and to render me much less bouyant to work as I otherwise might have done. Having spent the best years of youthful vigour, enormous exertion and almost a fortune on a plan which now, to a certain extent, had been frustrated,...'

The Victorian Nauturalist 44,134.

The Botanist at Como: Mueller and the Armytage Family

Carmel McPhee[1]

Recently, while sifting through Armytage family papers at the Melbourne University Archives, attempting to broaden our understanding of the Como garden, a colleague and I came across four brief letters from Baron Ferdinad von Mueller, by then in his early seventies, to Armytage family members at Como.

Written between 20 April 1895 and 27 April 1896, within the last two years of Mueller's life, the letters tell us of the enduring friendship which had existed between the botanist and this well-to-do early Melbourne and Western District family.

> 'When I receive dear Miss Armytage kind letters from ladies, which is not very often, I feel always much cheered and thus I was particularly the case when I received your thoughtful communication...
>
> ...For some months I shall be overpowered with professional work in my Department, but after that time I hope to call again on the few friends which I have...'
>
> (To Ada Armytage, 27 April, 1896)

Such poignant phrases from Mueller in the last months of his life and twenty three years after his ignominious departure as director of the Melbourne Botanic Gardens, speak of the loneliness he must have endured until his death later in that same year.

Two of the letters refer to future outings with the Armytage women, one to a 'festival' at Como to which he had been invited and the second, an invitation to Ada Armytage to accompany him to a 'discourse with limelight views... in the Prahran Town Hall by an arctic voyager' - a Mr Wilkinson.

Mueller's long association with Como, in fact, began before the Armytage friendship, in the days when Como's second owners, the Brown family, donated many plants to the Melbourne Botanic Gardens at the time Mueller was director.

Such plant donations from well-to-do families across Victoria, usually took the form of an exchange, with Mueller returning the favour by supplying plants in return. In this way, wealthier members of the colony assisted in the establishment of the Melbourne Botanic Gardens, through it is not certain whether this was how Mueller and the Armytages first met.

Perhaps the family approached him asking for advice on suitable pasture grasses for their Victorian Western District and Queensland properties. In two of the letters, Mueller discusses his uncertainty regarding the successful establishment of two species of exotic grass which he had given the family to trial on their North Queensland station.

> 'Allow me dear Madam to mention, that the enlarged ninth edition of the Select Plants is now going into print so that any occurrence with the Coapin grass (*Panicum spectabile*) in your Queensland Station could now be recorded in the work under your honoured name.
>
> But the last year has been one of such dryness, that perhaps the experiments gave no favourable results. Neverthcless it would be well to persevere with the trials...'
>
> (To Caroline Armytage, 20 April, 1895)

In 1857, almost forty years before these final letters were written to the Armytage women, Mueller had first voiced his arguments for exotic plant introductions to Victoria, in his paper *'On a General Introduction of Useful Plants into Victoria'*, a forum for the debate of such issues. About this time, thousands were leaving the goldfields empty-handed, swelling unemployment in the young colony of Victoria. A pressing issue for the government had become the need to expand agriculture and industry, so the evaluation of potentially productive species was regarded very favourably.

[1] Manager of National Trust Gardens in Victoria.
39 Brackenbury Street, Warrandyte, Victoria 3113.

Later, as an inaugural member of the Acclimatisation Society of Victoria, established in 1861, Mueller went on to systematically disperse both native and exotic plants across Australia and internationally. His intense interest in introducing useful plants led him to compile a book on the subject, first published in 1876 under the title *Select Plants readily eligible for Industrial Culture or Naturalisation in Victoria, with indications of their Native Countries and some of their Uses.* This work was re-published several times with revisions, enlargements or translations. It is to the 1895 edition that Mueller refers in his letter above to Caroline Armytage.

Whatever the origins of their relationship, the strong friendship Mueller obviously felt for the Armytage family, sheds a little extra light on the final years and months of this great botanist's remarkable life.

Acknowledgments
I would like to thank Sara Maroske for her invaluable help and advice in the preparation of this article.

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Laura Armytage and friend in an undeveloped part of Como garden - early 1880's. Photo courtesy Como Photographic archive.

Emigrant Eucalypts: Gum Trees as Exotics

by Robert Fyfe Zacharin

Publisher: *c Robert Fyfe Zacharin,'Khumbila', RMB 1772, Cape Schanck, Victoria 3939. RRP $25.00 plus postage*

The motivation for this book was hatched from the author's first of many visits to the Fistula Hospital in Addis Ababa in 1967, where his curiosity revealed that the introduction of eucalypts (notably *E. globulus*) was almost the sole factor enabling the establishment of this city in a land bereft of vegetation. From that point, he has used his unique professional opportunities to visit an extraordinary kaleidoscope of countries and study introduced eucalypts first hand, together with the related local literature, much of which would be difficult to access in Australia. The result is a book which will fascinate any who share his great love of this remarkable genus, roaming across countless lands and portraying the innumerable familiar, and less familiar, personalities involved.

Club members will enjoy reading the Foreword by our late Jim Willis, reproduced directly in his delightful hand. Oddly, one of the best-known seed transfers to the Trappist monks of the Tre Fontane Monastery (Rome) - with its goulish links to the execution of St Paul - is the subject of *two* stories, firstly (page 58-59) attributed to the Howitts (father and son), and later (page 68), the better-known story of Mueller and Archbishop Goold, as recorded in *Eucalyptography*. Unfortunately, however, the clarity of Zacharin's photographs is often poor and not sufficient to properly appreciate the species portrayed.

The rather brief cover of the eastern Mediterranean, towards the end of the book, inspires me to add a little that may well interest readers. For the Syrian crews manning artillery batteries on the Golan Heights above Galilee, the summer climate was undoubtedly torrid. Hence, a suggestion from an Israeli source to plant a few Blue Gums around each for shade was evidently received, and embraced by Syrian authorities. Subsequently, in the Six-Day War of 1967, these little clumps of Blue Gums became 'sitting ducks' for Israeli artillery - and survived better than most of the fortifications and their crews.

Strangely, the two-page coverage of our compatriots across the Tasman is somewhat brief, apparently as a result of an oversight of the substantial tome by Rev J.H. Simmonds, *Eucalypts in New Zealand*. Nonetheless, this book will bring joy to any lovers of the genus.

Alan Parkin

2 Hazel Drive, Templestowe, Victoria 3107.

The Natural Art of Louisa Atkinson

by Elizabeth Lawson

Publisher: *The State Library of New South Wales Press 1995; 144 pages, 84 colour plates; RRP $39.95 soft cover, $49.95 hard cover.*

As Government Botanist of the colony of Victoria, Ferdinand Mueller welcomed plant specimens collected within and beyond the borders of Victoria. Some of his collectors were women. One was Louisa Atkinson, who collected in various parts of New South Wales in the 1860s, and initially forwarded specimens via William Woolls in Sydney.

Louisa was also an artist. Unlike her artistic sisters, Helena and Harriet Scott who illustrated the natural history work of others, Louisa's art was an integral part of her own work as a naturalist. As this book reveals, Louisa depicted a wide range of subjects - landscapes, animals and plants. An impressive Murray River Crayfish graces the front cover, while inside beetles and butterflies, parrots and possums, appear frozen mid-action - courting, eating, flying . In sketching with precision and clarity 'moments of observed natural life', her images are of the field not the studio. Louisa was one of the first European artists in Australia to capture the swiftness and agility of the native fauna.

Her botanical art lacks elaborate scientific footnotes, but, as Lawson notes it 'maintains its primary task of precisely observed record'. Following the not uncommon posthumous destruction and disappearance of her work, the illustrations included in this book represent only fragments of her life's work. As representations of the Australian flora and fauna of over a century ago, her visual and verbal descriptions provide precious fragments of the horribly fragmentary record of Australia's environmental history.

Louisa Atkinson was born in February 1834 at Oldbury Farm, Sutton Forest, on the Southern Highlands of New South Wales. She died only thirty eight years later. During her short, and sometimes difficult life, she worked as a botanist, naturalist, taxidermist, journalist, novelist and artist, employing her diverse skills to maintain her financial independence. She collected, drew and wrote about animals and plants from the vicinity of her several homes in NSW - in the Southern Highlands, Blue Mountains, Sydney and Shoalhaven.

In the 1850s engravings of her drawings of birds, animals and places, illustrated her nature notes in the *Illustrated Sydney News*. Her long-running nature series 'A Voice from the Country' was published concurrently in the *Sydney Morning Herald* and the *Sydney Mail* right through the 1860s. Her lively descriptions of her excursions into the bush provided Sydneysiders with possibly their first popular, informal but informative descriptions of the indigenous flora and fauna. She nurtured a conservation ethic, warning that the native cedar was becoming scarce and should be planted, that 'while the woodman's axe can fell the growth of a century in an hour, the forest springs up but slowly', and that the feral cat should be 'determinately destroyed'.

While living at Fernhurst near Kurrajong Heights in the Blue Mountains, Louisa's interest in indigenous ferns flourished. She observed, collected, described, drew and planted them. Woolls named a small rasp fern *Doodia Atkinsoniana* in her honour. Nine of her herbarium specimens of ferns survive in the Mitchell Atkinson collection, along with forty fine watercolours. Louisa intended to publish her illustrations as a book. Seven of the plates are reproduced in this book.

In 1869 she married James Calvert, and moved to his property near Yass. Two excursions and one baby later Louisa died suddenly - collapsing on seeing James' horse returning riderless. She was survived by her husband and baby daughter, and various plants named in her honour by Woolls and Mueller - a genus *Atkinsonia*, and several species carrying various versions of her maiden and married name.

I am glad that Elizabeth Lawson has focussed her creative energy on this book, that the State Library of New South Wales has published it, and that I have had the opportunity to read it. I recommend it to anyone interested in natural history and past practitioners. I am also glad that Lawson's book prompted me to read an earlier book - Patricia Clarke's *Pioneer Writer. The life of Louisa Atkinson: novelist, journalist, naturalist.* [Allen & Unwin, 1990]. Clarke's book provides more botanical and biographical details, but only black and white illustrations.

Linden Gillbank
Department of History and Philosophy of Science,
University of Melbourne, Parkville, Victoria 3052

Mueller (background) with his staff at his house in Arnold Street, South Yarra, December 1894. Photo. courtesy Royal Botanic Gardens.

The A.S.N. Company's steam ship *The Wonga Wonga* on which Mueller returned to Melbourne from Twofold Bay.

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The Victorian Naturalist

Volume 113 (5) 1996 October

Published by The Field Naturalists Club of Victoria
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Winner of the 1996 Australian Natural History Medallion

The Club is pleased to announce that the winner of the Australian Natural History Medallion is **Ken Simpson**, one of the authors of '*Field Guide to the Birds of Australia*' and President of the Bird Observers Club of Australia. Congratulations to Ken.

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Acknowledgement

The editors wish to acknowledge and thank Elsie Graham for permission to use her photograph of the late Dr Jim Willis that appeared on the front cover of *The Victorian Naturalist* **113** (2) 1996.

The Victorian Naturalist

F.N.C.V.

Volume 113 (5) 1996 October

Editors: Ed and Pat Grey

ISSN OO42-5184

Cover: The Honey Fungus *Armillaria luteobubalina* (see page 255), photo courtesy Glen Kile, Forestry and Forest Products, CSIRO Australia .

New Holland Mouse *Pseudomys novaehollandiae* (Rodentia: Muridae) in South Gippsland, Southern Victoria Part One - Distribution and Status

Bruce R. Quin[1,2]

Abstract
Results of a survey for New Holland Mouse *Pseudomys novaehollandiae* populations in areas of South Gippsland, conducted by the then Department of Conservation and Natural Resources (currently Department of Natural Resources and Environment) in 1992-1993 are outlined. The survey employed trapping, hair-tubing and the collection of predator scats to determine the distribution of this species. Two previously unknown populations of New Holland Mouse totalling 15 individuals were located in vegetated sand dunes on the Yanakie Isthmus, Wilsons Promontory National Park. However, populations which were previously known from the Promontory and McLoughlins Beach (Nooramunga Marine and Coastal Park) are believed to be no longer present. The species was not detected at two further areas formerly known to support it, Dream/ Hummock Island and Mullungdung State Forest. Thus, the Wilsons Promontory populations currently represent the only populations of New Holland Mice known from South Gippsland where the species' range is in decline. Management issues for the New Holland Mouse in South Gippsland will be the subject of a follow-up paper. Distribution and habitat of other small ground mammals are noted. Generally, these species occurred in habitats similar to those found in previous studies. (*The Victorian Naturalist* 1996. 113, 236-246).

Introduction

The New Holland Mouse *Pseudomys novaehollandiae* (family Muridae) is a small native rodent with a limited distribution in south-eastern Australia, occurring on coastal and hinterland areas of central eastern New South Wales, central southern Victoria and north-eastern Tasmania (Kemper 1995) (Fig. 1).

The New Holland Mouse is classified as endangered in Victoria (CNR 1995). The species which has been listed under the *Flora and Fauna Guarantee Act* 1988 is rare, in decline and subject to a number of potentially threatening processes (Menkhorst 1995; Seebeck *et al. in prep.*).

Various studies provide descriptions and analyses of New Holland Mouse habitats (e.g. Keith and Calaby 1968; Fox and Fox 1978; Cockburn 1980; Wilson 1991). Typical habitats are coastal heathland or woodland and open forest with a heathy understorey on sandy substrate. Species of the following genera are commonly recorded at such sites : *Acacia, Banksia, Leptospermum, Dillwynia, Xanthorrhoea, Epacris, Hibbertia* and *Allocasuarina*; in addition to sedges (Cyperaceae, Restionaceae). Less typically this rodent occupies swamp edges (Keith and Calaby 1968) and vegetated sand dunes (Peter Menkhorst *pers. comm.*).

The New Holland Mouse prefers a heath understorey actively regenerating after disturbance from fire, vegetation clearing, sand-mining or grazing (refer above studies). This preference appears to relate to high vegetation cover close to ground level (Posamentier and Recher 1974; Fox and Fox 1978; Wilson 1991), high species diversity in the understorey (Fox and Fox 1978; Cockburn 1980), and a high abundance of Leguminosae species in the understorey (Keith and Calaby 1968; Posamentier and Recher 1974; Braithwaite and Gullan 1978).

Fig. 1. New Holland Mouse *Pseudomys novaehollandiae*

[1]*Current Address*
Department of Natural Resources and Environment
Yellingbo State Nature Reserve, Macclesfield Road
Yellingbo, Victoria 3139.
[2]Department of Natural Resources and Environment
310 Commercial Road. Yarram, Victoria 3971.

The 'aims of this study were to establish the distribution of New Holland Mice in the South Gippsland District, to determine habitat indicators, to identify important management issues and to formulate a long-term monitoring program.

Study Sites, Materials and Methods

Mullungdung and Won Wron State Forests

New Holland Mice were captured at two sites in Mullungdung State Forest in 1975 (Gilmore 1977). In the same general vicinity, a survey in 1992 by staff from Deakin University trapped what was believed to be one New Holland Mouse. The vegetation at this latter site was used as a guide for selecting other sites in Mullungdung. However, since the survey outlined in this paper was undertaken, doubts concerning the identity of the 1992 Deakin specimen have arisen (Barbara Wilson *pers. comm.*).

Eighteen sites were chosen after examining a Land Conservation Council vegetation map (LCC 1980), corresponding aerial photographs and ground checking. These sites were covered in four separate trapping sessions, each session covering four nights. At each site 14, 15 or 30 Elliott traps were located, generally in two or three straight line transects with 20 m intervals between traps and lines. The total number of trapnights (number of traps x number of nights that traps were open) is shown in Table 1. Locations of sites are illustrated in Fig. 2(. Bait was a mixture of peanut butter, honey, rolled oats, vanilla and/or almond essence. Traps were checked in the first few hours of daylight and the animal captures recorded. Animal captures were individually marked in one of two ways: with a small nick in one of the ears, or a non-toxic black pen mark on one of their hind feet or tail. Traps were kept closed during the day and re-opened in the last two hours before sunset.

Small hair tubes comprising a 30 mm diameter conduit design, modified from Suckling (1978), were placed at each trap station of the first ten sites for eight days inclusive (dates are shown in Table 2). Tubes were baited with the same mixture as used in the Elliott traps. Hairs collected by this technique were forwarded to Raelene Warren (Deakin University,

Table 1. Mammal species detected by Elliott trapping at study locations in South Gippsland. 1 = No. of Sites; 2 = No. of Trapnights; 3 = Sampling Period ; 4 = Species Captured; 5 = Total No. of Captures; TOTAL = Total No. of Captures (No. of individuals). (Note : site specific data is provided CNR (1993) and Quin (1994). Cage trapping was also employed at Wilsons Promontory and totalled 38 trapnights).

Location	1	2	3	4	5	6
Mullungdung State Forest	18	1253	19/11/92-04/04/93	Brown Antechinus	43	(35)
				Eastern Pygmy-possum	8	(6)
				Bush Rat	26	(13)
				Swamp Rat	7	(4)
				Black Rat	7	(5)
				TOTAL	**91**	**(63)**
Won Wron State Forest	5	296	19/12/92-23/12/92	Brown Antechinus	13	(8)
				Bush Rat	1	(1)
				Black Rat	2	(1)
				House Mouse	1	(1)
				TOTAL	**17**	**(11)**
Dream/Hummock Island	4	190	25/03/93 - 27/03/93	Swamp Rat	35	(29)
				House Mouse	33	(33)
				TOTAL	**68**	**(62)**
Wilsons Promontory National Park (Yanakie Isthmus)	6	562	15/02/93 - 24/04/93	Bush Rat	23	(15)
				Swamp Rat	10	(4)
				House Mouse	11	(11)
				New Holland Mouse	30	(15)
				TOTAL	**74**	**(45)**

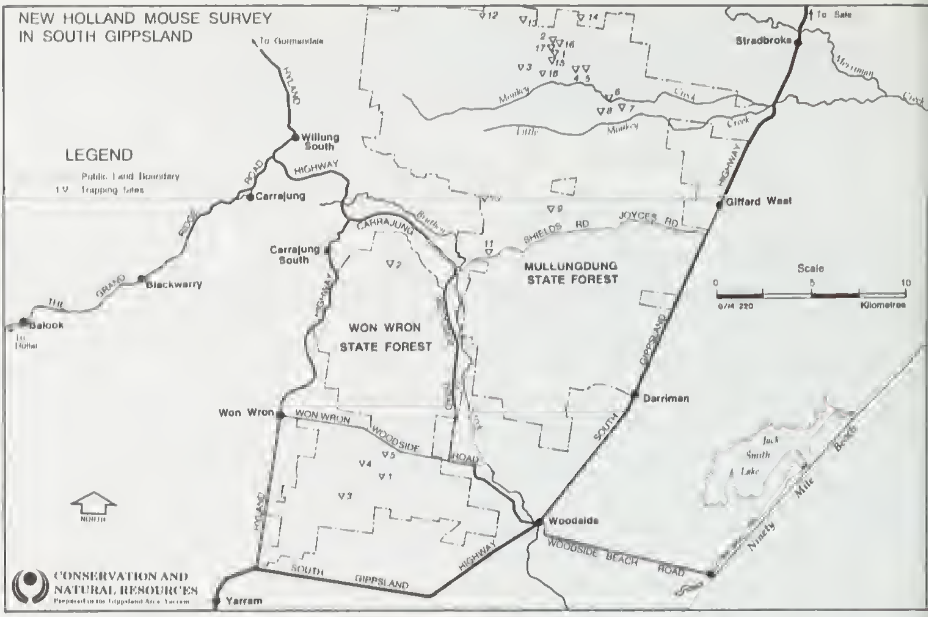

Fig.2. Location of trap and hair tube sites in Mullungdung and Won Wron State Forests.

Table 2. Mammal species detected by hair-tubing at study locations in South Gippsland.
1 = No. of sites; **2** = No. of Hair Tubes; **3** = Sampling Period; **4** = Species Detected
(Note : site-specific data is provided in CNR (1993) and Quin (1994). Two of the four sites hair-tubed at Wilsons Promontory were additional to those trapped at that location).

Location	1	2	3	4
Mullungdung State Forest	10	148 small tubes	21/11/92 to17/12/92	Brown Antechinus Unidentified Antechinus Bush Rat Unidentified Rat
Won Wron State Forest	1	2 small tubes	27/11/92 to05/12/92	Unidentified Antechinus
Wilsons Promontory National Park (Yanakie Isthmus)	4	22 small tubes/ 20 large tubes	18/02/93 to28/04/93	Unidentified Antechinus Bush Rat Unidentified Rat Black Wallaby Common Wombat *Vombatus ursinus*

Geelong) and Barbara Triggs ('Dead Finish', Genoa) for identification using the technique developed by Brunner and Coman (1974).

Small hair tubes were set with the Elliott traps to establish whether hair tubes would be suitable for detecting the New Holland Mouse. However, despite traps and tubes failing to detect New Holland Mice in Mullungdung State Forest, both techniques were employed elsewhere. The hair-tubing proved to be a useful secondary device for confirmation of trapping results.

New Holland Mice have never been recorded from Won Wron State Forest. However, this area occurs within close proximity to Mullungdung State Forest and supports large areas of heathland. For these reasons, five sites were established in Won Wron State Forest and sampled following principles already outlined (refer Figure 2; Tables 1 and 2.).

Predator scats were collected during concerted searches and opportunistically along

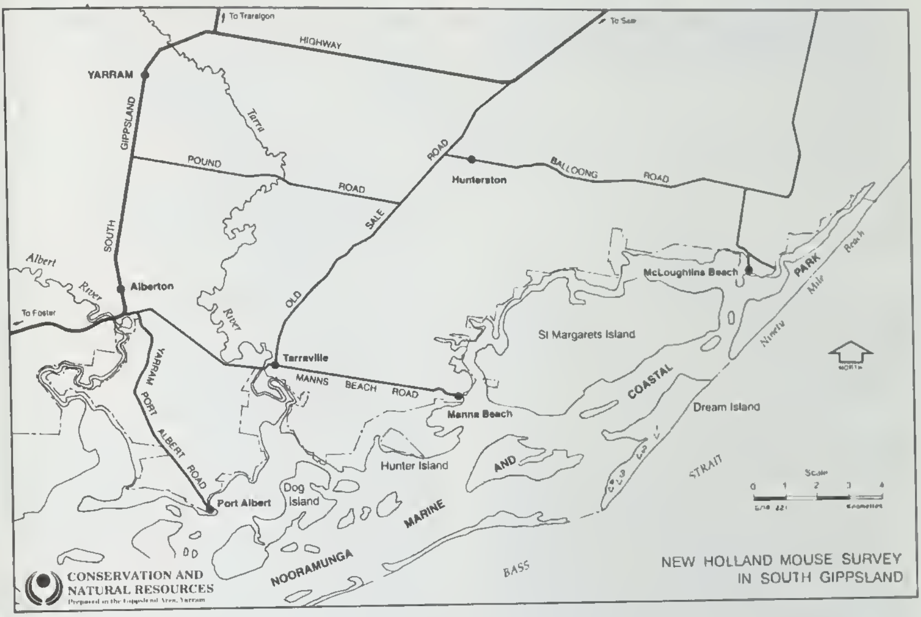

Fig. 3. Location of trap sites on Dream/Hummock Island, Nooramunga Marine and Coastal Park.

roads and narrow trail-bike tracks at sites. They were forwarded to Barbara Triggs for analysis.

Dream/Hummock Island

New Holland Mice were captured at the south-west point of this island in 1977 (Menkhorst 1995; Peter Menkhorst *pers. comm.*). Vegetation recorded at this site was used as a guide for selecting trapping locations for the 1992-1993 survey. General procedures employed in Mullungdung and Won Wron State Forests were followed on Dream/Hummock Island (refer Table 1), however, no hair-tubing was used. The fourth site (a camp area) was established on the final night following several chance observations of small rodents the previous night. However, only five traps were used at this site. No predator scats were located on the Island. Refer Figure 3 for trapping locations.

Wilsons Promontory National Park

New Holland Mice had been detected twice on the Promontory, in 1973 and 1975 (Mammal Survey Group of Victoria records). In February 1993, a previously unrecorded population was located on the Yanakie Isthmus of the Promontory during a separate trapping program. Some results of that survey are reproduced here from the corresponding report (refer CNR 1993).

The general design, material and methods used in the survey at Wilsons Promontory in February 1993 are provided in Quin (1994). However, three further sites were specifically targeted for New Holland Mice. Two were trapped and one was sampled by hair-tubing and further details are provided in Tables 1 - 3. Procedures for these three sites were similar to those described for Mullungdung State Forest and in CNR (1993). Large hair tubes similar to the design described by Scotts and Craig (1988) were also employed at the Promontory.

In April 1993, two sites sampled in the February survey were re-trapped (Tables 1 - 3) including the site where New Holland Mice were located. The vegetation at the most recently located site was used as a guide for selecting two further areas which were surveyed in April 1993 for New Holland Mice. Trapping transects were either straight or bent line, with 10 m spacing between traps (and lines where applicable). Other procedures were as outlined previously. Fig. 4 illustrates sites sampled for New Holland Mice on the Promontory.

Table 3. Mammal species detected by analysis of hair or predator scats collected from study locations in South Gippsland.
1= No. of Sites; **2** = Sampling Period; **3** = Species Detected.

Location	1	2	3
Mullungdung State Forest	8	09/12/92 to 21/12/92	Brown Antechinus Swamp Rat Common Ringtail Possum Unidentified Brushtail Possum Black Wallaby Eastern Grey Kangaroo Macropus *giganteus* Cat *Felis catus* (feral)
Wilsons Promontory National Park (Yanakielsthmus)	1	24/04/93 to26/04/93	Bush Rat Black Wallaby Common Wombat European Cattle *Bos taurus* (feral)

Animal Handling

A suite of morphological measurements was taken from captured New Holland Mice (refer Quin 1994). Additionally, Dr Barbara Wilson of Deakin University had requested that scats (dietary analyses) and hair samples (for genetic studies) from New Holland Mice be collected, to assist in formulating management recommendations for this species in South Gippsland and across its Victorian range. Scats and hair samples were collected from all individuals trapped and have been forwarded to Deakin University researchers. Invertebrates taken from the fur of some individuals were forwarded to the Museum of Victoria for identification.

Individuals of other species trapped were handled for identification purposes only, with the exception of Eastern Pygmy-possums *Cercartetus nanus*. This species can be difficult to detect and captured individuals represent a good opportunity to learn more about the species. Consequently, morphometrics were taken from Eastern Pygmy-possums captured in the present study.

Vegetation

The overall vegetation form at each site, in which traps or hair-tubes were set, was assessed and crudely classified into one of seven habitat types, largely based on understorey species composition, but also structural attributes. The habitats were: wet heathland, dry heathland, heathy woodland, heath-bracken woodland, rehabilitated gravel scrape vegetation, heathy open forest and coastal sand dune vegetation. Character species for each habitat are provided in Table 4. Time did not permit a more comprehensive analysis of habitat types at trap sites (with exceptions indicated below). The crude classification served to indicate broad habitats in which trapping occurred, and the major habitat type present at sites.

At Sites 1-3, 14, 16-18 in Mullungdung State Forest, a list of plants was compiled and each given a cover value according to the Braun-Blanquet scale (Mueller-Dombois and Ellenberg 1974). At Site 1 in Wilsons Promontory National Park, a full list of plant species was produced, however, cover values were not given. (Note: these lists are not included in the paper).

Particular note was made of the age of vegetation after fire when selecting study sites, due to the preference of New Holland Mice for an actively regenerating heath.

However, many sites surveyed did not support young vegetation for the following reasons: trapping of sites known to contain New Holland Mice in the past often meant trapping in relatively old vegetation; most of the Mullungdung sites surveyed were selected on the basis of their similar fire histories and plant composition to that of the most recent (unconfirmed) record of New Holland Mice in that forest (i.e. 11-year-old heath); much of the heathland vegetation in Mullungdung is ten years of age or older; the initial survey at Yanakie Isthmus (CNR 1993) discovered New Holland Mice can exist in relatively old

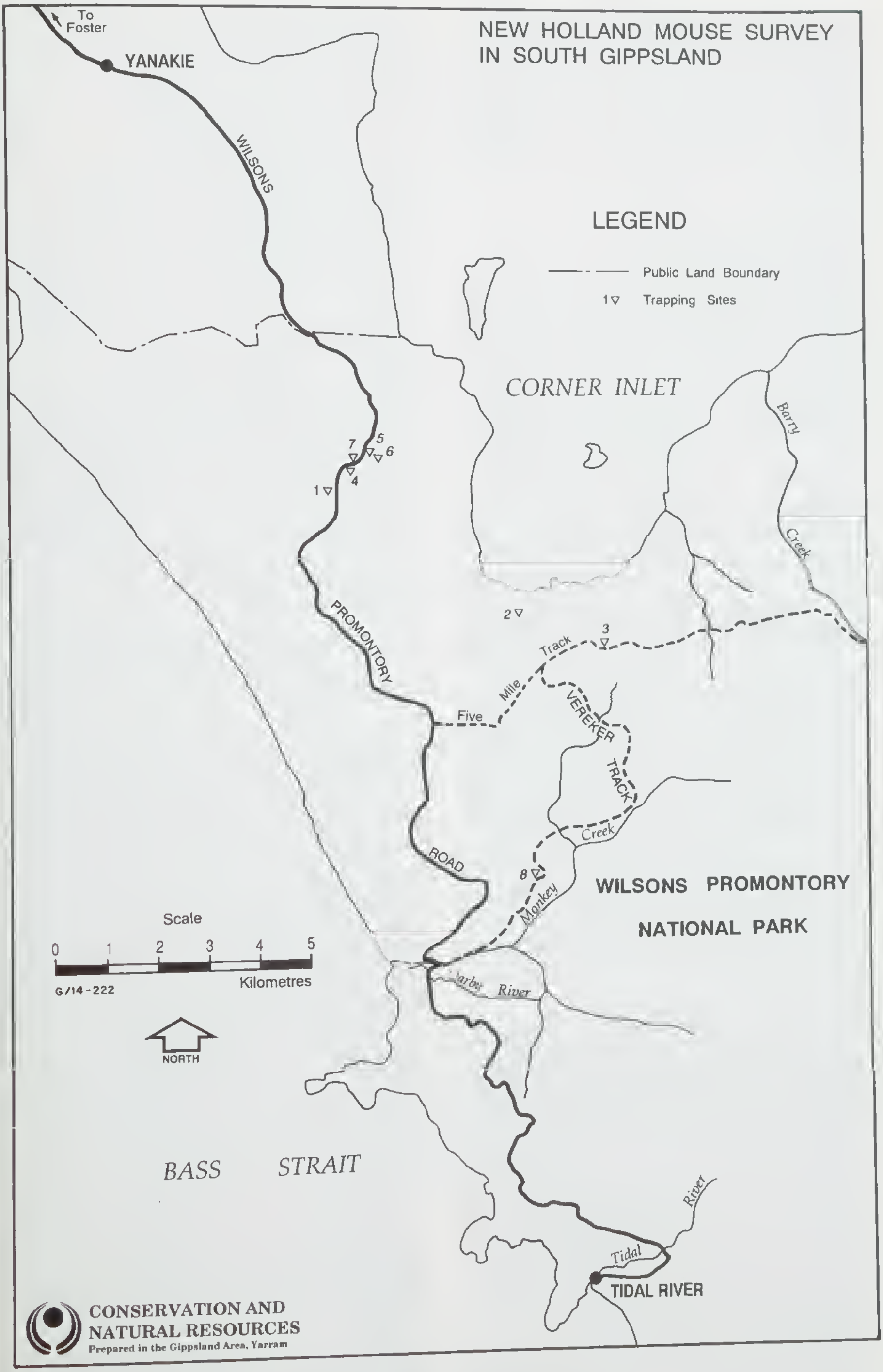

Fig. 4. Location of trap and hair tube sites on Wilsons Promontory

vegetation growing on sand dunes. Vegetation ages were obtained from fire history maps kept in the Yarram Natural Resources and Environment office. Those for the Yanakie Isthmus were obtained from Jim Whelan *(pers. comm.)*. All vegetation ages are given in Table 4.

Results

Mullungdung State Forest

Trapping at 18 sites in Mullungdung State Forest yielded 91 captures of 63 individuals (five species) from 1253 trapnights (7.3%), a low capture rate. The species most commonly trapped, Brown Antechinus *Antechinus stuartii*, occurred at most sites and habitat types. A notable species captured was Eastern Pygmy-possum. Three individuals (one male, two females) were located at two separate sites in heathy woodland and rehabilitated gravel scrape vegetation (heath). Swamp Rats *Rattus lutreolus* were caught only at the wet heathland site. New Holland Mouse was not trapped. Refer Table 1 (trapping data), Table 4 (vegetation). Additional information is contained in Quin (1994).

Hair-tubing did not detect species additional to those trapped (at the first 10 sites). For this reason, it was decided not to hair-tube Sites 11 - 18 and to concentrate on the trapping (Table 2). Predator scats analysed for the contents also failed to detect New Holland Mice. Remains of Swamp Wallaby *Wallabia bicolor* and Common Ringtail Possum *Pseudocheirus peregrinus* were common in predator scats (Table 3).

Won Wron State Forest

Low capture rates also characterised the trapping conducted in Won Wron State Forest; 17 captures of 11 individuals (four species) from 296 trapnights, a 5.7% success rate (Table 1). Brown Antechinus were captured at three sites (heathy woodland and heathy open forest), but not the two 'young' (0.8 years) heathy woodland sites; a single House Mouse *Mus musculus* was caught at one of the latter sites (Tables 1 and 4).

Dream/Hummock Island

Trapping rates at Dream/Hummock Island were relatively high, 35.8%, constituting 68 captures of 62 individuals from 190 trapnights. These trappings comprised approximately equal numbers of Swamp Rats and House Mice, when data from four sites were combined (Table 1). However, Swamp Rat captures were much higher at Sites 1 and 3, and the reverse applied for Site 2; Site 4 trapnights totalled only five and six House Mice were caught . All captured animals were judged as adult status (Quin 1994), though considerable size variation occurred with the Swamp Rats.

Wilsons Promontory National Park Summary - Trapping Results

Trapping at Wilsons Promontory National Park detected four small mammal species, including the New Holland Mouse (Table 1). The overall trapping rate was 13.2%, comprising 74 captures of 45 individuals from 562 trapnights. New Holland Mice comprised the highest number of captures - 30 captures of 15 individuals from two sites (Quin 1994).

New Holland Mouse - Trapping Results

New Holland Mice were trapped at Sites 1 and 5 (see Fig. 4). The New Holland Mouse captures at Site 1 constituted seven males and three females in the February 1993 survey. The seven males included two 'sub-adults' (both weighing approximately 13 g); the three females included a pregnant individual (24 g, the heaviest individual). In April 1993, six New Holland Mice (4 males, 2 females) were captured at this site, comprising four retraps from February and two additional individuals (1 male, 1 female). Thus, the two surveys captured 12 New Holland Mice (8 males, 4 females) at Site 1. Only three male New Holland Mice were caught at Site 5, including the lightest individual (15 g) captured in April (sites combined). Tail lengths ranged from approximately 85-98 mm for adult males, and 83-100 mm for adult females. Pes (hind foot) length ranges were similar for the sexes, ranging from about 16 to 17 mm for adult individuals. Refer Quin (1994) for other measurements and details of New Holland Mice located.

Some limited observations made on New Holland Mice movements during the current survey are noteworthy. Upon release, the majority of New Holland Mice moved toward the closest dense vegetation to make their escape. However, some jumped on to fallen, dead shrubs and used horizontal branches as pathways before leaping into dense ground vegetation.

New Holland Mice were generally re-trapped in close vicinity to their initial captive site. However, one individual was re-trapped the following night approximately 90 m from where it was first seized.

Three types of invertebrates were detected on New Holland Mice fur at Wilsons Promontory. They were :

1. flea, *Pygiopsylla* sp. (Family Pygiopsyllidae, Order Siphonoptera);
2. mite, *Dermanyssus* sp. or *Liponyssus* sp.(Family Dermanyssidae,Order Acarina);
3. beetle, *Myotyphlus* sp. (Family Staphylinidae, Order Coleoptera).

The mites were observed most commonly in fur surrounding the eyes of New Holland Mice. The fleas and beetles appeared to inhabit longer body fur on both dorsal and ventral surfaces of the mice.

New Holland Mouse - Habitat Descriptions

The habitat at Site 1 (a New Holland Mouse site) is described in Table 4, CNR (1993) and Quin (1994). It comprised of a calcareous dune system. Drooping Sheoak *Allocasuarina stricta*, Coastal Wattle *Acacia sophorae* and Coast Tea-tree *Leptospermum laevigatum* formed the overstorey. Black-anther Flax-lily *Dianella revoluta*, Spiny-headed Mat-rush *Lomandra longifolia* and Honey-pots *Acrotriche serrulata* dominated the understorey. The understorey cover was high in places; however, patches of fallen dead shrubs, litter and bare sand were obvious too.

New Holland Mice were also located at Site 5. The dune structure and vegetation at this site were similar to that at Site 1 (Table 4; Quin 1994). The vegetation was Saw Banksia *Banksia serrata*/*Allocasuarina stricta* open woodland with a sedge-dominated understorey. *L. longifolia* dominated the understorey of dunes, though patches of shrubs - an unidentified Guinea-flower *Hibbertia* species and Coast Pomaderris *Pomaderris oraria* - were prominent, in particular, on higher dune points. *L. laevigatum* and *A. sophorae* had invaded the area forming thickets in places. However, the overall structure of the vegetation was more open than at Site 1.

The vegetation at Sites 4, 6 and 7 was similar in species composition to that at the New Holland Mouse sites. However, patches of dense *L. laevigatum* were more extensive, giving the sites a more closed structure, with less open sedge-dominated or sandy areas. At Site 8, the sand dune had been extensively invaded by *L. laevigatum*. The dense thicket/scrub vegetation had very little understorey vegetation at ground level (Quin 1994).

Other species - Trapping and Habitat

Three species additional to New Holland Mouse were trapped at Wilsons Promontory (Table 1). Bush Rats *Rattus fuscipes* (with one exception of an individual caught in wet heathland adjacent to heathy woodland at Site 2) and House Mice were trapped only in sand dune vegetation; Swamp Rats were caught only in the wet heathland Site 2. Bush Rats were captured at three of the dune systems where trapping occurred and House Mice at all dune sites sampled. No small ground mammals were caught in dry heathland.

Hair Tube Results

Hair-tubing detected four mammal species from three different sites (Table 2). At Site 1, where New Holland Mice exist, only Bush Rats were discovered by hair tubes. At Site 4, three different mammal species were detected, including an unidentified species of Antechinus, probably Brown Antechinus, a species not detected at any other Wilsons Promontory site. At Site 8, hair tubes failed to detect any species.

Discussion

New Holland Mouse - Overall Distribution in South Gippsland

New Holland Mouse is known in South Gippsland only from Wilsons Promontory National Park (Quin 1994). Populations were detected inhabiting sand dune vegetation at two previously unknown sites on the Yanakie Isthmus of the Promontory in

Table 4. Vegetation attributes at sites sampled for New Holland Mice in each study area. * = Fire history taken from written records, but on-site evidence of a much more recent burn apparent. Key: 1 = vegetation type; 2 = vegetation age (years); 3 = major character species

Area / Sites	1	2	3
Mullungdung State Forest			
1-8, 10, 12, 15, 16	heathy woodland	10-11	*Eucalyptus radiata, Banksia serrata, B. marginata, Acacia oxycedrus, Leptospermum continentale, L. myrsinoides, Bossiaea cinerea, Dillwynia glabberima, Epacris impressa, Gahnia radula, Hypolaena astigiata,Lomandra filiformis, L. glauca, Pteridium esculentum*
9, 13, 17	heath-bracken woodland	6, 9, 11	Generally as for heathy woodland but *P. esculentum* much more abundant
11	rehabilitated gravel-scrape vegetation (heath)	6	*Eucalyptus obliqua, E. muelleriana, L. continentale, L. myrsinoides, P. esculentum,* Poaceae spp.
14	heathy woodland	8	*Eucalyptus cephalocarpa, E. radiata, B. marginata, L. continentale, L. myrsinoides, E. impressa, Monotoca scoparia, Selaginella uliginosa, Amperea xiphoclada*
18	wet heathland	11	*Eucalyptus* spp., *Melaleuca squarrosa, L. continentale, Cyperaceae* spp.
Won Wron State Forest			
1, 3	heathy woodland	0.8	*Eucalyptus* spp., *B. serrata, Xanthorrhoea australis, P. esculentum, Acacia* spp.
2	heathy woodland	>50	*Eucalyptus nitida, B. serrata, X. australis, L. continentale, L. myrsinoides, B. cinerea,*
4, 5	heathy open forest	>50*	*Eucalyptus sp., Spyridium parvifolium, B. marginata, Gonocarpus* sp., *Gahnia radula*
Dream/Hummock Island			
1-4	coastal sand dune vegetation	>50	*Acacia sophorae, Leptospermum* sp.,*Myoporum insulare, Banksia integrifolia, Lepidosperma* sp., *Ammophila arenaria,* Asteraceae sp.
Wilsons Promontory National Park			
1,4-8	coastal sand dune vegetation	20-30	*A. sophorae, Allocasuarina stricta, L. laevigatum, Dianella revoluta, Lomandra longifolia, Acrotriche serrulata, Bursaria spinosa, Pomaderris oraria*
	wet heathland	4	*Melaleuca squarrosa, L. continentale, E. impressa, Allocasuarina paludosa, Xanthorrhoea sp., Dampiera stricta, S. uliginosa, Restio complanatus, Leptocarpus tenax*
3	dry heathland	3	*B. marginata, Xanthorrhoea* sp., *A. oxycedrus, L. continentale, E. impressa, B. cinerea*

1993. This species has since been found to be more widespread on the Isthmus (Darren Carman *pers. com.*). Populations at Mullungdung State Forest (Gilmore 1977) and Dream/Hummock Island (Menkhorst 1995) are apparently no longer present. The New Holland Mouse was not found at Won Wron State Forest, however, it has never been recorded from this forest. It was known from McLoughlins Beach

(Cockburn 1980; Menkhorst 1995); however, recent surveys at McLoughlins Beach failed to locate it (Fauna Survey Group, Field Naturalists Club of Victoria and Deakin University records). It was not detected at Gellions Run (Lumsden and Schultz 1985), nor was it found on Sunday Island (Myroniuk *et al.* 1993).

Possible reasons for the decline of New Holland Mouse populations in the survey areas together with future management prescriptions are discussed in the follow-up paper (part 2) (Quin and Williamson *in press*). The nearest known extant populations of New Holland Mouse to those of Wilsons Promontory occur approximately 170 km to the north-east at the Loch Sport and Providence Ponds areas in South Gippsland. Individuals were trapped at Loch Sport in 1990 and 1992, and at Providence Ponds as recently as April 1994 (Deakin University and Mammal Survey Group of Victoria records; Seebeck *et al. in prep.*).

Other Small Mammal Species - Habitat and Distribution in South Gippsland

The Brown Antechinus inhabits a wide range of habitats (Hampton *et al.* 1982), including heath communities, as the present study found. However, it was not detected in sand dune vegetation at Dream/Hummock Island or Wilsons Promontory, possibly because of a lack of tree hollows (refuge sites) in this habitat type (*pers. obs.*).

Bush Rats likewise occupy a range of habitats; however, they reach greatest abundance in habitat with exceptionally dense understoreys (Lunney 1995). At sites sampled in Mullungdung and Dream/Hummock Island, vegetation at the ground level was in places relatively sparse, especially where species of either Tea-tree or Wattle were abundant. This may explain the low trapping rate of Bush Rats at the former area and their absence at the Island. Areas dominated by sedges and lilies on dunes at Wilsons Promontory provide suitable ground cover vegetation for them.

Swamp Rats were relatively abundant in sand dunes at Dream/Hummock Island, as they were in 1977 (Peter Menkhorst *pers. comm.*). Otherwise, this species was only caught in the wetter heaths of Mullungdung and Wilsons Promontory. This is somewhat consistent with the findings of previous studies (Braithwaite and Gullan 1978; Braithwaite *et al.* 1978; Wilson 1991), although the sedge component of understoreys, implicated in influencing Swamp Rat distribution, was generally quite low at sites on both Dream / Hummock Island and at Mullungdung.

House Mice clearly favour vegetated sand dunes as habitat at Wilsons Promontory and Dream/Hummock Island, suggesting that vegetation on the sampled dune sites is in a state of disturbance. Geologically, Oyston (1988) considered sand dunes on the Yanakie Isthmus have stabilised since the cessation of grazing and regular burning by cattle graziers. A single House Mouse was captured in recently burnt (0.8 years after fire) heathy woodland at Won Wron State Forest.

The Eastern Pygmy-possum inhabits a variety of vegetation forms, from rainforest to coastal heath. It especially favours habitats with an abundance of hollows for refuge sites (Turner and Ward 1995). Consequently, heathy woodlands of Mullungdung (and probably Won Wron) would be suitable habitat. However, Eastern Pygmy-possums were also trapped at a rehabilitated gravel scrape in Mullungdung. This scrape was created in the 1960's and intermittently used until the late 1970's. Natural regeneration was occurring, and in the late 1980's, rehabilitation works - top soil spreading and Eucalypt planting - was conducted (Graeme Davis *pers. comm.*). An abundance of potential food shrubs, including Tea-tree, occurs in the scrape, but not Banksias. Additionally, the Eastern Pygmy-possums may be taking advantage of the fallen logs, left during the initial scrape creation, as diurnal refuge sites.

Acknowledgments

I thank Barbara Wilson (Deakin University) for advice given in directing the project. The study site selection process benefited from discussions with Barbara, Tim Buttle, Peter Menkhorst, Jim Whelan, Tony Willet, the Fauna Survey Group of the Field Naturalists Club of Victoria, and the Mammal Survey Group of Victoria. Barbara, Peter and the two groups are also thanked for permitting access to their survey records.

The following persons provided valuable field support which is acknowledged: Dale Antonysen, David Body, Tim Buttle, Steve Darby, Kath and Andrew Gosden, Darren Heil, Belinda Kee, Irma Keskinen, Les Leunig, the Luckock family, Frankie MacLennan, Joan Quin, Susan Taylor and David Knowles, Jim Whelan, Ross Williamson and Andy Wise. Special thanks must go to Neil Scanlon who assisted with all aspects of field work in Mullungdung and Won Wron State Forests. Ross Williamson assisted in supervising the project.

Joy Darby's expertise produced the maps. Catriona McPhee and Beverley Van Praagh kindly identified invertebrates. Barbara Triggs identified hair samples and components of scats. Raelene Warren also analysed some hair samples. Ed and Pat Grey, Darren Quin, Susan Taylor, Sonya Feodoroff and Robyn Watson provided valuable suggestions to improve the manuscript. Further constructive comments were provided by an anonymous referee. Toni Carroll and Tracey Fuller word processed the manuscript.

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The Consumption of Onion Grass *Romulea rosea Corms by Purple Swamphens *Porphyrio porphyrio* -

Is there Potential for Native Animals to help Control Weeds?

S. Diez[1,2] and M.F. Clarke[1]

Abstract

Swamphens fed on the underground corms of the weed Onion Grass *Romulea rosea* in autumn and winter, when the ground was soft and shoots of the weed were present. These Birds fed significantly more often on the weed in areas where the plants were in high densities and the ground soft. Corm depth and soil moisture content were unimportant in determining whether a swamphen chose to feed on Onion Grass at a particular site. Experiments in which the soil at some sites was lightly tilled demonstrated that swamphens would feed on onion grass corms in such areas, even though they had not previously grazed on onion grass at these sites. This paper discusses the potential use of a native species in weed management programs. (*The Victorian Naturalist* 113, 1996 , 247-255)

Introduction

Native bushland and re-vegetated areas are often subject to invasion by introduced plants. Weeds can out-compete native or desirable species and subsequently lead to the degradation of areas set aside for conservation purposes (*e.g.* Carr *et al.* 1992). Attempts to control such weeds often involve the use of herbicides whose residues may persist in the environment. However, utilising the grazing activities of herbivorous animals to control weeds may offer an alternative method with fewer long-term risks.

Past consideration of such an approach to weed control has focused on the use of domestic animals to maintain or enhance communities and control undesirable plant species (*e.g.* Gibson *et al.* 1987, Bokdam and Wallis-de-Vries 1992). To date, there appears to have been very little research on the possible use of native animals to assist in restoration processes. When one considers that the activities of native animals may have shaped the very ecosystems that are being restored, this neglect seems a serious oversight. Part of the reason may be that the restoration of ecosystems is itself such a new field (Jordan *et al.* 1987).

In an attempt to address the effects of native grazers upon re-generating ecosystems, this study focused on the interaction between a native grazer, the Purple Swamphen *Porphyrio porphyrio* (Fig. 1) and an introduced weed, Onion Grass *Romulea rosea* (* = introduced plant).

The major components of the swamphen's diet consist of pieces of vegetation gleaned from swamps and pastures (Readers Digest 1977). Creation of areas of open pasture for cattle has also created ideal habitat for grazing by swamphens (Fordham 1983). A high proportion of plant species found in these pastures are exotic plants, introduced into Australia. Detailed records of the dietary habits of the swamphen in the Gippsland region of Victoria have shown that a significant proportion of the diet was composed of introduced plant species (Norman and Mumford 1985). Species consumed include exotic plants from the families Gramineae (grasses), Cyperaceae (sedges) and Hydrocharitaceae(water plants). These records highlight the ability of swamphens to incorporate new foods into their diet.

Members of the genus *Romulea* are part of the Iridaceae family, and were originally

Fig. 1 Purple Swamphen *Porphyrio porphyrio*

[1]School of Zoology, La Trobe University, Bundoora, Victoria 3083
[2] Current address: NRE, P. O. Box 401, Bendigo, Victoria 3550

restricted to parts of Southern Africa (deVos 1972). **Romulea rosea* persists as an underground corm or food storage organ during the dry summer months. Inconspicuous grass-like shoots emerge after the autumn rains, and pink flowers appear in the spring. In Victoria, the distribution of **R. rosea* (hereafter referred to as *Romulea* to include other species within the *Romulea* genus) seems to have been restricted to the area around the Melbourne Botanical Gardens in the mid 1800's, but had dispersed widely and become a serious problem by the early 1900's (Ewart 1906, 1909). Early ideas on the control of the weed in pastures included manuring and bringing the land under cultivation (Ewart 1907).

In an analysis of the gizzard contents of swamphens collected in the Gippsland region, Norman and Mumford (1985) recorded parts of the corms of *Romulea* in many of the birds examined. Although present in the crops of many individuals, it was not a significant proportion of the diet. How, or where, the corms of this plant were obtained and consumed was not addressed in that study. To investigate the relationship between swamphens and *Romulea*, the following questions were addressed:

i) How does the swamphen forage upon *Romulea*?

ii) What are the characteristics of the soil and plants at sites where swamphens feed on *Romulea*?

iii) Using the results of the above investigation, is it possible to manipulate the environment to increase the likelihood that swamphens will feed upon *Romulea*?

Study area and methods

The study site was located within a regenerating woodland being managed as a bushland reserve, within the grounds of La Trobe University in Bundoora, Victoria, Australia (37°41' S, 145°3' E). The site was originally a River Red Gum *Eucalyptus camaldulensis* woodland, but had been cleared and grazed as farmland prior to acquisition by La Trobe University in 1968. During the last twenty-five years much of the site has been revegetated with indigenous flora. The site includes a water treatment system of billabongs and lakes, which act as catchment for the area north-east of the University. Wetland flora from the nearby Plenty and Yarra Rivers have been used to re-create a complex wetland system. Waterfowl have arrived as a natural consequence of habitat development .

Romulea abundance

Seasonal changes in *Romulea* abundance were determined by counting plants in 12 (90x90 cm) wire plots which were set up at the study site prior to full emergence of *Romulea* in April, 1993. Sub-sampling of these plots was randomised by choosing three of a possible nine (30 x 30 cm) sub-plots within the plot. Counts were carried out every 2-3 weeks to take into account the relatively long period of germination of *Romulea* (Eddy and Smith 1975). Small numbers of **Romulea minutiflora* (Small Onion Grass) are known to exist within the study site (*pers.comm.* G. Carr). However, these were not identified or distinguished from **R. rosea* during this study.

Feeding Behaviour

Observations of the feeding behaviour of swamphens were carried out from 28 April to 12 August,1993, to determine whether swamphens used particular feeding techniques to consume *Romulea* corms. Although the swamphens were not individually marked, detailed observations were obtained on the foraging behaviour of at least eight individual birds feeding on *Romulea* at the study site between May and August 1993, and the actual number of different birds observed was probably much greater. Further observations were carried out at Towt's Swamp near Whittlesea (37° 31' S, 145° 07' E). Birds were observed from a distance of between 5-40 m using Carl Zeiss 10 x 50 binoculars. Observations of feeding behaviour were recorded in note form and photographs were taken.

In order to determine the conditions that were most favourable for the consumption of *Romulea* by swamphens, the birds were observed regularly during the autumn and winter of 1993, by traversing a fixed transect of 1.51 km every three days. Five types of data were collected at all sites within a 1 m radius of where swamphens were observed:

a) A relative measure of soil hardness was obtained using a soil penetrometer (Geotester Pocket Penetrometer).

b) Cylindrical soil cores (of a depth of 10 cm, and a diameter of approximately 8 cm) were removed to obtain an estimate of the number of *Romulea* corms and their depths.

c) The soil contained in the cores was used to determine the relative soil moisture at each foraging site. An estimate of soil moisture was obtained by weighing and then heating the soil samples at 105°C for 24 hours in order to remove moisture (Reynolds 1970). The samples were then re-weighed and relative soil moisture for each sample was calculated using the change in weight as a percentage of the pre-dried weight of the soil.

d) Where swamphens were foraging and *Romulea* shoots were observed, a 30 x 30 cm quadrat was placed immediately adjacent to the foraging area, and the number of individual *Romulea* plants within the quadrat was recorded

e) Swamphens were recorded as having fed on *Romulea* if *Romulea* corm basal sheaths were found in the foraging area (Fig. 2)

Disturbance experiment

During habitat usage surveys it became clear that a significant proportion of birds feeding on *Romulea* were observed in areas in which the soil penetrability reading was low (*i.e.* soil was soft), and areas where the soil had been disturbed by machinery. In order to test the hypothesis that swamphens were attracted to disturbed areas, soil penetrability was experimentally manipulated by tilling.

Fig. 2. Basal sheaths left after Swamphens have eaten the corm

Ten pairs of control and experimentally-tilled plots were set up within the bushland reserve. Some plots were located along compacted pathways and others close to known feeding sites. Each plot consisted of two (90 cm x 90 cm) adjoining areas; in one the soil was gently loosened with a garden fork, whilst the other was left as an un-tilled control plot. *Romulea* abundance prior to disturbance was determined by counting the number of above-ground shoots in three randomly selected subplots, each of 30 cm x 30 cm within each plot. An estimate of the foraging intensity of swamphens at each plot was determined twice by counting the number of *Romulea* corm basal sheaths in each plot 7 days and 14 days after the commencement of the experiment. After four to five weeks, the final numbers of *Romulea* plants remaining in all plots was determined using the same methods as during the earlier counts.

Parametric statistical tests were used, unless otherwise indicated. Where necessary, data were log-transformed to achieve homogeneity of variance. Means of un-transformed data ± one standard error are presented.

Results

The number of *Romulea* plants visible above the ground surface increased steadily throughout April and June, with abundances fluctuating between July and August (Fig. 3).

The initial increase was due to both germinating seedlings and the re-emergence of adult plants after summer dormancy.

Feeding behaviour

Swamphens were first observed consuming *Romulea* corms on May 1. They removed entire plants either by digging with the beak to loosen the soil, or by pulling up the plant by the base of the shoot. The swamphen would then raise one foot to its beak, an action often accompanied by a simultaneous lowering of the head and neck (Fig. 4). The plant was transferred from the bill to either the left or right foot, and then held firmly between two of the fore toes. The corm was broken

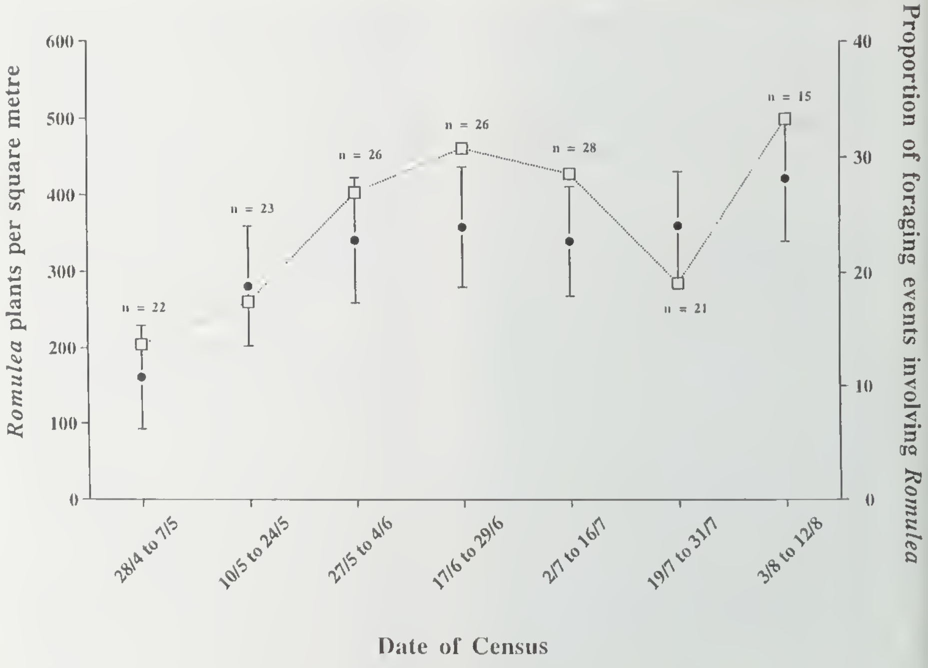

Fig. 3. Proportion of foraging events involving *Romulea*

up using the beak, generally whilst the bird was balancing on one leg. Alternatively the plant was pinned to the ground and the corm broken up. Once the internal portion of the corm was consumed, the characteristic corm basal sheaths and the shoot, with a small portion of the corm attached, were all that remained (Fig. 5).

One swamphen was observed carrying a *Romulea* plant to a puddle and washing it prior to consumption. This same behaviour was observed on a separate occasion by another observer (B. Malone *pers. comm.)* at a nearby location. Because birds were not individually distinguishable, it was unclear if this washing behaviour was limited to one individual.

Fig. 4. Swamphen feeding behaviour.

Features of the foraging sites

When compared statistically, the number of *Romulea* plants/m² above the ground surface was significantly higher in areas where swamphens were foraging upon *Romulea* than in areas where *Romulea* was present but not foraged upon (Table 1). There was also a significantly greater number of corms per core where swamphens were foraging on *Romulea* than in areas where swamphens refrained from foraging on *Romulea* despite the weed being present (Table 1).

The soil penetrability ranged from 6.1 kg/m² (very hard) to 0.6 kg/m² (very soft) during the study. The soil penetrability readings at sites where swamphens foraged on *Romulea* were significantly lower than at the sites where swamphens failed to forage on *Romulea* even though the weed was present (Table 1).

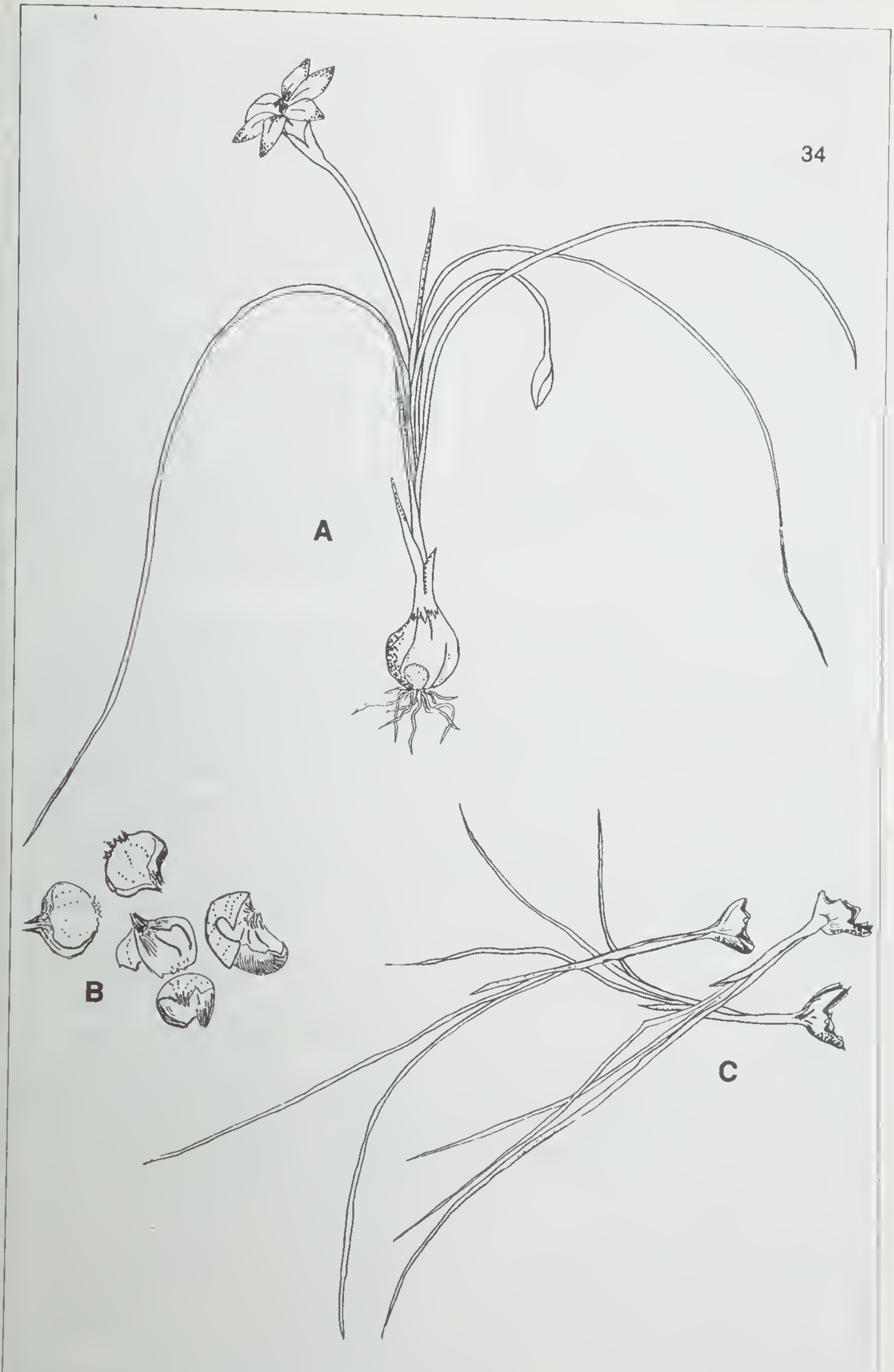

Fig. 5. A - Onion Grass *Romulea rosea*, whole plant. B.and C. show the remains of Swamphen foraging, B - corm sheathing leaf bases, C - shoot remains.

When compared statistically, the soil moisture at sites where swamphens foraged on *Romulea* was not significantly different to the soil moisture at sites where swamphens did not forage on *Romulea* despite the weed being present (Table 1). There was a significant correlation between soil moisture and penetrability (r = 0.42, df = 99, p = 0.0001, n =101). However, only 17% of the variation in soil penetrability could be explained by percentage moisture, suggesting that other factors possibly may be affecting soil penetrability.

The mean depth at which *Romulea* corms were located in soil cores ranged from 0.5 - 6.0 cm. These mean depths did not differ significantly in areas where swamphens foraged on *Romulea* and where swamphens did not forage on *Romulea* despite the weed being present (Table 1).

Disturbance plots

Significantly more *Romulea* corms were consumed by swamphens in the tilled sites than in the control plots. This was evident from the number of corm basal sheaths/m² on the tilled plots which were significantly higher than the number found on the control plots seven days after the disturbance (Table 2).

After 14 days, the number of corm basal sheaths counted on the tilled plots indicated that foraging intensity was increasing compared to that on undisturbed control plots (Table 2).

Four weeks after the experiment was initiated, a count of *Romulea* plants was carried out to determine if the disturbance had affected seedling recruitment. The number of *Romulea* plants present increased on both tilled plots and control plots during the experiment. However, the increase was smaller in the tilled plots than in the control plots, although the difference was not statistically significant (Table 2).

Table 1. Features of the foraging sites where *Romulea* was present and either foraged upon, or not foraged upon by Purple Swamphens
Note that n = the number of samples, SE is the standard error, X = the mean, df = the degrees of freedom (n-1), t is the test statistic, and P is the probability that the two sets of samples are the same. For the soil moisture analysis the degrees of freedom were adjusted following the method of Watson and McGaw (1980) to account for non-homogeneity of variances.
Key: 1 = Sites where *Romulea* was foraged upon; 2 Sites where *Romulea* was present but not foraged upon

Variable	1		2		t	df	p
	X ± SE	n	X ± SE	n			
Number of *Romulea* plants/m²	273 ± 35.3	36	117 ± 52	18	3.95	52	0.0002
Number of *Romulea* corms/core	9.4 ± 1.2	36	3.0 ± 0.9	18	4.62	45	0.0001
Soil penetrability	1.3 ± 0.2	35	2.4 ± 0.4	18	3.36	51	0.002
Soil moisture	23.5 ± 0.8	34	23.9 ± 2.2	18	0.60	20	p>0.2

Table 2. Mean number of *Romulea* corm basal sheaths and mean number of *Romulea* plants found at sites where the soil had been tilled, and at control plots where the soil had not been tilled.

Variable	Tilled plots		Control Plots		t	df	p
	X ± SE	n	X ± SE	n			
Number of corm basal sheaths after 7 days	12 ± 4.1	10	0.8 ± 0.4	10	3.53	9	0.0064
Number of corm basal sheaths after 14 days	34.7 ± 13.3	10	1.4 ± 0.5	10	6.04	9	0.0002
Mean increase in the number of *Romulea* plants after 4 weeks	67.3 ± 13.1	10	79.6 ± 9.4	10	0 1.42	9	0 188

Discussion

Feeding technique and seasonality

Observations of swamphen feeding techniques indicated that the use of their feet was an important part of *Romulea* consumption. By manipulating plants with their feet, swamphens were able to extract the entire contents of the corm, destroying it in the process. These observations are important because the manner in which swamphens feed on *Romulea* has obvious consequences for the individual plant being consumed, but may also have consequences for the local population of the weed. Swamphens may be viewed as 'predators' (as defined by Thompson 1982) since grazing results in the death of whole plants. Because swamphens feed on plants before they begin seed production (seed may begin forming from September to October or November, Ewart 1907), they have the potential to affect the future abundance of the weed.

The consumption of *Romulea* by swamphens is clearly not restricted to certain localities. Swamphens have been recorded feeding on *Romulea* corms in other parts of Victoria (e.g. at Coolart (38° 24' S, 145° 09' E) (S. Yorke, *pers. comm.*), at Whittlesea (37° 31'S, 145° 07'E) (M. Towt, *pers. comm.*), and at Gippsland (Norman and Mumford 1985)).

The method used by swamphens to feed on *Romulea* is not restricted to this one food type. Rowley (1968) has described a similar technique exhibited by swamphens feeding on figs, where figs were transferred from bill to foot, and the foot was used to pin fruit to the ground. Also, Holyoak (1970) described washing of food and extensive use of feet in feeding as a common characteristic of captive swamphens.

Bryant (1940a and 1940b) also recorded the use of feet for feeding, though there seemed to be some perception at the time of his publications that the technique was quite uncommon among swamphens. In Victoria, swamphens have incorporated significant amounts of introduced vegetation into their diets (Norman and Mumford 1985). Extensive modifications to wetlands and their surrounds (Shaw *et al.* 1990, Wood 1990) may have altered the quantity and/or types of foods available to waterfowl. It is likely that the increased availability of introduced plants has had an important influence on the feeding behaviour of swamphens.

Characteristics of the foraging sites

**Romulea rosea* was more likely to be consumed by swamphens at sites where the soil was soft, and where *Romulea* numbers were high. It is likely that *Romulea* was easier to extract in areas where the soil was soft. Furthermore, it is possible that removal of *Romulea* plants may lead to even further softening of the soil, such that the energy required to obtain additional plants is less than that required to obtain the first plants in an area. A benefit such as this is more likely to occur at sites with high densities of *Romulea*.

That corm depth and soil moisture were not good predictors of where swamphens would forage on *Romulea* was a somewhat surprising result. Swamphens appeared capable of feeding on *Romulea* corms at all depths, provided the soil was soft enough. Though not highly correlated with soil penetrability, moisture was expected to play some role in determining the ease with which swamphens could remove corms. It may be that other soil parameters such as composition and structure are better predictors of soil penetrability.

Although both the number of corms present and the number of above-ground shoots were good predictors of the likelihood of swamphens foraging on *Romulea* at a site, the number of corms was a better predictor than number of above-ground shoots. The number of shoots will differ from corm number because of corms that may remain dormant and also because seedlings do not form corms until the end of their first growing season (*pers. obs.*). Swamphens may be able to discern differences in the available below-ground food resource without using the number of shoots as a cue. There is potential for further experimentation to test this hypothesis by removing *Romulea* shoots from areas of soft soil. If swamphens continue to dig for the corms this might suggest they are indeed using other cues or memory to assess the abundance of below-ground corms.

Artificial disturbance experiment

By itself, the correlational evidence that swamphens foraged more often on *Romulea* where the ground was soft, did not prove conclusively that ground hardness was of key importance in the foraging behaviour of swamphens upon this weed. Such a correlation could have been due to corms being larger, or at a higher density, at sites with soft soils. The fact that experimental loosening of the soil attracted swamphens to feed on these sites more heavily than in adjacent undisturbed control areas (when other confounding variable were controlled) provides strong experimental evidence that swamphens preferentially forage upon *Romulea* in areas where the soil is soft.

Interestingly, as indicated by an increase in the number of corm basal sheaths over the two-week study period, the number of corms in the tilled areas was not totally depleted by swamphens at their initial discovery. This could be due to individual birds becoming satiated, and then leaving the patch of food to possibly return at some later date, or the discovery of the patch by successive birds, each of whom forages until satiated, and then leaves. Similar habits were also reported for the Long-billed Corella *Cacatua tenuirostris*, which 'habitually returned' to feed on **R. rosea* in ploughed fields (Temby and Emison 1986). It is also possible to interpret these habits in the light of Charnov's (1976) marginal value theorem, which predicts that areas of high energy return should be foraged only as long as no alternative site offers a better rate of return. If accessibility of *Romulea* varies over time (due to rainfall or other factors), then this may explain why the birds might leave one food patch for another, and also, why they may later return to feed in the original patch.

The fact that swamphens are easily attracted to feeding on *Romulea* if the area where it is growing has been lightly tilled may affect the way that this weed is managed near wetlands. Firstly, loosening soil in small areas may be a useful alternative to herbicides, an advantage when working near wetlands. Secondly, particular sites can be targeted without damaging surrounding areas. Given that corms are consumed prior to seed being set, it is likely that consumption of *Romulea* by swamphens and other birds such as Sulphur-crested Cockatoos *Cacatua galerita* (Ewart 1907); Stubble Quail *Coturnix pectoralis* Hyett (1967) and Long-billed Corella (Temby and Emison 1986)) could affect the density of plants in an area over time. A longer-term study is needed to examine this.

The consumption of *Romulea* corms by Swamphens is not likely to reduce plant numbers permanently. If there are adult plants setting seed in the vicinity of the tilled area, *Romulea* will almost certainly re-invade. Similarly, other weeds may invade where there is soil disturbance. Thus tilling and foraging by swamphens may be useful as a weed control tool, but only as part of a combined approach with other methods such as burning which prevents *Romulea from* flowering.

However, it is clear that native herbivores may have a potential role to play in controlling the spread of weed species.

Acknowledgments

We would like to thank the staff of the Wildlife Reserves, La Trobe University for permission to conduct our research there and in particular, G. Paras who drew our attention to the Purple Swamphen/*Romulea* interaction. We would also like to acknowledge assistance from the van Roosendael Family and M. Towt, who allowed us to observe Purple Swamphens (and *Romulea)* on their properties. We would like to acknowledge G. Carr and N. Scarlett for providing information on the life history of *Romulea*.

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Advance of the Honey Fungus

The merry month of May has been a disappointing one in our area for mushrooms and for fungi in general. Only the Honey Fungus *Armillaria luteobubalina* proliferates in the native park opposite my house, festooning the roots and butts of its victims with its fruiting bodies. The freely shed spores whitewash the surrounding areas. The spores themselves will not attack a living tree but must establish a base on a dead stump or similar deadwood of which, alas, there are plenty. From this base long rhizomorphs that resemble the black bootlaces wander out through the soil until they strike the roots of a living tree spreading the infection up toward the trunk and eventually killing it. The fungus is moving inexorably down the park claiming eucalypts, angophoras, wattles, sheoaks and lesser shrubbery. I wish I knew how to check it, short of digging deep trenches around the more valued trees.

On a visit to Perth in the seventies we noticed the gardeners in Kings Park lifting their shrubs with great balls of earth, lining the holes with black plastic and replacing them. On being asked the reason for this odd behaviour, they cried in distracted tones 'We've got the Honey Fungus!'.

However, back in Victoria, 1996, a bonus for me - also in the park, was a nice colony of Wood Blewit *Lepista nuda* delightful in their tonings of cinnamon caps and palest mauve gills and stems. They grew amongst grass and fallen leaves under a Cherry Ballart/Angophora clump. They are an excellent culinary mushroom, very tasty in the pan. Know them by their pale pink spores. I must admit that I have tried young and tender specimens of the Honey Fungus too, first bringing them to the boil in salted water to dispel any evil humours. Verdict? They are not bad!.

Ellen Lyndon
7 Steele Street, Leongatha, Victoria 3953

Using Nest Boxes to Survey for the Brush-tailed Phascogale *Phascogale tapoatafa*

T. R. Soderquist[1], B. J. Traill[1], F. Faris[2], K. Beasley[3]

Abstract
The Brush-tailed Phascogale *Phascogale tapoatafa* is an arboreal carnivorous marsupial previously found in dry forest and woodland throughout much of Australia. The species' distribution has declined during the past two centuries, with its current range and status being poorly understood. Of the several survey methods available for arboreal mammals, the use of nest boxes is the most efficient for locating phascogales. We describe this survey technique as it applies to phascogales, and propose that nest boxes be established and checked by interested volunteers so as to monitor populations trends in the long-term. Whether conducted by a concerned individual or a naturalist group, each survey will contribute to the conservation of this rare species.(*The Victorian Naturalist* 113,1996, 256-261).

Introduction

The Brush-tailed Phascogale *Phascogale tapoatafa* is a medium sized carnivorous marsupial (family Dasyuridae) found in the dry sclerophyll forests and woodlands of mainland Australia (Cuttle 1983)(Fig. 1). The name Tuan is commonly used for *P. tapoatafa* in Victoria. It originally derived from an Aboriginal name for Sugar Gliders (Conole 1987). Since the arrival of Europeans in Australia, the distribution of the species has declined greatly and the species is now apparently extinct in South Australia and rare in the other states. Due to the relatively extensive fauna surveys conducted in Victoria (e.g. Menkhorst and Gilmore 1979; Norris *et al.* 1983), the species. decline in this state is particularly well documented (Atlas of Victorian Wildlife, Department of Conservation and Natural Resources). Phascogales were previously distributed throughout much of Victoria (Fig. 2) but have become locally extinct in many regions. The lack of observations after 1960 in the southern Gippsland forests and in coastal eucalypt woodlands indicates that the extinction process is continuing. Further local extinctions are likely among many of the fragmented, remnant forests in central and western Victoria.

Three aspects of the natural history of *P. tapoatafa* (hereafter referred to as phascogales) make it unusually vulnerable to extinction, especially when small populations become isolated. Firstly, the lifespan of phascogales is relatively short. All male phascogales die after the short annual breeding season when 11-12 months of age (Cuttle 1982). Thus, reproduction must be successful in every year so that sires are present during the next breeding season. Females seldom live longer than two years. Due to the energetic stress of lactation, they typically succeed in weaning only one litter (Soderquist 1993*a*). Secondly, the density of phascogales is typically very low. For example, the apparently high quality habitat in the Chiltern Regional Park (4,200 ha) only sustains 35-50 breeding females. This sparse density is due, in part, to the low abundance of their prey

Fig. 1. Brush-tailed Phascogale (or Tuan) *Phascogale tapoatafa*.

[1] Department of Ecology and Evolutionary Biology, Monash University, Clayton, Victoria 3168
[2] Friends of the Tuan, Threatened Species Network, 10 Parliament Place, East Melbourne, Victoria 3002.
[3] Australian Trust for Conservation Volunteers, P. O. Box 423, Ballarat, Victoria, 3353

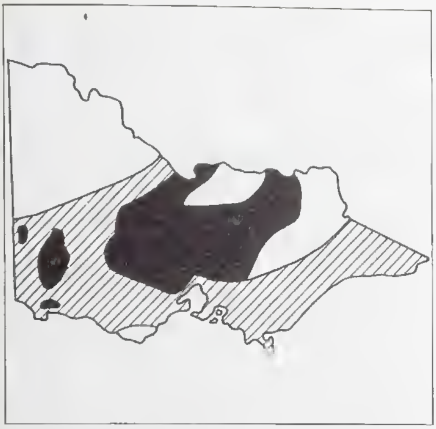

Fig. 2. Distribution of *P. tapoatafa* in Victoria. The shaded area indicates regions currently occupied, although populations are highly fragmented within these areas. The hatched area indicates probable historical distribution (see Menkhorst 1995). In addition, unverified reports of phascogales have recently come from Gippsland and the Bellarine Peninsula.

(large insects) which forces females to forage over surprisingly large home ranges, mean 40 ha (Soderquist 1995). Females are territorially aggressive towards unrelated females and seldom share a home range with daughters (Soderquist and Ealey 1994). Hence, few litters can be raised in a given area. Thirdly, juvenile males tend to disperse long distances (>3 km) from their natal home ranges (Soderquist and Lill 1995). This assists genetic interchange in large, contiguous populations. However, it means that small populations of phascogales are likely to lose all locally produced sons. If females are to reproduce they must be located by males dispersing from other areas.

The low densities of phascogales make it difficult to survey for the species. The consequent lack of information on distribution is hindering efforts to protect phascogales. Land managers are usually unwilling to curtail destructive activities without proof that phascogales (or other rare species) exist at a site. Surveys and long-term monitoring need to be initiated now to determine the current distribution and status of phascogales and to stimulate appropriate management of their habitat.

In this paper we briefly review five survey techniques for phascogales. We then discuss in detail one technique - the use of nest boxes - which probably offers the most time-efficient method of surveying and monitoring phascogale populations. It is also of use in surveying other hollow-using mammals that occur in low densities (Menkhorst 1984).

Survey Techniques for Phascogales

Public response surveys

In areas where phascogales may exist but no recent records are known, local residents can be encouraged to report sightings. This documents observations obtained by chance (e.g. animals killed by cats) and also increases public interest in the species. The value of such surveys was recently demonstrated when a phascogale distribution map was published in a widely circulated newsletter (Sharpe 1993). The map elicited reports of three recent observations of phascogales near Portland (K. Aldredge *pers. comm.*) in an area where no previous sightings had been recorded.

Predator scat analysis

The scats of mammalian predators and the pellets of owls may contain hair or bones from phascogales (Van Dyck and Gibbons 1980, Erstberg and Braithwaite 1985, Traill 1993). However, phascogales typically comprise only a very small proportion of any predator's diet and are unlikely to be found except in large samples of scats. Examination of mammal scats also requires considerable expertise in distinguishing phascogale hair and bone from that of other dasyurids.

Spotlighting

This technique is commonly used for nocturnal species and is efficient for species that exist in high densities such as Sugar Gliders *Petaurus breviceps*. However, successful spotting of phascogales is difficult due to their low densities. Traill and Coates (1993) observed an average of only 4.3 phascogales per 100 hours of spotlighting in areas known to contain resident animals.

Trapping

The low densities and trap shyness of phascogales makes trapping surveys relatively less efficient for this species than for many others. Traill and Coates (1993) trapped an average of only 4.9 phascogales per 1,000 trap-nights with wire-mesh traps set in trees. Phascogales can escape from Elliott traps, and are prone to damaging themselves while escaping or attempting to escape from aluminium and wire-mesh traps. Young animals are also particularly vulnerable to death from exposure in traps on cold nights.

Hair tube sampling

The use of hair tubes (Suckling 1978, Scotts and Craig 1988) is a simple, non-invasive technique which has great potential for identifying the presence of rare mammals. Few surveys have been conducted in phascogale habitat, so that the efficiency of the technique remains uncertain. Recent surveys in the Box-Ironbark forests of central Victoria have used hair tubes to detect phascogales where spotlighting was unsuccessful (L. Lumsden *pers comm.*) However, the technique requires specialist identification of hair which is difficult to distinguish from that of *Antechinus* spp. For professional survey teams with specialist support or training, hair tubes may provide an efficient alternative to other techniques.

Nest boxes

Individual phascogales use 10-40 nest sites each year. These may be in tree stumps, hollows in live or dead trees, the dome-shaped nests of birds or even under flaking bark. Some are poor-quality sites offering little protection from weather and predators. However, lactating females are more particular in the selection of nursery nests (in which young are left while the mother forages). Such nests are typically large cavities with small entrances (Soderquist 1993*b*).

Phascogales readily use artificial nest boxes (Fig. 3), especially in habitats lacking many natural tree-hollows (Lindner 1983, Traill and Coates 1993). In Victoria and most other parts of southern-eastern Australia, much of the remaining phascogale habitat has had the larger trees cut down and few natural tree-hollows remain (Traill 1991). Even in habitats that have numerous hollows, nest boxes are occasionally used. Unlike traps, boxes can be checked by the survey team when convenient, and observations of nests or seats are further indications of the presence phascogales. This survey technique is only useful if nest boxes are left out for long periods of time (>4 months).

Surveying Phascogales using nest boxes

Nest box design and construction is excellently described in Victoria's Land For Wildlife Note Number 14 (available from the regional offices of the Victorian Department of Conservation and Natural Resources). Boxes for phascogales should be no smaller than 150 X 150 X 300 mm high. A larger box is preferable, allowing a female to use more material in building her nursery nest, and thus improving the insulation of the litter (Soderquist 1993*b*). If the floor space of the box is much greater than 600 cm^2, one third of it should be partitioned off with a 10 cm high vertical strip of wood attached to the floor. This partition serves two purposes: (1) it provides a brace for the leaf nests of antechinus and gliders, which otherwise tend to collapse in larger hollows and (2) it creates a 'foyer' which phascogales use for a toilet, thus keeping the nest unsoiled.

Rough-sawn timber serves as a better nest box surface than finished planks or plyboard as it provides a secure grip for the phascogales. If smooth timber is used, shallow saw cuts on the interior beneath the entrance will provide footholds. The

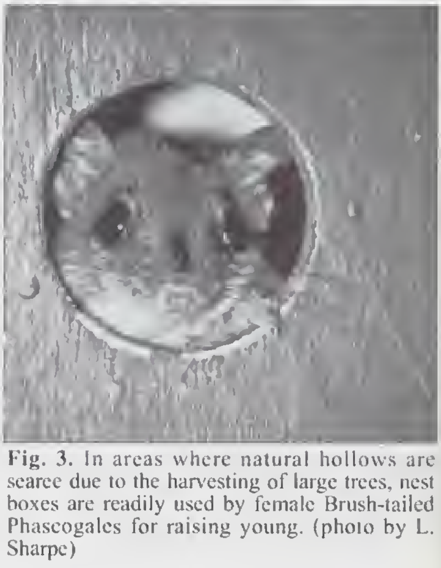

Fig. 3. In areas where natural hollows are scarce due to the harvesting of large trees, nest boxes are readily used by female Brush-tailed Phascogales for raising young. (photo by L. Sharpe)

wood should not be treated with toxic chemicals, but can be protected with non-toxic paint. A piece of carpet tacked to the inner ceiling of the box may discourage Honeybees *Apis mellifera* from colonizing the box by hindering attachment of the wax comb to the ceiling. However, tests of this technique have only recently been initiated and the benefit remains uncertain (I. Fenselau and R. Trainor pers. comm.). A round entrance hole of 35 mm diameter provides the best compromise between excluding large, common species such as Ringtail Possums and allowing access by large male phascogales.

Boxes should be placed at least 4 m off the ground on trees greater than 25 cm in diameter. Avoid smooth-barked trees (e.g. the 'gum' types of eucalypts) as phascogales have great difficulty climbing them. Trees should be selected that lack natural hollows. Because metal nails in trees may pose a safety hazard to anyone cutting the tree years later, the box should not be nailed directly to the tree. Instead it should be suspended by a metal strap or wire which loops around the tree trunk. This strap must be adjusted as the tree slowly grows, and care should be taken to ensure that the loop does not cut through the bark (e.g. by padding the wire with rubber or small pieces of wood). Alternatively, if nails are certain to be removed eventually, a bracket attached to the nest box can slip over nails placed in the tree above and below the box. As the tree grows, the box is slowly pushed outward without damage.

For an intensive survey we suggest setting boxes about 300 m apart (1 per 9 ha). Densities less than this are still very useful. If a box is consistently used by species other than phascogales (e.g. Sugar Gliders), a second box can be set about 30 m away as an alternative. Boxes should not be erected on public land without the approval of the local land management agency (e.g. Victorian Department of Conservation and Natural Resources). Avoid placing boxes where vandals will easily find them.

The best time to schedule box checks is in April-June (breeding season) and February-March (juvenile dispersal period). Boxes are frequently used by phascogales from August-November (nursery period when young are left in the nest) but great care should be taken not to disturb resident females during this critical period. If a large nursery nest is present in a box, the phascogale will not be visible inside the domed nest, but fresh scats will be present on or in the box. Observation of the box at dusk can verify the female's presence as she departs to forage.

Surveys with boxes provide three ways to confirm that phascogales are present in the area: a phascogale nest, phascogale scat, or observation of an animal. Note that it is illegal to handle any native animals using nest boxes without a permit to do so from the appropriate state agency. If public education and involvement is intended as one of the benefits of the survey project, interested observers can return at dusk to gain a rewarding and non-intrusive view of animals occupying the boxes.

During the nursery period, the nest is usually a very large ball of nesting material commonly filling nearly all of the box. Nests made at other times of the year vary in size from a few scraps of nesting material, to well formed bowls. Occasionally no attempt is made to make a nest. Nests are made primarily from bark. If available, the bark of 'stringybark' eucalypts is strongly preferred, and is stripped and interwoven to form the nest. However, exfoliating bark strips from wattles and smooth-barked eucalyptus trees are also used (Lindner 1983, Soderquist 1993b) as well as feathers and fur if available. Phascogale nests will sometimes contain leaves, but these are from the remains of nests constructed by other species.

Phascogales commonly defecate in their nest box and on top of it. If the box is used repeatedly, the scat builds up in one corner and becomes a solid mass. An individual scat of an adult is roughly 4-6 mm in diameter and, if unbroken, over 15 mm long. It is usually black and comprised of numerous insect pieces, many of which are 2-3 mm in width.

The nests and scats of other hollow-using animals can also be found in nest boxes. Details of those likely to be found in Victorian phascogale habitat are as follows:-

Ringtail Possums Psuedocheirus peregrinus. Nests can be similar to those of phascogales, but usually will include twigs and branchlets as well as bark. Only immature ringtails can squeeze through entrance holes smaller than 35 mm. No scats are left in the nest.

Sugar and Squirrel Gliders *Petaurus breviceps* and *P. norfolcensis*. Fresh green eucalypt leaves are shaped into a rough bowl or dome. No scats are left in the nest.

Yellow-footed and Brown Antechinus *Antechinus flavipes* and *A. stuartii*. Old dried eucalypt leaves are used, often built into a dome. Many scats are usually found in and near the nest. The scat of *Antechinus* species that use nest boxes is smaller than 3 mm in diameter and seldom contains large, whole insect parts as they chew prey more finely. Unfortunately, the scat of juvenile phascogales can be confused with that of *Antechinus* spp.

Bats (various species). No nest is made. Numerous small scats may be left in the box, but these are smaller than *Antechinus* scats and have very fine insect fragments.

Brown and White-throated Treecreepers *Climacteris picumnus* and *C. leucophaea*. Nests are made with layers of very finely shredded bark and/or fur forming a shallow bowl. The scats of birds may look similar to those of small mammals, but have a blob of white uric acid attached to the scat (as do those of frogs and reptiles).

Australian Owlet-Nightjar *Aegotheles cristatus*. If breeding in the nest box, there will be a lining of green eucalypt leaves. This species also roosts in nest-boxes with no nest.

Parrots (various species). No new nesting material is added. Any existing material may be finely chewed. Eggs are laid directly onto the base of the nest box.

Adding phascogale scats or nest material to newly erected boxes as an attractant can cause confusion in the survey. If desired, exotic nest materials (e.g. wood shavings, raw wool or cloth) can be used to improve insulation. Once a phascogale builds and then abandons a nest, it can be pushed flat or the pieces pushed to one side. Any subsequent occupant will reform the inner chamber or build a new nest on top of the old. Scat should be removed or crushed so that any new additions are detectable.

Pest species such as the Common Starling *Sturnus vulgaris*, Common Myna *Acridotheres tristis* and Honeybees should be removed from boxes. At some sites feral bees are a major problem in nest-boxes. For example, during one year, bees occupied 8 of 14 large nest boxes at Chiltern Regional Park and 7 of 18 nest boxes at Whipstick State Park. One method for removing bees is to push a 4 cm^2 piece of an insecticide pest strip (e.g. Shelltox or Sureguard brands) through the entrance into the comb (Land For Wildlife Note 14). Using a long pole, insert the strip at night or in the early morning when low temperatures will help keep the bees quiet. The hive will be killed within several days, after which the toxic strip and honeycomb should be removed. Note that this method is not one of the uses recommended by the manufacturers of pest strips. As such, an individual choosing to eliminate hives in this manner must ensure safe handling of the strip and disposal of the hive contents. Furthermore, a warning message should be posted below the box during the several days between poisoning and hive removal. Alternatively, hives can be physically destroyed or removed by apiarists. The ease of locating and destroying hives in artificial boxes makes this survey method a useful means of controlling feral bees which would otherwise occupy natural hollows.

Record Keeping

Although surveys with nest boxes benefit conservation by identifying sites where phascogales exist, long-term monitoring of phascogale populations is even more important. As phascogales typically occur at low densities, only repeated surveys over many years can accurately identify trends in the status of a population, or verify local extinction. We strongly encourage anyone using nest boxes or other survey techniques to maintain long-term records that note survey dates and the number of animals, nests and scats observed. Victoria, New South Wales and the Northern Territory maintain wildlife databases to which records of phascogales should be submitted. Alternatively, a volunteer state coordinator can be selected to maintain such files and distribute information to those interested in conducting surveys (e.g. the 'Friends of the Tuan' in Victoria).

Results from a Survey of Rushworth State Forest

To test the efficiency of nest boxes for broad scale surveys we conducted a trial survey in the Rushworth State Forest in central Victoria. The Rushworth Forest has approximately 31,000 ha. of habitat that is apparently suitable for phascogales. Prior to this study, there were no confirmed records of phascogales from this forest in the Atlas of Victorian Wildlife and only three records from adjacent areas.

Ninety-two boxes were constructed by volunteers with the Australian Trust for Conservation Volunteers (ATCV). These were placed at 23 sites in the Rushworth Forest. Four boxes were placed at each site, approximately 100 m apart. Sites were at least 1 km apart. Ten ATCV workers placed the boxes during two days in early December 1992. A single, experienced worker can check about 60 boxes per day without difficulty.

Boxes were checked by the authors and ATCV volunteers in late April 1993. No phascogales were actually observed in the boxes, but phascogale nests and scats were found in four boxes at three sites. In addition Sugar Gliders or their nests were observed in 30 boxes, and Yellow-footed Antechinus or their nests were observed in three boxes. During the most recent check in early 1996, members of the Field Naturalists Club of Victoria Fauna Survey Group found one phascogale, and 12 phascogale nests (R. Gibson *pers. comm.*). The Group has erected additional boxes and intends to monitor trends in phascogale populations at Rushworth and other sites for several decades. When combined with long-term survey results from other naturalist groups and individuals, this information will provide a valuable foundation for conserving this rare species.

Acknowledgements

Our special thanks to the workers from the Australian Trust for Conservation Volunteers who made and erected the nest boxes for the Rushworth survey. That study was made possible by a grant from Telecom to cover the expenses for transporting volunteers and the material costs of making the nest boxes. We also thank Ed and Pat Grey, Lyndall Rowley and a reviewer for comments on the manuscript. Field work was carried out under Victorian Department of Conservation and Natural Resources Permit Number 93-109.

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Use of Supplementary Nest Hollows by an Endangered Subspecies of Red-tailed Black-Cockatoo

William B. Emison[1,2]

A study, conducted from 1988 to 1994 in south-eastern Australia, on the endangered subspecies of Red-tailed Black-Cockatoo *Calyptorhynchus banksii graptogyne* indicated that: -

1) it is restricted to south-western Victoria and adjacent parts of the south-east of South Australia;

2) its numbers are low, probably not more than 1000 individuals remain;

3) its diet is specialised, consisting mainly of seeds of Brown Stringybarks *Eucalyptus baxteri* and Bulokes *Allocasuarina luehmannii*;

4) breeding, which seems to involve only a small proportion of the population (10% or less), has only been recorded within the northern half of the birds' range;

5) nesting occurs in hollows of large, often dead, trees in farmland;

6) its habitats are fragmented and threatened (Joseph *et al.* 1991; Emison and Joseph 1992).

Although considerable effort was directed towards finding nesting birds, only a few pairs were found each breeding season, the highest number being 16 in 1992-93 and the lowest being 3 in 1991-92 (Fig. 1). The majority of nests (85%) were in hollows in dead, usually ring-barked, River Red Gums *E. camaldulensis* while the rest (15%) were in live River Red Gums or Yellow Gums *E. leucoxylon*. More than 98% of all nests found were on private property and over 90% were in three traditional nesting areas.

During the course of our study, we began to suspect that an important reason for the small number of nests was because suitable nest hollows were limited in the traditional Red-tailed Black-Cockatoo nesting areas. Over the years, losses of nest hollows have resulted from the old dead trees being cut down for firewood, while others have been pushed over simply to tidy up a property or have fallen from natural decay.

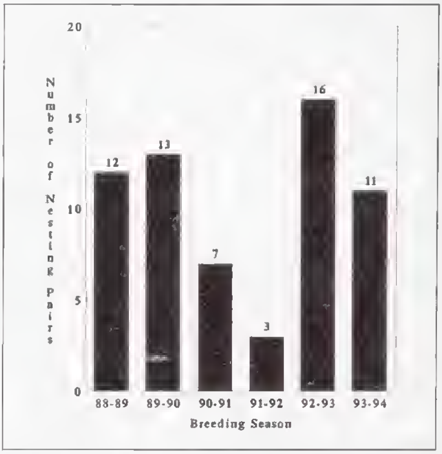

Fig. 1. Number of pairs of Red-tailed Black-Cockatoos found nesting in south-eastern Australia, 1988-1994. The number of active nests found in the 1992-93 season totalled 23, but 7 of these were considered to be re-nestings (Emison et al. 1995) so the number of pairs involved in nesting was only 16.

To determine if a lack of nest hollows was limiting breeding, we placed four supplementary nest hollows (made from natural hollows cut from fallen trees) in dead trees without suitable natural hollows, in a traditional nesting area after the 1991-92 breeding season. One of these supplementary nest hollows was used by a pair of Red-tailed Black-Cockatoos in 1992-93 and a young one was successfully reared.

After the success of the first supplementary hollow in the 1992-93 breeding season, we placed an additional 6 supplementary hollows in dead trees in traditional nesting areas. Additionally, because there were so few dead trees in which to place the hollows, we obtained 6 disused wooden electricity poles, put them into place in the areas and attached a supplementary nest hollow to the top portion of each one (Fig. 2). Therefore, at the start of the 1993-94 breeding season, we had in place 16 supplementary nest hollows (10 supported by dead trees and 6 on electricity poles) in tra-

[1] Department of Natural Resources and Environment, P.O. Box 41, East Melbourne, Vic. 3001
[2] Present address: Invertebrate Zoology, Museum of Victoria, P.O. Box 666E, Melbourne, Vic. 3001

Fig. 2. Supplementary nest hollow on an electricity pole. Photo by W.B. Emison.

ditional Red-tailed Black-Cockatoo nesting areas. Of these 16 supplementary hollows, 5 (3 in dead trees and 2 on electricity poles) were used by nesting Red-tailed Black-Cockatoos in 1993-94. These 5 nests represented 45% of the total Red-tailed Black-Cockatoo nests found in 1993-94. We also recorded Yellow-tailed Black-Cockatoos *Calyptorhynchus funereus*, Long-billed Corellas *Cacatua tenuirostris*, Australian Wood Ducks *Chenonetta jubata*, owls and feral Honeybees *Apis mellifera* using the supplementary nest hollows. Continuing occupancy by Honeybees would prevent future use of hollows by either Red-tailed Black-Cockatoos or other birds.

The results of this study indicate that supplementary nest hollows are quickly utilised by a variety of animals and of the supplementary hollows available (4 in 1992-93 and 16 in 1993-94) at least 30% were used by Red-tailed Black-Cockatoos. In view of the endangered status of this subspecies of Red-tailed Black-Cockatoo, the provision of more supplementary nest hollows in traditional and potential nesting areas is recommended. However, an ongoing monitoring program should also be established to: (1) detect any illegal human activities such as the taking of eggs or young; (2) determine if the Red-tailed Black-Cockatoos continue to use the hollows on a long-term basis; (3) determine whether birds using the supplementary hollows are new breeders (thus increasing the number of breeding pairs) or are established breeders which have simply moved from less suitable natural hollows; and (4) determine the long-term impact of feral Honeybees on the availability of the supplementary nest hollows.

Support for this study was from the Department of Natural Resources and Environment (Victoria), the London-based World Parrot Trust and the Department of Environment and Natural Resources (South Australia). Other details of this breeding/nest hollow study appear in Emison *et al.* (1994) and Emison and Caldow (1994).

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Australian Native Species in Aquaculture

G. Kibria[1], D. Nugegoda[1], R. Fairclough[1] and P. Lam[2]

Abstract
Australian native freshwater fish and crayfish possess good food, recreational and commercial values. Although aquaculture is an infant industry, expanding rapidly due to recent local and overseas (Asian)demands for native species. This article gives a glimpse of the status of native freshwater aquaculture in Australia. (*The Victorian Naturalist* **113**, 1996, 264-267)

Introduction

Australian native fish and crayfish form the main freshwater aquaculture industry of the country. Australia has few freshwater fish (180-190 species) (Merrick and Schmida 1984), most of which are native to Australia. Among them only four native fish possess potential for aquaculture, Silver Perch *Bidyanus bidyanus*) Golden Perch *Macquaria ambigua*, Murray Cod *Maccullochella peeli* and Freshwater Catfish *Tandanus tandanus* (Hume and Barlow 1993)

Silver Perch

Silver Perch farming is booming in the country and there is an interest in cultivating the species in countries like China, and Taiwan. The farms are spread over the warmer parts of New South Wales, Queensland and Victoria. New South Wales has the highest number of Silver Perch farms followed by Victoria and Queensland. Factors contributing to the expansion of the Silver Perch industry include good growth rates, their acceptance of low-protein diets (Barlow 1986; Rowland and Barlow 1991), the ease of culture in earthen ponds (Rowland *et al.* 1994) and their omnivorous feeding habits (Rowland and Barlow 1991). The demand for Silver Perch farming is so great that at this stage three commercial feed companies (Kinta, Janos, Barstock) are manufacturing Silver Perch feeds. Further stimulus for Silver Perch arose with the huge recent shipment of fry and fingerlings to China. It is believed that the Chinese are interested in rearing Silver Perch in their traditional ponds since it is an ideal species for Chinese pond polyculture systems. At the recent international conference held in Beijing (Fourth Asian Fisheries Forum, 16-20 October 1995), a number of enquires were made regarding Silver Perch (Fig. 1).

Fig. 1 Silver Perch fingerlings are in great demand both in Australia and in overseas (e.g. China) to stock in ponds and dams.

Above all, freshwater fish production is increasing in Australia mainly due to an increasing interest and investment in growing Silver Perch (Table 1).

Table 1. Native Aquaculture Production (value $000).
Source : O'Sullivan(1994)

Year	Native Fish	Native Crayfish
1989-90	2,888	1,599
1990-91	2,913	2,339
1991-92	4,355	2,235

Golden Perch

Golden Perch farming has not been so popular although it is more attractive to consumers than Silver Perch. Trials are being conducted by the government research institutes to develop Golden Perch diets (Arumugam and Geddes 1987). Once commercial Golden Perch feeds become available in the market, then Golden Perch farming would become a popular aquacul-

[1]Victoria University of Technology, PO Box 14428, Melbourne 8001, Australia
[2] City University of Hong Kong, Kowloon , Hong Kong

ture industry since consumer demand for Golden Perch is high and can therefore fetch higher market prices. Some private companies are conducting research to develop Golden Perch feed from sewage-grown zooplankton (Zootech News 1994).

Freshwater Crayfish

Australia has the most diverse collection of freshwater crayfish in the southern hemisphere, three of which used in aquaculture. These are, Yabby *Cherax destructor*, Marron *Cherax tenuimanus* and Redclaw *Cherax quadricarinatus*. Yabby farms are located in South Australia, Victoria and New South Wales (Kailola *et al*. 1993). Marron have been commercially cultured in Western Australia for the last 20 years (Kailola *et al*. 1993). Redclaw requires more tropical conditions and is cultured mainly in Queensland. The natural distribution of freshwater species can be seen in Fig. 2. There is a big domestic market for crayfish but both live and frozen crayfish are also being exported to nearby Asian countries. A summary of biological information on native Aquaculture species is given in Table 2.

Conclusion

The demands for freshwater and marine foods in Australia are increasing as a result of population increase, Asian migration and health consciousness. It is predicted that Australian native aquaculture industry would become a lucrative primary industry in food production (Gooley and Rowland 1993).

However, it should be noted that effluents from aquaculture industry may cause water pollution as nutrients discharged may cause eutrophications to water bodies (Foy and Rosell 1991; Ketola *et al*. 1991). An increase in water turbidity and oxygen demand in natural systems may come from the solid wastes of aquaculture. Therefore it is essential to monitor the level of nutrient discharged from aquaculture industry to the natural system in order to prevent any environmental disasters.

Since natural populations of Australian native freshwater species are either threatened or in decline due to physical, chemical and biological reasons (Cadwallader 1978; Scott 1989), the demands of Australian aquaculture for large numbers of fingerlings, to supply the overseas market and to stock dams and ponds in Australia, could also offer the opportunity to restock natural Australian freshwater systems and reduce the necessity of fishing them. Thus, this programme would also offer the opportunity to help reverse the decline in natural populations.

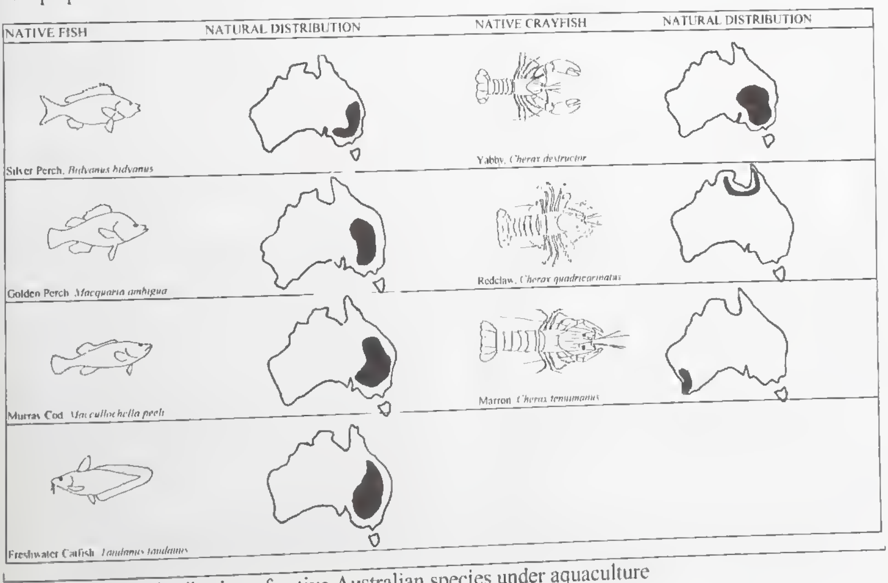

Fig. 2. Natural distribution of native Australian species under aquaculture

Table 2. Summary of biological information on native species.
Legend: C=Celsius; CL=Carapace length; F.W= Freshwater; WT=Water temperature; T= temperature
A= Breeding season; **B**= Age and size at maturity;**CC**= Breeding stimulus; **D**= Temperature tolerance;
E= Optimum growth temperature; **F**= Fecundity; **G**= Feeding habits
Figures in parenthesis denotes source
Sources: 1.Lake (1967a); 2. Merrick (1980); 3.Lake(1967b); 4. Rowland(1992a);5.Whiteley(1960);6.Backhouse et al.(1991a); 7.Lake(1967c);8. Cadwallader(1977); 9.Lake(1967d);10. Backhouse et al,(1991b);11.Kailola et al.(1993); 12.Llewellyn and Macdonald(1980); 13.Cadwallader(1978); 14.Rowland(1988); 15. Mosig(1982); 16. Rowland(1992b); 17. Llewellyn and Pollard(1980); 18.Davis(1977); 19.Macleans(1975); 20.Johnson(1988); 21.Merrick and Lambert(1990); 22.O'Sullivan((1992); 23.Mitchell and collins(1989); 24.Jones(1990).

SPECIES	A	B	CC	D	E
Silver Perch	Oct-Dec(1)	M-2 yrs;F-3 yrs(2)	T >23.3 C + increase in water level(3	2-37 C(4)	23-28 C(4)
Golden Perch	Oct.-Mar(8)	2-3 years(3),	T 23.5 C 4- & flooding(9,1)	38 C(4)	23-28 C(4)
Murray Cod	Oct.-Dec(12)	4 years(13,1)	T > 21 C , water level rise not essential (3,14)	2-33 C(15)	20 C(4)
F.W Catfish	Oct.-Dec(1)	few at 2 years most by 5 years(17)	T 24 C (18)	1-38 C(15)	19-25(1)
Yabby	Oct.-Mar(11)	0.2-0.3 year (30-50mmCL)(11)	T>15 C (20) increase in daylength	1-38 C(21) 28 C (23)	20-23 C (22)
Redclaw	All year(11)	1.0 year(11)	WT above 20 C & increment in day length(11)	5-42 C(24)	24-30 C(23)
Marron	Sep.-Oct(11)	1-3 years, (25-30mmCL)(11)	rise in water temp.(11)	5-32 C(21)	24-30 C(22), 24 C(11)

SPECIES	F	G
Silver Perch	50,000(1.8-2.0 kg)(5)	omnivore-consists of zooplankton(ostracods),shrimps,small aquatic insects,molluscs,earth worms & plant material(6,7);larvae feed on both phyto & zooplankton(7)
Golden Perch	500,000(2.2-2.4kg)(3)	carnivore-mainly crustaecans(yabbies) ,aquatic insects,molluscs and fish(10). Young golden feed on zooplankton on recently inundated floodplains(11)
Murray Cod	30,000-50,000 for 1-2kg fish(16)	carnivore-adults feed on crustaceans,molluscs,fish, occasionally amphibians and reptiles(11,14), larval feed consists of copepods,cladocerans(16),
F.W Catfish	18,000(1.25kg)-26,000(2.27kg(3)	adults are omnivorous, young eat zooplankton & worms(19),adults carnivores & bottom feeders feed on molluscs & crustaceans(1)
Yabby	1000(large female)(11)	juvenile - filter feeder, adult feeds on detritus,plant material and small invertebrates(23)
Redclaw	300-1000(24)	larvae diet includes zooplankton & detritus and adult diet mainly detritus(24)
Marron	40-2400(21)	opportunistic scavenger-detritus,plant and animal material & aquatic insects(11)

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The Fauna of Tasmania: Mammals

by R.H. Green

Publisher: *Potoroo Publishing, Launceston, [1994].*
Paperback, 15 x 22 cm, viii + 56 pp. and 64 coloured plates. RRP $14.95

This attractively presented little book is printed on good quality paper and its cover features a colour photograph of a Tasmanian endemic, the Long-tailed Mouse, *Pseudomys higginsi*. The Introduction confirms what the title suggests, that this is the first of a series; the second is on birds, and subsequent volumes on reptiles, frogs and freshwater fishes are intended. The contents are tallied most succinctly on the rear cover; '2 monotremes, 20 marsupials, 38 eutherians, including 13 marine mammals [of about 32 known from local waters], and 10 introduced mammals. Giving information on evolution, relationship[s], identification, distribution, habitat, abundance, food, behaviour and breeding. Illustrated with 64 photographs [mainly by the author].'

Introductory sections entitled 'A special island' and 'The mammal fauna' provide an essential historical, geographical, evolutionary and biogeographical background to the main offering of the work - brief discursive essays on each natural mammalian group and on each species known in the state. These essays are full of information and throughout are enhanced by personal anecdotes and field observations made by the author during his distinguished career over a period of 30 years as the Curator of Zoology at the Queen Victoria Museum and Art Gallery in Launceston. The text is written in a simple and economical style and because the author has drawn directly on his own extensive experience it has an intimacy and verve that is generally lacking from similar works. Technical terms have been kept to a minimum.

As is to be expected, the discussion of aspects of biology and ecology in the species accounts is authoritative, but some of the comments on factors possibly causing or exacerbating population crashes (e.g. of the Thylacine) and recoveries (e.g. of the Tasmanian Devil), while intriguing, are based on uncertain and largely circumstantial evidence. Many mammalogists would also be uncomfortable with the broad generalisation that '... much of the [Tasmanian mammal] fauna is today as abundant or even more so than it was prior to European colonisation.', although some species, e.g. Brushtail Possum and Red-bellied Pademelon, have clearly benefited from changes wrought by agricultural development in many parts of the island. Nevertheless, the author draws on a lifetime of experience and research and his assessments merit careful consideration.

This book is not, nor is it intended to be, a formal identification guide, although the photographs and brief descriptions should enable an inexperienced observer encountering any of the larger and more distinctive terrestrial species to put a name to them. Some of the bats, rodents and the superficially mouse-like marsupials could not be so confidently identified, however, the author has very helpfully mentioned several other relevant references and field guides. Of the 32 or so marine mammals recorded in Tasmania waters, the author has included the five seals and eight cetaceans which are local or are frequent visitors, and of these, only the Australian Fur Seal and the Southern Right Whale are illustrated.

Errors are few and generally of little consequence, e.g. the Eastern Barred Bandicoot survives on the mainland in three not two small colonies; the Brushtail Possum is stated to be arboreal yet most of its described activities occur on the ground; the Little Pygmy Possum has an extra pair, not set, of cheek teeth; open sea whaling in the Australian region during the 19th century did not involve Japanese ships, but did involve French, as well as British and American ships; the scientific species name given for the Long-finned Pilot Whale is the obsolete *melaena* [now *melas*] and is misspelled *melanea*; the two local species of dolphins, Bottlenose and Common, are said to strand rarely in groups, yet in Tasmania group strandings are relatively common, in contrast to the mainland states, and their young are said to become independent at 12 months as well as being suckled for 18 months [age at weaning is actually highly variable, from 5 to 19 months]; the Southern Right Whale is said to be entirely black, which most are, but some have white belly flashes of varying size and shape, while others are pale grey with black mottling; and the species name of the Brown Rat, *Rattus norvegicus*, is misspelled.

An index is provided, which is merely a compilation of all the species names mentioned in the text, and includes scientific binomials, generally accepted common names and a few Tasmanian colloquial names. Considering the appropriate emphasis given throughout the text to Tasmanian endemic species and subspecies it is a pity that the latter, of which there are nine, are not in each case identified by their full scientific trinomials, e.g. *Tachyglossus aculeatus setosus*, for the Tasmanian Echidna.

This little book is recommended to naturalists and students seeking an informative overview of Tasmania's mammal fauna, including its unique features and its recent history, in comparison to the status of those species which also once or still occur on the Australian mainland.

Robert M. Warneke
Blackwood Lodge, RSD 273 Mount Hicks Road,
Yolla, Tasmania 7325

From our Naturalist in Residence, Glen Jameson

Middle Yarra Timelines

Here the coldest weather of the year after the solstice does not slow down the fauna. Most of the residents are involved in breeding activities to gain an advantage over the Spring/Summer migrants. The Flora begins to awaken with flowering processes being prepared.

Deep Winter

As the early dawn light separates shapes in the **riparian forest**, a female Powerful Owl sweeps low on the Yarra River to bathe in the icy cool waters. After a night on the nest containing two eggs laid in the first week of June, it is a welcome relief from the tight confines of the nest hollow. The male Powerful Owl watches from a nearby roost tree within view of the nest tree - a huge River Red overhanging the water.

A male Brush-tailed Phascogale, dazed and exhausted after the frenzy of the breeding period, is easy prey for the Black Kite who picks him off for breakfast as the light of day defines the forest floor. Nearby lies another breeding frenzy fatality, a dead male Brown Antechinus, not yet snapped up by the roving carnivores.

Along the river, Common Reed has dried out completely and thickly fringes the waters edge with a pale, brown, dried sheath. Small-leaf Clematis cascades from a Silver wattle in a bower of white flowers. It is a quiet season for the aquatic invertebrates, their life cycles are restricted by the cold and turbid waters. However, the Yarra Crayfish spawns on the muddy river bottom.

When heavy rain falls during the early morning, the rest of the day will remain enclosed in heavy grey clouds, some touching the forest tops in faint wisps. The ambience tends gloomy and introspective, the colours are dulled with a sombre stillness pervading the day. Some Deep Winter days are consumed by Gondwanan mists, others are so bleakly freezing that they suggest other climates with their Artic generated winds, honed and sharpened and so cold that they can cut out the fat from your kidneys and not leave a mark. Occasionally, for days on end, neither the Moon, Sun nor Stars are visible. If the weather stabilises for a few days, frosts are followed by clear sunny days.

The reflected glow of Silver Wattles' golden flowers on the brown rising river water, is a seasonal event that has enchanted everyone who has cared to look - Artists, Naturalists and lovers of beauty. The prodigious blooming marks the returning Sun from the Northern hemisphere. The mournful trill of the Fan-tailed Cuckoo heralds the blooming of the Wattles as spoken of by Barak of the Wurundjeri, when he told of the timing of his father's death and the timeline for his own passing. Silver Wattles wreath the river in a yellow timelonic celebration of the passing of the Elders. There seems to be changes to the human body that correspond to the Sun's return, a wrenching, twisting feeling of bio-magnetic calibration.

Downstream on the sodden **riparian flood-plains** of Yarra Flats, flocks of Australian White and Straw-necked Ibis probe the soft earth for food flushed to the surface by rising water table levels. Cattle Egret mobs similarly work Birrarung Park where later they will roost for the night on the Billabong island there or at Petty's Lake. The generally solitary White-faced Heron, is now found in flocks and individuals work together to find food sources in the wet pastures whilst a lone Pacific Heron stalks the swale drain of Westerfolds. A Royal Spoonbill sweeps the edge of a wetland where nightly small choruses of Southern Brown Tree Frogs, Common Froglets and the Whistling Tree Frog are heard on all but the very cold, frosty nights.

Wetlands have slowed down, productivity levels are reduced as many of the aquatic plants such as River Club-rush, Marsh Club-rush and especially the introduced Bullrush die off after the cool winter weather stops growth. Pairs of Wood Ducks perch on entrances to breeding hollows, clucking away to each other about the coming brood.

In the **corridor** along Gold Memorial Gully, a flock of Silvereyes disturb the foraging of a pair of Pink Robins who have migrated from Tasmania for the Winter. Another uncommon species using the local bushland corridors is the locally-nomadic winter migrant, the Olive Whistler. In a colourful display, an Eastern Spinebill collects nectar from a pink flowered Common Heath. Working his way up the Mullum Mullum Creek corridor, a male juvenile Koala is killed on the Warrandyte-Heidelberg Road as he discovers the fatal breaks in the faunal corridors.

A few days before the Winter solstice a female Wedge-tailed Eagle sits in a huge Candlebark in the River Paddock of Longridge Park. A Little Raven tries a few harassing sweeps and is then joined by several Sulphur-crested Cockatoos for ariel harassment. This all stops with the arrival of the male Wedge-tail Eagle landing in the Candlebark near the female. Gently, the big Eagles move together to touch and then complete the ritual and cycle of thousands of years by copulating.

European Rabbits are in top breeding gear, providing plenty of food for the breeding Wedge-tail Eagle and Barking Owls. What will provide the food when they are gone?

Pleasant wailing whistles of the Yellow-tailed Black Cockatoos are heard long before they are seen. When they finally sweep into view, it is breathtaking as a flock of forty or so pass low overhead in slow mannered flight. They resemble lumbering galleons as they head for a stand of Silver Wattles to search for Wood-moth lavae (family Cossidae) that bore their way through the trunks and branches. Usually there are only five to six Yellow-tailed Black Cockatoos resident all year round in the Yarra Valley Parklands. This annual visitation by the mob during Deep Winter may be part of the Yellow-tailed Black Cockatoo songline journey to visit parts of their greater territory range, perhaps acquainting young birds with the terrain. Their happy chorus is such a thrilling challenge to the cold winter weather that their presence in flocks is an awaited Timelonic pleasure.

In the **grassy woodlands** on the valleys and slopes, Magpies and Australian Ravens are adding the finishing touches to nests, as is a Brown Thornbill whose nest is tucked amidst a stand of Bracken. Flocks of Red-rumped Parrots, or Yellow-rumped Thornbills and mixed flocks of Red-browed Firetail are still found together. Superb Fairy-wrens, males in breeding plumage flock with White-browed Scrub Wrens. Standing out in brilliant golden blooms are the pest plants Cootamundra Wattle and Early Black Wattle. Also in prolific flower is the Yellow Box an important component of many vegetation communities and supplier of winter nectar. On the ground are the fungi *Cordyceps* sp. which parasitise various insect larvae in order to complete their life cycle. Leaves of many orchids and herbaceous plants have sprouted and begin to grow vigorously.

On a **rocky escarpment**, a small group of Echidnas are found together in breeding mode. They have been digging up nests of Meat Ants to exploit the energy-rich food source of the virgin queens whose nests are located closer to the surface during this season. Once the Echidna mating is completed, the female will retire to her nursery burrow with an egg in the pouch. Occasionally two or more Echidnas may share a shelter site, which may be a hollowed tree trunk base. On a fence is a Scarlet Robin as welcome as winter sunshine. The first flowers of Early Nancy, Common Beard-heath and Spreading Wattle are out and Tiny Greenhood, Nodding Greenhood and Trim Greenhood flowers can be found and fruits have formed on Cranberry Heath.

On a **hilltop** a flock of Varied Sittellas and Striated Pardalotes glean insects from a Red Box, under which Spreading Wattle begins to flower. Gang Gangs, although often found eating the ripe red berries of the introduced Hawthorn, also eat the seed from Long-leaved Box. Here the Maroonhood is in flower in addition to the Tiny, Nodding and Trim Greenhoods.

Just prior to darkness falling, into the gloaming night, a female Powerful Owl emerges from the nest hollow for a stretch and a feed from her partner. The male had gently hooted to the female to encourage her out and passes to her a headless Ringtail Possum as both birds sit on a dead branch. The female then goes to a feeding roost to eat, preen and finally returns to the nest as the stars Achenar, Bootes, Spica, Antares and Regulus begin their domination of the Deep Winter night skies. Above all, it is the return of the Aquila constellation, the Eagle of the ancient Greeks and the Bunjil of the Wurundjeri, that marks the return of the Sun from the northern hemisphere, the creative life force of the Earth.

Glen Jameson
PO Box 568, Templestowe, Victoria 3106

Species list. Key: * = introduced species

Animals
Antechinus, Brown - *Antechinus stuartii*
Echidna, Short-beaked - *Tachyglossus aculeatus*
Koala - *Phascolarctos cinereus*
Phascogale, Brush-tailed - *Phascogale tapoatafa*
Possum, Common Ringtail - *Pseudochirus peregrinus*
*Rabbit, European - *Oryctolagus cuniculus*

Black-Cockatoo, Yellow-tailed - *Calyptorhynchus funereus*
Cockatoo, Gang-gang - *Callocephalon fimbriatum*
Cockatoo, Sulphur-crested - *Cactua galerita*
Cuckoo, Fan-tailed - *Cuculus flabelliformis*
Duck, Wood - *Chenonetta jubata*
Eagle, Wedge-tailed - *Aquila audax*
Egret, Cattle - *Ardea ibis*
Fairy-wren, Superb - *Malurus cyaneus*
Finch, Red-browed - *Neochmia temporalis*
Heron, Pacific - *Ardea pacifica*
Heron, White-faced - *Ardea novaehollandiae*
Ibis, Australian White - *Threskiornis molucca*
Ibis, Straw-necked - *Threskiornis spinocollis*
Kite, Black - *Milvus migrans*
Magpie, Australian - *Gymnorhina tibicen*
Owl, Powerfull - *Ninox strenua*
Pardalote, Striated - *Pardalotus striatus*
Parrot, Red-rumped - *Psephotos haematonotus*
Raven, Australian - *Corvus coronoides*
Raven, Little - *Corvus mellori*
Robin, Pink - *Petroica rodinogaster*
Robin, Scarlet - *Petroica multicolor*
Scrubwren, white-browed - *Sericornis frontalis*
Silvereye - *Zosterops lateralis*
Sittella, Varied - *Daphoensitta chrysophera*
Spinebill, Eastern - *Acanthorhyynchus tenuirostris*
Spoonbill, Royal - *Platalea regia*
Thornbill, Brown - *Acanthiza pusila*
Thornbill, Yellow-rumped - *Acanthiza chrysorrhoa*
Whistler, Olive - *Pachycephala olivacea*

Froglet, Common - *Crinia signifera*
Tree Frog, Southern Brown - *Litoria ewingi*
Tree Frog, Whistling - *Litoria verreauxi*

Crayfish, Yarra - *Euastacus yarraensis*

Ant, Meat - *Iridomymex* sp.

Plants
Austral Bracken - *Pteridium esculentum*
Beard-heath, Common- *Leucopogon virgatus*
Club-rush, Marsh - *Bolboschoenus medianus*
Club-rush, River - *Schoenoplectus validus*
Cranberry Heath- *Astroloma humifusum*
Box, Long-leaved - *Eucalyptus goniocalyx*
Box, Red - *Eucalyptus polyanthemos*
Box, Yellow - *Eucalyptus melliodora*
Candlebark - *Eucalyptus rubida*
Clematis, Small-leaved - *Clematis microphylla*
Early Nancy - *Wurmbea dioica*
Greenhood, Tiny - *Pterostylis parviflora*
Greenhood, Trim - *P.concinna*
Greenhood, Nodding - *P. nutans*
Gum, River Red - *Eucalyptus camaldulensis*
*Hawthorn - *Crataegus monogyna*
Heath, Common - *Epacris impressa*
Maroon-hood - *Pterostylis pedunculata*
Reed, Common - *Phragmites australis*
Bullrush (Reedmace, Great) - *Typha latifolia*
Wattle, Cootamundra - *Acacia baileyana*
Wattle, Early Black - *Acacia decurrens*
Wattle, Silver - *Acacia dealbata*
Wattle, Spreading - *Acacia genistifolia*

National Parks Field Guides

Uluru, Kata Tjuta And Watarrka

by Anne Kerle

Publisher: *University of New South Wales Press 1995; 202 pages, 10 maps, over 200 colour illustrations; RRP $24.95*

Uluru (Ayers Rock) and nearby Kata Tjuta (the Olgas) are Australian icons. Over 300 000 people visit Uluru National Park every year making it one of our premier tourist attractions. Neighbouring Watarrka (Kings Canyon) National Park is newer and one of our best kept national secrets. The current level of visitation to the Rock is a far cry from 1958 when the year's total was only 2 296. Pioneer tour operator Len Tuit is credited with opening up this unique part of Australia to the world. After a tour in 1950 with a party from Sydney's Knox Grammar School, he recognised the tourist potential of Ayers Rock and began to offer regular tours. The millions of government dollars that now flow into the national park each year would surely bring a smile of satisfaction to Len's lips were he still alive today. At the time the Administrator of the Northern Territory believed there was "no future for tourism in the Territory" and southern travel agents were not convinced they could market " a lump of rock". How wrong they were, says author Anne Kerle in her newly released field guide for the region.

Anne Kerle spent 14 years living in the centre of Australia. This book is a window to the vast repository of knowledge she built up over that time. Her thoroughly researched text, with over 200 colour photographs and illustrations, unlocks the door to the region's history, geology and landforms, its plants and animals, and how they live. She writes not only form the perspective of a keen naturalist, and sometime professional nature guide, but also with the expertise of a zoologist highly regarded by her peers.

Most of the excellent colour photographs that illustrate the text were taken by the author. These are complemented by some remarkable wildlife scenes by Mike Gillam. Gillam is undoubtedly one of Australia's most outstanding photographers. His insect's eye view inside a honeyant's nest on page 128 is one of the book's gems. Another is his image of the rarely-sighted Marsupial Mole dragging its body across the red sand dunes. These are the kinds of things field naturalists dream about!

The book begins with a rundown on the landforms of Uluru, Kata Tjuta and Watarrka. Aboriginal perspectives of the landscape are included as well as geological explanations. To help the botanically-bent traveller, plant information is presented in a habitat format, from sand dunes to rocky ranges. The region's abundant but elusive animal life is introduced and conservation issues highlighted.

The book concludes with a very useful section detailing points of interest along the highways and roads to the parks as well as information concerning walking tracks. This is the kind of stuff keenly sought by travelling field nats. It's a shame the editors have chosen to hide it at the end of the book instead of featuring it more prominently upfront.

The book is sturdily bound and will fit easily into a car glove box of a walker's daypack. On the down side, however, is the annoyingly small print. It's difficult to read by the dim light of a motel bedroom or while travelling along in a car. Bigger and better page headings are also needed to make the book more user friendly.

Nonetheless, it's worth the $24.95 it sells for and will be a good help to travellers who want more from their Rock visit than the usual postcard sunset scenes.

Stuart Traynor
Parks and Wildlife Commission
PO Box 1046, Alice Springs, NT 0871

Never Truly Lost: A Bushwalker's Life

(Reprint)

by Paddy Pallin

Publisher: *University of New South Wales Press, 1996; Paperback, 224 pages; RRP $19.95.*

We read of many pioneers who met the rigours of the high country and the Australian bush to eke out an existence in the early days of European settlement. However, all too rarely we read the personal accounts of other 'pioneers' who also met the challenges of travel and recreation in the Australian bush we have all come to love and appreciate.

Paddy Pallin was an explorer, not in search of new gold seams and pastures, but of the pleasures to be had by the slow movement through the endless variety that awaits the careful observer in the different environments of Australia. Paddy Pallin was an artist who could capture the essence of a place and describe it in words that easily evoke the atmosphere of the moment, as when canoeing on the Shoalhaven River:

"... as the sun rays slanted into the valley the mist gradually dispersed and the diaphanous scarves of cloud rose from the valley, clinging to the tree tops as though reluctant to leave this beautiful spot."

Modern-day visitors to the Australian bush would shudder at Paddy's methods of camping and his apparent lack of any minimal impact practices. Techniques of the 1930's, such as building beds two-foot deep of *Richea scoparia* to escape the water-sodden ground in south-west Tasmania but "which rival an inner-spring mattress for springiness", cutting "tent poles and pegs and lots of brush for the tents", building large, roaring fires that lasted all night, and an unhealthy reliance on the comforts of huts have, thankfully, all but faded into memories. But our new-found ethics owe much to Paddy Pallin who, as Australia's firs outdoor equipment manufacturer, we responsible for much of the innovation and development that lead to the bushwalking equipment that enables us nowadays to be more environmentally friendly in our bush travels.

An immigrant and self-taught bushman, Paddy Pallin developed a prodigious and accurate knowledge of bushwalking areas in New South Wales. Alas, his comments on bushwalking and ski touring in Victoria's high country are, at times, a little inaccurate and outdated. Never-the-less in his book, Paddy Pallin uses his skills of observation and memory to relate many fine alpine adventures in great detail.

As if to help us realise we are never too old to try something new and challenging, Paddy Pallin describes his arduous trip to (the then unspoiled) Lake Pedder and Federation Peak at aged 58, and taking up cross-country skiing at 54 years of age.

Not content with merely walking in beautiful natural area, Paddy Pallin also contributed to the protection of such areas through his involvement in enterprises such as buying back the lease on the threatened Blue Gum Forest in the Blue Mountains, and in introducing others (including a young Rover Scout named Dick Smith) to the joys of the bush they later went on to help protect.

This book gives us glimpses of the life of a bushwalker, equipment manufacturer, cross-country skier, and conservationist. It traces the life of one of the icons of bushwalking in Australia and helps us understand the role this gentle man played in helping all of us to visit and appreciate the nature we now all love.

" we looked down on a world asleep under a woolly blanket of cloud. The high ridges stood out like fingers, sharp and clear in the morning sun, but every valley was filled in. We stood and watched a while, and even as we stood the warmth of the sun began to unroll the blankets from the surrounding valleys."

Neville Byrne

Chairman, Bushwalking & Mountaincraft Training Advisory Board Program Co-ordinator, Australian Alps National Parks program.

Fred J. C. Rogers 1927 - 1996

Victoria and Australia lost a top quality naturalist who was a very caring, influential and important person earlier this year.

Fred Rogers was born on 17 December 1927 in the Victorian Wimmera. He was always a Wimmera boy at heart and later in life he returned with his wife June to Vectis South.

When 17 years old, Fred was too young to be accepted at Teachers College, so he was sent to teach in small country schools where he was the only teacher. Eventually he was able to enroll at Ballarat Teachers' College, where he met his future wife June. They were married in 1952 at Horsham and then lived initially at Ballarat. It was as a teacher that Fred went on to be an inspirational leader and friend to so many during his very full and active life.

In 1954 the Rogers moved to Ringwood and it was from this time that Fred's influence in the area of natural history had a major impact, through a variety of activities with a wide range of people, from the youngest of children to the elderly. He was renowned as a friendly and inspirational person who could be involved in a conversation at any level.

In 1959 Fred was elected to membership of The Field Naturalists Club of Victoria and was a foundation member of the Ringwood Field Naturalists Club. He was also a foundation member of the Society for Growing Australian Plants, which was initiated in March 1957 and he became involved in the Society at a local, state and Federal level. From 1963 to 1986 Fred was Victorian State President of S.G.A.P. and it was during these years that there was a very dramatic upsurge of interest in our Australian flora. Fred initiated the formation of S.G.A.P. Maroondah Region and was the foundation leader of the group, with early meetings in the Rogers' home. During this period he was very active in the Ringwood Field Naturalists Club.

In 1967 Fred approached Ringwood council regarding the preservation and development of some native bushland adjacent to the railway line at Heathmont. Fred donated plants for the area and, with helpers from S.G.A.P. Maroondah, spent many hours in planting and maintenance of the site. In 1973 Ringwood Council officially named the area *The F. J. C. Rogers Reserve*.

In 1976 Fred and June returned to Horsham and a year later moved to Vectis South. In true Fred Rogers fashion, an Australian Plant group was formed soon after his arrival in the district.

At the Federal S.G.A.P. conference in Canberra in 1988, Fred delivered the keynote address. He was awarded Honorary Life Membership of S.G.A.P. Maroondah and S.G.A.P. Victoria. In 1995 Fred was honoured once again for his contribution to the activities of S.G.A.P. with the Australian Plants Award at the National Conference at Ballarat.

It was as a lecturer that Fred made a tremendous impact. He was always willing to talk to groups and during his lifetime he presented over 2000 lectures.

He was an author of note and his *Victorian Wattles* book, with the marvellous illustrations by John Truscott became the standard text for those who were eager to gain a greater knowledge of the often-confusing Victorian species of the *Acacia* genus. Other books by Fred included *Growing Australian Plants* (1971), *Growing More Australian Plants* (1975) and *A Guide to the Plants in the Little Desert and Mt Arapiles Area*.

Fred also wrote for *Your Garden* magazine in the 1960s and early 1970s. While a teacher he assisted with numerous publications by the Gould League and the series entitled *Nature Notes*, which were distributed through Victorian primary schools, provided much information and inspiration for teachers and students alike.

Fred was foundation president of the Friends of the Mallee Fowl and, after retiring, he often led groups of Australian and overseas visitors on tours of the Little Desert. He willingly shared his intimate knowledge and love of that wonderful region.

In 1991 Fred was judged to have made a meritorious contribution to the understanding of Australian natural history and was awarded by the FNCV, the prestigious Australian Natural History Medallion for his contribution to Botany (popularisation and conservation).

Fred was a keen propagator of Australian plants and over the years gave away literally 1000s of plants, now growing in home gardens as well as in regeneration areas on roadsides and farms. The Rogers' gardens and planting at Ringwood and Vectis South were regularly visited by people keen to understand more about Australian plants. There was always an open invitation to friends who were passing by. Fred was ever-keen and willing to provide a guided tour and in a true educator's role would supply food for thought as the plants and accompanying birds were enjoyed.

Fred's primary school teaching career spanned four decades and during this time he was a teacher and headmaster at Yarra Park, Clifton Hill, Mooroolbark, North Ringwood, Knox Park, Donvale and Horsham West. His influence and inspiration for his pupils is legendary as was evident at his funeral service at Horsham and at the Tribute Afternoon held in Ringwood on May 19 this year.

Fred was a meticulous gatherer of information which he tried to keep at the forefront of his brain or very close to his fingertips. He also developed an extensive herbarium of plant specimens, had a marvellous photographic collection and his large library was one that was in constant use as he sought to gain that extra bit of knowledge which would be useful, not only to himself but to pass onto to someone else.

Fred's other activities included weaving and woodwork, and he was also a highly talented sportsman with particular expertise in cricket, baseball and tennis. He was presented with the Victorian Provincial Baseball League's Special Services Award.

Fred Rogers was an Australian of truly exceptional ability who would never shirk the responsibility of making sure that people had the opportunity of gaining a better understanding of the natural world.

We are certainly richer for Fred's mentorship and acknowledge with deep appreciation his life of unstinting service to the country he loved so dearly.

Rodger and Gwen Elliot
S.G.A.P. Maroondah, Victoria

The Handbook of Australian, New Zealand and Antarctic Birds

Produced by the Royal Australasian Ornithologists Union
Publisher: Oxford University Press

The Handbook of Australian, New Zealand and Antarctic Birds (HANZAB), to be produced in five volumes, is one of the most significant projects in Australasian ornithology today. It continues the tradition of authoritative and exciting publications that began with Gould's Handbook of the Birds of Australia (1865).

The area covered by HANZAB includes Australia, New Zealand and Antarctica, the Antarctic and subantarctic islands, the Cocos-Keeling, Christmas, Lord Howe, Norfolk, Kermadoc and Chatham Islands and the islands and reefs of the Coral Sea.

Within this region about 900 species of birds have been recorded. Species descriptions are divided into: Field Identification, Habitat, Distribution and Population, Movements, Food, Social Organisation, Social Behaviour (illustrations of behavioural postures and plumage), Voice (including sonograms of calls and songs), Breeding (maps showing breeding and non-breeding ranges plus diagrams of cycles of breeding and moulting) and Plumages and related matters. Each account concludes with a full list of references.

All species, except those extinct in historical times, those not recorded since 1900 A.D. or those for which records are doubtful, are illustrated in spectacular colour plates, painted especially for HANZAB by J.N. Davies.

Volumes published to date are: Volume 1, in two parts: Part A, Ratites to Petrels; Part B, Australian Pelican to Ducks, *RRP* $395.00. Volume 2, *RRP* $325.00. Volume 3, Snipe to Pigeons, *RRP* $325.00.

Ed Grey

The Field Naturalists Club of Victoria

Established 1880

In which is incorporated the Microscopical Society of Victoria

OBJECTIVES: To stimulate interest in natural history and to preserve and protect Australian flora and fauna.

Membership is open to any person interested in natural history and includes beginners as well as experienced naturalists.

Registered Office: FNCV, 1 Gardenia Street, Blackburn, Victoria 3130. Phone/Fax (03)9877 9860

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The Victorian Naturalist

All material for publication to: The Editors, FNCV, Locked Bag 3, PO Blackburn, Victoria 3130

MEMBERSHIP

Members receive *The Victorian Naturalist* and the monthly *Field Nat News* free. The Club organises several monthly meetings (free to all) and excursions (transport costs may be charged). Research work, including both botanical and fauna surveys, is being done at a number of locations in Victoria, and all members are encouraged to participate.

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Printed by Brown Prior Andereson, 5 Evans Street, Burwood, Victoria 3125

The Victorian Naturalist

Volume 113 (6) 1996 December

F.N.C.V.

Published since 1884 by
The Field Naturalists Club of Victoria Inc.

From the Editors

The Victorian Naturalist would not be successful without the enormous amount of time and effort voluntarily given by a large number of people who work behind the scenes.

The Editors would like to say thank you to those who refereed papers published in 1996:

Helen Aston
Malcolm Calder
Helen Cohn
Leon Costermans
Mike Coupar
Tom Darragh
Nik Dow
Sophie Ducker
Arnis Dzedins
Ron Fletcher
Patrick Fricker
Louise Gilfedder
Christopher Hill
Rod Horne
John Hunter
Patrick lang
Ian Lunt
Ian Mansergh
Neville Marchant
Clive Marks
Andrew McMahon
Peter Menkhorst
Kim Robinson
Jon Sago
Martin Schulz
Ken Simpson
Andrew Straken
Rob Wallis
Barbara Wilson

We also have a team of dedicated proof-readers who help with the readability and expression of our articles:

Max Bartley
Tania Bennell
Arnis Dzedins
Gill Earl
Ian Endersby
Jennie Epstein
Todd Gardner
Linden Gillbank
Ken Green
Murray Haby
Steve Hill
John Hunter
Patrick Lang
Ian Mansergh
Tom May
Mandy Naylor
Michelle Smith
Kathie Strickland
Rob Wallis
Rosemary Ward

and our editorial team who continue to advise and assist:

Gill Earl, Ian Endersby, Ian Lunt, Ian Mansergh and Tom May.

As always we particularly thank our authors and book reviewers who provide us with excellent material for publication.

On the production side, a thank you to the printers, Brown Prior Anderson Pty.Ltd and especially to Steve Kitto at Abb Type who spent a lot of time teaching us how to use Quark Xpress.

The Victorian Naturalist

All material for publication to:

The Editors, FNCV, Locked Bag 3, PO Blackburn, Victoria 3130

The Victorian Naturalist

Volume 113 (6) 1996 December

Editors: Ed and Pat Grey

ISSN 0042-5184

Cover: Ken Simpson, winner of the 1996 Australian Natural History Medallion (see article p. 280), photo by Zoe Wilson.
Inside Back Cover: 1996 Mueller Medal winner, Dr Sophie Ducker, with the Premier of Victoria, photo courtesy Media Unit, University of Melbourne.

Australian Natural History Medallion 1996

Kenneth Nigel Graham Simpson

Birds have been a lifelong passion for Ken Simpson, and his career as a naturalist, scientist, teacher and author reflects this completely.

From University High School, Ken worked as an interested junior assistant at the School of Geology at the University of Melbourne for several years. From 1962 to 1964 he was a technical assistant for Dr Mervyn Griffiths at the CSIRO's Division of Wildlife Research, helping with marsupial nutrition and physiology studies. Bird and bat banding and general ornithology were spare time occupations. His time from 1963-1966 in the Antarctic Division included two periods on Macquarie island, where penguins became a personal focus which still continues. His book '*Birds of Bass Strait*' published in 1972 by A. H. & A.W. Reed for BHP reflects his fascination with seabirds.

From 1967-70, work as a Field Officer for the National Museum involved him in the Chowilla Project with its emphasis on all aspects of anthropology and fossil material, plus general ornithology. This interest in palaeontology continued through his work from 1970-1976 at Monash University as a research technician under Prof. Jim Warren, with field and laboratory work on vertebrate fossils.

In 1974 he was awarded the second only *M.Sc. Honoris causa* from Monash University.

From 1973-1979 he lectured for the Victorian Council of Adult Education, taking evening classes and summer schools.

Ken was editor of '*The Australian Bird Watcher*' for five years from 1977-1981.

From 1976 to 1992 he was a lecturer in primary science at Victoria College/Deakin University, Burwood and Toorak Campuses, specialising in earth sciences, photography, environmental sciences, ornithology research and publication techniques. Out-of-hours, he led many staff and student groups on recreational birdwatching.

Ken's name is best known to birdwatchers throughout Australia as the editor and author of Simpson and Day's '*Birds of Australia*', first published in 1984 by Lloyd O'Neil, South Yarra, Victoria. The fifth edition of this very popular volume now entitled '*Field Guide to the Birds of Australia*' was published in 1996 by Viking O'Neil (Penguin). Each edition has been rewritten and expanded to reflect growing knowledge of bird taxonomy, behaviour and habitat. It is the first Australian bird book to have been published as a CD-Rom. This multi-media interactive disc contains data for identification by illustration and by the use of 480 bird calls, with additional habitat data.

A monumental effort by Ken resulted in '*The Bird-Book Book CD-Rom*, A Bibliography of Bird Books', published in 1995 by Natural Learning NSW, with over 4,000 entries in the 1st edition of which some 1,200 are extremely detailed. It became BOCA Report no. 5 in a series.

For ten years he has been, and continues to be, a member of the Evaluation Panel for Victoria of the Australian Heritage Commission, Natural Environment Documentation Project. He is a member of many natural history societies and organisations, and is currently the President of the Bird Observers Club of Australia, of which he has been a member for 45 years.

Ken's published articles and papers reflect his range of scientific interest, and encourage the wider community to be aware of, and interested in, the world of birds.

It is appropriate that the Bird Observers Club of Australia nominated him for this honour, as his boyhood interest in birds began through club meetings and outings. His early interest in a survey on the migratory swifts encouraged birdwatchers all over Australia to become involved in collecting data.

He now leads many early morning community birdwalks; he gives many well-researched lectures; he conducts many excursions, tours and study weeks; he is a friend to all who have questions about birds or want some help. His contribution has been exceptional as through his knowledge and teaching skills he brings birds to people and people to birds.

Ellen M. McCulloch
6 Bullen Avenue, Mitcham, Victoria 3132

New Holland Mouse *Pseudomys novaehollandiae* (Rodentia: Muridae) in South Gippsland, Southern Victoria. Part Two - Conservation and Management

Bruce R Quin [1,2] and Ross C Williamson [1]

Abstract

A survey for New Holland Mouse *Pseudomys novaehollandiae* populations in areas of South Gippsland, conducted by the then Department of Conservation and Natural Resources (currently Department of Natural Resources and Environment) located two previously unknown populations of New Holland Mouse numbering15 individuals on the Yanakie Isthmus, Wilsons Promontory National Park. However, populations which were known from the Promontory and McLoughlins Beach (on Ninety Mile Beach) are believed to be no longer present. The species was not detected at two further areas formerly known to support it, Dream/Hummock Island and Mullungdung State Forest; however, further surveying at both areas is recommended. At Wilsons Promontory, New Holland Mice were found in vegetated sand dune systems which had not been burnt for 20-30 years. This finding indicated that New Holland Mice inhabiting such habitat were not necessarily reliant on an actively regenerating understorey as they are in other habitats (e.g. coastal heath). Their habitat at Wilsons Promontory appears to be under threat from Coast Tea-tree *Leptospermum laevigatum* and Coastal Wattle *Acacia sophorae* invasion. Recommendations for appropriate management of the New Holland Mouse populations and their habitat are provided. Restoration of the native grassland - open woodland vegetation types in the vicinity of the populations will assist viability of the species in the long-term. Dunes systems in other areas of South Gippsland similar to those inhabited by New Holland Mice at Wilsons Promontory should be surveyed for this species. The Wilsons Promontory populations currently represent the only populations of New Holland Mice known from South Gippsland. (*The Victorian Naturalist* 1996. 113, 281-288)

Introduction

The New Holland Mouse *Pseudomys novaehollandiae* (family Muridae) has a patchy distribution on coastal and hinterland areas of central eastern New South Wales, central southern Victoria and north-eastern Tasmania (Kemper 1995). Habitats utilized by New Holland Mice include coastal heathland, woodland and open forest with a heathy understorey, swamp edges and vegetated sand dunes. Habitats with heathy understoreys that are actively regenerating provide particularly favourable habitat (e.g. Keith and Calaby 1968; Posamentier and Recher 1974; Cockburn 1980; Wilson 1991; Menkhorst 1995; Quin 1996). In Victoria the New Holland Mouse is classified as endangered and a number of processes threaten populations (CNR 1995; Menkhorst 1995; Seebeck *et al. in prep.*). A survey in South Gippsland, central southern Victoria during 1992-93 determined the species was in decline, being located only at Wilsons Promontory (Quin 1996). This paper outlines management recommendations for New Holland Mouse at the Promontory and other sites where it has been recorded in South Gippsland.

[1]Department of Natural Resources and Environment
310 Commercial Road,Yarram, Victoria 3971.
[2]*Current Address*
Department of Natural Resources and Environment
Yellingbo State Nature Reserve, Macclesfield Road, Yellingbo, Victoria 3139.

Study Sites, Materials and Methods

The location of study sites and a full description of materials and methods utilized in determining the distribution of New Holland Mouse occur in part 1 of this series (Quin 1996). Three sites which formerly supported New Holland Mice, Mullungdung State Forest, Dream/Hummock Island and Wilsons Promontory National Park (Yanakie Isthmus) were trapped. Trapping also occurred at Won Wron State Forest (for which no New Holland Mice records exist) which is adjacent to Mullungdung State Forest. Additionally, hair-tubes were set and predator scats collected at Mullungdung and Wilsons Promontory; hair-tubes were also set at Won Wron. Sites chosen were based on those of past records provided by Gilmore (1977) and Barbara Wilson (*pers.*

Table 1. Mammal species detected by Elliott trapping at study locations in South Gippsland; provided from Quin (1996).
1 = No. of Sites; 2 = No. of Trapnights; 3 = Sampling Period ; 4 = Species Captured; 5 = Total No. of Captures; 6= No. of individuals (in brackets). (Note : site specific data is provided CNR (1993) and Quin (1994). Cage trapping was also employed at Wilsons Promontory and totalled 38 trapnights).

Location	1	2	3	4	5	6
Mullungdung State Forest	18	1253	19/11/92-04/04/93	Brown Antechinus	43	(35)
				Eastern Pygmy-possum	8	(6)
				Bush Rat	26	(13)
				Swamp Rat	7	(4)
				Black Rat	7	(5)
				TOTAL	**91**	**(63)**
Won Wron State Forest	5	296	19/12/92-23/12/92	Brown Antechinus	13	(8)
				Bush Rat	1	(1)
				Black Rat	2	(1)
				House Mouse	1	(1)
				TOTAL	**17**	**(11)**
Dream/Hummock Island	4	190	25/03/93-27/03/93	Swamp Rat	35	(29)
				House Mouse	33	(33)
				TOTAL	**68**	**(62)**
Wilsons Promontory National Park (Yanakie Isthmus)	6	562	15/02/93-24/04/93	Bush Rat	23	(15)
				Swamp Rat	10	(4)
				House Mouse	11	(11)
				New Holland Mouse	30	(15)
				TOTAL	**74**	**(45)**

comm.) for Mullungdung; Peter Menkhorst (*pers. comm.*) for Dream/Hummock Island; CNR (1993) for Wilsons Promontory. Additional sites at the Promontory and those of Won Wron were chosen because of their diverse, heathy understorey, an attribute typical of New Holland Mouse habitat (see references in 'Introduction'). The survey was conducted from between November 1992 to April 1993.

Results

Tables 1-3 (mammal species found) and Table 4 (vegetation at trapping locations) of Quin (1996) summarise results of the survey; Table 1 is re-produced in this paper. New Holland Mice were located only on the Yanakie Isthmus of Wilsons Promontory, and only via trapping, not hair-tubing or predator scats. They were found in vegetation on sand dunes which had not been burnt for 20-30 years. Saw Banksia *Banksia serrata* and Drooping She-oak *Allocasuarina stricta* formed the overstorey. Spiny-headed Mat-rush *Lomandra longifolia*, Black-anther Flax-lily *Dianella revoluta*, and several shrub species comprised the understorey. Coastal Wattle *Acacia sophorae* and Coast Tea-tree *Leptospermum laevigatum* had invaded parts of the dunes forming dense thickets with little understorey.

Eight male and four female New Holland Mice were trapped at one site, while three males were found at another site. Morphometric data and other details taken from the mice are presented in Quin (1996). New Holland Mice may no longer exist at Mullungdung State Forest, Dream/Hummock Island, or parts of Wilsons Promontory where they once occurred.

Discussion and Recommendations

Mullungdung State Forest

The sites in Mullungdung State Forest where New Holland Mice have been recorded appear to no longer support this species (Quin 1994; 1996). The heathy woodland vegetation communities at these sites (and many other areas of Mullungdung) were over ten years of age, possibly a post-fire succession stage beyond that favoured by this species. Gilmore (1977) described the 'low heath' habitat where he trapped New Holland Mice and suggested a burning regime which maintained its regenerating nature. He compared this habitat to heath sites in Mullungdung where New Holland Mice were not trapped, and the latter were apparently at a similar stage of succession to many of the sites sampled in 1992-1993. Additionally, studies elsewhere have demonstrated this species prefers heath actively regenerating after fire or other disturbances (e.g. Keith and Calaby 1968; Posamentier and Recher 1974; Braithwaite and Gullan 1978; Fox and Fox 1978; Wilson 1991).

The aforementioned studies indicate that various factors associated with vegetational succession may influence New Holland Mice numbers. It was not possible to isolate the factors responsible for the decline in populations in Mullungdung. Some areas, including one former New Holland Mouse site, had an abundance of Austral Bracken *Pteridium esculentum* in the understorey. Long-term monitoring would have been needed to assess the effect of this plant species on other understorey species. However, its abundance may have reduced the vigor of certain key plant species, for example legume species, which are important food sources (Cockburn 1980). Additionally, structural features may have altered which adversely affected New Holland Mouse populations.

Overall, the heathy woodlands of Mullungdung could potentially provide habitat for New Holland Mice. A burning regime which provides the habitat suitable for this species needs to be formulated. A mosaic of variously-aged heaths over small areas would provide short-term and long-term habitat (see Pye 1991; Wilson 1991). If New Holland Mice are still present in the heathy woodlands of Mullungdung, the populations are likely to be small and habitat manipulation of this kind will undoubtedly be required to avoid population loss. However, it appears that the New Holland Mouse is absent in this State Forest and the establishment of this burning regime would produce habitat suitable for the re-introduction of the species. Re-introduction would also require genetic studies to establish a 'donor' population most similar to those that possibly still exist at Mullungdung. Feral predator control would also be necessary. Small scale trial burns should be conducted in the near future.

Recommendations for Mullungdung State Forest

1. **Develop and implement a burning regime in the heathy woodlands of Mullungdung which is appropriate for the New Holland Mouse; small scale fires implemented at intervals which produce a mosaic of habitats with differing ages are indicated in this regard.**
2. **Conduct further surveys of suitable habitat at Mullungdung State Forest to locate extant populations or demonstrate that the species is locally absent.**
3. **Investigate the potential of Mullungdung to provide suitable New Holland Mouse re-introduction sites, as a long-term aim.**

Won Wron State Forest

New Holland Mice were not captured at the five sites sampled in Won Wron State Forest (Quin 1994; 1996). This species had never been recorded from Won Wron. Gilmore (1977) trapped at two heathland sites in this forest but regarded the vegetation as too old for New Holland Mice. During the present study the heathy woodland sites trapped were perhaps too young (0.8 years after fire) or too old (>50 years); refer Braithwaite and Gullan (1978); Wilson (1991). The heathy open forest sites of at least 50 years post-fire age were also possibly too old to support New Holland Mice. However, evidence of a much more recent burn at these sites was apparent and the low and diverse heath understorey of the open forest sites did appear suitable for New Holland Mice. It may still be worthwhile searching on a larger scale for New Holland Mice in Won Wron State Forest.

Recommendations for Won Wron State Forest

1. Further survey for New Holland Mouse populations in Won Wron State Forest; priority areas to be the young, actively regenerating heathy woodland areas where long-term monitoring sites should be established.

2. Following on from (1), further determine the suitability of the heathy woodland and open forest of Won Wron State Forest as habitat for New Holland Mice.

Dream/Hummock Island

New Holland Mice were captured on vegetated dunes at the south-west point of this island in 1977 (Menkhorst 1995; Peter Menkhorst *pers. comm.*). Some of the dunes appeared to have eroded since 1977, and adjacent vegetated dunes were unsuitable habitat for New Holland Mice. Trapping at three sites further along the seaward coastline of the island, which supported similar vegetation to that of the 1977 site, failed to detect this species (Quin 1994; 1996). Trapping at four sites (of different habitat) on the north-east section of the island also did not detect New Holland Mice (Fauna Survey Group, Field Naturalists Club of Victoria *unpubl.*). New Holland Mice may no longer occur on Dream/Hummock Island.

The survey detected House Mice at a trapping success rate of 17% (cf. 4% recorded by Peter Menkhorst in 1977). Although the available evidence on interactions between New Holland Mice and House Mice living in sympatry tends to suggest the former out-competes the latter (Cockburn 1980; Wilson 1991), the reverse outcome perhaps cannot be ruled out for island populations. The New Holland Mice detected on Dream/Hummock Island in 1977 probably comprised descendants of populations present when the island was connected to McLoughlins Beach some 30 years ago (Tim Buttle *pers. comm.*).

Recommendations for Dream/Hummock Island

1. The primary dune and swale vegetation along the southern coastline of Dream/Hummock Island should further be assessed with the aim of determining its suitability for New Holland Mice.

Wilsons Promontory National Park
Distribution and Habitat

This survey and others (by the Fauna Survey Group, Field Naturalists Club of Victoria and Deakin University *unpubl.*) have indicated New Holland Mice no longer occur in heathland communities of Wilsons Promontory National Park (Quin 1994; 1996). Much of the heathlands remained unburnt for extended periods prior to the 1970's, and probably reached succession stages unsuitable to New Holland Mice (refer for example Wilson 1991).

In February-April 1993, two populations of New Holland Mice were discovered in sand dune vegetation on the Yanakie Isthmus of the National Park (CNR 1993; Quin 1994; 1996). A follow-up survey during 1994 found further populations comprising at least 59 individuals existed in similar sand dune habitat on the Isthmus (Darren Carman *pers. comm.*) (Figs 1, 2, 3). Generally, this vegetation had not been burnt for 20 - 30 years (Jim Whelan *pers. comm.*). The habitat was, to a degree, comparable with sites on Dream/Hummock Island, although the Yanakie sites were not primary dunes. The floristic composition of New Holland Mice habitat at Wilsons Promontory appeared similar to that described for north-east Tasmanian populations (Pye 1991). Sand dune habitat may be more important for New Holland Mouse populations than previously thought.

The dune systems where New Holland Mice occur are calcareous in composition, quite steep in parts, and, unlike many of the smaller dunes present on the Isthmus, have not been extensively invaded by Coast Tea-tree and Coastal Wattle. The reasons for this require investigation. Coast Tea-tree in the swales around the dunes containing the New Holland Mouse populations has been slashed as part of a program initiated by the then Department of Conservation and Environment in 1991 to restore Kangaroo Grass *Themeda triandra* native grassland-open woodland vegetation over selected areas of the Yanakie Isthmus. The decline of these grasslands and grassy woodlands has been ascribed to factors associated with European settlement, including inappropriate fire regimes, and the activities of cattle and rabbits (DCE 1992). This program should conserve the habitat of New Holland Mice by reducing Tea-tree encroachment onto the dunes they occupy. This is imperative because trapping in Tea-tree infested dune vegetation did not locate any small mammal species at all, probably due to the lack of ground vegetation (CNR 1993; Quin 1994). Furthermore, New Holland Mice are believed to be extinct at the Red Hill Track site where they were captured in 1973 because of invasion by Coast Teatree (*pers. obs.*).

The restoration work includes a proposed 1080 baiting program for the slashed areas which aims to reduce rabbit numbers. This is required to enhance grassland establishment. The grassy areas are to be burnt periodically to maintain their diversity and prevent re-invasion by Coast Tea-tree (DCE 1992). The bait will be placed in slashed swales along a small ploughed groove. However, the program will need modification at sites from which New Holland Mouse is now known. It is not known whether New Holland Mice would take 1080 bait as food. Trapping records indicate New Holland Mice may at least occasionally traverse swales between dunes. In one instance, a swale approximately 20 m wide was crossed; it is not known whether scattered shrubs at one end of the swale were used as cover during the crossing. Another New Holland Mouse crossed a vehicular track bisecting dune vegetation. Consequently it is inadvisable to bait until the susceptibility of New Holland Mice on the Yanakie Isthmus to the proposed 1080 baiting program is determined. Some suggestions for determining their susceptibility are provided in CNR (1993). In the interim, Coast Tea-tree regeneration surrounding the dunes should be systematically slashed. There is also a need to ascertain the extent of distribution and association of New Holland Mice with the dune systems described before the baiting program is conducted.

Changes in vegetation on the Yanakie Isthmus over the last 150 years or so raises the question, 'What habitat(s) did New Holland Mice occupy on the Isthmus before the present?' It is probable that this species occupied sand dunes which would have supported a similar plant species composition to that at the New Holland Mouse sites described in this paper (DCE 1992). The possibility of New Holland Mice also inhabiting grassland areas cannot be ignored. New Holland Mice, which existed at McLoughlins Beach in coastal vegetation, had quite a high proportion of grain in their diet, though invertebrates were also taken (Cockburn 1980). This type of diet would be available in diverse grasslands. Additionally, structural attributes of grassland areas would, apparently, not be grossly different from some of the sedge-lily dominated areas of dunes where New Holland Mice were trapped in 1993. Whether or not the Kangaroo Grass *Themeda triandra* grasslands are habitat of New Holland Mice will only be known when the restoration process is well progressed. The New Holland Mouse populations at Wilsons Promontory provide an ideal opportunity to learn more about this species, especially in what is to a degree atypical habitat.

Densities

The number of New Holland Mice at Site 1 was encouragingly high (12). The trapping arrangement at this site during the February 1993 survey covered an area of approximately 0.8 hectares. Thus, a crude density estimate of New Holland Mice was approximately 12.5 individuals/hectare. However, approximately one third of traps were located in open swales which failed to trap any New Holland Mice. Hence this figure may have under-estimated the densi-

Fig. 1. New Holland Mouse habitat, site 1 on Yanakie Isthmus. Slashed area in foreground, calcareous dune in mid picture.

Fig. 2. Close-up of dune habitat at site 1, Yanakie Isthmus.

Fig. 3. New Holland Mouse habitat, site 5, on Yanakie Isthmus.

ty of mice on the vegetated dunes. Furthermore, on these dunes New Holland Mice apparently selected sites with a specific micro-habitat; Coast Tea-tree thickets with little ground vegetation were avoided. Kemper (1995) noted that New Holland Mice living in optimum habitat can reach densities of 17 individuals/hectare. At Site 5 of the Wilsons Promontory survey, three New Holland Mice were caught over an area of 0.4 hectares (i.e. 7.5 individuals/ hectare).

Weights of New Holland Mice at Wilsons Promontory were generally less than those at Otway Ranges (Wilson 1991) and north-east Tasmania (Pye 1991; Kemper 1995), but fell within the weight range of specimens from the central coast of New South Wales (Keith and Calaby 1968). New Holland Mice at the Promontory possessed tail and hindfoot lengths that were within ranges provided by Keith and Calaby (1968) and Pye (1991). The capture of a pregnant female and 'sub-adults' (of approximately 13.0 g) in late February conformed to the spring-summer breeding season determined by Kemper (1995) and Wilson (1991) elsewhere. However, it also suggested breeding could extend into autumn as it does in Tasmanian populations of New Holland Mice (Pye 1991).

Movements

The presence of fallen, dead shrubs on dunes appeared important for short distance movements of at least some of the New Holland Mice. Additionally, the dead shrubs may provide for the mice some cover and protection from predators. Consequently, dead shrubs are seen as important components of New Holland Mice habitat. However, a greater understanding of vegetational succession on the dunes is needed for the management of New Holland Mice.

The 90 m movement of an individual New Holland Mouse in a 24-hour period seemed a considerable distance for an animal of its size. However, Pye (1991), working in Tasmania, recorded a 400 m movement of a New Holland Mouse in a 48-hour period.

Invertebrates - ectoparasites

The three genera of invertebrates collected from New Holland Mice include two ectoparasites: *Pygiopsylla* sp.; *Dermanyssus* sp. or *Liponyssus* sp. The life mode of the third genus taken, *Myotyphlus*, requires re-assessing (see below). *Pygiopsylla* contains species which occur on a number of native rodents (including *Rattus* spp.) and marsupials (CSIRO 1970). Mites of the family Dermanyssidae are known parasites of mammals, and also birds and reptiles. They feed on the blood of their hosts and are capable of transmit-

Recommendations for Wilsons Promontory National Park

1. Monitor known populations of New Holland Mice in Wilsons Promontory National Park at least once per year.

2. Gather further base-line data on the ecology of New Holland Mice at the Promontory, including data on population dynamics and composition, mortality, home range, breeding biology, dispersal patterns, diet and the degree of genetic isolation of the populations. The collection of scats and hair samples for analysis by Deakin University scientists should continue.

3. Describe fully the habitat of New Holland Mice at Wilsons Promontory; study vegetational succession on the dunes in order to implement more precisely, management requirements of New Holland Mice.

4. Search similar dune systems of Wilsons Promontory National Park and other areas of South Gippsland for further populations of New Holland Mice.

5. In the short-term, continue some slashing of the swales surrounding the dunes occupied by New Holland Mice at the Promontory to reduce the extent of Coast Tea-tree *Leptospermum laevigatum* and Coastal Wattle *Acacia sophorae* invasion on to the dunes; meanwhile, investigate the susceptibility of New Holland Mice to the proposed 1080 baiting program. In the long-term, the New Holland Mouse sites should be incorporated into the entire native grassland - open woodland restoration program, as this should conserve and enhance their habitats and ensure the species survival.

6. Investigate the potential of Wilsons Promontory heathlands to provide suitable New Holland Mouse re-introduction sites, as a long-term aim.

ting diseases (Krantz 1978). Whether or not the Dermanyssidae mites found on New Holland Mice at Wilsons Promontory transmit disease to their hosts is not known, but may be worthy of investigation. *Myotyphlus* sp. is included in the tribe Amblyopinini. Members of this tribe occur in the Neotropics as well as Australia, and until recently, were thought to be obligate ectoparasites on small mammals. However, two species of a central and southern American genus *Amblyopinus*, are known to be highly specialized predators on ectoparasites of the mammals (Ashe and Timm 1987a,b). *Myotyphlus* sp. has been previously collected from the fur of *Rattus* spp. in both Victoria and Tasmania. In addition, it has been detected free-living in the guano of bats in Victorian and New South Wales caves (Hamilton-Smith and Adams 1966).

With this evidence it is highly likely that *Myotyphlus* sp. specimens on New Holland Mice at Wilsons Promontory were using the ectoparasites (*Pygiopsylla* sp.; *Dermanyssus* or *Liponyssus* sp.) as prey items. Clearly, the relationship between *Myotyphlus* sp. and New Holland Mice could be mutualistic and not parasitic, and deserves investigation.

The management recommendations given for New Holland Mouse are not expected to adversely affect other small ground mammal species. In fact, the long-term viability of these other species would benefit by an increased knowledge of their requirements (if further monitoring proceeds), greater understanding of their habitats, and habitat enhancement through restoration and appropriate management.

Acknowledgments

A complete set of acknowledgments for this research report was given in the associated paper of Quin (1996); those persons and groups are thanked again. Additionally, Darren Carmen provided results of follow-up work on New Holland Mice at Wilsons Promontory. We are grateful for the comments given by an anonymous referee.

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Results of Surveys of the Herpetofauna of Several Areas in North-western Victoria

A.J.Coventry[1]

Abstract

This paper reports the results of several surveys of the herpetofauna in areas of north-western Victoria. Included are brief descriptions of the soils and flora of each site, comments on species diversity and zoogeography. In addition a list, arranged in families and including both scientific and, where appropriate, common names of species known to occur in the Victorian mallee is included (Appendix 1). Comments are made under the results on distribution patterns and zoogeography. (*The Victorian Naturalist* 1996, 113, 289-299)

Introduction

The herpetofauna of various areas of the Victorian mallee have been reported on by Coventry (*in press*) Mather (1979) Menkorst (1982) Robertson *et.al.* (1989) and Woinarski (1989). In addition, Rawlinson (1966) listed the reptiles and Littlejohn (1966) the amphibians of the Victorian mallee. Baverstock (1979) has reported on the Billiatt Conservation Park, South Australia, which is close to the western border of the northern Victorian Mallee. This current paper, by reporting on previously poorly known areas, adds to our knowledge of these fauna within north-western Victoria.

Method

Data was obtained from four areas, and the results are expressed below in tabular form. Fauna was surveyed by means of pitfall trapping, traps being checked early each morning, and in extremely warm conditions during the day and/or early evening. Each site consisted of a single drift fence 50 m in length, 13 cm high, with approximately 2 cm buried in the soil, and contained ten pit fall traps approximately 5.5 m apart along the drift fence. Traps were 30 litre buckets 39 cm deep and with an opening diameter of 29 cm. Sites were selected because of their diverse topographical and floral characteristics. Co-ordinates were obtained using a Sony Pyxis GPS. Zoological nomenclature, together with common names of reptiles follow Cogger, 1992, while *Phyllodactylus marmoratus* follows Cogger, 1986 and common names of frogs follow Hero, Littlejohn and Marantelli (1991).

[1] Herpetology Department, Museum of Victoria, 71 Victoria Crescent, Abbotsford, Victoria 3067.

Localities sampled (Fig. 1)

Sampling commenced in October 1984, at six sites in the Round Swamp (35°42'S 141°43'E) to Arnolds Springs (35°40'S 141°42'E) area, in the north-eastern region of the Big Desert, and concluded in February 1986. The sites, starting from the swamp, followed the track northwards for 7 km, the last site being near Arnolds Springs.

Between November 1985 and March 1987, five trips were undertaken at 12 sites from the east of Milmed (35°40'S 141°40'E) to the Pigeon Springs (35°37'S 141°32'E) area. These sites were spread along the Milmed Rock track from a point 2.9 km E. to 18.7 km W. of Milmed Rock,

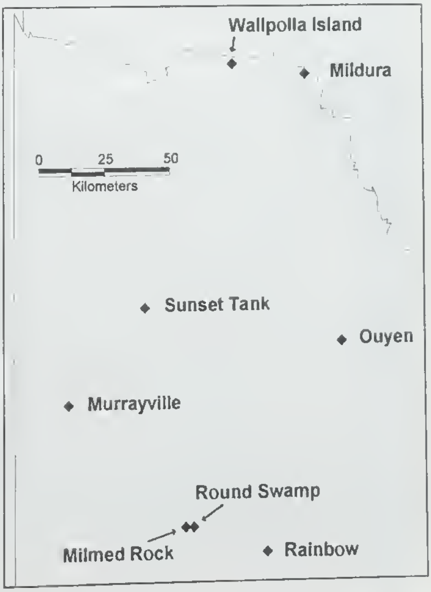

Fig. 1. Map showing localities where sampling was done.

(= 1.3 km W. of Pigeon Springs).

Fauna was surveyed along Sunset Track, to the west of Sunset Tank (34°56'41"S 141°30'21"E) at 18 sites, with a total of three trips, from October, 1987 to February, 1988. One trip from 26 October gave over four full weeks of continuous survey. The Sunset Tank sites began 1.3 km W. of Sunset Tank and followed the track to a point 25.1 km W. of the Tank.

Finally, twelve sites were established on Wallpolla Island, from Horseshoe Lagoon (34°09'S 141°52'E) westwards, an area formed by Wallpolla Creek and the Murray River, west of Mildura, with four trips between September and December 1988.

Round Swamp Sites

1. 300 m S.E. of the well in 35°42'36"S 141°43'00"E, was at the bottom of a consolidated sand dune. Soils were deep, dark friable sands. The upper stratum consisted of *Callitrix preisii* with a mid layer of *Eucalyptus porosa*. Ground layer consisted of ephemeral grasses dominated by *Stipa falcata*.

2. 300 m N.E. of the well in 35°42'33"S 141°42'37"E, and in the swamp proper, was an area of "crab holes" in clayish, saline soils. The upper stratum consisted of *Eucalyptus behriana*, *Eucalyptus calycogona, E. porosa* and *Acacia bivenosa* with a lower layer of *Chenopodium desertorum*. Ground layer was *Carpobrotus modestus* interspersed with ephemeral grasses.

3. 5.4 km N. of the well in 35°40'13"S 141°42'47"E, and running down the northerly aspect of a large sand dune which had been devastated by the 1981 fires. Regenerating *Eucalyptus incrassata* together with *Melaleuca uncinata* were the most common plants with some *Grevillea pterosterum, Hibbertia spp.* and sparse grasses.

4. 6.1 km N. of the well in 35°39'54"S 141°42'50"E, and on the southerly aspect of a large dune some 200 metres in from the edge of the 1981 fires. The upper layer comprised *E. incrassata* with a fairly dense mid-layer dominated by *M. uncinata* with some *Baeckea behrii*. There was very little ground layer and litter was virtually absent.

5. 6.7 km N. of the well in 35°39'38"S 141°42'44"E, and in an area of whipstick

Table 1 Number of specimens recorded, from 120 pitfall trap day/nights per site, at each of the Round Swamp sites.

	Site Number						
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**TOTALS**
Gekkonidae							
Diplodactylus intermedius	0	0	0	1	0	0	1
Diplodactylus vittatus	0	1	0	0	1	1	3
Lucasium damaeum	0	0	4	3	0	2	9
Phyllodactylus marmoratus	1	0	0	0	0	0	1
Pygopodidae							
Aprasia inaurita	0	0	1	0	0	0	1
Delma australis	0	1	0	0	0	0	1
Agamidae							
Amphibolurus nobbi coggeri	0	0	0	1	0	0	1
Ctenophorus fordi	0	0	1	0	0	0	1
Ctenophorus pictus	0	0	8	2	0	3	13
Scincidae							
Ctenotus brooksi iridis	0	0	1	0	0	0	1
Ctenotus robustus	0	0	3	0	0	0	3
Ctenotus uber orientalis	0	0	0	0	1	1	2
Egernia inornata	0	0	0	1	0	0	1
Lerista bougainvillii	1	0	0	1	0	1	3
Menetia greyii	0	0	1	0	0	0	1
Tiliqua occipitalis	0	0	0	1	0	0	1
Typhlopidae							
Ramphotyphlops australis	1	0	0	0	1	0	2
Ramphotyphlops bituberculatus	3	2	0	0	0	0	5
TOTALS	6	4	19	10	3	8	50

mallee on compacted red soils. The upper stratum consisted chiefly of *E. calycogona* and *M. uncinata*. There was very little ground cover or litter.

6. 7 km N. of the well in 35°39'22"S 141°42'42"E, was on the end of a low ridge containing red sandstone. The area had been lightly burnt in the 1981 fires and consisted of regenerating *E. calycogona, Eucalyptus dumosa* and *M. uncinata* between fairly large areas of open ground with sparse ephemeral grasses.

The results of this work are listed in Table 1.

Milmed Sites (Fig. 2)

1. 2.9 km E. of Milmed Rock in 35°39'09"S 141°38'45"E, and in a sandy swale. The upper story was dominated by *E. behriana* and *Eucalyptus foecunda* with a mid story consisting of *Hakea muellerana, Acacia hakoides* and *Callitris verrucosa*. Old *Triodia irritans* constituted the ground layer. Some litter was present. This site appeared not to have been affected by fire for a considerable number of years.

2. 1.2 km E.N.E. of Milmed Rock in 35°38'58"S 141°36'23"E, and in an area of open woodland, on compacted black soils, and shallow "crab holes". There was a sparse upper layer of *E. calycogona*, with a mid layer of *Atriplex nummularia* and *Zygophyllum glaucum*. Ground cover consisted of *Carpobratus modestus* and some ephemeral grasses, with a little ground litter.

3. 0.2 km N. of Milmed Rock in 35°39'15"S 141°36'04"E, was on a sand plain with a vein of sandstone running approximately north - south. The area had been totally destroyed in the 1981 fires, and consisted chiefly of regenerating *E. foecunda, T. irritans* and *Grevillea ilicifiora*, with *H. muellerana, C. verrucosa, M. uncinata* and some grasses.

4. 2.2 km W. of Milmed Rock in 35°38'39"S; 141°34'57"E, was on the edge of a low sand dune. The upper story was dominated by *E. foecunda* and *E. incrassata*, with *C. verrucosa* and *Lepidospermum coriaceum* common in the midstory. Old *T. irritans* formed the major ground cover.

5. 7.6 km W. of Milmed Rock (s. of track) in 35°36'24"S; 141°31'47"E was on a low dune. The upper canopy was dominated by

Fig. 2. Desert heath, Big Desert

E. incrassata with a sparse lower canopy dominated by *L. coriaceum*. Grasses, including sparse *T. irritans* provided the ground cover.

6. 7.6 km W. of Milmed Rock (n. of track) in 35°37'26"S; 141°31'48"E, was on a low inter-dune plain. The low upper canopy was dominated by *L. coriaceum, Leptospermum myrsinoides* and *Banksia ornata*, with a lower canopy where *Casuarina pusilla* was dominant over *T. irritans*.

7. 9.3 km W. of Milmed Rock in 35°37'13"S 141°30'45"E, was on the top of a low dune dominated by dense *B. ornata* and *L. coriaceum. C. pusilla* provided the lower canopy. There was very little litter or ground cover. *T. irritans* was absent.

8. 10.3 km W. of Milmed Rock in 35°37'08"S 141°29'59"E, The upper canopy was dominated by *E. incrassata*, with *Calytrix tetragona*, mid canopy by *L. coriaceum, B. behrii, Baeckea crassifolia* and *H. muellerana*. Grasses, including sparse *T. irritans* were present.

9. 12.7 km W. of Milmed Rock in 35°36'03"S 141°28'22"E, The upper story consisted of *C. verrucosa, C. tetragona* and *E. incrassata*, with a mid-story of *L. coreaceum, B. behrii, B. crassifolia* and *H. muellerana*. The lower story was dominated by *C. pusilla*.

10. 14.6 km W. of Milmed Rock in 35°36'25"S 141°27'18"E, and running from the top to the bottom of a small dune which had very sparse regenerating *E. foecunda* and *E. incrassata* and fairly dense *B. ornata* and *C. pusilla* following burning in the 1981 fires. Ground cover consisted of very sparse grasses including regenerating *T. irritans*.

11. 17.4 km W. of Milmed Rock in 35°36'32"S 141°26'03"E, and lying on the top and side of a large dune. The upper story was dominated by *Eucalyptus baxteri*, with *L. coriaceum*. The mid layer included *B. crassifolia* and the lower layer *C. meullerana*. Ground cover contained some grasses and litter. *T. irritans* was absent.

Table 2. Number of specimens recorded, from 180 pitfall trap day/nights per site, at each of the Milmed sites.

	Site no												
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Totals**
Gekkonidae													
Diplodactylus intermedius	0	0	1	0	2	4	0	1	0	1	1	0	10
Diplodactylus vittatus	1	1	0	0	0	0	0	0	0	0	1	2	5
Lucasium damaeum	0	0	1	0	0	0	0	0	0	2	8	0	11
Pygopodidae													
Aprasia inaurita	0	0	0	1	0	0	0	0	0	0	0	0	1
Delma australis	0	0	0	0	0	0	0	0	0	0	1	0	1
Agamidae													
Amphibolurus norrisi	4	0	1	1	5	2	3	3	1	0	0	0	20
Ctenophorus fordi	2	0	5	3	9	2	0	6	1	3	4	0	35
Ctenophorus pictus	1	0	4	4	3	2	1	3	3	13	5	0	39
Pogona vitticeps	0	0	1	0	0	2	3	8	0	1	0	0	15
Scincidae													
Ctenotus brooksi iridis	2	0	1	1	0	0	1	0	0	2	7	0	14
Ctenotus robustus	0	0	0	5	7	18	6	9	7	0	4	2	58
Ctenotus uber orientalis	1	0	3	0	0	0	0	0	0	0	0	12	17
Lerista bougainvillii	0	0	2	0	2	0	1	0	0	0	11	0	16
Menetia greyii	0	0	0	0	1	1	0	0	0	0	0	0	2
Morethia obscura	0	0	1	1	0	0	0	2	1	2	2	0	9
Typhlopidae													
Ramphotyphlops australis	1	1	0	0	0	0	0	1	1	0	1	0	5
Ramphotyphlops bituberculatus	1	1	0	0	1	0	0	0	0	0	0	0	3
Elapidae													
Drysdalia mastersii	1	0	0	0	0	0	0	0	0	0	0	0	1
Suta nigriceps	0	0	0	0	0	0	0	1	0	0	1	0	2
Suta spectabilis	0	0	0	0	0	0	0	0	1	0	0	0	1
TOTALS	14	3	20	16	30	31	15	35	14	24	46	16	**265**

12. 18.7 km W. of Milmed Rock in 35°35'46"S 141°25'06"E, on a large inter-dune plain. The upper canopy was dominated by *E. baxteri* with sparse *E. foecunda* and *E. incrassata*. The fairly dense lower canopy comprised young *C. verrucosa*. Some *H. muellerana* and *T. irritans* were also present.

The results of this work are listed in Table 2.

Sunset Tank Sites (Fig. 3.)

1. 1.3 km W. of Sunset Tank in 34°56'50"S. 141°29'27" E. was on a plain dominated by *Casuarina cristata* and mixed low shrubs and grasses, approximately 50 metres in from track and parallel to track.

2. 4.35 km W. of Sunset Tank in 34°57'13"S. 141°27'44" E. was on a plain in an open area with *A. nummularia* on soils containing much limestone.

3. 6.3 km W. of Sunset Tank in 34°57'07"S. 141°26'25" E. was on a sand dune with mixed mallee and *Triodia*.

4. 7.7 km W. of Sunset Tank in 34°57'05"S. 141°25'33"E. was on a small plain of compacted soils in mixed mallee and sparse *Triodia*.

5. 8.7 km W. of Sunset Tank in 34°56'59"S. 141°24'55" E. was on compacted soils in open mallee.

6. 9.5 km W. of Sunset Tank in 34°56'53"S. 141°24'21" E. was in mixed mallee on compacted soils with little undergrowth.

7. 10.5 km W. of Sunset Tank in 34°56'56"S. 141°23'52" E. was on compacted sands in an open area of grassland with *C. verrucosa* and *C. cristata*.

8. 12.7 km W. of Sunset Tank in 34°57'41"S. 141°22'35" E. and adjacent to a medium sized sand dune, with *C. verrucosa* some *Melaleuca*, mixed mallee, and *Triodia*. (Fig. 4)

9. 13.15 km W. of Sunset Tank in 34°57'49"S. 141°22'15"E. was in mixed mallee and *Triodia*.

10. 14.4 km W. of Sunset Tank in 34°57'54"S. 141°21'27" E. was on friable soils, with fairly dense mixed mallee and sparse *Triodia*.

11. 16.05 km W. of Sunset Tank in 34°58'06"S. 141°20'26" E. was on a low sand dune in *Melaleuca* and scattered mallee.

12. 16.6 km W. of Sunset Tank in 34°57'53"S. 141°19'51" E. was in medium dense mallee.

13. 20.6 km W. of Sunset Tank on S. in 34°58'12"S. 141°17'59" E. was on com-

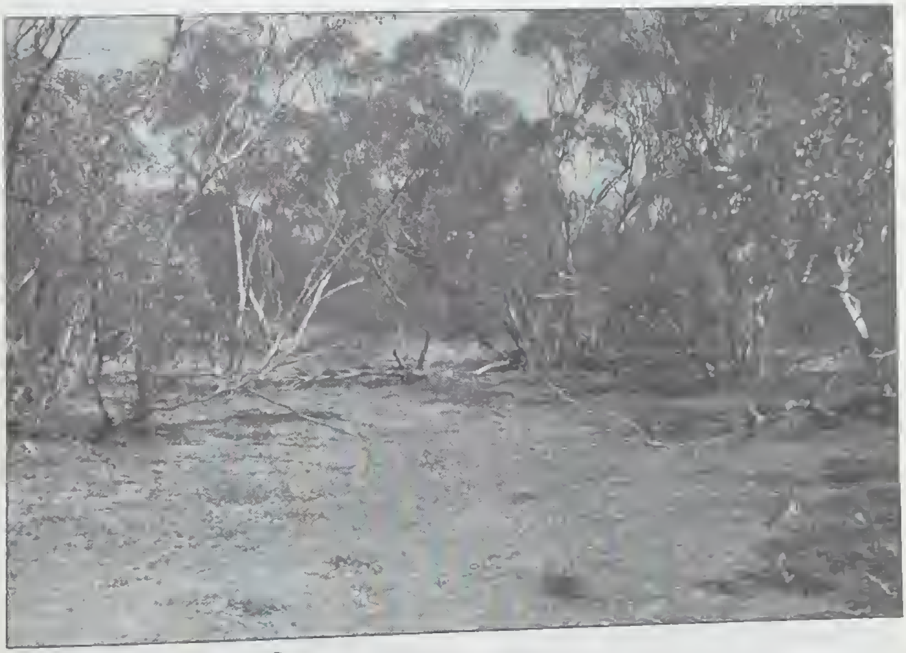

Fig. 3. Open mallee, Sunset Country

pacted red sands with fairly dense "whipstick" mallee and little to no undergrowth.
14. 21.3 km W. of Sunset Tank in 34°58'16"S. 141°17'03" E. was on sandy soils with mixed mallee and some *Triodia*.
15. 21.7 km W. of Sunset Tank in 34°58'07"S. 141°17'52" E. and in a mixed community of mallee, pine and *Triodia* on friable sand.
16. 23.0 km W. of Sunset Tank in 34°58'10"S. 141°16'08" E. was in an area of mixed sands and darker soils with 'crabholes'. This area had been burnt some two years earlier and had regenerating mallee and *Triodia*.
17. 24.1 km W. of Sunset Tank in 34°58'06"S. 141°15'06" E. was situated on the side of a dune in an area burnt some two years earlier. Some *C. verrucosa* and regenerating mallee, with ephemeral grasses.
18. 25.1 km W. of Sunset Tank in 34°57'33"S. 141°15'23" E. This site ran from the top of a large dune, which had been burnt some two years previously. Some regenerating mallee.
The results of this work are listed in Table 3.

Wallpolla Island Sites
1. Horseshoe Lagoon in 34°08'07"S. 141°50'19"E was on black soils with *Eucalyptus largiflorans* and some *Muehlenbeckia cunninghamii*.
2. 6.4 km S.W. of Lilly Pond in 34°08'30"S. 141°45'49"E was a fenced regeneration area situated on a sandy dune with some ephemeral grasses and *C. verrucosa*, *E. largiflorans* and *E. camaldulensis* in adjacent areas.
3. 5.6 km S.W. of Lilly Pond in 34°08'44"S. 141°46'18"E it was on black soils dominated by young *E. largiflorans* with some shrubs and ephemeral grasses.
4. 3.1 km S.W. of Lilly Pond in 34°08'01"S. 141°47'08"E was on a black soil plain, with ephemeral grasses and sparse *M. cunninghamii*.
5. 1.6 km S.W. of Lilly Pond in 34°07'23²S. 141°47'54"E was on black soil with dense *M. cunninghamii* and sparse *E. largiflorans*.
6. Dedman Creek in 34°07'12"S. 141°42'52²E was on black soils in dense *M. cunninghami*, with *E. largiflorans* and *E. camaldulensis*.
7. 1.6 km E. of Dedman Creek in 34°07'12"S. 141°43'55"E on black soil plain with ephemeral grasses and very sparse *E. largiflorans*.
8. 2.2 km E. of Dedman Creek in 34°07'04"S. 141°44'09"E on black soil

Fig. 4. Mallee and Triodia.

plain with *Carpobrotys modestus*.

9. 4.7 km E. of Dedman Creek in 34°06'58"S. 141°45'30"E with a fairly dense upper canopy of *E. largiflorans* and lower canopy of *M. cunningham*.

10. 4.0 km W.N.W. of Lilly Pond in 33°06'50"S. 141°46'18" on black soil with moderately dense upper canopy of *E. camaldulensis* with ephemeral grasses.

11. 4.5 km W.N.W. of Lilly Pond in 33°06'35"S. 141°46'20"E on black soil with scattered *E. camaldulensis* and ephemeral grasses.

12. Lilly pond in 34°07'23"S. 141°47'54"E and adjacent to a small lagoon at the eastern end of the pond, consisted of scattered *E. camaldulensis*.

The results of this work are listed in Table 4.

Results

Interestingly the results shown in the tables is related to some of the distributional data. For example, *Amphibolurus nobbi coggeri*, appears to replace *Amphibolurus norrisi* in the north east of the Big Desert and in the Sunset Country, while *Ctenotus robustus*, a common species in the Big Desert, was only recorded once from the Sunset Country, where it appears to be replaced by *Ctenotus brachyonyx*. Among the elapid snakes, *Drysdalia mastersii*, while fairly common on the Big Desert, was not recorded from the Sunset Country, while species such as *Demansia psammophis* and *Pseudonaja nuchalis*, while recorded on the Sunset Country were not located in the Big Desert. Still further north where the influence of the Murray River impacts on the environment, species such as *Rhynchoedura ornata*, *Pseudechis porphyriacus*, *Notechis scutatus*, and *Suta suta* occur. It seems strange that *Diplodactylus tessellatus*, a species inhabiting cracking black soils of riverine and lake habitats, and recorded from Kewell further to the south during the last century (Museum of Victoria records) should now apparently be restricted to the Murray River region. Spencer (1896) proposed three zoogeographic regions for Australia:- the Torresian, to include tropical north-eastern Australia, the Bassian for south-eastern Australia, and the Eyrean for the remaining areas, including the arid interior. Rawlinson (1971) expanded on Spencer's concept, subdividing the Victoria Bassian region into subregions:- warm temperate Bassian, cool temperate bassian and cold temperate bassian. The rest of Victoria he regarded as Eyrean. Rawlinson (1966) listed all the then recognised reptile species from the mallee, and in 1971 he allocated them into his various zoogeographic regions. This study would indicate that the semi-arid regions of north-western Victoria, rather than being true Eyrean, fall within a transition zone between the warm temperate Bassian of Rawlinson and the Eyrean regions of Spencer.

Discussion

The semi-arid mallee regions of north-west Victoria supports a rich and diverse herpetofauna, with representatives of all of the five Australian lizard families, the Pygopodids or legless lizards, Gekkonids or geckoes, Agamids or dragons, Varanids or goannas and Scincids or skinks, three of the four families of Australian terrestrial snakes, Typhlopids or blind snakes, Boids or pythons, Elapids or front fanged venomous snakes, and two of the four families of the indigenous Australian amphibians, the Hylids or tree frogs, and the Myobatrachids or ground frogs. The numerous micro-environments in the semi-arid regions of north-western Victoria, ranging from salt lakes, grass plains, sand dunes, and whipstick scrub through to desert heaths, provide ample opportunity for species specialisation, and this is utilised by the reptile fauna. Skinks are the most diverse family, with 21 species, one species complex of which, the *Morethia boulengeri* group, is represented within the mallee by three species, *M. boulengeri* being found in open grassland or farmland type habitats, *Morethia obscura* in mallee heath habitats, and *Morethia adelaidensis* in association with saline soils. Snakes on the other hand were poorly represented, with the 69% of those recorded being nocturnal and of these nocturnal species, 66.6% were burrowers. Apart from the Death Adder, Fierce Snake, Red-bellied Black Snake and Tiger Snake, which either probably no longer exist in the mallee, or whose presence there is dependent on the Murray River, only four species of diurnal elapids, are present (Fig 5). This is possi-

Table 3 Reptiles and amphibians recorded, from 410 pitfall trap day/nights per site, at Sunset Tank localities.

SPECIES	Site No 1	2	3	4	5	6	7
Gekkonidae							
Diplodactylus damaeus	3	0	13	16	0	3	4
Diplodactylus intermedius	0	1	3	1	0	2	3
Diplodactylus vittatus	2	2	1	12	4	6	1
Heteronotia binoei	0	0	0	0	0	0	0
Underwoodisaurus milii	0	1	0	0	0	1	0
Pygopodidae *Aprasia inaurita*	0	0	1	0	0	0	1
Delma australis	0	0	3	2	0	3	2
Delma nasuta	0	0	3	1	0	1	0
Liasis burtonis	0	0	1	0	0	0	0
Pygopus lepidopodus	0	0	0	0	0	0	0
Varanidae							
Varanus gouldii	0	0	0	0	1	0	0
Agamidae							
Amphibolurus nobbi coggeri	3	1	5	5	15	6	0
Ctenophorus fordi	0	0	23	7	2	1	0
Ctenophorus pictus	5	11	28	49	11	8	21
Pogona vitticeps	0	0	2	0	1	1	6
Scincidae							
Ctenotus brachyonyx	2	0	11	1	0	0	0
Ctenotus regius	11	0	0	5	0	0	12
Ctenotus robustus	0	0	0	0	0	0	0
Ctenotus uber orientalis	0	17	3	0	2	1	1
Egernia inornata	0	0	1	0	0	0	0
Lerista bougainvillii	0	0	0	1	1	0	0
Lerista punctatovittata	6	0	5	1	10	4	2
Menetia greyi	1	0	3	2	1	1	1
Morethia boulengeri	2	3	1	0	8	4	0
Morethia obscura	0	0	1	1	0	0	0
Tiliqua occipitalis	0	0	0	0	0	0	0
Typhlopidae							
Ramphotyphlops australis	0	0	0	0	0	2	0
Ramphotyphlops bituberculatus	1	0	0	2	1	3	0
Elapidae							
Demansia psammophis	0	0	0	0	0	0	0
Pseudonaja nuchalis	0	0	0	0	1	0	0
Pseudonaja textilis	0	0	0	0	0	0	0
Simoselaps australis	0	0	2	5	4	6	4
Suta nigriceps	1	1	2	0	0	0	0
Vermicella annulata	0	0	0	0	1	0	1
Myobatrachidae							
Neobatrachus pictus	0	0	0	0	0	0	0
TOTALS	**37**	**37**	**112**	**111**	**63**	**53**	**59**

bly due to the presence of both varanid lizards and raptors, which could prey upon them. This theory would be supported by the fact that only large brown snakes, over 1 metre in length, and yellow-faced whip snakes were observed either basking or moving. Juveniles of both species of Brown snakes were recorded immediately adjacent to large clumps of *Triodia*. Unfortunately the results obtained during the surveys at Round Swamp and Milmed were probably affected by the 1981 fires, where Coventry, (*in press*) has demonstrated that elapids are slow to re-establish.

Acknowledgements.
For help, encouragement and company in the field, thanks are due to L. Ahern, J.Calwell, A., J., P., and P. Coventry, K.C.Norris, the late

Table 3' cont.

Site No. 8	9	10	11	12	13	14	15	16	17	18	TOTALS
10	2	18	2	8	0	2	1	7	17	14	120
1	2	3	0	4	0	0	0	0	0	6	26
8	6	1	4	6	9	2	6	2	0	3	75
0	0	0	0	0	0	0	0	1	0	0	1
0	0	0	0	0	0	0	0	0	0	0	2
2	1	5	2	3	0	0	0	1	1	0	17
1	2	2	2	10	2	5	2	1	3	0	40
1	1	0	0	2	0	0	0	0	0	0	9
1	1	0	0	2	0	2	0	0	0	0	7
0	1	0	1	0	1	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0	0	1
4	4	12	6	5	12	7	9	3	1	5	103
24	30	16	21	46	0	5	1	22	8	7	213
36	41	72	80	57	17	24	44	8 9	28	52	673
1	5	2	6	7	1	1	2	3	2	1	42
6	12	6	3	10	0	11	0	3	7	2	74
0	0	0	0	0	0	0	0	0	0	0	28
0	1	0	0	0	0	0	0	0	0	0	1
1	0	0	0	0	4	0	1	1	0	0	31
2	0	0	0	1	0	0	0	0	0	0	4
0	0	0	4	0	0	2	0	2	0	1	11
3	0	8	1	3	3	6	0	1	1	0	54
1	2	4	4	2	0	5	0	0	1	0	28
0	0	0	1	1	1	0	2	0	0	0	23
0	0	0	0	0	0	0	0	0	0	0	2
0	0	0	0	2	0	0	0	0	0	0	2
2	0	0	1	1	0	0	0	0	0	0	66
0	0	0	4	1	1	1	0	1	0	0	15
0	0	0	1	1	0	0	1	0	0	0	3
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	1
0	4	0	5	0	0	0	0	0	0	0	30
0	0	0	0	0	1	0	1	0	0	0	6
0	0	0	0	1	1	0	2	0	1	0	7
0	0	0	0	0	0	0	0	1	0	0	1
104	**115**	**149**	**149**	**173**	**53**	**73**	**72**	**137**	**71**	**91**	**1659**

P.Rawlinson, P.Robertson, D.Webster, S.Wild, A. and P.Yen. P.Johnson and a team of Raleigh students installed the trap lines along Sunset Track, and the Friends of the Museum of Victoria very ably assisted in installing the trap lines at Milmed. John Wainer offered valuable and constructive advice on the manuscript.

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Table 4 Species collected, from 410 pitfall trap day/nights per site, at each site at Wallpolla Island.

SPECIES	Site no 1	2	3	4	5	6	7	8	9	10	11	12	Totals
Chelidae													
Chelodina longicollis	0	0	0	0	0	1	0	0	0	0	0	1	**2**
Gekkonidae													
Diplodactylus tessellatus	1	0	1	3	5	0	4	1	6	0	0	0	**21**
Gehyra variegata	1	1	0	0	0	1	0	0	0	0	0	0	**3**
Lucaseum damaeum	0	2	0	0	0	0	0	0	0	0	0	0	**2**
Phyllodactylus marmoratus	1	0	0	0	0	1	0	0	0	0	0	0	**2**
Rhynchoedura ornata	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Scincidae													
Cryptoblepharus carnabyi	4	0	0	0	0	1	0	0	0	0	0	0	**5**
Eulamprus quoyii	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Lerista punctatovittata	0	1	1	0	0	0	0	0	0	0	0	0	**2**
Morethia boulengeri	3	6	4	2	0	9	0	0	0	1	0	1	**26**
Morethia obscura	0	2	0	1	2	1	0	0	1	0	0	1	**8**
Typhlopidae													
Ramphotyphlops bituberculatus	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Elapidae													
Furina diadema	0	0	1	0	0	1	0	0	0	0	0	0	**2**
Suta suta	1	0	0	0	0	0	0	0	1	0	0	0	**2**
Myobatrachidae													
Crinia parinsignifera	0	0	1	0	0	2	0	0	0	1	0	2	**6**
Limnodynastes d. dumerilii	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Limnodynastes fletcheri	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Limnodynastes tasmaniensis	0	0	3	0	0	0	0	0	0	0	1	5	**9**
Hylidae													
Litoria peronii	0	0	0	0	0	0	0	0	0	0	0	1	**1**
TOTALS	**12**	**12**	**11**	**7**	**7**	**18**	**4**	**1**	**8**	**2**	**1**	**14**	**97**

Fig. 5. Bandy-Bandy *Vermicella annulata*, photo by E.R. Rotherham

Fig. 6. Rosenberg's Goanna *Varanius rosenbergi*, photo by P. Robertson.

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Appendix 1. Amphibians and Reptiles recorded from the Victorian Mallee, (based on the Museum of Victoria collections).
* denotes possibly no longer found in the mallee. (Coventry and Robertson 1991).

Amphibians

Hylidae
Litoria peroni Peron's Tree Frog
Litoria raniformis Growling Grass Frog

Myobatrachidae
Limnodynastes dumerilii Pobblebonk
Limnodynastes fletcheri Barking Marsh Frog
Limnodynastes tasmaniensis Spotted Marsh Frog
Neobatrachus pictus Mallee Spadefoot Toad
Neobatrachus sudelli Common Spadefoot Toad
Crinia parinsignifera Plains Froglet
Crinia signifera Common Froglet

Reptiles

Chelidae (tortoises)
Chelodina longicollis Long-necked Tortoise
Emydura macquarii Murray Turtle

Gekkonidae (geckos)
Diplodactylus intermedius Eastern Spiny-tailed Gecko
Diplodactylus tessellatus Tessellated Gecko
Diplodactylus vittatus Wood Gecko
Gehyra variegata Tree Dtella
Heteronotia binoei Bynoe's Gecko
Lucasium damaeum Beaded Gecko
Phyllodactylus marmoratus Marbled Gecko
Rhynchoedura ornatus Beaked Gecko
Underwoodisaurus milii Thick-tailed Gecko

Pygopodidae (legless lizards)
Aprasia aurita
Aprasia inaurita
Aprasia striolata
Delma australis
Delma butleri
Delma impar
Delma inornata
Delma nasuta Spinifex Snake-lizard
Lialis burtonis Burton's Snake Lizard
Pygopus lepidopodus Common Scaly-foot
Pygopus nigriceps Hooded Scaly-foot

Agamidae (dragon lizards)
Amphibolurus nobbi coggeri
Amphibolurus norrisi
Ctenophorus fordi Mallee Dragon
Cenophorus pictus Painted Dragon
Pogona barbata Bearded Dragon
Pogona vitticeps
Tympanocryptis l. lineata

Varanidae (goannas)
Varanus gouldii Gould's Goanna
Varanus rosenbergi Rosenberg's Goanna
Varanus varius Lace Monitor

Scincidae (skinks)
Cryptoblepharus carnabyi
Ctenotus brachyonyx
Ctenotus brooksi iridis
Ctenotus regius
Ctenotus robustus
Ctenotus uber orientalis
Egernia inornata Desert Skink
Egernia multiscutata
Egernia striolata Tree Skink
Egernia quoyii Eastern Water Skink
Hemiergis millewae
Lerista bougainvillii
Lerista muelleri
Lerista punctatovitta
Menetia greyii
Morethia adelaidensis
Morethia boulengeri
Morethia obscura
Tiliqua occipitalis Western Blue-Tongued Lizard
Trachydosaurus rugosus Shingle-back

Typhlopidae (blind snakes)
Ramphotyphlops australis
Ramphotyphlops bituberculatus
Ramphotyphlops nigrescens
Ramphotyphlops proximus

Boidae (pythons)
Morelia spilota variegata Carpet Python

Elapidae (front-fanged snakes)
**Acanthophis antarcticus* Common Death Adder
Demansia psammophis Yellow-Faced Whip Snake
Drysdalia mastersii Masters' Snake
Echiopsis curta Bardick
Furina diadema Red-naped Snake
Notechis scutatus Eastern Tiger Snake
**Oxyuranus microlepidotus* Fierce Snake
Pseudechis porphyriacus Red-bellied Black Snake
Pseudonaja nuchalis Western Brown Snake
Pseudonaja textilis Eastern Brown Snake
Simoselaps australis Coral Snake
Suta nigriceps
Suta spectabilis
Suta suta Curl Snake
Vermicella annulata Bandy-Bandy

Diet of Red Foxes and Cats: Their Impact on Fauna Living in Parks Near Melbourne

R. L. Wallis[1] , H. Brunner[1] and J. H. Seebeck[2]

Introduction

Red Foxes *Vulpes vulpes* and Cats *Felis catus* (subsequently referred to as 'fox' and 'cat') have had significant impacts on native fauna in many parts of Australia. They are introduced predators which are considered highly efficient hunters and which have adapted to a wide range of habitats in Australia. Dietary studies of foxes and cats have indicated that both species are highly opportunistic, but that mammals form the major component of the food intake in both species (Coman and Brunner 1972; Seebeck 1978; Triggs *et al.* 1984; Brown and Triggs 1990; Seebeck *et al.* 1991). There have, however, been few published dietary studies of sympatric populations of foxes and cats in urban or semi-urban environments. Furthermore, there has been debate on whether these predators can cause extirpation of populations of native vertebrates (Barratt 1995), although Paton (1993) considers that cats may account for 80% of the annual productivity of birds in an area, effectively killing most of the 'standing crop' each year.

Most previous studies on the comparative diets of foxes and cats have been based in non-urban or undisturbed habitats (Bayly 1978; Triggs *et al.* 1984; Brown and Triggs 1990). Brunner *et al.* (1991) have previously reported on the diets of foxes, dogs and cats in an urban park in Melbourne and showed that in parkland along Dandenong Creek, mammals were found in most scats of the three predators, while birds occurred more frequently in fox scats than in those of the other two species. Although the actual mammalian prey taken by the three predators were similar, cats tended to consume a higher percentage of smaller prey species, such as small possums and rodents, in contrast to prey taken by dogs and foxes. A higher percentage of dog remains and garbage were found in fox scats than in scats from cats. They also speculated on the likely impact of continued predation on native species such as Sugar Gliders *Petaurus breviceps* and many waterbirds, particularly because of the fragmented and linear nature of the Park.

Dowling *et al.* (1994) analysed the causes of admission to wildlife shelters in Victoria of wildlife and found that cats posed a significant threat to possums, particularly Common Ringtail Possums *Pseudocheirus peregrinus* and Sugar Gliders, in addition to preying upon a large suite of other species.

In this report we present further data on the comparative diets of foxes and cats living in eight parks near Melbourne, including the parks which formerly constituted the Dandenong Valley Metropolitan Park reported in Brunner *et al.* (1991). As well, we discuss the possible impact that predation by these introduced carnivores may have on native vertebrates which are now often reduced to low numbers in confined patches of remnant bushland surrounded by housing, roads or agriculture. We examine whether such predation can contribute to the reduction of the diversity of native vertebrates which live in the Greater Melbourne Area.

Methods

The location of the eight parks is presented in Fig. 1 and Table 1 lists the sizes and distances from central Melbourne (GPO) of each of the sites, as well as the nature of the surrounding land use.

As part of a survey of mammals in the study sites, scats were randomly collected throughout the year and identified as fox, cat and dog scats using smell, size and shape characteristics (Triggs 1984; Triggs *et al.* 1984; Lunney *et al.* 1990) and placed in small manilla envelopes on which were recorded details of the predator, site and collection date. Cat scats which did not have obvious hair, feathers or bones (and

[1]School of Aquatic Science & Natural Resources Management, Deakin University - Rusden Campus, Clayton, Victoria 3168.
[2]Flora and Fauna Branch, Department of Natural Resources & Environment, 4/250 Victoria Pde., East Melbourne, Victoria 3002.

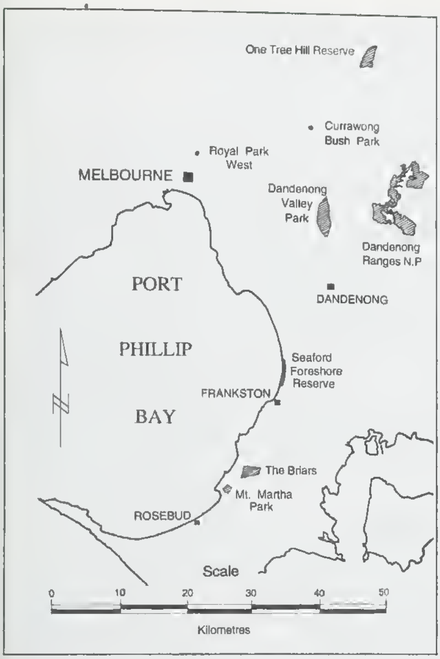

Fig. 1. Map showing the locations of the eight survey sites.

which were presumed to contain the remains of processed pet food) were not collected. The scats were sterilized at 100°C for at least 24 hours to destroy parasites. They were then washed through a fine sieve into a large white tray. Presence of various food categories was recorded. Mammals were identified using skeletal remains and hair. Bones and teeth found in the scats were compared with reference material held at Deakin University. Hair was microscopically analysed using the keys in Brunner and Coman (1974). Scats were generally collected from all seasons in each of the sites. Data from scats which could not be positively identified as fox or cat have not been included in this report. Only low numbers of dog scats containing hair or evidence of other 'naturally occurring' food items were collected and these were not included in our analyses.

Results

Mammalian remains occurred in 72% of fox and 75% of cat scats respectively overall in the eight parks. Bird remains were detected in 18% of fox scats in contrast to 27% of cat scats, and insects were found in 40% of fox scats and 24% of cat scats. The percentage occurrences of bird and insect remains are each significantly different for fox scats and cat scats ($p<0.05$ for bird remains, $p<0.01$ for insect remains).

The percentage occurrence of species of mammals which occurred in the 1992 fox scats and 273 cat scats which contained mammalian remains are listed in the Appendix. Figure 2 presents the percentage occurrences of the more common dietary items for the two predators. It can be seen that the percentage occurrences for each prey species are very similar for the two predators.

Discussion

Our studies support previous findings on diets of foxes and cats for Victoria. Both species are carnivorous, taking mainly mammals and birds which are available and accessible.

Cats

Coman and Brunner (1972) found mammals to constitute 88% (by volume) of cats' diets in samples taken across Victoria from primary (forest) and secondary (agricultural) habitat. Mammals occurred in 79% of cat scats we analysed. Coman and Brunner (1972) also noted the opportunistic nature of cat feeding habits, in that 44% of the diet of cats in primary habitat comprised native mammalian prey species, while in secondary habitat no native mammals were recorded. Jones and Coman (1981) reported similar findings; in their mallee study sites native mammals comprised 2% (by volume) of the diet and introduced species (mainly rabbits) 85%. In the Eastern Highlands, however, the percentages were 40% and 45% respectively.

Our data support the opportunistic habits of cats as well. For instance, at 'The Briars' on Mornington Peninsula, rabbits are reasonably common and of the 71 cat scats collected from the property, 56% contained the remains of rabbits. Similarly, in Currawong Reserve, rabbits were found in 56% of cat scats. However, where rabbits are much less common, they were less likely to appear in cat scats (e.g. Royal Park West, Mount Martha Park).

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Table 1. Comparison of size, distance from Melbourne and surrounding land use for each of the eight sites. Key: 1 = size of reserve in ha; 2 = distance from Melbourne in km; 3 = surrounding land use; 4 = source.

Reserve	1	2	3	4
Royal Park West	3	3	Housing, parkland	Wallis *et al.* 1993
Currawong Reserve (Currawong Bush Park)	50	20	Housing, riparian vegetation, recreation reserve	Adams *et al.* 1994
Dandenong Valley Metropolitan Park (now named by the constituent park titles)	736	21	Market gardens, grazing, quarry, golf course, housing, refuse transfer station, woodland	Brunner *et al.* 1991
One Tree Hill Reserve, Christmas Hills	143	37	Forest	*Unpublished data*
Sherbrooke Forest Park (component of Dandenong Ranges National Park)	802	37	Housing in forest setting	Brunner *et al.* 1975; unpublished data
Seaford Foreshore Reserve	50	38	Highway, housing, beach	Brunner and Wallis 1993
Mount Martha	50	50	Housing, grazing, woodland/ forest	Brunner *et al.* 1992a
The Briars	225	51	Grazing	Brunner *et al.* 1992b

specimens from the public that have been attacked by cats. Seebeck *et al.* (1991) reported 24 species of mammals, 18 species of bird and three reptile species that had been taken by cats (number of cat victims = 172, period 1960-1990). They also reported on high numbers of Sugar Gliders taken by cats in the outer suburbs. The same authors reported data collected by a single wildlife shelter in Melbourne. In seventeen months (1990-1991) 364 prey specimens were received by the shelter. Of these, 272 were mammals and 92 were birds. Of the mammals, 242 were Common Ringtail Possums.

Dowling *et al.* (1994) found that cats were responsible for 75% of attacks on wildlife by introduced predators. Cat attack was the third largest cause of injury of animals admitted to shelters or veterinarians (11%, compared with 20% by impact with vehicle and 15% by human interference). Mammals comprised 61% of animals attacked by cats and birds 38%.

Overall, we found the Common Ringtail Possum was the most frequently detected prey species in cat scats, being an especially important dietary component at Dandenong Valley Metropolitan Park (41% occurrence in cat scats containing mammal remains), Mount Martha Park (88%), Seaford Foreshore Reserve (67%), One Tree Hill Reserve (36%) and Currawong Reserve (24%). Dowling *et al.* (1994) reported that of nearly 7000 mammals presented to wildlife carers, 84% were possums. Most (63%) were Common Ringtail Possum. Victims of cat attack were mostly possums (93% of total) and again, most were Common Ringtail Possum (77%). Juveniles were most at risk.

Data collected by Barratt (1995) in the Canberra Nature Park produced quite different data. He found that cats preyed mainly on introduced mammals (House Mouse and Black Rat) and only 1% of prey items were native mammals. Barratt (1995) suggested that his results probably reflected the relative abundance of the various potential prey species. He also found that 23% of prey items taken by Canberra cats were birds.

Foxes

Foxes have been found to be opportunistic predators, with small mammals comprising the bulk of the diet (Brown and Triggs 1990). Birds, carrion, rubbish, fruit and insects are also taken when available (Brunner *et al.* 1991). A ten-year dietary survey of foxes in Dandenong Ranges National Park reported 20 species of mammal taken, and that possums, rats, antechinuses and rabbits were the species most frequently preyed on (Wallis and Brunner 1987).

Sympatric populations of foxes and cats

Previous studies of foxes and cats living together have suggested remains of birds and lizards occur more frequently in scats of cats than in those of foxes (Bayly 1978; Triggs *et al.* 1984). Triggs *et al* (1984) found that remains of mammal species occurred in similar percentages of scats from the two predators.

Our data from eight parks ranging from 1-51 km from Melbourne support these other studies in that foxes and cats consume a similar range of prey opportunistically. We found that mammals form the bulk of the diets of both predators, although the frequency of occurrence of bird and insect remains were different for foxes and cats; bird remains were slightly more common in cat scats than in fox scats. This agrees with studies by Bayly (1978) and Triggs *et al.* (1984). Furthermore, we found that remains of each species of mammalian prey occurred in similar percentages of scats from foxes and cats (Fig. 2).

Possible impact of foxes and cats on wildlife

Elsewhere in Australia foxes and cats have been thought to have had a major impact on native prey species. especially small to medium-sized species (Burbidge and McKenzie 1989). Foxes and cats have had a significant role in thwarting re-establishment programs of locally extinct populations of mammals and birds (Gibson *et al.* 1995; Christensen and Burrows 1995; Short *et al.* 1995).

In urban environments cats are thought to exert significant predation pressure on wildlife. In Melbourne, for instance, Dowling *et al.* (1994 p. 12) believe the major impact is on 'the mid-sized, colonial-nesting Common Ringtail Possum and the Sugar Glider. Not only are the adults taken, but there is high mortality among young or sub-adults. On several occasions, cats were reported to bring a series of animals of the one species to the observer's attention over a short period of time. Those events indicate that the cats in question had found a nest and were systematically preying on the whole colony. Local extinction may be hastened by such predation efficiency'.

In urban environments much of the local fauna is typically confined to remnant habitat patches. Intense predation by cats can thus add to other processes such as habitat loss, change and isolation and contribute to local extinctions (Barratt 1996). Many of the cats whose diets have been reported in this study are likely to be domestic pets. Paton (1993) has suggested that an average domestic cat kills at least 32 vertebrate animals per year (8 birds, 16 mammals and 8 reptiles). Furthermore, a study by George (1974) suggests that only 50% of prey captured by domestic cats is actually brought home. Paton's estimate is thus likely to be conservative. There have been numerous studies which have detailed the contribution of cat predation to extirpation of native species (e.g. King 1984; Delroy *et al.* 1986; Dickman 1993).

Urban parks can be considered ecologically as 'islands' of suitable habitat (bush-

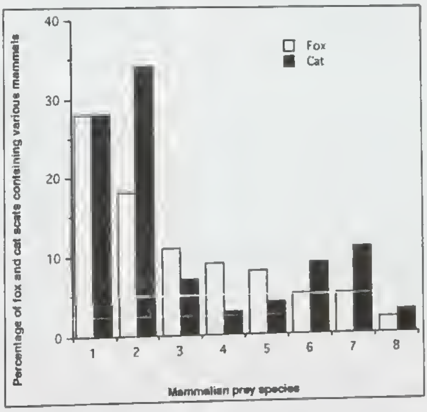

Fig 2. Percentage of fox scats (n = 1992) and cat scats (n = 273) containing eight mammalian prey species. 1 = European Rabbit *Oryctolagus cuniculus*, 2 = Common Ringtail Possum *Pseudocheirus peregrinus*, 3 = Common Brushtail Possum *Trichosurus vulpecula*, 4 = Bush Rat *Rattus fuscipes*, 5 = Brown Antechinus *Antechinus stuartii* , 6 = Black Rat *Rattus rattus*, 7 = House Mouse *Mus musculus*, 8 = Swamp Rat *Rattus lutreolus*.

land) in a 'sea' of unsuitable habitat (urban buildings, pasture grasses, 'formal' urban parkland and roadways, including those with well-vegetated median strips). We maintain that foxes and cats may well be having significant impact on the reduction of biodiversity of native vertebrates which live in the Greater Melbourne Area.

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	Royal Park W.		Currawong Res		D'nong Valley		One Tree Hill		D'nong Ranges National Park		Seaford Foreshore Res.		Mount Martha		The Briars		OVERALL %	
	FOX	CAT	FOX	CAT	FOX	CAT	FOX	CAT	FOX	CAT	FOX	CAT	FOX	CAT	FOX	CAT	FOX	CAT
Mammal species (%)																		
MONOTREMES																		
Short-beaked Echidna	0	0	0	0	0	0	8	0	0.7	0	0	0	4	0	2	0	1	0
MARSUPIALS																		
Common Ringtail Possum	0	0	12	24	13	41	37	36	11	8	64	67	66	88	8	9	18	34
Common Brushtail Possum	72	0	5	10	9	7	10	5	10	4	3	8	11	5	9	11	11	7
Sugar Glider	0	0	2	0	0	2	2	9	0.9	4	0	0	0.8	3	2	3	0.9	3
Unidentified possum	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	1	0.4
Koala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	<0.1	0
Common Wombat	0	0	0	0	0	2	3	0	0.2	0	0	0	0	0	0	0	0.3	0.4
Pigmy Possum	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0.1	0
Greater Glider	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0.1	0
Swamp Wallaby	0	0	0.9	0	0	0	18	0	0.2	0	0	0	0.8	0	0	0	0.8	0
Brown Antechinus	0	0	0	0	0	0	2	0	12	22	0	0	2	0	0	0	8	4
Dusky Antechinus	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	4	0
Antechinus sp.	0	0	0	0	0	0	0	0	4	6	0	0	0	0	0	0	3	1
Bandicoots	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0
EUTHERIANS																		
European Rabbit	0	0	78	67	6	4	21	50	27	15	12	8	2	0	65	57	28	28
Brown Hare	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	<0.1	0
Black Rat	3	0	4	0	15	33	0	0	3	0	14	25	10	13	0	0	5	9
Brown Rat	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0.8	0	0.2	0
Unidentified rat	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	4	0
Swamp Rat	0	0	0	0	0	0	0	0	2	0	0	0	7	3	5	9	2	3
Bush Rat	0	0	0	0	0	0	0	0	13	17	0	0	0	0	0	0	9	3
Broad-toothed Rat	0	0	0	0	0	0	0	0	3	6	0	0		0	0	0	2	1
House Mouse	13	50	0	5	20	35	0	0	4	10	1	8	0.8	0	4	6	5	11
Dog	5	0	0	0	14	2	0	0	0.2	0	2	0	4	0	0	0	2	0.4
Cat	0	75	0.9	14	1	11	0	0	0.5	8	0	13	0.8	2	0	3	0.5	8
Fox	13	0	2	0	9	0	6	0	0.8	0	2	0	8	0	2	0	2	0
Sheep	0	0	0.9	0	4	0	0	0	0.4	0	2	0	0.8	0	0.8	3	0.8	0.7
Cattle	0	0	0	0	9	7	0	0	0.5	0	2	0	0.8	0	2	3	1	2
Human	0	0	0	0	4	0	0	0	<0.1	0	0	0	0.8	0	0.8	0	0.5	0
Goat	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0.3	0

The Distribution and Abundance of Australian Fur Seals *Arctocephalus pusillus* and Bottlenose Dolphins *Tursiops truncatus* in Western Port, Victoria.

P Dann[1], R Jessop[1] and M. Healy[1]

Abstract
The distributions and seasonal occurrences of Australian Fur Seals and Bottlenose Dolphins in Western Port were examined at monthly intervals between 1991 and 1994 along an 81 km route at sea. Fifty-seven seals were seen on 27 surveys (79%) with a maximum number of six in any monthly count. Most seals were recorded in the western and northern arms of the bay, particularly at the western entrance near the breeding colony. Generally single and relatively small individuals were seen and these were presumed to be juveniles or small adult females. Forty-six dolphins were seen in the bay on eleven occasions (32% trips) but no seasonal pattern was obvious. Usually the dolphins were recorded in small pods near the two entrances of the bay and the maximum number recorded was ten (*The Victorian Naturalist* 1996, **113** 306-310).

Introduction

Twenty-four species of marine mammals have been reported in Victoria (Wakefield 1967; Menkhorst 1995) but with the exception of a few species, notably Australian Fur Seals *Arctocephalus pusillus* (Warneke 1975, 1982; Warneke and Shaughnessy 1985), there is little published information on their local distributions or life histories. Australian Fur Seals range widely in south-eastern Australian waters but appear to be restricted to the seas on and near the continental shelf. The total population is estimated to be between 35,000 and 60,000 (Kirkwood *et al.* 1992), of which more than two thirds are concentrated at three sites in Bass Strait: Judgement Rocks, Seal Rocks and Lady Julia Percy Island (Warneke 1982). Ten to twelve thousand seals breed at Seal Rocks, four kilometres south-west of the western entrance of Western Port (Warneke and Shaughnessy 1985), but very few are reported feeding in bays, estuaries or along the coast although they are thought to pose a problem to mesh-net fisheries in Port Phillip Bay and Western Port (Warneke 1982).

The Bottlenose Dolphin *Tursiops truncatus* is widely distributed around the Australian coast and throughout the world (except in polar seas). It is commonly encountered along the Victorian coast and in the larger bays and estuaries. Little is known of the life history and status of the Bottlenose Dolphin in Victorian waters (LCC 1993) but recent studies of the species in Port Phillip Bay suggest that one or more pods are resident there (Jeff Weir *pers. comm.*).

Western Port lies on the southern coast of Victoria, east of Melbourne, and includes 680 km² of tidal mudflats. It has a 263 km coastline, 107 km of which are mangrove-lined (Shapiro 1975). One large island (Phillip Island) lies across the southern edge and a larger island (French Island) occupies the centre of the Bay (Fig.3). In recent years there have been a number of publications on the distribution and abundance of birds in Western Port (Loyn *et al.* 1994; Dann *et al.* 1994; Dann and Jessop *in prep.*) but no systematic study of the distribution and abundance of the marine mammals has been carried out.

In this paper we present information on the distribution and seasonal occurrence of Australian Fur Seals and Bottlenose Dolphins in Western Port between 1991 and 1994 based on monthly boat surveys along a 81 km route. This information was collected as part of a study of the marine birds in Western Port (Dann and Jessop *in prep*).

Methods

Thirty-four monthly surveys were completed in the 40 months between May 1991 and August 1994. We aimed to space the counts at four-weekly intervals but boat engine failure and inclement weather caused five counts to be abandoned or postponed. Marine mammals were counted along an 81 km series of transects (Fig.3) from a boat travelling at *c.*35 km/h (Table 1).

[1] Penguin Reserve Committee of Management, PO Box 97, Cowes, Phillip Island, Victoria 3922.

The transects were perpendicular to the main channels to cover the entire range of sub-tidal water depths in each section of the bay and thus avoided any biases associated with potential depth preferences of either species. Intertidal areas were not traversed and subtidal areas less than two metres deep at high tide were also not counted, with the exception of those areas in the eastern part of the Bay (Fig.3). The northern part of the western arm could not be traversed due to the dangerous conditions for boats caused by a combination of shallow water and substantial waves. However, no seals or dolphins were located in surveys of this area in autumn and spring during calm weather.

Usually two observers were stationed on either side of a seven-metre boat (eye height c.4 m) and counted all pinnipeds and cetaceans in the right-angled sector from the bow to starboard or port. Sightings of each seal or dolphin were made up to 500 m from the boat and recorded on a tape cassette. The observation included the time, transect, number of individuals and behaviour at the time. Difficulties of visibility caused by weather (Tasker *et al.* 1984) were reduced by only counting on days with wind speeds of less than 10 knots. The transect runs usually took five hours and were carried out around the middle of the day and, when possible, within a few hours of high tide. Identifications were made using 8 x 40 binoculars.

Results

Australian Fur Seals

A total of 57 seals was recorded during the survey period (this figure includes seven seals seen between Cowes and the start of the survey route at the western entrance to Western Port), giving a mean number of 1.7 per trip. Seals were seen on 27 surveys (79%) and the maximum number observed in any monthly count was six (in July 1993, Fig.1). The seasonal pattern of abundance in Western Port was more clearly illustrated by the monthly means of all counts (Fig.2.). Slightly higher numbers of seals were found in March and July but there did not appear to be any marked seasonal pattern.

Seals were seen in all parts of the bay and on all transects except two of the shorter runs at the top of the north arm (Fig.3). Most were recorded in the western and northern arms of the bay, particularly at the western entrance near the breeding colony (Fig.3). Relatively few were seen in the shallower eastern arm and none over intertidal areas.

Generally single (mean group size, 1.08 ± 0.23, n = 51, range1-2) and relatively small individuals were seen and these were presumed to be juveniles or small adult females. Only one adult male was recorded (February 1992). Almost all were 'sailing' when seen (i.e. resting with one flipper held vertically out of the water) and only one was observed feeding (on a Southern Fiddler *Trygonorhina guanerius*).

Table 1. The numbers of seals and dolphins seen each month in Western Port, June 1991 to August 1994. N. = no count.

	1991		1992		1993		1994	
	Seals	Dolphins	Seals	Dolphins	Seals	Dolphins	Seals	Dolphins
Jan			4	0	1	6	1	0
Feb			1	0	1	0	0	0
Mar			2	4	1	0	4	0
Apr			2	0	0	0	3	0
May			2	0	2	4	0	0
Jun	1	0	2	5	N	N	3	0
Jul	2	0	3	10	6	2	N	N
Aug	0	0	N	N	2	0	4	0
Sep	N	N	0	0	1	0		
Oct	1	0	0	0	1	0		
Nov	0	8	2	0	1	2		
Dec	1	0	3	5	N	N		
Total	5	8	21	24	16	14	15	0

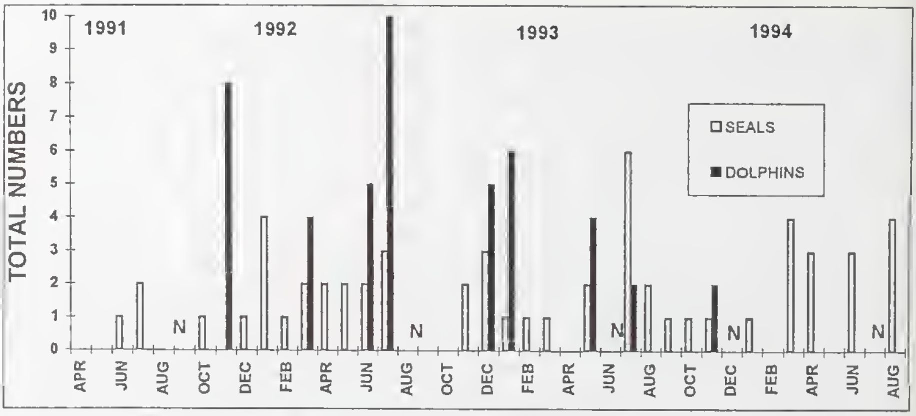

Fig. 1. The total numbers of seals and dolphins counted each month in Western Port between April 1991 and August 1994. N denotes missing counts.

Bottlenose Dolphins

A total of 46 dolphins was recorded during the survey period, giving a mean number of 1.4 per trip. Dolphins were seen in the bay on 11 occasions (32% trips) and the maximum number recorded was 10 (July 1992). Monthly means of all counts showed slightly higher numbers of dolphins in July and November but no obvious seasonal pattern was apparent (Fig.2).

Most of the dolphins were recorded in the western and eastern arms of the bay usually in the vicinity of the two entrances (Fig.3). None was seen in the northern parts of the bay or over intertidal areas. Dolphins were generally recorded in small pods (mean group size, 4.6 ± 2.84, n = 10, range 1-10).

Discussion

Our surveys suggest that Western Port is not important for pinnipeds and cetaceans; the only two species recorded, Australian Fur Seal and Bottlenose Dolphin, being uncommon and sporadic in their occurrence in the bay during the survey period.

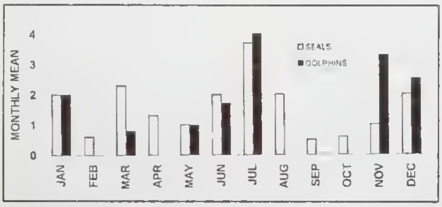

Fig. 2. The mean numbers of seals and dolphins counted each month in Western Port between April 1991 and August 1994.

Australian Fur Seals

Fur Seals were more frequently encountered at the western entrance near their breeding colony than in other parts of Western Port: all but one individual were judged to be juveniles. Juveniles are relatively sedentary with the natal colony being the focus of their activities (Warneke 1975). There have been 67 recoveries of juveniles tagged at Seal Rocks and reported dead in the western arm and central Western Port and adjacent coasts (Warneke 1975). Proportionally these represented a small part (13%) of the 514 recoveries of tagged juveniles to that time. It could be argued that many of the recovered carcasses found on the west coast of Phillip Island were a result of the prevailing southwesterly swells, i.e. were carried there from Seal Rocks rather than representing seal activity along that portion of coast (Warneke *pers. comm.*). A relatively large area on the western side of the western arm was not surveyed regularly (Fig.3) and may have been used by a few seals. However, Warneke's (1975) opinion that Western Port was not an important area for seals is supported by the low numbers reported during the course of this study. The bay seems to serve as a relatively small part of the range of juvenile seals and to be unimportant as a foraging area for the adult population. Western Port's influence on the colony, if any, would seem to be through indirect mechanisms, such as its role in determining the water quality around Seal Rocks or possibly

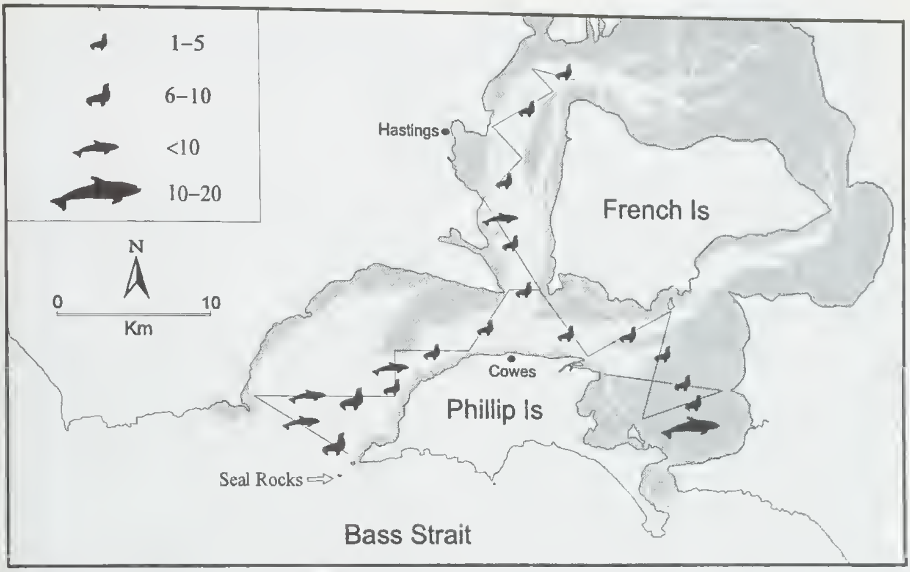

Fig. 3. The distribution of Australian Fur Seal sightings, and the distribution of Bottlenose Dolphin sightings in Western Port. The series of transects are shown as black lines and the stippled areas are those less than two metres deep at high tide and include all intertidal areas and some shallow subtidal areas.

through effects on inshore productivity in the region.

Bottlenose Dolphins

Dolphins were more likely to be recorded in the vicinity of the eastern and western entrances and, unlike those in Port Phillip Bay (Jeff Weir *pers. comm.*), may not be resident. Their occurrence in Western Port appeared transitory and individuals seen in this survey may have been part of the groups commonly frequenting Port Phillip Bay or Bass Strait. There appears to be no published data on the occurrence of dolphins in Western Port in the past which would shed some light on any changes in their use of the bay.

Bottlenose Dolphins are thought to consist of inshore and offshore forms, and the inshore form is occasionally reported in freshwater rivers, but these reports are most likely to be of vagrants or temporary visitors (Klinowska 1991). Excursions upstream have been reported in Western Port also. For example, two individuals were recorded in the Bass River four kilometres upstream from the bay on the 20 October 1980, one an aged lactating female which died and the other a young, possibly adult, male which was taken to Taronga Zoo for rehabilitation (Atlas of Victorian Wildlife, Department of Conservation and Natural Resources; R. Warneke *pers. comm.*).

The mean size of groups frequenting Western Port was typical of group sizes in Victoria and elsewhere in the world. Locally, they are commonly seen in herds of about five to 20 inshore and occasionally in larger aggregations further out to sea (Menkhorst 1995). Leatherwood and Reeves (1982) reviewed group sizes in this species and gave mean values of between two and 18. There is some degree of segregation within nearshore populations based on sex and age (Klinowska 1991) and this may also influence group size. McBrearty *et al.* (1986) give the most common group size for Bottlenose Dolphins in Europe as two to five individuals and the second most common sighting is of solitary animals.

This study has found that Australian Fur Seals and Bottlenose Dolphins appear to make little regular use of Western Port and has highlighted the lack of published information on the foraging areas, movements and seasonal patterns of occurrence of these two species in Victorian waters.

Acknowledgements

This project was funded by Esso, BHP Petroleum, BHP Community Chest and the Penguin Reserve Committee of Management and we would like to express our gratitude to these organisations for all their support. We are indebted to Darrell Bray and Ian Huther for their capable boat handling and Wendy D'amore and Leanne Renwick who provided considerable assistance in the field sometimes under difficult conditions. Additional help with data collation and figure preparation was generously given by Marion Wood, Maria Belvedere and Wetgens Dimmlich. Bob Warneke, Ian Norman and Mike Cullen kindly provided comments on drafts of this paper.

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Dan Mc Innes - 90 Years Young!

We congratulate Dan on reaching this milestone.

Dan is the oldest, active member of the FNCV, and, throughout a distinguished time with the Club, he has held a large number of the possible official positions. His interests range over a wide spectrum from geology and the computer to atomic physics, but his special love is the microscopical life in Melbourne's ponds - still under the scrutiny of Dan's beady eye. As well, Dan finds time to attend and help at the Melbourne Junior Field Naturalists Club (ex Hawthorn Juniors) meetings, where he was once a long-time president.

Dan epitomises what an FNCV member is all about:

Knowledgeable

Keen to pass on that knowledge

Willing to take part

It is a privilege to know him.

Observations of White-footed Dunnart *Sminthopsis leucopus:* Behaviour and Nest-site Locations on the Anglesea Heathlands, Victoria.

S. D. Hutchings[1]

Introduction

Various activities of the White-footed Dunnart *Sminthopsis leucopus* were observed during a study of the home range and habitat utilisation conducted during 1993 on the Bald Hills heathlands of Anglesea, Victoria (BT507466). Prior to this study, information regarding *S. leucopus* was limited to data obtained via trapping studies (Cheetam and Wallis 1981; Lunney *et al.* 1989) and no knowledge of the behaviour of this species beyond trap sites was available. However, during the winter months of 1993, dunnarts captured during trapping sessions were fitted with radio collars and radio tracked. This enabled individual dunnarts to be followed between trap sites and beyond trapping grids and subsequently dunnart behaviour was observed.

Study Area

The Bald Hills heathlands are located within the ALCOA lease area of the Anglesea heathlands approximately 100 km southwest of Melbourne. These heathlands are dominated by a midstorey of shrubs, mainly *Leptospermum myrsinoides*, *Xanthorrhoea australis*, *Leptospermum continentale*, *Monotoca scoparia*, *Dillwynia glaberrima*, *Epacris impressa*, with a sparse overstorey of *Eucalyptus willisii* (Land Conservation Council 1987).

Methods

Trapping

Trapping was conducted for three nights before and after each radio tracking session. One hundred Elliot traps, baited with a mixture of rolled oats, peanut butter and honey, were placed 15 m apart in a 10 x 10 grid configuration. Traps were checked each morning and all species captured were numbered, weighed and body measurements were taken.

Radio Tracking

A small number of *S. leucopus* captured during trapping sessions were fitted with a radio collar. Each collar carried a single stage radio transmitter that emitted a unique frequency output. This enabled a number of dunnarts to be radio tracked at the one time. The range of each collar was approximately 200 m and battery life extended for eight days.

Individual dunnarts fitted with radio collars were released into the field and radio tracked using a portable receiver and a three element Yagi hand held antenna. Radio tracking was conducted on consecutive nights between 6:00 pm and 1:00 am for a maximum of eight nights. The position of each dunnart was noted every half hour either by sight or when estimated to be within 5 m of the observer. When an individual was sighted some time was devoted to observing its behaviour. To remove the radio collars at the end of the radio tracking session, dunnarts were retrapped, the collars were cut off and the animals were released.

Results

Dunnart Captures

Five dunnarts that were trapped during the study period were selected for radio tracking. Three individuals, one female and two males, were radio tracked for sessions consisting of a period of eight nights. A further two individuals, one male and one female, were radio tracked on two separate occasions, both sessions consisting of eight night periods.

Response to Radio Collars

Although it was common for *S. leucopus* individuals fitted with radio collars to move away from the capture site immediately upon release, not all did so. Observations of these dunnarts found that they displayed a variety of immediate responses to the attachment of a radio collar. A number of dunnarts scratched at the collar as if it were an irritation before moving away. A male dunnart vigorously groomed his face and head and then commenced a series of somersaults as if trying to rid himself of the collar. A female dunnart clung to a stick with her feet and jaws and proceeded to hiss and roll around on the ground for two to three minutes. When these dunnarts were observed later in the radio tracking ses-

[1]Department of Biological and Chemical Sciences, Deakin University, Geelong, Victoria 3217.

sion they rarely appeared to pay any attention to the collar except for an occasional scratch. However, collars attached too loosely can wear at the skin around the dunnarts' necks and some may also get their front legs trapped under the collar whilst trying to remove it.

Response to Telemetry Operators

Although the dunnarts moved away from the operators during daylight hours, at night they appeared to be quite unconcerned. This was especially the case for dunnarts that had been handled regularly during trapping sessions conducted prior to radio tracking. Alternatively, dunnarts that were infrequently handled during trapping never allowed close approach by the operators. However, on many occasions dunnarts would pass within centimetres of the operators, apparently ignoring their presence, even while the operators were talking. Most dunnarts also remained unresponsive to any direct approach by the operators and subsequent close observation of their behaviour was possible.

Hunting and Feeding Behaviour

Two instances of *S. leucopus* hunting behaviour were observed during radio tracking. In the first instance a dunnart climbed the leaves of a Austral Grass Tree *Xanthorrhoea australis* to capture a frog clinging to the leaves. The dunnart then disappeared under the skirt of the plant to eat. When the skirt of the *Xanthorrhoea* was parted, the dunnart was observed feeding on the captured frog. Feeding began with the back legs of the frog and continued towards the head while the frog was still alive. This same dunnart was later observed climbing the stalk of a Thatch Saw Sedge *Gahnia radula* to capture a moth which had alighted at the top of the plant.

General observations of feeding behaviour found that *S. leucopus* sat up on their hind legs to feed, grasped their prey with their front feet, and chewed upon the prey using the side of the mouth. Afterwards the dunnarts thoroughly groomed their front feet, face and head before moving on. Most prey items appeared to be insects, such as moths, millipedes and grasshoppers but, as mentioned above, small vertebrates were also preyed upon.

Nests

Five dunnart nests were found in a variety of places. Three nesting sites appeared to be holes in the ground but whether the dunnarts dug the holes themselves or were utilising holes abandoned by other animals was unclear. When a dunnart was in the nest the opening was obvious and clear of debris. However, when the dunnart left the nest, the opening was covered over with moss and leaves.

Another observed dunnart nest was located in a hollowed out burnt stump of a *Xanthorrhoea*. The bottom of the hollow was covered with moss and leaves. An uncollared, presumably female, dunnart was in this nest and the male dunnart being radio tracked at the time was often observed in the immediate vicinity.

A third nest, found during daylight hours in ground level vegetation, appeared to be similar to a small bird's nest. It was made of dried grass and moss and protected above by *Xanthorrhoea* leaves. It was unknown whether the nest was made by the dunnart or whether it was the abandoned nest of a bird.

Conclusion

Generally dunnarts appeared to be relatively solitary animals. Sometimes two radio tracked individuals would be found within a few metres of each other, but most of their time appeared to be spent hunting alone.

The two dunnarts that were frequently handled during trapping sessions appeared to become de-sensitised to human presence. This particular observation of *S. leucopus* behaviour has lead to the presumption that dunnart movement and behaviour in some cases was not biased by the operator, whilst in other cases movement by the dunnarts appeared to be an attempt to avoid the operator.

Acknowledgments

I would like to thank in particular Wes Prosser and Graeme Castleman for consistently accompanying me on those long, cold, wet winter nights down to Anglesea. Not only were they great company during what can often become tedious field work, but they were also a great help, taking over when my antenna arm got tired.

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From our Naturalist in Residence, Glen Jameson

Middle Yarra Timelines

Most of the resident Bird population activities are dominated by the strategies of breeding, the landscape is ablaze with Wattle and the ground Flora paints the landscape with the sensuous brush of Spring. A warm change is in the air and all in the bushlands are swept up in a surge of the powers of production.

Early Spring

An Early Spring dawn is a soundscape filled with an explosion of birdsong proclaiming the joys and power of parenthood. It is a tumultuous time, loud with , territorial trumpeting , a feathered fanfare of clucks, whistles, trills, caws, twitters and pipings from all points of the compass. Weebills to Wedge-tailed Eagles are either on the nest, feeding young, or telling the world about it.

Along the **Yarra River** the Pallid Cuckoo, with an ear out for those who are proclaiming nest sites, joins in the chorus from a Silver Wattle whose blooms have faded.

The River is in high flow with constant rain, the water is highly turbid, cold and productive levels are still low. The upstream migration from the sea of Common Galaxias, Broad-finned Galaxias and the Spotted Galaxias begins. On the Riverbanks, bowers of Small-leaved Clematis flowers cascade from Burgan catching morning streams of sunlight. Dusty Miller, Prickly Moses and Shrubby Tree Violets flower in the Riparian forest and, on the ground, Kidney Weed is in bloom with its minute flowers. A fledgling Powerful Owl, just out from the hollow, finds a precarious perch on Burgan while the parents keep watchful vigilance from above on the boughs of a tall Manna Gum. A fox idles below the Burgan hoping for a mishap.

The seasonal change came one morning in early August when a waft of warm wind filled with magical fragrances enveloped the day with the promise and energy of

Spring. Young Eastern Grey Kangaroos venture out of the pouch and stretch youthful legs by bounding exuberantly over everything, real and imagined, in fact, the whole mob moves with real spring in their long leaps. ' Early Spring fever' even touches the normally reserved, cagey behaviour of four Little Ravens who uncharacteristically involve themselves in joyous ariel displays over Longridge Park.

Dramatic weather changes are a feature of early Spring and occur frequently within hours, sometimes going from cloudy showers, to warm, bright sunny periods to cloud, hail and arctic winds. All six seasons in one day. The warming weather transforms the days with the restless energy of an awakened changeling. The power of the Sun surges through the productive forces stirring up the food chains to energetic generation of new life. Everything is caught up in the excitement of the new biotic rhythm.

Downstream, on the Wetlands of the Peninsula Paddock at Yarra Flats (reputed to be the site of Streeton's *Still Glides the Stream*) a dozen Pelicans herd fish by moving in formation with a circular manoeuvre. In a slow motion watery ballet, they close the circle around the herded fish, then with avian elegance simultaneously dip underwater to feed. Cattle Egrets follow the slow pace of agisting cattle. The ponds begin to warm, and aquatic plants begin to show new shoots while on the waters edge, there is the frothy bubble of Froggy metamorphlings slowly forming new arms and legs. Flotillas of baby ducklings follow their parents in the hunt for a feed in the Wetlands of Yarra Flats. A Chestnut Teal pair have successfully bred this year in the ephemeral pond north of the Picnic Shelter and they join the Wood Ducks and Pacific Black Ducks in raising families.

Across the landscape is splashed the paint of Wattle. The diversity of form and adaptable ecology of the Wattle Family, insures that wherever you look, Wattle blossom dominates the vista capturing your focus as they worship the Sun's return in a celebration of its golden tones. The fragrance of their pollen ladens the air with a heavy, sweet scent; a Bush incense marking the ritual arrival of Early Spring. The planting of non-indigenous Wattles in Gardens, some of which have escaped into Bushlands, such as the Cootamundra and early Black Wattles, add further to the domination by this genus.

In the Grassy Woodlands on the slopes and valleys, Blackwoods, Kangaroo Thorn, Hop Wattle and Juniper Wattle lead an awesome floral array. Colonies of Greenhood Orchids - Nodding, Blunt, Trim and Tall patch the forest floor. Whilst Blue Bonnet, Common Beard Heath, Early Nancy, Love Creeper, Pink Bells, Yam Daisy, Scented Sundew, Spur Vellia. Small Swamp Daisy and Native Violets amongst others, daub the bushlands in a riotous profusion of colour. Wonga Vine is in flower as it hangs from a Yellow Box in a moist gully where a Horsefield Cuckoo awaits a moment when it can find an unguarded nest.

Spur-winged Plovers nesting in open country are in dispute with all who venture near their nesting sites, in fact, they seem to be in a constant state of agitation. Magpies with hatching young , swoop across their territory in search for the unwary who may venture on to their territory and leave a skull unguarded. Sometimes they are heard carolling during the night, perhaps warning of the Powerful Owl' s presence or commenting on hatchlings.

The Australian Painted Lady Butterfly, one of the first to emerge are spiralling in two's and three's above the grasses. The diurnally active Magpie Moths are in flight above their host plant, Cotton Fireweed.

The first of the migrants, Fairy Martins, arrive with time to spend on the neat mud nests that they place under bridges and in tall culverts. Olive-backed Orioles, Rufous Whistlers and Satin Flycatchers arrive soon after.

Exotic Grasses such as Yorkshire Fog, Sweet Vernal and Cocksfoot grow prodigiously during this season outcompeting the Native Grasses. They have the biological advantage of evolving in a colder climate and are therefore able to grow faster during cooler weather. The Native Grasses, have thrown up flowering culms, but need the extra warmth of True Spring to get into growth motion.

On the Hilltops out in the Bend of Isles at Kangaroo Ground, Red Ironbarks are in prodigious flower, feeding a range of

Parrots and Honeyeaters during the day and Sugar Gliders and Brush-tailed Phascogales during the night. The Golden Wattle, Myrtle-leaf Wattle and Thin-leaf Wattle lead the flowering show across the hills. Climbing up on a Spreading Wattle is a Purple Coral Pea and the mix of the yellow and purple colours is superb, and the vivid red of running Postman contrasts with the creamy tops of Candlesticks; the Bush has a storehouse of pleasurable items.

On Fourth Hill of Warrandyte State Park there is perhaps the most spectacular display of the floral year. Just before the Spring equinox, the northern slope is covered with the Golden Bush-pea in flower. The golden colours are a show in themselves but when contrasted with the fire blackened trunks of the Red Box, Red Stringybark and Long-leafed Box, they are sensational. Fire is essential in regenerating the Golden Pea-bush and the prescribed burn in 1991, has resulted in a rejuvenated garden of delight.

Amongst the native grasses and leaf litter of Fourth hill are Leopard Orchids, a few Waxlips and Green-comb Spider Orchids. However, a little later in True Spring will be the time to see Orchids there.

In the late afternoon sun, a Fan-tailed Cuckoo gulps down a fat caterpillar, the juices of which spray golden splinters into the air above its head. It is a haughty celebration of a successful breeding campaign whereby the food caught is its alone, not needing to share it with mate or brood. Wood White Butterflies are blown along on the breezes as they search for partners in between bursts of inclement weather and Golden Whistlers are heard calling vigorously.

The night skies dominated by the stars Altair, Canopus, Achernar, Vega and Spica rebound with the amplified swamp orchestra of the Southern Brown Tree Frog, Common Froglet and the Whistling Tree Frog. The sound levels emanating from the mist shrouded Glynns wetlands, part of Laughing Waters Park, generated by the Frogs, are in counterpoint with the soundscape of the Birds at dawn, a euphonious celebration of the Early Spring euphoria.

Glen Jameson
PO Box 568, Templestowe, Victoria 3106.

Species List.

* denotes an introduced species

Animals

Glider, Sugar - *Petaurus breviceps*
Australian Kangaroos, Eastern Grey - *Macropus giganteus*
Phascogale, Brush-tailed - *Phascogale tapoatafa*

Cuckoo, Fan-tailed - *Cacomantis flabelliformis*
Cuckoos, Horsefield's Bornze - *Chrysococcyx basalis*
Cuckoos, Pallid - *Cucullus pallidus*
Duck, Pacific Black - *Anas superciliosa*
Duck, Australian Wood - *Chenonetta jubata*
Egrets, Cattle - *Ardea ibis*
Magpie, Australian - *Gymnorhina tibicen*
Martins, Fairy - *Hirundo ariel*
Oriole,Olive-backed - *Orialus sagittatus*
Owl, Powerful - *Ninax strenua*
Raven, Little - *Corvus mellori*
Pelican Australian - *Pelecanus conspicillatus*
Teal, Chestnut - *Anas castanea*
Weebill - *Smicrornis brevirastris*
Wedge-tailed - *Aquila audax*
Whistler, Golden - *Pachycephala pectaralis*
Whistler, Rufous - *Pachycephala rufiventris*
Froglet, Cpommon - *Ranidella signifera*
Tree Frog, Southern Brown - *Litoria ewingi*
Tree Frog, Whistling - *L. verreauxi*
Galaxias, Broad-finned - *Galaxias brevipinnis*
Galaxias, Common - *G. maculatus*
Galaxias, Spotted - *G. truttaceus*

Painted Lady Butterfly *Vanessa kershawi*
Moth, Magpie - *Nyctemera amica*

Plants

Beard Heath, Common - *Leucopogon virgatus*
Bells, Pink - *Tetratheca ciliata*
Blackwood - *Acacia melanaxylon*
Bonnet, Blue - *Hovea linearis*
Burgan - *Kunzea ericaides*
Bush-pea, Goldern - *Pultenea gunnii*
Clematis, Small-leaved - *Clematis microphylla*
*Cocksfoot - *Dactylis glomerata*
Daisy, Small Swamp - *Brachyscame uliginosa*
Daisy, Yam - *Microseris lancealata*
Dusty Miller - *Spyridium parvifalium*
Early Nancy - *Wurmbea diaica*
Fireweed, Cotton - *Senecio quadridentotus*
Greenhood, Blunt - *Pterasylis curta*
Greenhood, Nodding - *P. nutans*
Greenhood, Tall - *P. longifolia*
Greenhood, Trim - *P. pedunculata*
Gum, Manna - *Eucalyptus viminalis*
Kangaroo Thorn - *Acocia paradoxa*
Love Creeper - *Comespermo volubile*
Prickly Moses - *Acacia verticillata*
Scented Sundew - *Drosera whittakeri*
Spur Vellia - *Velleia paradoxa*
*Sweet Vernal - *Anthoxanthum odoratus*
Red Ironbark - *Eucalyptus tricarpa*
Violets, Native - *Viola hederacea*
Violet, Shrubby Tree - *Hymenanthera dentata*
* Wattle, Cootamundra - *Acacia baileyana*
*Wattle, Early Black -- *A.decurrens*
Wattle, Golden - *A. pycnantha*
Wattle, Hop - *A. stricta*
Wattle, Juniper - *A. ulicifolia*
Wattle, Myrtle-leaf - *A. myrtifolia*
*Wattle,Sallow - *A. longifolia*
Wattle, Silver - *A. dealbata*
Wattle, Thin-leaf - *A. aculeatissima*
Weed, Kidney -*Dichondra repens*
*Yorkshire Fog - *Holcus lanatus*

Reserve Named in Honour of the Late Dr Jim Willis

The following letter was sent by the Bayside City Council to Mrs M. Willis and we acknowledge their kind permission to reproduce it here:-

Dear Mrs Willis

Council at its meeting on 26th August, 1996 resolved that a letter under the seal of BAYSIDE CITY COUNCIL be presented to you, as a mark of respect for your late husband, Dr Jim Willis AM.

It is well known that Dr Willis was a notable Australian Botanist and author of numerous publications. As a resident of Brighton since 1937, local flora and the preservation of the foreshore were of special interest to him. His professional advice was freely given to local environmental and horticultural groups.

Dr Willis's research and writings added significantly to our knowledge of Australian plant species. He was a distinguished Brighton and Australian citizen.

Accordingly, BAYSIDE CITY COUNCIL has honoured his memory by naming the area of Bayside foreshore between the Brighton Lifesaving club and Green Point as "Dr Jim Willis Reserve" in acknowledgement of his contribution to our community.

The Common Seal of BAYSIDE CITY COUNCIL was hereunto affixed on the 26th Day of August, 1996 in the presence of

the Chief Commissioner,
Commissioner and
Chief Executive Officer.

Sheila Houghton
1996 Honorary Member of the FNCV

In recognition of outstanding service to the Club, Sheila has been awarded honorary membership.

Some highlights of her long and productive association with the FNCV are: 1972 - joined the FNCV; 1981- elected as Councillor; 1982 - elected as Secretary, a position held until 1985; 1985 - elected as Librarian and still holds this position. During the period 1986-1990 and from 1993 to the present, has held the postion of Secretary to the Australian Natural History Medallion Award Committee.

As Librarian, Sheila was responsible for moving the library from the Herbarium to our Blackburn Hall and for the design of the new library. In 1994 she organised the sale of 'rare books', which were not utilized by the Club, and raised $42,000 by this effort.

Our congratulations to Sheila for a well-deserved Honorary Membership.

Geelong's Birdlife. In Retrospect

A Selection of Geelong *Advertiser* Articles by P.J.W. 1945-1958

by Trevor Pescott

Publisher: *Yaugher Print, Belmont 1996;*
176 pages, 16 pages of illustrations (black & white, colour); RRP $20.00

For this book, Trevor Pescott has edited a selection of the articles about birds written for Geelong's daily newspaper, *The Geelong Advertiser*, between 1945 and 1958 by P.J.W. (Percival John Wood). Pescott is Wood's successor, and has written a natural history column in the Geelong Advertiser since 1960. To provide some modern context, and to clarify some of Wood's idiosyncratic writing, Pescott has provided commentary on the current status of some of the birds, and modern nomenclature.

Wood was born in Geelong in 1878 and pursued amateur ornithology as his employment allowed, but after retirement he spent a great deal of this time watching, writing about, painting and sketching birds. His particular interest in Corio Bay and its birds was fostered by his activities as a shipping provedore, when he travelled on the bay to meet incoming ships.

Wood's somewhat formal style is reminiscent of natural history writing of the late nineteenth century. He had a keen eye, and his observations are both careful and well written. His illustrations were of a style perhaps most generously described as naive - at times bordering on the bizarre! His written work is, however, an important document of the status of birds in the GEelong area in the post-war era, and pescott has done us all a service by making some of Wood's writings more readily available. His columns are particularly interesting because they allow us to see the changes that have taken place in local bird populations since the war. Whilst birds such as Little Egrets, Galahs, Pied Oystercatchers and Black-shouldered Kites are more abundant now than then, others have fared less well, and for example the Bush Stone-curlew, Grey-crowned Babbler and Australian Bustard are now locally extinct.

This book would no doubt be of greatest interest to readers from the Geelong district, but is probably of general interest to any fans of historical natural history writing. The recommended retail price is $20.00 and readers from outside the Geelong area can order it directly from the publisher Yaugher Print, 4 Victorian Terrace, Belmont, Victoria 3216, phone (052) 43 4368, fax (052) 41 3227.

Lawrie Conole
2/45 Virginia Street, Newtown, Victoria 3220

Trevor Pescott
1996 Honorary Member of the FNCV

Trevor Pescott was awarded honorary membership of the FNCV at the December general meeting after 40 years membership.

Trevor, who won the Australian Natural History Medallion in 1983, has made an outstanding contribution to natural history study and the conservation of wildlife and its habitat, particularly in the Geelong region. He was President of the Geelong Field Naturalists Club from 1961-1964, and is a well known author, both of a column, in *The Geelong Advertiser,* and a number of books.

We extend our congratulations to Trevor

1996 Mueller Medal Awarded to Dr Sophie Ducker

The 1996 Mueller Medal was presented to Dr. Sophie Ducker by the Premier of Victoria, Hon. J. G. Kennett, M.P., at a reception in Queen's Hall, Parliament House during the Royal Botanic Gardens 1996 Commemorative Conferences. ANZAAS presents the award to a scientist who is author of important contributions to anthropology, botany, geology or zoology, preferably with special reference to Australia, and Dr. Ducker is eminently qualified to be a recipient.

The nomination was based on Dr. Ducker's contributions to marine botany in Australia; her researches into the history of botanical exploration and collecting in Australia and the Pacific; excellence in teaching and involvement in the wider community.

Dr. Sophie Ducker (nee von Klemperer) was born in Berlin in 1909 and was educated both in Germany and England. In 1929 she entered the University of Geneva and later the Technische Hochschule in Stuttgart where she studied the natural sciences until her marriage in 1931. Forced to leave Nazi Germany in 1938 she arrived in Australia in 1941 and was appointed as a laboratory technician at the School of Botany at the University of Melbourne in 1944. While curating the department's collection of soil moulds she undertook part time studies in science and graduated with a bachelor of science degree in 1953, and a master of science in 1956 for her research on soil fungi. In 1978 Dr. Ducker was awarded a D.Sc. degree for the originality of her research on the reproductive biology of Australian seagrasses and, in 1993, an honorary degree of Doctor of Laws in recognition of her contribution to the community at large.

Dr. Ducker's interest in the algae was stimulated by Professor R. Chodat during her studies in Geneva in 1930 but the opportunity to pursue this interest did not arise until 1961 when she studied with the phycologist Dr. Peter Dixon in Liverpool, England. She returned to Melbourne in 1962 and founded a course in Marine Botany which was the first of its kind in Victoria. In 1995 Dr. Ducker achieved fifty years of continued contribution to research and teaching at the University of Melbourne. She has published over 100 academic papers and is the author of two books.

Upon receiving the medal Dr. Ducker commented on the similarities between the life of Ferdinand Mueller and her own: they both had migrated from Germany to Australia and had spent their lives in botanical studies. Her father had been born in Schleswig-Holstein, Mueller's birth place also. She could have added that Mueller's first botanical collection in Australia was a seaweed, collected from the side of the ship just before he disembarked.

Ian Endersby
56 Looker Road, Montmorency, Victoria 3094

Sophie Ducker talks to the Premier of Victoria, the Honourable Jeffrey Kennett M.P., after he presented her with the Mueller Medal. Photo courtesy Media Unit, University of Melbourne.

The Field Naturalists Club of Victoria Inc.

Established 1880

In which is incorporated the Microscopical Society of Victoria,

OBJECTIVES: To stimulate interest in natural history and to preserve and protect Australian flora and fauna.

Membership is open to any person interested in natural history and includes beginners as well as experienced naturalists.

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Programme Secretary/Newsletter Editor: Dr NOEL SCHLEIGER, 1 Astley Street, Montmorency, 3094. (03) 9435 8408.
Conservation Coordinator: JENNY WILSON, 206 Pascoe Vale Road, Essendon, 3040, AH (03) 9370 6434)

Group Secretaries

Botany: Mr JOHN EICHLER, 18 Bayview Crescent, Black Rock, 3143. (03) 9598 9492.
Day Group: Dr NOEL SCHLEIGER, 1 Astley Street, Montmorency, 3094. (03) 9435 8408.
Geology: Mr DOUG HARPER, 33 Victoria Crescent, Mont Albert, 3127. (03) 9890 0913.
Fauna Survey: Ms FELICITY GARDE, 18 College Parade, Kew, 3101. (03) 9818 4684.
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MEMBERSHIP

Members receive *The Victorian Naturalist* and the monthly *Field Nat News* free. The Club organises several monthly meetings and excursions. Research work, including both botanical and fauna surveys, is being done at a number of locations in Victoria, and all members are encouraged to participate.

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Printed by Brown Prior Andereson, 5 Evans Street, Burwood, Victoria 3125.

The Victorian Naturalist

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Volume 112, 1995

Compiled by K.N. Bell

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Australian Natural History Medallion

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