Surveys of areas having potentially high botanical diversity near Pooncarie, South Far Western Plains

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Clements, AnneMarie, Rodd, Tony, Moore, Rosalind J., Crane, Adele G. (Anne Clements and Associates Pty Ltd, P.O. Box 1623, North Sydney, NSW Australia, 2059) and Simpson, John (RZM Pty Ltd, 250 St. Georges Terrace, Perth, W.A. Australia, 6000) 2000. Surveys of areas having potentially high botanical diversity near Pooncarie, South Far Western Plains. Cunninghamia *6(3): 611–643.* Vegetation in the remote Pooncarie region of south-western New South Wales was surveyed in the springs of 1995 and 1997 following rain. One area of 100 km^2 was examined in 1995 and three zones totalling 468 km^2 were surveyed in 1997. Sampling in 1997 targeted sites removed from artificial watering points and human habitation. Two of the three areas examined in 1997 were remote from access tracks. These areas were assumed to be relatively free from human impacts, have reduced grazing pressures and hence higher plant species diversity and a greater conservation value than areas which were closer to human disturbance or artificial water supplies.

Both the 1995 and 1997 data were statistically analysed using a hierarchical agglomerative clustering technique. Three broad vegetation groupings were discerned, Mallee dune crests, Lake beds and Mallee with *Trioda scariosa*.

Species richness for the area was high with 36% of the total species recorded being ephemerals. Exotic species were found in almost all the sampling locations, accounting for approximately 10% of the total species diversity. As exotic species are indicators of disturbance, it can be concluded that disturbance, or its influence, is widespread, but relatively minimal, throughout the area. Scats of native and exotic grazing animals were found throughout the survey areas.

A total of 375 species (328 native and 47 exotic) from 64 families/subfamilies was recorded in both surveys. In the 1995 survey, 263 species (226 native and 37 exotic) from 57 families/subfamilies were recorded. In the 1997 survey, 311 species (277 native and 34 exotic) from 61 families/subfamilies were noted. In terms of species of conservation significance, two species of national, five species of state and 21 species of regional significance were recorded. One new species was recorded for New South Wales and 25 new species were recorded for South Far West Plains botanical division.

Introduction

The vegetation of some of the most remote areas within the South Far Western Plains botanical division of New South Wales, east of the Darling River and west of Lakes Garnpung and Mungo (Fig. 1), was surveyed in the springs of 1995 and 1997 following rains. The November 1995 survey followed 52.6 mm of rain in October 1995. Prior to the September/October 1997 survey, 31 mm fell in August (Fig. 2). Wellard (1987) and

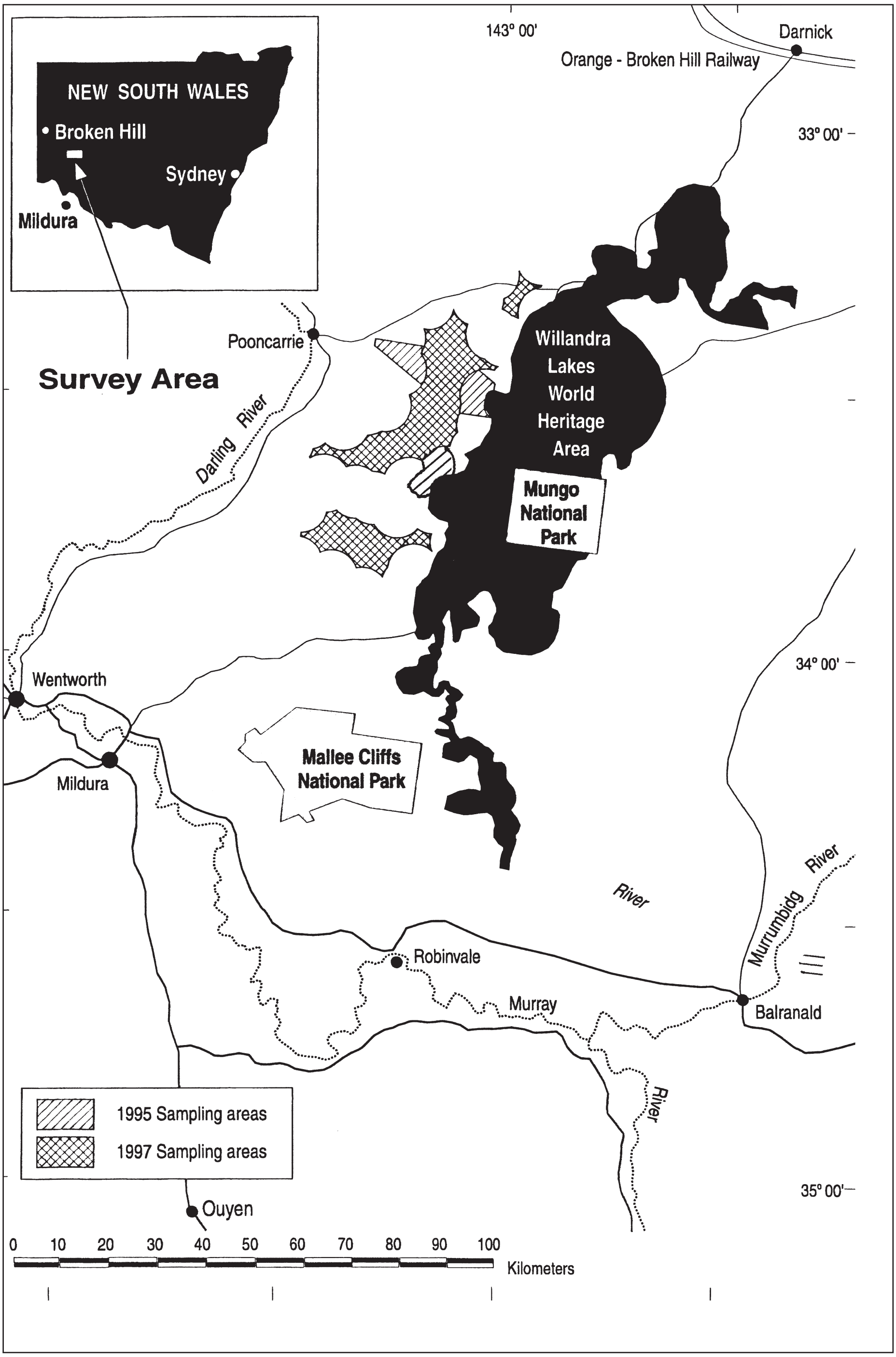

Fig. 1. Location map of 1995 and 1997 sampling areas.

Robertson (1987) found that rainfall in the previous six months explained 70% of the biomass variation in arid areas. In the repetitive sampling of mallee vegetation in western New South Wales from 100 m × 40 m quadrats, Fox (1990) found that both the number and composition of species recorded varied as a function of seasonal rainfall.

The initial survey in November 1995 was centred on an area surrounding 629000N 680000E (Australian Grid Map) covering about 100 km^2 on the western shore and parts of the dry lake bed of Lake Garnpung. There was minimal human impact and few artificial watering points in this area. The high species diversity and low weed occurrence were likely to be related to the relatively low intensity of grazing (Landsberg et al. 1997). Dr J. Landsberg, Wildlife and Ecology, CSIRO, Canberra and Professor T. Dawson, School of Biological Sciences, University of New South Wales (personal communication, March 1997) both estimated that feral goats had a grazing impact range of 5 km from watering points. In an attempt to survey ungrazed vegetation in the region, three areas, more than 5 km from artificial watering points, were targeted for investigation in the 1997 survey. These areas are within the Australian Map Grid rectangle 625000–632000N 640000–690000E (Fig. 3), at an elevation of approximately 70–120 m:

- Northern Area — 18 km^2 (631000N, 690000E) on Pan Ban and Garnpung Stations
- Central area — 300 km^2 (L-shaped 628000N, 647000–670000E; 628000–635000N, 670000E) on Lethero, Balranald Gate, Pt Balranald Gate, Birdwood, Yarraman and Garnpung Stations
- Southern area — 150 km^2 (626500N, 647000–670000E) on Studley, Lethero, Murragi, Petro and Arumpo Stations.

Climate

The climate of western NSW is semi-arid to arid. The features of the region are low, unreliable and highly variable rainfall, low humidity, high summer temperatures and evaporation rates, frequent dry periods lasting from several months to a number of years and occasional floods with rainfall occurring as intense storms (Date 1992).

In the study region, the average annual rainfall varies between recording stations within a narrow range of 234–275 mm, with a mean of 254 mm for ten stations in the vicinity. The average rainfall is uniformly distributed through the year with a 3% mean difference between summer and winter rainfall. Annual evaporation is about eight times the average rainfall (Dare-Edwards 1979).

Temperatures are consistently hot in summer and mild in winter (Date 1992). The monthly maximum temperature is 33.9°C in January and the monthly minimum is 4.7°C in July (Menindee Post Office meteorological station #047019) (Bureau of Meteorology 1988).

Soils

The 1995 survey sampled vegetation from six of the land systems described by Green (1980) in the Pooncarie 1: 250 000 sheet, namely: Arumpo Dunefields (Ap), Leaghur

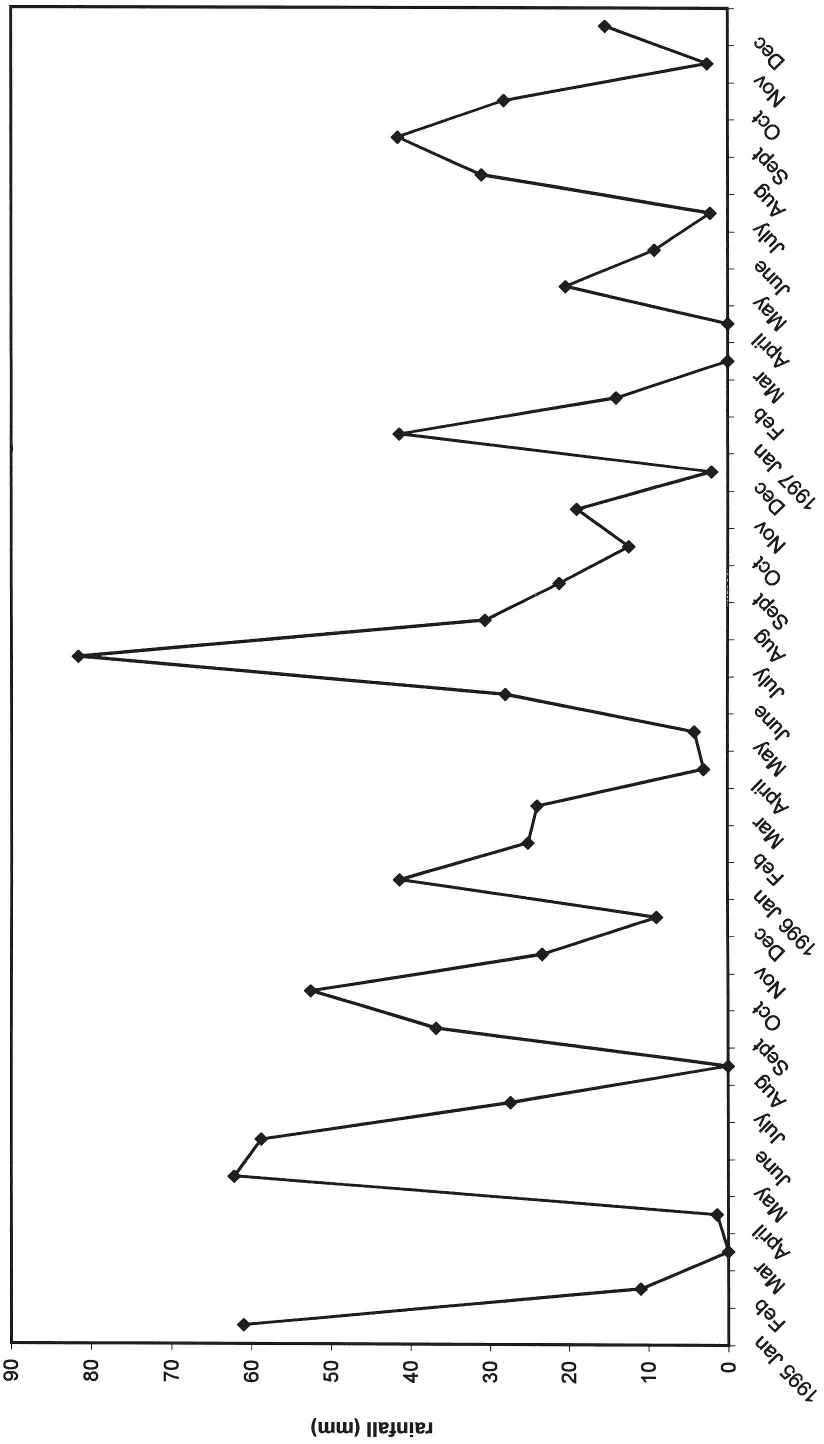

Fig. 2. Pooncarie: monthly precipitation January 1995–December 1997.

Fig. 3. Location of 1995 and 1997 survey areas in relation to artificial watering points.

Dunefields (Lh), Mandelman Dunefields (Mm), Overnewton Sandplains (Ov) and Garnpung Playas and Basins (Gn). The 1997 transect survey, although covering a greater area, only sampled flora from Ap, Mm and Mungo Playas and Basins (Mu) systems (Appendix 1). Leaghur Dunefields (Lh), Gn and Ov systems were sampled in spot surveys during 1997. Mandelman Dunefield is the only land system that occurred in both the 1995 and all 1997 survey areas.

Land use

The first wave of human occupation of the mallee lands of the South Far Western Plains Area dates from 50 000–40 000 years BP. Intervening arid phases with dune destabilisation and xeric conditions probably prevented any continuous occupation (Harris 1990). Evidence of ancient human occupation is found in the high shoreline gravels on Outer Arumpo and on the western side of all major lakes. In the dry lakes of the Willandra Creek system, there is evidence of a core and scraper industry associated with fires, burnt bones and unionid shells, coinciding with periods when lake water and aquatic life were present (17 000–32 000 years BP) (Bowler 1971).

In the 1870s, European occupation of the hinterland became possible with the introduction of well, bore and tank sinking techniques (Palmer 1991). Pastoral and agricultural activities introduced to the area expanded, leading to over-grazing, removal of vast areas of native vegetation and encroachment of exotic species of both fauna and flora (Webb 1998). The first reports of rabbit invasions occurred in 1884 concurrent with records of the proliferation of inedible native shrubs *Dodonaea* spp. (Hopbush), *Senna* spp. (Punty Bush) and *Eremophila sturtii* (Turpentine). Legislation in 1884 divided runs into term leasehold areas (Palmer 1991).

The 1901 New South Wales Royal Commission into the conditionof crown tenants in the Western Division of New South Wales listed seven principal factors contributing to widespread depression and general unprofitibility of the pastoral industry. The majority of these were based on the unsuitability of the environment for European farming practices, namely low rainfall, rabbit plagues, overstocking, sandstorms, growth of non-edible scrub, fall in prices and want of sufficient area (Noble 1997). Vast areas were windswept, with sand drifts covering fences, water troughs, stockyards and earthen dams. Extensive areas of perennial shrubs, notably the *Atriplex* spp. (Saltbush) and *Maireana* spp. (Bluebush), were destroyed, often on the more erodible soils (Palmer 1991).

Currently, grazing on uncleared land is the major land use. There are some short-rotation pastures and crops. These have varying success dependent on the erratic climate of the mallee land systems (Calder 1990). Condon (1986) suggested that there has been a major recovery since the 1940s and early 1950s with the frequency of these events having declined. He attributes this decline to the tight controls on land use in the Western Division of New South Wales exercised by the Western Lands Commission. Limitations are placed on the proportion, total area and pattern of clearing on any grazing leases. Restrictions on the clearing of sandhills have contributed to the relatively small proportion of mallee being cleared in the Western Division of New South Wales in recent years. The Western Division occupies an area of 320 000 km^2. Budd et al. (1990) noted that of the 28 783 km^2 of mallee in New South Wales (Fitzpatrick 1982), 22 940 km^2 (80%) occur in the Western Division within the Murray Geological Basin. This represents approximately 7% of the area of the Western Division. The vast majority of this area is Crown Land, held under pastoral leases administered by the Department of Land and Water Conservation. In the mid to late 1980s approximately 8% of the Western Division was under the control of National Parks and Wildlife Service (Pickard 1987).

Previous flora surveys

One of the earliest surveys of the vegetation of south-western NSW (Turner 1904) describes the area between 141–147°E and between 33°S and the NSW-Victorian border. The current study area is located at approximately 143°E, 33.4°S. In Turner's accompanying tables, 147 members of the Compositae (family Asteraceae), including 23 exotics were listed.

The 1945 vegetation map (1: 1 000 000) of western NSW (Beadle 1948) is the most extensive representation of vegetation of the mallee areas of NSW. The vegetation communities identified by Beadle in the region were:

Atriplex vesicaria Association (Saltbush)

*Kochia pyramidata (*now *Maireana pyramidata*)-*Kochia sedifolia* (now *Maireana sedifolia*) Association (Bluebush)

Casuarina-Heterodendrum (now *Alectryon*) Association (Belah and Rosewood)

Eucalyptus oleosa-Eucalyptus dumosa Association (mallee)

Porteners and Ashby (1996) describe the vegetation of the Pooncarie 1:250 000 map sheet recording the vegetation communities, native plant species with descriptions of significant species and plant uses. For the Pooncarie 1: 250 000 sheet, Porteners et al. (1997) recognise 18 plant communities and record 330 species of vascular plants. Exotics accounted for 40 (12%) of the species. Their sampling sites were close to primary and secondary roads. The composition and extent of the present native vegetation was mapped from 1: 100 000 Landsat images and ground-truthed from 110 sites each of 1000 m^2 (50 m × 20 m). They noted that during their survey (May 1994 to April 1995) the region was undergoing a severe drought.

In the area covered by the 1995 survey, Porteners et al. (1997) identified five plant communities (Irregular Dune Mallee, Linear Dune Mallee, Belah-Rosewood, Belah-Rosewood/Lunette Shrubland and Open Area/Scattered Belah-Rosewood).

In the 1997 survey target areas, four plant communities were identified (Irregular Dune Mallee; Linear Dune Mallee; Belah-Rosewood and Black Bluebush/Disturbed Shrubland Complex).

The area of Irregular Dune Mallee (3a) south east of Pooncarie, extending over parts of Lethero, Petro and Arumpo Stations and known locally as 'No Man's Land' was identified as one of key conservation value (Porteners et al. 1997). This area was targeted in our 1997 survey.

In the 1: 250 000 land system mapping of the Western Division (Walker 1991), the vegetation was categorised into broad vegetation types, resulting in a vegetation map of low resolution (Fox 1984).

Mungo National Park, adjoining the study area, was surveyed by by Westbrooke and Miller (1995) in September 1992 following rain. Two hundred and thirty-five plant species were noted of which 26% were exotic. Morcom and Westbrooke (1990) mapped the vegetation of Mallee Cliffs National Park, located to the south of the study area (Fig. 1). They recognised 215 plant species, 20% of which were exotic.

Methods

In November 1995, the vegetation from 56 transects and 68 spot locations was surveyed. The majority of transects used in the 1995 survey were 100 m × 10 m, consisting of ten contiguous 10 m × 10 m quadrats. Transects 50, 54, 55 and 56 were all half this size, 50 m × 10 m (consisting of five 10 m × 10 m quadrats), the stands of homogeneous vegetation being of a smaller size at these locations. During the 1995 survey species-area curves were used to determine the minimum area required to adequately sample the vegetation. This area was found to be 500–600 m^2.

The relative frequency of plant species was objectively assessed by recording the presence/absence of each species in each of the contiguous 10 m × 10 m quadrats, though species not exceeding 2 m height were scored only for a 5 m × 5 m sub-quadrat in each quadrat. In each 10 m^2 quadrat, the numbers of individuals over 2 m high of each species were noted. In both surveys, transect sampling was supplemented by spot recordings.

Target areas for the 1997 survey were selected on the basis of being at a distance of over 5 km from known artificial watering points. The transect sampling area chosen was consistent with the 1000 m^2 sampling area size (50 m × 20 m) used in the 1: 250 000 Pooncarie sheet survey (Porteners et al. 1997). Transects of 100 m × 10 m were examined, homogeneity of vegetation recorded in the transects was assessed visually at the time of sampling, so that each transect should sample only one vegetation type. 'Spot' recording sites of 10 m radius (sampling area 300 m^2) were also examined.

In the 1997 survey, the methods were as used in 1995. Data from the northern, central and southern target areas were collected.

For the northern area, vegetation was sampled at a total of 27 locations, with 22 transects (57–66, 97–108) and five spot locations (A69, A79–A81 and A85). All spot locations and 20 of the 22 transects were within 1 km of the northern target area.

In the central area, vegetation was sampled from 44 sampling locations, with 30 transects (67–96) and 14 spot locations A70–A78, A82–A84, A86–A87). All but one of the transects and 11 of the spot locations were within 1 km of the central target area.

For the southern area 22 transects (109–130) and 40 spot locations (A88–A94, A96–A106, A109–A130) were surveyed. Spot locations A109–A130 were within 100 m of transects. Of the 62 locations, 19 transects and 30 spot locations were within 1 km of the southern target area.

Boundary and exploration tracks were used to identify exact locations during the 1995 survey. In 1997, sampling locations were recorded using a Garmin 38 GPS. In the northern and the central areas sampling was evenly spread over the area, whereas in the southern area, sampling was adjacent to access tracks. Sampling in the central area was limited to an individual land holding. Geographical co-ordinates for both the 1995 and 1997 transect and spot locations are shown in Appendix 1.

Due to the remoteness of the study area and small size of many of the plants to be identified, samples of all plants in each quadrat were collected and bagged separately, except for very common species which were collected at least once per transect. All bagged specimens were checked before data entry and any species of conservation significance sent to the Royal Botanic Gardens, Sydney for further confirmation. During 1997, in addition to the vegetation study, animal scats were collected from the transects. The scat data were supplemented by spot recordings allowing for an objective assessment of the presence of animal species.

Results

Flora observations

A total of 375 species (328 native and 47 exotic) were recorded in the 1995 and 1997 surveys. In the 1995 survey, 263 species (226 native and 37 exotic) were recorded. In 1995, the number of species per transect ranged from 21 (transect 34) to 57 (transects 1 and 21) (Appendix 1) with an average of 39 species of which 89% were native. Two transects recorded zero exotics.

Of the total 311 species (277 native, 34 exotic) recorded in the 1997 survey for the northern, central and southern areas, the following were observed in the individual areas:

Northern area: 167 species (145 native and 22 exotic). The number of species per transect ranged from 13 (transect 62) to 54 (transect 104) (Appendix 1) with an average of 33 species of which 31 (94%) were native. The transects with the greater number of species have the higher percentages of exotic species. In this relatively small area only two of the 22 transects had zero exotic species.

Central area: 218 species (199 native and 19 exotic). The number of species per transect ranged from 19 (transects 69 and 79) to 57 (transect 86) (Appendix 1) with an average of 34 species per transect of which 32 (95%) were natives. In 10 of the transects (33%), there were no exotic species recorded.

Southern area: 233 species (210 native and 23 exotic). The number of species per transect varied from 13 (transect 126) to 58 (transect 128) (Appendix 1) with an average of 33 species of which 31 (94%) were natives. No exotic species were recorded in 50% of the southern area transects.

The percentages of exotic species found in the 1997 survey were lower than those noted by Westbrooke and Miller (1995) in Mungo National Park (26%), and Morcom and Westbrooke (1990) in Mallee Cliffs National Park (20%), indicating that the remoteness of the 1997 target areas had aided the conservation of the indigenous flora.

Ephemerals

These are described in *Flora of New South Wales* (Harden 1990–1993) as annual herbs, except for a very few that are described as annual or perennial. In the arid western New South Wales environment, a species described as annual or perennial would most commonly behave as an annual. A total of 136 species of ephemerals was recorded in the 1995 and 1997 surveys (Appendix 2), accounting for 36% of the species. Of these 106 (78%) were native and 30 (22%) exotic. Ephemerals formed 36% of the total flora in both surveys. In 1995 there were 95 ephemeral species recorded, 22 (25%) of which were exotics. The 1997 survey recorded 112 ephemeral species, of these, 25 (22%) were exotic.

The number of ephemerals varied between the three 1997 survey areas (Appendix 2). In the northern and central areas compared with southern area there were higher percentages of ephemerals (47 and 42% compared with 37% respectively) and lower total numbers of species recorded (167 and 218 compared with 233 respectively).

Conservation significance

Communities

No Endangered Ecological Communities, as defined in the NSW *Threatened Species Conservation (TSC) Act 1995*, were noted in either the 1995 or 1997 surveys. Although there are existing mallee reserves in New South Wales, there has also been widespread retention of mallee on Crown Lands held as Western Lands Leases, in part to reduce the risk of dryland salinity and soil loss in agricultural areas (Brickhill 1988).

The *Eucalyptus socialis*-*Eucalyptus dumosa*-*Eucalyptus gracilis*-*Eucalyptus polybractea* mallee vegetation community is found in nine conservation reserves (Yathong, Nombinnie, Kajuligah, Round Hill, Tollingo and Loughnan Nature Reserves; Mallee Cliff, Mungo and Cocoparra National Parks), representing a large part of the range of the biogeographic regions in which the community occurs (Specht et al. 1995).

Species

In the 1995 survey, twelve species of conservation significance were recorded; one species at a national (ANZECC 1997, Briggs & Leigh 1996) and state (TSC Act 1995) level, namely *Brachycome papillosa*, one species, *Swainsona sericea* (formerly *Swainsona oroboides* subsp. *sericea*) under a state Vulnerable listing (TSC Act 1995) and twelve at a regional (Pressey et al. 1990) level: *Atriplex nummularia, Blennodia canescens, Boronia caerulescens, Brachycome papillosa, Calandrinia volubilis, Exocarpos sparteus*, *Grevillea pterosperma*, *Nicotiana occidentalis* subsp. *obliqua, Poa fax*, *Podotheca angustifolia, Sida* sp. aff. *corrugata* and *Swainsona sericea*.

Nineteen species of conservation significance were recorded in the 1997 survey, including one at national (ANZECC 1997, Briggs & Leigh 1996) level, namely *Lepidium monoplocoides*; four at state (TSC Act 1995) level namely: *Acacia acanthoclada, Lepidium monoplocoides, Santalum murrayanum* and *Swainsona sericea* and nineteen at a regional (Pressey et al. 1990) level, namely: *Acacia acanthoclada*, *Atriplex nummularia* (includes

Atriplex nummularia subsp. *omissa* in Harden (1990–1993)) *Atriplex vesicaria* subsp. *macrocystidia*, *Blennodia canescens*, *Boronia caerulescens*, *Calandrinia volubilis*, *Ceratogyne obinoides*, *Eucalyptus porosa*, *Exocarpos sparteus*, *Gahnia lanigera*, *Grevillea pterosperma*, *Lepidium monoplocoides*, *Menkea australis*, *Nicotiana occidentalis* subsp. *obliqua*, *Podotheca angustifolia*, *Santalum murrayanum*, *Sida* sp. aff. *corrugata*, *Swainsona sericea* and *Velleia arguta*. In the southern area twelve species of conservation significance were recorded, eleven species of conservation significance were recorded for the central area, and four species of conservation significance were recorded for the northern area (Table 1).

New records for New South Wales

No new records for New South Wales were noted in 1995. In the 1997 survey, one new record for New South Wales was found, namely *Lasiopetalum behrii.* A specimen has been lodged with the National Herbarium of NSW, Royal Botanic Gardens, Sydney.

Lasiopetalum behrii, a stiff-leaved shrub to 1.5 m high, flowering July to October (Jessop & Toelken 1986), was recorded at spot location A114 in the southern area in the 1997 survey. This species has been recorded by Willis (1973) for the region of north-western Victoria approximately north of Horsham and west of Swan Hill. Jessop and Toelken (1986) record *Lasiopetalum behrii* in the following botanical regions of South Australia: Flinders Ranges, Eyre Peninsula, Northern Lofty, Murray, York Peninsula, Southern Lofty, South Eastern and Kangaroo Island. These regions are all in the south-east quarter of that state.

Species not recorded by Porteners et al. (1997) and/or previously unrecorded for the South Far Western Plains botanical division

Our surveys found 74 species not listed by Porteners et al. (1997), doubtless a result of the better rainfall preceding our visits and the more extensive sampling of areas away from roads. In addition, 25 species not recorded by Harden (1990–1993) as occurring in the South Far Western Plains botanical division were noted (Table 2). Some species fell into both these categories, so that the total number of additional species records was 78.

Numerical analysis of the transect data

The combined data from 1995 and 1997 were numerically analysed using PATN (Belbin 1995). The transects were grouped using a hierarchical agglomerative clustering technique with a Bray-Curtis similarity measure of the abundance (0–10) of species within each transect. The estimate is based on the presence/absence of plant species in quadrats of the transects.

Three broad groupings were identified, namely:

Group 1 Mallee dune crests, mallee with *Callitris* spp. and lake shore with sand overblow (transects 9, 40, 42). This group was well represented in the 1995 survey area, with 22 of 56 transects. In the 1997 survey it occurred in the northern area (8 of 22 transects), in the central area (3 of 30 transects), but not in the southern area.

Table 1. Species of conservation significance recorded in 1995 and 1997 at the sampling locations

1995 : 1995 transects/points
N : northern 1997 transects/points
C : central 1997 transects/points
S : southern 1997 transects/points

Species	Location	National ANZECC (1997)	ROTAP (1996)	State TSC Act (1995)	Regional Pressey et al. (1990) category	priority
	S: 124, A96, A126	-	-	E	3B	4
Atriplex nummularia (includes *Atriplex nummularia* subsp. *omissa* in Harden 1990–1993)	1995: 11, 47 C: 78	-	-	-	3A	3
Atriplex vesicaria subsp. *macrocystidia*	C: 78 S: 128, 130, A105	-	-	-	4A	4
Blennodia canescens	1995: 6 N:58, 97	-	-	-	3B	4
Boronia caerulescens	1995: 7, 15, 26, 27 S: A88	-	-	-	3B	4
Brachycome papillosa	1995: A59, A60	V	3V	V	2	2
Calandrinia volubilis	1995: 11, 13, 28, 32, 54 C: 78 S: 130, A105	-	-	-	3A	3
Ceratogyne obinoides	C: 88 S: 110, 111, 113, A116	-	-	-	3B	4
Eucalyptus porosa	S: A92	-	-	-	3B	4
Exocarpos sparteus	1995: A10, C: 87, A77 N: 104	-	-	-	3B, 4A	4
Gahnia lanigera	S: 115, 116, 120	-	-	-	3B	4
Grevillea pterosperma	1995: 18, 36, 54 C: 67, 68, 79, A70 S: 121, 123, A120	-	-	-	3B	4
Lepidium monoplocoides	C: A82	E	3ECi	E	3A	2
Menkea australis	N: 61 C: 74, 75, 84 S: 113, 115, 117, 120, 123, 124, A116	-	-	-	3B	4
Nicotiana occidentalis subsp. *obliqua*	1995: 1, 4, 19, 21, 23, 27, 28, 29, 30, 32, 33, 39, 40,	-	-	-	3B	4

Species	Location	National ANZECC (1997)	ROTAP (1996)	State TSC Act (1995)	Regional Pressey et al. (1990) category	priority
	42, 44, 56, A1, A25, A30, A31, A33, A38, A40, A45, A48, A49, A62, A64, A65 C: 88, 94, A75 N: 66, 97, 98, 99, 107, A85 S: 110, 123, A110					
Poa fax	1995: 11, A58	-	-	-	3B	4
Podotheca angustifolia	1995: 14, 28, 29, 46, 49, 53, 54, A10, A41, A43, A51, A63 C: 87 S: 110, 111, 113	-	-	-	3B	4
Santalum murrayanum	N: 62	-	-	E	3B	4
Sida sp. aff. *corrugata*	1995: 3, 45 C: 89	-	-	-	3B	4
Swainsona sericea (formerly *Swainsona oroboides* subsp. *sericea*)	1995: 21, 35, A32, A34, A45 C: A75			V preliminary	4B	4
Velleia arguta	S: A106	-	-	-	3A	3

Key for Table:

National	ROTAP (Briggs & Leigh 1996)	State	Regional
ANZECC (1997)	3: distribution of >100 km	TSC Act (1995)	Pressey et al. (1990)
E: endangered	E: endangered	E: endangered	Categories
	V: vulnerable	V: vulnerable	1 occurring only in the Western Division with a restricted distribution
	C: present in a conservation reserve		3 restricted distribution in the western Division and also occurring interstate:
	i: inadequately conserved		A: small range and/or few records interstat
			B: wide range and/or many records interstate
			4 disjunct occurrences in the Western Division
			A: main population interstate
			Priorities
			1 protection measures in the Western Division will completely determine the survival of these taxa nationally
			2 protection measures in the Western Division will be a very important contribution to conservation of the taxa throughout Australia
			3 conservation of the species in the Western Division will influence its overall survival
			4 protection in the Western Division is desirable to conserve genetic variation within the ranges of these taxa

Table 2. Species not recorded by Porteners et al. (1997) and/or not previously recorded for SFWP (South Far Western Plains) as listed in Harden (1990–1993)

New SFWP	Botanical name	When Found
Yes	*Acacia havilandiorum*	97
Yes	*Aira caryophyllea*	95, 97
-	*Amphipogon caricinus* var. *caricinus*	95, 97
Yes	*Amyema cambagei*	97
Yes	*Anagallis arvensis*	95, 97
-	*Angianthus tomentosus*	97
Yes	*Aotus subspinescens*	97
Yes	*Atriplex turbinata*	95
-	*Austrostipa mollis*	
	(formerly *Stipa mollis*)	95
Yes	*Austrostipa scabra* subsp. *scabra*	
	(formerly *Stipa scabra* subsp. *scabra*)	95, 97
Yes	*Austrostipa tuckeri*	
	(formerly *Stipa tuckeri*)	97
-	*Avena barbata*	95
-	*Bertya* sp.	95
Yes	*Beyeria leschenaultii*	95, 97
-	*Billardiera versicolor*	97
-	*Blennodia canescens*	95, 97
-	*Brachycome ciliaris* var. *lanuginosa*	95, 97
-	*Bulbine alata*	95
Yes	*Calandrinia granulifera*	97
-	*Calandrinia volubilis*	95, 97
-	*Carthamus lanatus*	95
-	*Centipeda thespidioides*	95
-	*Citrullus lanatus*	95
-	*Cressa cretica*	97
Yes	*Cryptandra amara* var. *floribunda*	95, 97
Yes	*Daviesia acicularis*	95, 97
-	*Einadia nutans* subsp. *oxycarpa*	95, 97
-	*Epaltes australis*	95
-	*Eragrostis dielsii*	95
-	*Erodium cygnorum* subsp. *glandulosum*	95, 97
-	*Frankenia serpyllifolia*	95
-	*Gahnia lanigera*	97
-	*Gnaphalium sphaericum*	95, 97
-	*Gnephosis eriocarpa*	95
-	*Goodenia glauca*	97
Yes	*Goodenia havilandii*	95, 97

New SFWP	Botanical name	When Found
Yes	*Gypsophila australis*	97
-	*Halosarcia pergranulata*	97
-	*Halosarcia* sp.	97
Yes	*Lasiopetalum behrii*	97
-	*Lemooria burkittii*	95, 97
-	*Lepidium monoplocoides*	97
-	*Lepidosperma* sp. aff. *viscidum*	97
-	*Limosella curdieana*	97
-	*Lomandra leucocephala* subsp. *leucocephala*	95, 97
-	*Lotus cruentus*	95
-	*Maireana pentagona*	95
-	*Menkea australis*	97
-	*Millotia tenuifolia* var. *tenuifolia*	97
-	*Myoporum platycarpum* subsp. *perbellum*	95
Yes	*Pentaschistis airoides*	97
-	*Plantago turrifera*	95, 97
-	*Poa fax*	95
-	*Pogonolepis muelleriana*	95, 97
-	*Polygonum aviculare*	95
-	*Pterostylis* sp. aff. *biseta*	97
Yes	*Ranunculus trilobus*	95
-	*Rhodanthe microglossa*	95
-	*Rhyncharrhena linearis*	95, 97
-	*Rutidosis helichrysoides*	95
Yes	*Sagina apetala*	97
-	*Scaevola spinescens*	97
-	*Senecio quadridentatus*	97
-	*Sida* sp. aff. *corrugata*	95, 97
Yes	*Silene nocturna*	97
-	*Stuartina hamata*	97
Yes	*Stuartina muelleri*	97
Yes	*Swainsona sericea*	95, 97
-	*Synaptantha tillaeacea*	97
-	*Thysanotus patersonii*	95, 97
-	*Tripogon loliiformis*	97
Yes	*Triptilodiscus pygmaeus*	95, 97
Yes	*Velleia arguta*	97
Yes	*Velleia paradoxa*	97
-	*Vittadinia condyloides*	95, 97
-	*Vittadinia eremaea*	95, 97
Yes	*Vittadinia sulcata*	95, 97

Group 2 Lake beds with *Casuarina pauper*, *Dodonaea viscos*a subsp. *angustissima, Alectryon oleifolius* subsp. *canescens*, herbfield, or *Atriplex vesicaria* subsp. *macrocystidea* shrubland; mallees without abundant *Triodia scariosa* and sometimes with *Casuarina pauper.* This group was represented in all survey areas with 13 of 56 transects in 1995 survey and 5 of 22 transects in the northern area, 12 of 30 transects in the central area, but only 2 transects in the southern area and 4 transects outside the southern target area in the 1997 survey.

Group 3 Mallee with abundant *Triodia scariosa.* This group was represented in all survey areas with 21 of 56 transects in the 1995 survey, 9 of 22 transects in the northern area, 15 of 30 transects in the central area, and 16 of 22 transects in the southern target area in the 1997 survey.

The grouping of individual transects is shown in Appendix 1.

Fauna observations

Investigations by Dawson and Ellis (1994) on open plains in far western New South Wales demonstrated that domestic sheep (*Ovis aries*) and red kangaroos (*Macropus rufus*) had considerable dietary overlap (87%) with grasses being the major component for both species. The diet of feral goats (*Capra hircus*) at Fowlers Gap Research Station (approximately 250 km north of the study area) was studied by Dawson and Ellis (1996). Fowlers Gap lies approximately 250 km north of the study site and has a diverse topography, the western portion includes part of the Barrier Ranges, whereas flood plains occur in the east. Goats have a broad diet with a preference for browsing, taxa consumed included *Acacia aneura* (Mulga), *Alectryon oleifolius* (Rosewood), *Canthium oleifolium* (Wild Lemon), *Casuarina pauper* (Belah) and *Myoporum platycarpum* (Sugarwood), eucalypts were not eaten.

Scats were collected at the time of the vegetation survey. At this time, there was standing water in many of the clay former lake beds. Grazing animals, especially kangaroos, were observed near standing water. Kangaroo scats were recorded in all transects where scats had been collected. Goats were the second most widespread of the animal species noted in the area. Goat scats were not recorded in:

• the central area in mallee with *Triodia* (transects 67, 69, 70, 79, 83, 84, 85) and former lake beds (transects 72, 78, 80, 81, 82, 86)

• the southern area in mallee with *Triodia* (transect 115) and former lake bed (transect 130).

Goats were recorded in all transects sampled in the northern area. Sheep were recorded once and possibly twice on four sampled transects in the northern area, four times in 20 sampled transects in the central area, and three times on 22 sampled transects in the southern area. Emus (*Dromaius novaehollandiae*) were recorded infrequently. Emus did not appear to discriminate in terms of vegetation structure and were noted on each of the three major vegetation groups (transects 71, 74, 129).

Rabbits were not recorded in the northern area. They were noted once in the central area (transect 71 in mallee with *Triodia*) and in 7 of the 22 transects in the southern area (five lake bed, and two mallee with *Triodia* transects). The scat collections appear to be consistent with Dawson and Ellis (1996) at Fowlers Gap, namely that kangaroos can travel large distances from watering holes, goats are tolerant of the arid conditions and sheep are restricted. The fencing in the area may have limited the distribution of sheep, but it is more likely that the lack of water determined their distribution. The southern area contained the largest core area of undisturbed vegetation; observations of scat densities during surveys in the southern area indicated a marked decrease in goat presence at distances in excess of 8 km from water sources.

Conclusion

Surveys of the Pooncarie area were conducted in 1995 and 1997. An area centred at 629000N and 680000E was examined during 1995, whereas the 1997 survey targeted three zones that were selected to be more than 5 km from any artificial watering points. The areas surveyed, 100 km^2 (1995) and 468 km^2 (1997) were relatively remote from roads and human habitation. The surveys covered approximately 4% of the 15 180 km^2 mapped by Porteners et al. (1997). Porteners et al. (1997) reported nine species not previously recorded for the South Far Western Plains botanical subdivision of New South Wales, namely, *Abutilon fraseri*, *Amaranthus macrocarpus* var. *macrocarpus*, *Chamaesyce* species B, *Cheilanthes distans*, *Cheilanthes lasiophylla*, *Digitaria ammophila*, *Evolvulus alsinoides* var. *decumbens*, *Leptorhynchus panaetiodes* and *Sporobolus caroli*. None of these species was recorded in our 1995 and 1997 surveys. However, we noted 78 species that had not previously been recorded by Porteners et al. (1997) and/or recorded in the South Far Western Plains botanical division (Harden 1990–1993). There were 136 ephemeral species (95 in 1995 and 112 in 1997) recorded. Of these ephemerals, 30 (22%) were exotics. The timing of the Porteners et al. (1997) survey coincided with a drought, whereas the 1995 and 1997 surveys followed rain which would have encouraged the germination of ephemerals.

Despite the remoteness from artificial watering points, scats of native and exotic grazing animals were found in the 1997 survey areas. Kangaroo scats were recorded at all collection locations and goat scats were frequently observed. Animals were observed near the standing water that collected in the clay former lake beds after rain.

In the 1997 survey, the number of plant species recorded in the 300 km^2 central area (218 total, 199 native, 19 exotic) was similar to the number in the 150 km^2 southern area (233 total, 210 native, 23 exotic). The lower number of species recorded in the 18 km^2 northern area (167 total, 145 native, 22 exotic) is likely to be related to the smaller size of the sampling area (Fig. 2). Exotic plants were part of the flora assemblage in virtually all locations sampled. The presence of exotic seedlings, such as *Hypochoeris glabra*, indicates their very high wind-borne dispersal ability. In many communities, their seeds germinate after rain but the plants fail to establish in the longer term. The numbers of exotic species have been consistent between the 1995 survey (39 exotics) and the 1997 survey (34 exotics), also between the three target areas in 1997 (19–22 exotics). In 1995, 15% of the species noted were exotics. Exotics formed approximately 10% of the total species diversity in the 1997 surveys (13% in northern area, 9% in central and 10% in southern areas).

In terms of conservation significance, nineteen species of National, State and/or Regional level were recorded in the areas surveyed in 1997. Four species of significance were noted in the northern, 11 in the central and 12 in the southern area. In 1995, 12 species of conservation significance (National, State and/or Regional) were recorded. No Endangered Ecological Communities (TSC Act 1995) were noted.

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References

ANZECC (1997) Threatened Australian Plants. Prepared by the Endangered Flora Network for the Australian and New Zealand Environment and Conservation Council.

Beadle, N.C. (1948) *The vegetation and pastures of western New South Wales with special reference to soil erosion* (Government Printer, Sydney).

Belbin, L. (1995) *PATN pattern analysis package. Technical reference* (Division of Wildlife and Ecology: CSIRO).

Bowler, J.M. (1971) Pleistocene salinity and climatic change: evidence from lakes and lunettes in southeastern Australia. In Maleny D.J. and Golson J. (eds) *Aboriginal man and environment in Australia.* (ANU Press: Canberra).

Brickhill, J. (1988) Conservation of mallee in western NSW. *National Parks Journal*. 32(3): 34–37.

Briggs, J.D. & Leigh, J.H. (1996) *Rare or threatened Australian plants* (CSIRO: Canberra).

Budd, G.R., Williams, R.M., Cook, P. & Walker, G. (1990) Impact of Mallee clearing on rainfall accession to the groundwater in far southwest New South Wales: implications for management. In Noble J.C., Joss P.J. and Jones G.K. (eds) *The Mallee lands — a conservation perspective* (CSIRO: Melbourne).

Bureau of Meteorology (1988) *Climatic averages Australia* (Australian Government Publishing Service).

Calder, M. (1990) Nature conservation in mallee lands in Australia. In Noble J.C., Joss P.J. and Jones, G.K. (eds) *The Mallee lands — a conservation perspective* (CSIRO: Melbourne).

Condon, R.W (1986) Recovery of catastrophic erosion in western NSW. In Joss P.J., Lynch, P.W. and Williams, O.B. (eds) *Rangelands: a resource under siege* (Australian Academy of Science).

Dare-Edwards, A. (1979) *Late Quaternary soils on clay dunes of the Willandra Lakes, New South Wales*. unpub. PhD thesis, ANU, Canberra.

Date, W. (1992) Climate. In Simpson I. (ed.) *Rangeland management in Western New South Wales.* (NSW Agriculture) pp. 17–23.

Dawson, T.J. & Ellis, B.A. (1994) Diets of mammalian herbivores in Australian arid shrublands: seasonal effects on overlap between red kangaroos), sheep and rabbits, and on dietary niche breadths and electivities. *Journal of Arid Environments* 26: 257–271.

Dawson, T.J. & Ellis, B.A. (1996) Diets of mammalian herbivores in Australian arid, hilly shrublands: seasonal effects on overlap between euros (hill kangaroos), sheep and feral goats, and on dietary niche breadths and electivities. *Journal of Arid Environments* 34: 491–506.

Fox, M.D. (1984) Mapping the vegetation of the mallee landscapes. In Storrier R. R. and Stannard M.E. (eds) *Aeolian landscapes in the semi-arid zone of south-eastern Australia.* Australian Society of Soil Sciences Inc., Riverina Branch, Wagga Wagga. pp. 147–148.

Fox, M.D. (1990) Composition and richness of New South Wales Mallee. In Noble J.C., Joss P.J. & Jones G.K. (eds) *The Mallee lands - a conservation perspective* (CSIRO: Melbourne).

Green, D.R. (1980) Pooncarie 1:250 000 land system mapping. In Walker P.J. (1991 compiler) *Land systems of Western New South Wales.* Soil Conservation Service of NSW. Technical Report No. 25.

Harden, G.J. (ed.) (1990–1993) *Flora of New South Wales*. Volumes 1 to 4 (University of New South Wales Press: Kensington).

Harris, C.R. (1990) The history of mallee land use: Aboriginal and European. In Noble J.C., Joss P.J. and Jones G.K. (eds) *The Mallee lands — a conservation perspective* (CSIRO: Melbourne).

Jessop, J.P. & Toelken, H.R. (ed.) (1986) *Flora of South Australia* (South Australian Government Printing Division: Adelaide).

Landsberg, J., James, C.D., Morton, S.R., Hobbs, T.J., Stol, J., Drew, A. & Tongway, H. (1997) *The effects of artificial sources of water on rangeland biodiversity.* Final report to the Biodiversity Convention and Strategy Section of the Biodiversity group, Environment Australia, CSIRO and Environment Australia.

Morcom, L. & Westbrooke, M. (1990) The vegetation of Mallee Cliffs National Park. *Cunninghamia* 2(2): 147–166.

Noble, J. C. (1997)*The delicate and Noxious Scrub — CSIRO Studies on Native Tree and Shrub Proliferation in the Semi-Arid Woodlands of Eastern Australia*. CSIRO.

NSW Threatened Species Conservation Act (1995) New South Wales State Government.

Palmer, D. (1991) Western New South Wales — A miracle of recovery. *Australian Journal of Soil and Water Conservation* 4(4) November 1991.

Pickard, J. (1987) *Mallee management strategy* (Western Lands Commission: Sydney).

Porteners, M.F. & Ashby, E. M. (1996) *Plants of Pooncarie and the Willandra Lakes* (Royal Botanic Gardens: Sydney).

Porteners, M.F., Ashby, E.M. & Benson, J.S. (1997) The natural vegetation of the Pooncarie 1: 100 000 map. *Cunninghamia* 5(1): 139–232.

Pressey, R.L., Cohn, J.S. & Porter, J.L. (1990) Vascular plants with restricted distributions in the Western Division of New South Wales. *Proceedings of the Linnaean Society of NSW* 112(4): 213–227.

Rice, B. (1986) Aspects of the vegetation of the Willandra World Heritage Region. Final report to the NSW Department of Environment and Planning on investigations under the National Estates Program.

Robertson, G. (1987) Plant dynamics. In Caughley G., Sheperd N. and Short J. (eds), *Kangaroos: their ecology and management in the sheep rangelands of Australia*, pp. 14–34 (Cambridge University Press).

Specht, R.L., Specht, A., Whelan, M.B. and Hegarty, E.E. (1995) *Conservation atlas of plant communities in Australia* (Centre for Coastal Management, Southern Cross University: Lismore).

Turner, F. (1904) Botany of South-western New South Wales. *Proceedings of the Linnaean Society of NSW* 29: 132–181.

Walker, P.J. (1991) *Land systems of western New South Wales.* Soil Conservation Service of New South Wales Technical Report No. 25.

Webb, C. (1998) Westward ho! *National Parks Journal* 42(3).

Wellard, G. (1987) The effect of weather on soil moisture and plant growth in the arid zone. In Caughley G., Sheperd N. and Short J. (eds), *Kangaroos: their ecology and management in the sheep rangelands of Australia*, pp. 35–49 (Cambridge University Press).

Westbrooke, M. & Miller, J.D. (1995) Vegetation of Mungo National Park, western New South Wales. *Cunninghamia* 4(1): 63–80.

Willis J.H. (1973) *A handbook to plants in Victoria*. Volume 2 (Melbourne University Press).

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Appendix 1. Site locations and soil and vegetation descriptions for spots and transects

Soils as described by Green (1980):
Sandplains: Ov — Overnewton, Dunefield: Ap — Arumpo, Mm — Mandleman, Lh — Leaghur
Playas and Basins: Gn — Garnpung, Mu — Mungo
Vegetation as described by Porteners et al. (1997):
3a Irregular Dune Mallee, 3b Linear Dune Mallee, 3d Sandplain Mallee,
4 Belah-Rosewood, 8 Black Bluebush, 22 Disturbed Shrubland Complex, 30 Lunette Shrubland
OA Open Areas, C Cleared and/or cropped

Spots A1–A68: 1995
A69, A79–A81, A85: Northern 1997
A70–A78, A82–A84, A86–A87: Central 1997
A88–A94, A96–A106, A109–A130: Southern 1997

Spot	Spot locations		Vegetation	Soil	Total no.of species	Exotic species	Percent exotic species
	North	East					
A1	6294500N	674200E	3a	Ap	19	1	5
A2	6294300N	674300E	3a	Ap	1	0	0
A3	6294300N	674800E	3a	Ap	1	0	0
A4	6294100N	675300E	3a	Ap	1	0	0
A5	6294400N	675400E	3a	Ap	1	0	0
A6	6294300N	675800E	3a	Ap	7	0	0
A7	6294400N	676000E	3a	Ap	8	0	0
A8	6294200N	676250E	3a	Ap	16	0	0
A9	6294000N	676400E	3a	Ap	4	0	0
A10	6293800N	676700E	3a	Ap	5	0	0
A11	6294100N	677200E	3a	Ap	6	1	17
A12	6293800N	677400E	3a	Ap	14	1	7
A13	6293700N	678300E	3a	Ap	22	5	23
A14	6293700N	678700E	3a	Ap	10	1	10
A15	6293600N	679200E	3a	Ap	8	0	0
A16	6293800N	679600E	3a	Ap	1	0	0
A17	6293700N	680000E	3a	Ap	6	1	17

Spot	Spot locations North	East	Vegetation	Soil	Total no.of species	Exotic species	Percent exotic species
A18	6293300N	682100E	3a	Lh	9	0	0
A19	6292500N	683100E	3a	Gn	1	0	0
A20	6290600N	682700E	3a	Ap/Lh	12	3	25
A21	6290400N	682600E	3a	Ap/Lh	16	3	19
A22	6291400N	675600E	3a	Ap	3	0	0
A23	6290200N	682400E	3a	Ap	18	6	33
A24	6297800N	672600E	3a	Mm	1	0	0
A25	6297600N	672700E	3a	Mm	26	7	27
A26	6296800N	672400E	3a	Mm	2	0	0
A27	6290800N	673800E	3a	Ap	4	0	0
A28	6291250N	677300E	3a	Ap	22	3	14
A29	6295400N	679300E	3a	Ap	18	1	6
A30	6291000N	681000E	3a	Ap	10	1	10
A31	6290750N	681100E	3a	Ap	17	4	24
A32	6291000N	681500E	3a	Mm	45	16	36
A33	6290500N	681350E	3a	Ap	14	2	14
A34	6290000N	681900E	3a	Ap	16	6	38
A35	6289200N	681100E	3a	Ap	4	0	0
A36	6291100N	679200E	3a	Ap	1	0	0
A37	6274700N	666100E	3a	Mm	7	2	29
A38	6290800N	679500E	3a	Ap	9	1	11
A39	6290350N	679200E	3a	Ap	1	0	0
A40	6290350N	679000E	3a	Ap	23	6	26
A41	6290500N	677600E	3a	Ap	16	2	13
A42	6289800N	678400E	3a	Ap	11	0	0
A43	6289600N	678000E	3a	Ap	16	0	0
A44	6289400N	677800E	3a	Ap	7	0	0
A45	6289750N	678200E	3a	Ap	19	5	26
A46	6291500N	679500E	3a	Ap	25	4	16

Spot	Spot locations North	East	Vegetation	Soil	Total no.of species	Exotic species	Percent exotic species
A47	6294000N	684250E	3a	Gn	15	5	33
A48	6274200N	666200E	3a	Mm	17	7	41
A49	6274000N	666000E	3a	Mm	18	5	28
A50	6290000N	675400E	3a	Ap	17	1	6
A51	6289400N	677200E	3a	Ap	19	1	5
A52	6289250N	677500E	3a	Ap	17	4	24
A53	6291000N	675200E	3a	Ap	20	4	20
A54	6292400N	676500E	3a	Ap	8	0	0
A55	6292750N	677900E	3a	Ap	8	4	50
A56	6291600N	678200E	3a	Ap	15	0	0
A57	6291600N	678800E	3a	Ap	5	0	0
A58	6292500N	674750E	3a	Ap	17	5	29
A59	6301000N	696600E	C	Gn	23	8	35
A60	6306300N	695400E	OA/22	Gn	10	6	60
A61	6280900N	671100E	3b	Mm	9	0	0
A62	6280000N	671000E	3b	Mm	37	1	3
A63	6278900N	670800E	3a	Mm	13	2	15
A64	6276800N	670500E	3a	Ap/Mm	24	2	8
A65	6276400N	670400E	3a	Ap/Mm	23	4	17
A66	6274200N	670100E	3a	Ap	23	5	22
A67	6271250N	664100E	3a	Mm	2	0	0
A68	6282000N	671400E	3b	Ap/Mm	32	2	6
A69	6314000N	687000E	3a	Mm	1	0	0
A70	6281000N	659000E	3a	Mm	9	0	0
A71	6281700N	660500E	3a	Mm	0	0	0
A72	6290750N	674700E	3a	Ap	4	0	0
A73	6281700N	660100E	3a	Mm	4	0	0
A74	6281500N	659700E	3a	Mm	6	0	0

Spot	Spot locations North	East	Vegetation	Soil	Total no.of species	Exotic species	Percent exotic species
A75	6290700N	679800E	3a	Ap	32	6	19
A76	6290700N	682700E	3a	Lh	5	0	0
A77	6284100N	672500E	3b	Ap	4	0	0
A78	6279400N	656250E	3a	Mm	5	1	20
A79	6312350N	687100E	3a	Ov	11	1	9
A80	6311700N	689100E	3a/3b/3c	Gn	3	0	0
A81	6310500N	688100E	3a	Gn	21	2	10
A82	6282700N	656900E	3a	Mm	18	4	22
A83	6275100N	659400E	3a	Mm	20	0	0
A84	6277500N	661900E	3a	Mm	4	0	0
A85	6305700N	687250E	4/30	Gn	8	0	0
A86	6279600N	654000E	3a	Mm	7	3	43
A87	6278600N	655800E	3a	Mm	27	3	11
A88	6266100N	660600E	4	Mm	2	0	0
A89	6264500N	657100E	3a	Mm	1	0	0
A90	6264000N	658000E	3a	Mm	1	0	0
A91	6260900N	658400E	3a	Mm	1	0	0
A92	6257100N	660400E	3a	Mm	1	0	0
A93	6262300N	649200E	3a	Mm	1	0	0
A94	6260750N	670000E	3a	Mm	1	0	0
A95	non existent						
A96	6262700N	649200E	3a	Mm	1	0	0
A97	6266600N	647400E	3a	Mm	1	0	0
A98	6263500N	658500E	3a	Mm	1	0	0
A99	6270600N	661250E	3a	Mm	1	0	0
A100	6260800N	658000E	3a	Mm	1	0	0
A101	6262600N	649100E	3a	Mm	1	0	0
A102	6269600N	670400E	3a	Ap	3	1	33
A103	6269600N	671800E	3a	Ap	47	7	7

Spot	Spot locations North	East	Vegetation	Soil	Total no.of species	Exotic species	Percent exotic species
A104	6262800N	658200E	3a	Mm	1	0	0
A105	6269200N	672600E	3a	Mu	33	6	18
A106	6272800N	670600E	3a	Ap	1	0	0
A107	non existent						
A108	non existent						
A109	6267400N	649500E	3a	Mm	9	0	0
A110	6262900N	661600E	3a	Mm	21	5	24
A111	6261600N	662000E	3a	Mm	7	0	0
A112	6261200N	661000E	3a	Mm	11	2	18
A113	6259500N	658100E	3a	Mm	5	0	0
A114	6260100N	658100E	3a	Mm	15	1	7
A115	6260100N	658500E	3a	Mm	14	2	14
A116	6261700N	658650E	3a	Mm	11	0	0
A117	6262800N	658850E	3a	Mm	7	0	0
A118	6262600N	669600E	3a	Mm	10	1	10
A119	6263700N	669800E	3a	Mm	4	0	0
A120	6264400N	670000E	3a	Mm	10	0	0
A121	6265100N	670000E	3a	Mm	6	0	0
A122	6261500N	648900E	3b	Mm	9	0	0
A123	6264200N	649100E	3a	Mm	2	0	0
A124	6265600N	649300E	3a	Mm	5	1	20
A125	6266800N	651500E	3a	Mm	9	0	0
A126	6266500N	652500E	3a	Mm	3	0	0
A127	6266100N	652100E	3a	Mm	1	0	0
A128	6269500N	672400E	8/22	Mu	2	0	0
A129	6269200N	671800E	8/22	Mu	9	17	11
A130	6271400N	671300E	8/22	Mu	7	0	0

Transects 1–56: 1995

57–66, 97–108: Northern 1997
67–96: Central 1997
109–130: Southern 1997
Site key: A.l. = *Acacia ligulata*, A.o. = *Alectryon oleifolius* subsp. *canescens*, B.o. = *Beyeria bursariifolia*, Ca.p. = *Callitris preissii*, C.p. = *Casuarina pauper*, D.b. = *Dodonaea bursariifolia*, D.h. = *Duboisia hopwoodii*, D.v. = *Dodonaea viscosa*, G.p. = *Grevillea pterosperma*, L.c. = *Leptospermum coriaceum*, T.s. = *Triodia scariosa*.
(X) = number of quadrats out of a total of 10, in which *Triodia scariosa* was found.

Transects

T	North	East	Vegetation	Soil	Site	Ordination group	Total no. of species	Exotic species	% exotic species
1	6296200N	664900E	3a	Ov	Mallee, no T.s.	1	57	9	16
2	6295000N	667400E	3a	Mm	Mallee, T.s. (6)	3	49	5	10
3	6294000N	669200E	3a	Mm	Open C.p., no T.s.	3	53	7	13
4	6292100N	678600E	3a	Ap	Mallee, Ca.p., T.s. (7)	1	50	6	12
5	6291700N	678600E	3a	Ap	Mallee, T.s. (10)	2	28	1	4
6	6291900N	678400E	3a	Ap	Mallee dune crest, T.s. (7)	1	46	4	9
7	6291400N	678000E	3a	Ap	Dense mallee, T.s. (10)	2	39	2	5
8	6292800N	677300E	3a	Ap	Mallee, Ca.p.,T.s (10)	2	28	0	0
9	6291600N	676400E	3a	Ap	Lake Shore, D.h., no T.s.	1	40	10	25
10	6290800N	674200E	3a	Mm	Mallee, T.s. (2)	3	57	5	9
11	6290700N	674800E	3a	Mm/Ap	Lake bed, no T.s.	3	46	10	22
12	6290300N	674700E	4	Mm/Ap	Mallee, T.s. (9)	1	40	1	3
13	6291300N	675600E	3a	Ap	Mallee, T.s. (8)	1	49	6	12
14	6291200N	675900E	3a	Ap	Mallee on dune crest, T.s. (10)	1	53	4	8
15	6290200N	676750E	4	Mm/Ap	Mallee on dune crest, T.s. (10)	2	35	1	3
16	6291600N	676750E	3a	Ap	Mallee, Ca.p., T.s. (9)	2	24	3	13

Transects

T	North	East	Vegetation	Soil	Site	Ordination group	Total no. of species	Exotic species	% exotic species
17	6291100N	677600E	3a	Ap	Mallee, T.s. (9)	2	28	1	4
18	6291250N	678200E	3a	Ap	Mallee, G.p., T.s. (10)	2	24	0	0
19	6290700N	679100E	3a	Ap	Lake edge mallee, D.h., T.s. (9)	2	31	3	10
20	6291000N	680000E	3a	Ap	Lake bed, no T.s.	3	33	9	27
21	6290750N	680000E	3a	Ap	Sparse mallee, T.s. (9)	1	57	10	18
22	6294500N	673800E	OA/4sc	Mm	Sandy low mallee, T.s. (10)	2	28	1	4
23	6294400N	675700E	3a	Mm	Mallee on red sand, no T.s.	1	52	4	8
24	6294000N	675600E	3a	Mm	Low mallee, T.s. (8)	2	29	1	3
25	6293800N	677000E	3a	Mm	Mallee on red sand, T.s. (10)	2	36	1	3
26	6293300N	679900E	3a	Ap	Mallee, T.s. (9)	2	31	2	6
27	6293300N	680700E	3a	Ap	Dune crest mallee, red sand, T.s. (10)	1	45	3	7
28	6293300N	681400E	3a	Mm	Dune crest mallee, red sand, T.s. (10)	1	45	4	9
29	6293200N	682900E	3a	Mm	Dune crest mallee, red sand, T.s. (8)	1	51	5	10
30	6292900N	683000E	3a	Mm	Dune crest mallee, red sand, T.s. (3)	1	49	7	14
31	6291200N	682800E	3a	Lh	Mature mallee, T.s. (9)	2	26	3	12
32	6289200N	680800E	3b	Ap	Mallee, red sand, T.s. (3)	1	52	11	21
33	6289100N	681500E	3b	Ap	Mallee, Ca.p., T.s. (5)	1	47	8	17
34	6292400N	677600E	3a	Ap	Mallee, Ca.p., T.s. (10)	2	21	3	14
35	6309200N	696700E	4/30	Gn	D.v., no T.s. (mapped as Hopwood community by Porteners et al. 1997)	3	45	9	20
36	6290400N	679300E	3a	Ap	Mallee, G.p., T.s. (10)	1	47	8	17
37	6290300N	678750E	3a	Ap	Mallee, lichens, T.s. (9)	2	29	1	3
38	6289900N	678100E	3b	Ap	Dune crest mallee, surface clay/loam, T.s. (8)	3	32	1	3

Transects

T	North	East	Vegetation	Soil	Site	Ordination group	Total no. of species	Exotic species	% exotic species
39	6290200N	677800E	3b	Ap	Mallee on rocky outcrop, C.p., T.s. (2)	3	44	6	14
40	6290300N	678300E	3a	Ap	Depression, Ca.p., T.s. (9)	1	38	8	21
41	6291250N	679600E	3a	Ap	Mallee, T.s. (9)	2	24	6	25
42	6291400N	679800E	3a	Ap	Depression, D.h., T.s. (7)	1	28	6	21
43	6291750N	679300E	3a	Ap	Lake bed, no T.s.	3	36	7	19
44	6291900N	679100E	3a	Ap	Mallee, no T.s.	1	39	7	18
45	6297200N	679500E	3a	Mm	C.p. woodland, no T.s.	3	28	2	7
46	6289100N	676900E	3b	Ap	Mallee, open sand, T.s. (4)	1	36	3	8
47	6289000N	677500E	3b	Ap	Mallee on clay depression, C.p., no T.s.	3	46	2	4
48	6290100N	675250E	3b	Ap	Mallee, Ca.p., T.s. (4)	2	43	4	9
49	6291400N	674750E	3a	Mm	Mallee, T.s. (10)	1	36	3	8
50	6293200N	677600E	3a	Ap	D.v., no T.s.	3	41	7	17
51	6293300N	678000E	3a	Ap	Mallee, Ca.p., T.s. (2)	2	25	3	12
52	6283600N	671600E	3b	Ap	Dune crest mallee, T.s. (10)	2	28	2	7
53	6282600N	671400E	3b	Ap	Dune crest mallee, T.s. (7)	2	47	3	6
54	6281200N	671100E	3a	Mm/Ap	Mallee, T.s. (10)	2	37	4	11
55	6275600N	670400E	3a	Ap	Lake bed, A.o., T.s. (4)	3	34	6	18
56	6275000N	666400E	3a	Mm	Mallee, T.s. (10)	1	31	3	10
57	6314100N	687900E	3b	Mm	Lake bed, C.p., no T.s.	3	31	2	6
58	6312800N	688800E	3a	Mm	Dune crest, sandy, mallee, no T.s.	1	49	5	10
59	6312200N	688200E	3a	Mm	Mallee, T.s. (10)	2	28	2	7
60	6311800N	688000E	3a	Mm	Dune crest, sandy, L.c., T.s. (10)	1	19	1	5
61	6311900N	686800E	3a	Mm	Mallee, T.s. (10)	2	29	1	3

Transects

T	North	East	Vegetation	Soil	Site	Ordination group	Total no. of species	Exotic species	% exotic species
62	6312000N	685300E	3a	Mm	Mallee, T.s. (10)	2	13	0	0
63	6311200N	685100E	3a	Mm	Mallee, no T.s.	3	50	8	16
64	6310000N	688200E	3a	Mm	Dune crest, L.c., T.s. (3)	1	32	2	6
65	6309750N	688200E	3a	Mm	Lake bed, no T.s.	3	26	5	19
66	6308400N	687400E	3a	Mm	Mallee, T.s. (9)	1	52	6	12
67	6280600N	659700E	3a	Mm	Mallee, T.s. (10)	2	22	0	0
68	6280500N	660600E	3a	Mm	Mallee, L..c., T.s. (10)	2	23	1	4
69	6281400N	660600E	3a	Mm	Mallee, T.s. (10)	2	19	0	0
70	6282700N	660100E	3a	Mm	Mallee, T.s. (10)	2	20	1	5
71	6283400N	660000E	3a	Mm	Dune crest, A.l., T.s. (5)	2	33	4	12
72	6288500N	668400E	4	Mm	Lake bed, C.p., no T.s.	3	43	2	5
73	6288000N	668550E	3b	Mm	Lake bed, no T.s.	3	34	0	0
74	6287600N	668600E	3b	Mm	Mallee, T.s. (4)	1	55	6	11
75	6286400N	669200E	3b	Mm	Mallee, T.s. (10)	2	34	0	0
76	6284700N	668900E	3b	Mm	Mallee, T.s. (8)	1	43	1	2
77	6284500N	670600E	3b	Mm	Lake bed, C.p., no T.s.	3	29	0	0
78	6290700N	674800E	3a	Mm	Lake bed, no T.s.	3	40	5	13
79	6291250N	678200E	3a	Ap	Mallee on gravel slope, T.s. (10)	2	19	0	0
80	6287800N	673000E	4	Mm	C.p., no T.s.	3	30	0	0
81	6286700N	671800E	3b	Mm	D.v., no T.s.	3	33	3	9
82	6284750N	671500E	3b	Mm	Lake bed, A.o. with mallee, no T.s.	3	40	3	8
83	6283500N	670500E	3b	Ap	Mallee near dune crest, T.s. (9)	2	34	2	6
84	6280400N	671750E	3a	Mm	Mallee, T.s. (9)	2	29	0	0

Transects

T	North	East	Vegetation	Soil	Site	Ordination group	Total no. of species	Exotic species	% exotic species
85	6280100N	671500E	3a	Mm	Dune crest, A.. l., T.s. (10)	2	26	1	4
86	6281700N	671000E	3b	Ap	Lake bed, C.p., A.o., no T.s.	3	57	5	9
87	6281400N	670000E	3a	Ap	Ridgetop with mallee, T.s. (10)	2	33	2	6
88	6280900N	667900E	3a	Mm	Sparse mallee, A.l., T.s. (5)	2	34	1	3
89	6281200N	665750E	3a	Mm	Lake bed, no T.s.	3	47	5	9
90	6279900N	664200E	3a	Mm	Sparse mallee, T.s. (4)	2	33	2	6
91	6277900N	661900E	3a	Mm	Lake bed, no T.s.	3	47	4	9
92	6276800N	658500E	3a	Mm	Lake bed, C.p., no T.s.	3	37	1	3
93	6277850N	657600E	3a	Mm	Lake bed, C.p., no T.s.	3	20	1	5
94	6278700N	656100E	3a	Mm	Open sand plain, T.s. (1)	1	38	5	13
95	6279700N	653000E	3a	Mm	Mallee with B.o., T.s. (5)	2	30	0	0
96	6278400N	656700E	3a	Mm	Mallee on gravel slope, T.s. (6)	2	25	0	0
97	6311000N	689900E	3a	Mm	Sand dune mallee, T.s. (4)	1	50	5	10
98	6310700N	689200E	3a	Mm	Low sand ridge, open mallee woodland, no T.s.	1	34	4	12
99	6310400N	688900E	3a	Mm	Ridgetop woodland, A.o., no T.s.	1	48	13	27
100	6309900N	687400E	3a	Mm	Lake bed, C.p., A.o., no T.s.	3	38	6	16
101	6308700N	686000E	3a	Mm	Mallee, T.s. (10)	2	29	3	10
102	6307400N	685900E	3a	Mm	Mallee, T.s. (8)	2	28	0	0
103	6306500N	685800E	3a	Mm	Mallee, T.s. (8)	2	23	1	4
104	6305800N	687100E	3a	Mm	Lake bed, C.p., A.o., no T.s.	3	54	6	11
105	6306700N	687200E	3a	Mm	Mallee, T.s. (10)	2	25	2	8
106	6307700N	686900E	3a	Mm	Mallee, T.s. (8)	2	30	1	3
107	6308200N	687200E	3a	Mm	Dune ridge, A.o., no T.s.	1	46	10	22

Transects

T	North	East	Vegetation	Soil	Site	Ordination group	Total no. of species	Exotic species	% exotic species
108	6308900N	687800E	3a	Mm	Mallee, T.s. (10)	2	29	3	10
109	6267400N	649500E	3a	Mm	D.v., no T.s.	3	33	5	15
110	6262900N	661600E	3a	Mm	Mallee on dune crest, T.s. (8)	2	46	6	13
111	6261600N	662000E	3a	Mm	Mallee on dune crest, T.s. (2)	2	43	2	5
112	6261200N	661000E	3a	Mm	Swale of parabolic dune, no T.s.	3	23	3	13
113	6259500N	658100E	3a	Mm	Mallee on dune crest, T.s. (9)	2	44	1	2
114	6260100N	658100E	3a	Mm	Mallee on red swale, D.b., T.s. (2)	2	30	0	0
115	6260100N	658500E	3a	Mm	Sand plain mallee, T.s. (10)	2	40	2	5
116	6261700N	658650E	3a	Mm	Sand plain mallee, T.s. (10)	2	30	0	0
117	6262800N	658850E	3a	Mm	Sand plain mallee, T.s. (8)	2	25	0	0
118	6262600N	669600E	3a	Mm	Sand plain mallee, T.s. (7)	2	40	0	0
119	6263700N	669800E	3a	Mm	Mallee on red swale, T.s. (10)	2	26	0	0
120	6264400N	670000E	3a	Mm	Dune crest mallee, T.s. (10)	2	27	0	0
121	6265100N	670000E	3a	Mm	Sand plain mallee, T.s. (9)	2	18	1	6
122	6261500N	648900E	3b	Mm	Red swale, T.s. (3)	2	32	0	0
123	6264200N	649100E	3a	Mm	Sand plain mallee, T.s. (10)	2	26	0	0
124	6265600N	649300E	3a	Mm	Dune crest mallee, T.s. (8)	2	31	0	0
125	6266800N	651500E	3a	Mm	Mallee on red swale, no T.s.	3	45	5	11
126	6266500N	652500E	3a	Mm	Dune crest mallee, T.s. (10)	2	13	0	0
127	6266100N	652100E	3a	Mm	Sand plain mallee, T.s. (9)	2	25	0	0
128	6269500N	672400E	8/22	Mu	Lake bed, no T.s.	3	58	11	19
129	6269200N	671800E	8/22	Mu	Lake bed, no T.s.	3	32	6	19
130	6271400N	671300E	8/22	Mu	Lake bed, no T.s.	3	39	9	23

Appendix 2. Ephemeral Species

Key : * : exotic species
95: 1995 survey
97e: entire 1997 survey
N: northern area, 1997
C: central area, 1997
S: southern area, 1997

Species	**95**	**97e**	**N**	**C**	**S**
<u>Dicotyledons</u>					
Aizoaceae					
Tetragonia moorei sp. nov.	x	x	x	x	x
Apiaceae					
Daucus glochidiatus	x	x	x	x	x
Trachymene cyanopetala	x	x		x	x
Trachymene sp. (unidentified)		x		x	
Asteraceae					
Actinobole uliginosum	x	x	x	x	x
Angianthus brachypappus		x			x
Angianthus tomentosus		x			x
Brachycome leptocarpa	x				
Brachycome lineariloba	x	x	x	x	x
Bracteantha bracteata	x				
Calotis cymbacantha	x				
Calotis hispidula	x	x	x	x	x
**Carthamus lanatus*	x				
**Centaurea melitensis*	x	x	x		
Centipeda thespidioides	x				
Ceratogyne obionoides		x		x	x
Chthonocephalus pseudevax		x	x	x	x
Epaltes australis	x				
Gnaphalium sphaericum	x	x		x	
Gnephosis eriocarpa	x				
Gnephosis tenuissima	x	x	x	x	x
Hyalosperma semisterile		x			x
**Hypochoeris glabra*	x	x	x	x	x
Isoetopsis graminifolia	x	x	x	x	x
Lemooria burkittii	x	x	x	x	x
Millotia macrocarpa	x	x	x	x	x
Millotia perpusilla		x		x	x
Millotia tenuifolia var. *tenuifolia*		x			x
Myriocephalus pluriflorus		x		x	
Myriocephalus stuartii	x	x	x	x	x
Podolepis capillaris	x	x	x	x	x
Podolepis sp. (unidentified)		x		x	
Podotheca angustifolia	x	x		x	x
Pogonolepis muelleriana	x	x		x	x
Pseudognaphalium luteoalbum	x				
Rhodanthe corymbiflora		x			x
Rhodanthe floribunda	x	x	x		
Rhodanthe microglossa	x				
Rhodanthe moschata	x	x	x	x	x
Rhodanthe pygmaea		x	x	x	x
Rhodanthe sp.		x			x
Rhodanthe stuartiana		x	x	x	x
Rhodanthe uniflora	x	x			x
Senecio glossanthus	x	x	x	x	x
Senecio gregorii	x				
**Sonchus asper*		x	x		
**Sonchus oleraceus*	x	x	x		x
Stuartina hamata		x		x	

Species	95	97e	N	C	S
Asteraceae cont.					
Stuartina muelleri		x			x
Triptilodiscus pygmaeus	x	x		x	x
Vittadinia cervicularis subsp. *cervicularis*		x	x		x
Vittadinia cuneata var. *morrisii*	x	x	x	x	
Vittadinia dissecta var. *hirta*	x	x	x	x	x
Vittadinia eremaea	x	x	x	x	x
Vittadinia pterochaeta	x	x		x	
Vittadinia sp.	x	x	x	x	x
Vittadinia sulcata	x	x	x	x	
Waitzia acuminata	x	x	x	x	x
Boraginaceae					
**Echium plantagineum*	x				
Omphalolappula concava	x	x	x	x	x
Plagiobothrys plurisepaleus		x	x	x	x
Brassicaceae					
**Alyssum linifolium*	x	x	x	x	x
Blennodia canescens	x	x	x	x	
**Brassica tournefortii*	x	x	x	x	x
**Carrichtera annua*		x	x		
Geococcus pusillus		x			x
Harmsiodoxa brevipes var. *brevipes*	x	x	x	x	x
Lepidium fasciculatum	x				
Lepidium monoplocoides		x		x	
Lepidium papillosum	x	x	x	x	x
Lepidium phlebopetalum	x	x	x	x	x
**Lepidium* sp.		x	x	x	x
Menkea australis		x	x	x	x
Sisymbrium erysimoides		x		x	x
Stenopetalum lineare	x	x	x	x	x
Stenopetalum sphaerocarpum		x		x	x
Campanulaceae					
Wahlenbergia gracilenta	x	x	x	x	x
Wahlenbergia tumidifructa	x	x	x	x	
Caryophyllaceae					
Gypsophila australis		x	x		
**Herniaria hirsuta*	x	x	x	x	
**Sagina apetala*		x		x	
Scleranthus minusculus	x	x	x	x	x
**Silene apetala*	x	x	x	x	x
**Silene nocturna*		x			x
Chenopodiaceae					
Chenopodium cristatum	x	x		x	x
Chenopodium desertorum subsp. *desertorum*			x	x	x
Chenopodium desertorum subsp. indet.	x				
Chenopodium desertorum subsp. *rectum*	x		x	x	x
Chenopodium melanocarpum	x	x	x	x	x
Crassulaceae					
Crassula colorata var. *acuminata*	x	x	x	x	x
Euphorbiaceae					
Poranthera microphylla	x	x		x	
Fabaceae Faboideae					
**Medicago laciniata*		x	x		
**Medicago minima*	x	x	x	x	x
Geraniaceae					
**Erodium cicutarium*	x	x	x	x	x
Erodium crinitum	x	x	x	x	x
Erodium cygnorum subsp. *glandulosum*	x	x	x	x	
Erodium sp.		x	x	x	

Species	95	97e	N	C	S
Goodeniaceae					
Goodenia havilandii	x	x	x	x	x
Goodenia pusilliflora	x	x	x	x	x
Malvaceae					
**Malva parviflora*	x				
Plantaginaceae					
Plantago cunninghamii	x				
Plantago drummondii	x	x		x	x
Plantago sp.		x	x		x
Plantago turrifera	x	x	x	x	x
Portulacaceae					
Calandrinia eremaea	x	x	x	x	x
Calandrinia granulifera		x		x	x
Ranunculaceae					
Myosurus minimus var. *australis*	x				
Ranunculus pentandrus var. *platycarpus*		x			x
**Ranunculus trilobus*	x				
Rubiaceae					
Synaptantha tillaeacea		x		x	
Solanaceae					
Nicotiana occidentalis subsp. *obliqua*	x		x	x	x
Thymelaeaceae					
Pimelea trichostachya	x	x	x	x	x
Urticaceae					
Parietaria debilis		x	x	x	x
Zygophyllaceae					
Zygophyllum ammophilum	x	x	x	x	x
Zygophyllum apiculatum	x	x	x	x	x
Zygophyllum aurantiacum	x				
Zygophyllum iodocarpum	x	x	x	x	
Zygophyllum ovatum	x	x	x	x	
Zygophyllum simile	x	x	x	x	x
<u>Monocotyledons</u>					
Asphodelaceae					
Bulbine semibarbata	x	x	x	x	x
Juncaginaceae					
Triglochin calcitrapum		x	x	x	x
Poaceae					
Agrostis avenacea	x				
**Aira caryophyllea*	x	x	x	x	
Bromus arenarius	x	x	x	x	x
**Bromus rubens*	x	x	x	x	x
**Bromus* sp.	x				
**Hordeum leporinum*	x	x	x		
**Hordeum marinum*		x			x
Pentaschistis airoides		x	x	x	x
Poa fax	x				
**Rostraria pumila*	x	x	x	x	x
**Schismus barbatus*	x	x	x	x	x
**Vulpia bromoides*	x	x			x
**Vulpia muralis*	x	x		x	
**Vulpia myuros*	x	x	x	x	x
**Vulpia* sp.		x		x	x