The vegetation of Mungo National Park, Western New South Wales

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Westbrooke, M.E. and Miller, J.D. (University of Ballarat, PO Box 663, Ballarat, Victoria, Australia, 3353) 1995. The vegetation of Mungo National Park, Western New South Wales. Cunninghamia *4(1): 63–80.* The vegetation of Mungo National Park and the adjacent Joulni Station (latitude 33°43'S and longitude 143°02'E) in south-western New South Wales within the Balranald local government area was assessed using intensive quadrat sampling and mapped using extensive ground truthing, aerial photograph interpretation and Landsat Thematic Mapper satellite image analysis. Two hundred and thirty five species of vascular plants were recorded from 55 families including 62 (26%) exotic species. Twenty vegetation communities were identified of which the most widespread were *Maireana* spp. low open-shrubland, *Atriplex vesicaria* subsp. *vesicaria* low open-shrubland, *Bromus rubens/Hordeum marinum* herbland, *Eucalyptus* spp. open-shrubland and *Casuarina pauper* woodland/open-woodland. One hundred and fifty years of grazing by introduced herbivores has resulted in degradation of many of these communities.

Introduction

Mungo National Park (latitude 33°43'S and longitude 143°02'E) is located in far south western New South Wales 100 km north east of Mildura. It is located within the Balranald local government area. It was established in 1979, following significant archaeological finds, to protect the geomorphological, cultural and biological features of this portion of the Willandra Lakes system. Joulni Station immediately south of the Park, includes part of Lake Mungo and was included in this study. Mungo N.P. and Joulni Station together occupy approximately 47 000 ha incorporating most of Lake Mungo and parts of Lakes Arumpo and Leaghur, as well as extensive areas of dunes and sand plains to the east of the Lakes.

History of the area

Aboriginal occupation of Lake Mungo dates from least 40 000 years ago at which time the lake contained fresh water from Willandra Creek (Bowler & Thorne 1976). Since that time the climate has fluctuated and Aboriginal occupation probably fluctuated as the lake levels rose and fell. From 1838 grazing was established in south-western New South Wales, initially on the Murray and Darling Rivers, but later, areas away from the rivers were also utilised. Gol Gol Station (203 000 ha) which included Lake Mungo was established in the 1860s. The land was overstocked and large quantities of perennial vegetation were cut for feed. The arrival of rabbits, coupled with the onset of severe drought in the late 1890s, led to massive soil erosion including the exposure of the Lake Mungo lunette. At its peak the Mungo

woolshed on Gol Gol Station was used to shear up to 50 000 sheep but in 1922 the Station was broken up into a number of 16 000 ha 'soldier settlement' blocks including Mungo, Zanci and Joulni. The three properties were owned by members of the Barnes family until the purchase of Mungo by the NSW National Parks and Wildlife Service in 1978 and the addition of the adjacent Zanci Station in 1984. The area forms part of the 35 000 km^2 Willandra Lakes World Heritage area.

Climate

The climate is classified as cool semi-arid (Dick 1975), the area being within climatic zone 1B for New South Wales (Edwards, 1979): temperatures are high in summer and mild in winter with average daily maximum of 32° C in February and 15° C in July and average daily minimum of 16° C in February and 5° C in July; the mean annual rainfall is approximately 250 mm; the seasonal distribution of rainfall is fairly even but annual variation is high.

Geology and geomorphology

The study area lies within the Murray Basin geological province and consists of Quaternary material, with little rock outcropping (Lawrie and Stanley 1980). The area is dominated by parts of the Willandra Lakes System, relic features from the Pleistocene when they were filled by the Willandra Creek flowing through to the Murrumbidgee River (Magee undated). Three broad land systems are present (Walker 1991):

- the lake beds consisting of slightly saline calcareous clays and their associated lunettes of deep loosely cemented white sands and clay formed by deposition of particles from the lake bed
- dunefields consisting of low parallel ridges running east-west composed of red earthy sands and sandy solonised brown soils overlying sandy clays
- calcareous sandplains of loam or sandy loam solonised brown soils often with limestone nodules at the surface.

Previous studies

The most complete study of the vegetation of far western New South Wales is that by Beadle (1945, 1948) who included Mungo and Joulni within the *'Kochia pyramidata–K. sedifolia'*, *'Atriplex vesicaria'* and *'Casuarina-Heterodendron'* associations. Noy-Meir (1971) carried out a quantitative analysis of the large area of mallee shrubland in south-western New South Wales and north-western Victoria. More recently the National Herbarium of NSW, Sydney, has undertaken mapping of the vegetation of the area at 1: 250 000 scale: reports on Ana Branch-Mildura sheet (Fox 1991) to the west, Balranald-Swan Hill sheet (Scott 1992) to the south of the study area and the Hay Plain sheet (Porteners 1993) to the east of the study area have been published. A study

of the vegetation of the Willandra Lakes World Heritage Area was undertaken for the New South Wales Department of Planning and Environment (Rice 1987). Magee (undated) includes notes on the vegetation in his resource survey of the Willandra Lakes Region. A detailed survey and map of vegetation in Mallee Cliffs National Park to the south west of Mungo has also been published (Morcom & Westbrooke 1990). Mills (1984) undertook a preliminary vegetation survey of Mungo National Park but no systematic survey of the vegetation of the Park has been undertaken.

Methods

Two hundred 0.09 ha. (30 m x 30 m) quadrats were sampled and all vascular plant species occurring were recorded, together with a cover abundance value for each species modified from Braun-Blanquet (1928). Quadrats were subjectively located following the method of Gullan et al. (1979). This method ensured that all communities were sampled and provided data on floristic variability within the communities. Communities were in general sampled in proportion to the area they covered, however, since many quadrats were located along transects wherever community type was observed to change, those with a discontinuous distribution may tend to be over-sampled. Sampling was undertaken from the 8th to 16th September 1992.

The vegetation was classified using the computer based PATN (Belbin 1993) statistical package. The method used was an hierarchical, polythetic agglomerative classification using the Bray-Curtis (Belbin 1993) measure of association in conjunction with the Unweighted Pair Group Mean Arithmetic (UPGMA) fusion strategy. The resultant dendrogram displaying the relationships between quadrats, was assessed and subjectively and cut at the 17 group level. Each quadrat grouping on the dendrogram corresponded to a vegetation community and was deemed to adequately represent the vegetation communities recorded intuitively in the field. A further three restricted and/or interesting communities recorded during the field work but not evident from the numeric classification were added to the final classification to provide 20 vegetation communities. All vascular plant species recorded, from sampled quadrats and from opportunistic collection, were identified and a species list compiled (Appendix 2). For each quadrat the mean species richness and number of exotic species as a proportion of the total number of species was calculated (Table 1).

During a survey in September 1992 ground truthing was undertaken by driven (240km) and walked (210 km) transects. Information from these transects was used in conjunction with study of black and white aerial photographs and Landsat Thematic Mapper satellite image data (Scene 96–83 acquired on 13 April 1990) to produce a vegetation map at 1:50 000, subsequently reduced to 1:100 000 scale for publication. The vegetation communities mapped were defined by floristic and structural characteristics (Specht 1970).

All processing and manipulation of the digital satellite data was conducted using microBRIAN ver. 3.1 (MPA 1992). A supervised classification of the image, based on training sets derived from the vegetation classification, was undertaken. Due to

wide variation in the density and composition of the understorey species across the quadrats it was not possible to distinguish between many of the communities with any confidence. It was however possible to distinguish between the overstorey dominants. As a result, the 20 communities from the vegetation classification were reduced to six vegetation types (e.g. Tall Shrubland – Mallee spp.) for the mapping phase. The minor vegetation types of very restricted occurrence, e.g. *Acacia aneura, A. loderi,* were unable to be mapped at this scale. Difficulty was experienced with the classification of the *Callitris* woodland due to the sparseness of the the community and the background of herbland. This community was later added to the image. The classified image was then transferred to the Environmental Resources Mapping System Geographic Information System database for final production at a 30 m cell size, which co-incided with the minimum area on the map.

Results

The vegetation of the study area consists predominantly of *Casuarina pauper* open-woodland, *Eucalyptus gracilis/ E. dumosa/ E. socialis* open scrub, and Chenopod open-shrublands but 20 distinct communities were recognised (Table 1). While several of the communities are of limited distribution they add significantly to the conservation values of the area. The approximate area occupied by each community, the sampling intensity, mean species richness and mean % weediness of these communities are given in Table 1.

Vegetation communities are described below, grouped according to structural attributes. The distribution of vegetation types is shown on the vegetation map of Mungo National Park and Joulni Station provided inside the back cover.

223 vascular plant species from 55 families were recorded from the Park including 50 (22%) exotics. The seven species of mistletoe recorded in this study and the hosts on which they occurred are given in Table 2. An additional 12 species were recorded as artificial plantings. Though not naturalised these may be of historic or cultural significance.

The following species have not been previously recorded from South Far Western Plains Botanical subdivision (Jacobs and Pickard 1981; Jacobs and Lapinpuro 1986; Harden 1990, 1991; Morcom and Westbrooke 1990; Scott 1992): *Dianella revoluta* var. *revoluta, Pterostylis biseta, Brachycome perpusilla* var. *tenella, Harmsiodoxa brevipes* var. *brevipes* and *Lysiana linearifolia.*

Fieldwork was conducted in cool weather over two weeks following good rains. Mean percentage occurrence of exotic species ranged from 12% in the *Eucalyptus* open-shrubland with *Triodia* understorey (2b) to 47% in the herblands (Table 1). The highest levels of occurrence of exotic species were in communities subject to the greatest grazing pressure, i.e. the *Nitraria billardierei* open-shrubland found close to tanks, the herblands also associated with tanks and the *Callitris glaucophylla* open-woodland on the dunes which had been exposed to high grazing pressure from rabbits. A high negative correlation between occurrence of exotic species and distance from water in studies at Mallee Cliffs National Park and Nanya Station was found by Westbrooke (1990)

Table 1. Community, percentage of area, sampling intensity, species richness (species per quadrat) and weediness (percentage of exotics) of the plant communities of Mungo National Park and Joulni Station

Community	Area (%)	No. of quadrats	Mean species per quadrat	Exotics (%)
1a Eucalyptus largiflorens, Black Box open-woodland	<1	2	23	33
1b Casuarina pauper, Belah woodland/open-woodland	8	55	19	26
1c Callitris glaucophylla, Cypress-pine open-woodland	1	21	14	44
2a *Eucalyptus* spp. open-shrubland with shrub understorey		18	22	18
2b Eucalyptus spp. open-shrubland with *Triodia* understorey	22	18	12	2
3a Acacia aneura, Mulga open-woodland	<1	1	27	26
3b Acacia melvillei, Yarran tall open-shrubland	1	8	18	33
3c Acacia loderi, Nealie tall open-shrubland	<1	2	23	27
3d Acacia ligulata, Sandhill Wattle low open-shrubland	1	2	11	38
4a Dodonaea viscosa subsp. *angustissima*, Hopbush shrubland	1	5	26	26
4b Maireana pyramidata/M. sedifolia, Bluebush low open-shrubland	24	29	15	33
4c Atriplex vesicaria subsp. *vesicaria*, Bladder Saltbush low open-shrubland	20	18	13	31
4d Atriplex nummularia, Old-man Saltbush low open-shrubland	<1	4	17	31
4e Nitraria billardierei, Dillon Bush low open-shrubland	4	29	23	39
4f Chenopodium nitrariaceum, Nitre Goosefoot low open-shrubland	<1	2	7	46
4g Muehlenbeckia florentula, Lignum low open-shrubland	<1	1	10	33
4h Lycium australe, Austral Boxthorn low open-shrubland	<1	1	32	28
5a Eragrostis australasica, Canegrass tussock grassland	<1	3	13	20
5b Bromus rubens, Red Brome/*Hordeum marinum*, Sea Barley-grass herbland	17	13	17	47
5c Atriplex lindleyi, Annual Saltbush herbland	1	3	8	12

Table 2. Species of mistletoe and their hosts

Mistletoe	Hosts
Amyema linophyllum subsp. *orientale*	*Casuarina pauper*
Amyema miquelii	*Eucalyptus gracilis*
Amyema miraculosum subsp. *boormanii*	*Alectryon oleifolius*
Amyema preissii	*Casuarina pauper*
Amyema quandong	*Acacia melvillei*
Lysiana exocarpi	*Alectryon oleifolius, Casuarina pauper, Geijera parviflora, Myoporum platycarpum, Pittosporum phylliraeoides*
Lysiana linearifolia	*Casuarina pauper*

Description of plant communities

1. Woodlands

1a. *Eucalyptus largiflorens* open-woodland

Two small patches of *Eucalyptus largiflorens* open-woodland (10 metres tall) occur on heavy soil in the south western corner of Joulni Station adjacent to Box Tank. The understorey consists largely of exotic herbs and grasses including those widespread throughout the study area and others associated with moister fertile soils such as *Marrubium vulgare, Chenopodium murale* and *Sonchus oleraceus.*

1b. *Casuarina pauper* woodland/open-woodland

Casuarina pauper growing to 10–12 metres tall, occurs as a dominant species throughout the National Park on the brown loamy sands of interdune areas (Fig. 1). It is frequently associated with *Alectryon oleifolius* subsp. *canescens* and/or *Myoporum platycarpum* and *Geijera parviflora.*

Most commonly associated understorey shrubs are *Enchylaena tomentosa, Chenopodium curvispicatum, Maireana pyramidata* and *Sclerolaena patenticuspis.* Frequently occurring native herbs include *Tetragonia tetragonoides, Zygophyllum ammophilum, Pycnosorus pleiocephalus* and *Omphalolappula concava.* The widespread occurrence of exotic herbs including *Brassica tournefortii, Hordeum marinum, Medicago minima* and *M. polymorpha* reflects the long pastoral history of the area (Fig. 2).

The following five sub-communities can be recognised, although these may relate to past land-use rather than edaphic factors:

- *Casuarina pauper/Alectryon oleifolius* with a diverse, shrubby understorey
- *Casuarina pauper* occurring as dense mono-specific stands
- *Alectryon oleifolius* occurring as dense groves
- *Myoporum platycarpum* open-woodland

Fig. 1. *Casuarina pauper,* Belah, woodland/open-woodland with a diverse shrubby understorey near the western border of Mungo National Park.

Fig. 2. Much of the *Casuarina pauper*, Belah, woodland/open-woodland of Mungo National Park and Joulni Station has a sparse understorey.

- *Myoporum platycarpum/Geijera parviflora* woodland resulting from past removal of *Casuarina pauper* from the community by ringbarking (Western Lands Files).

1c. *Callitris glaucophylla* open-woodland

Callitris glaucophylla (10 metres tall) occurs as the dominant tree on sandy ridges to the east of Lake Mungo. The community carries an open understorey of herbs and grasses including the native species *Actinobole uliginosum, Calandrinia eremaea, Calotis hispidula, Crassula colorata* var. *acuminata, Rhodanthe moschata, Tetragonia tetragonoides* and *Zygophyllum ammophilum* with a very high occurrence of exotic weeds including *Brassica tournefortii, Bromus rubens, Erodium cicutarium, Hypochaeris glabra, Medicago polymorpha* and *Sisymbrium irio.*

2. Eucalypt shrublands (mallee)

2a. *Eucalyptus gracilis/ E. dumosa/ E. socialis* open-shrubland

Eucalyptus open-shrubland dominated by *E. gracilis, E. dumosa*, and *E. socialis* (8m tall) occurs on interdune plains of sandy-loam solonised soils. *Eucalyptus leptophylla* and *E. oleosa* occur less frequently. Associated understorey shrubs include *Atriplex stipitata, Dodonaea viscosa* subsp. *angustissima, Eremophila glabra, Maireana pentatropis* and *Enchylaena tomentosa.*

Native ground layer species include *Brachycome lineariloba, Calandrinia eremaea, Omphalolappula concava, Ptilotus seminudus, Sclerolaena diacantha, S. patenticuspis, Tetragonia tetragonoides* and *Zygophyllum ammophilum.*

There are few exotic species in this community.

2b. *Eucalyptus* open-shrubland with *Triodia* understorey

On low dune ridges where shallow sands overlie sandy clays a Eucalyptus open-shrubland community characterised by the presence of *Triodia scariosa* subsp. *scariosa* as the dominant component of the understorey occurs (Fig. 3).

Most frequent eucalypt dominants are *Eucalyptus socialis, E. gracilis, E. oleosa, E. costata* and *E. dumosa. Eucalyptus leptophylla* is an occasional associate.

Commonly associated shrubs include *Dodonaea viscosa* subsp. *angustissima*, *Maireana pentatropis*, *Eremophila glabra*, and *Grevillea huegelii*. Of interest is the occurrence of *Exocarpos sparteus* reported as infrequent in south west New South Wales (Cunningham et al., 1981). Native herbs include *Calandrinia eremaea*, *Waitzia acuminata* and *Lomandra leucocephala*. This is the least weedy of the communities of the study area.

3. Acacia shrublands

3a. *Acacia aneura* open-woodland

In the west of the Park is a patch of *Acacia aneura* open-woodland growing to 12 metres high. It is surrounded by *Casuarina pauper* woodland. The understorey is dominated by native and exotic herbs and grasses.

3b. *Acacia melvillei* tall open-shrubland

This community tends to occur on heavier soils and thus most sites are close to tanks and have been subjected to heavy grazing pressure. The understorey is dominated by exotic herbs and grasses, in particular *Hordeum marinum*, *Erodium cicutarium*, *Medicago polymorpha*, *Bromus rubens* and *Brassica tournefortii* along with the native *Tetragonia tetragonoides*.

3c. *Acacia loderi* tall open-shrubland

There are two small areas of *Acacia loderi* open-shrubland to 6 m, both on Joulni. The understorey is dominated by native and exotic herbs and grasses.

3d. *Acacia ligulata* low open-shrubland

Areas of *Acacia ligulata* low open-shrubland occur to 4 m on the Lake Mungo lunette. The understorey consists largely of native and exotic herbs. It is likely that this community has declined with erosion of the lunette.

4. Low open-shrublands

4a. *Dodonaea viscosa* subsp. *angustissima* shrubland

In a number of sites, *Dodonaea viscosa* subsp. *angustissima* forms dense stands to approximately two metres. This species is also found as a common understorey component of the *Eucalyptus* open-shrublands.

Fig. 3. *Eucalyptus* open-shrubland with *Triodia* understorey, an extensive community east of Lake Mungo, occupies 22% of the study area.

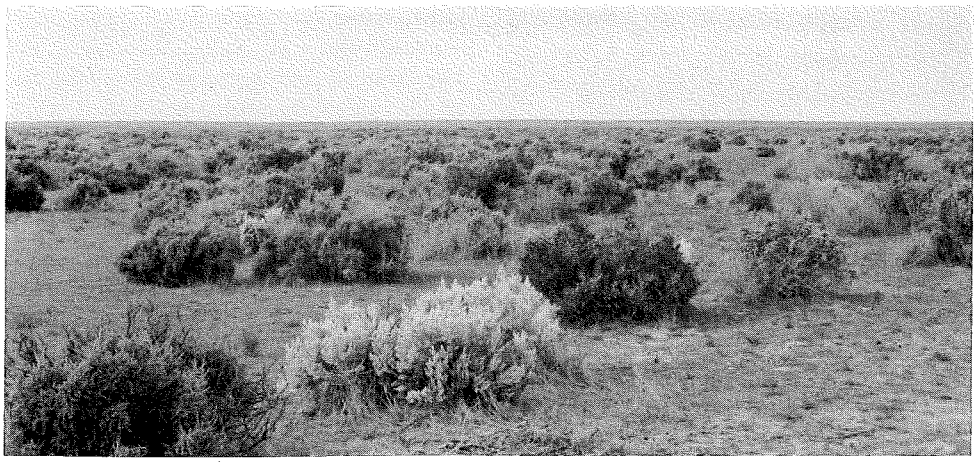

Fig. 4. *Maireana pyramidata/M. sedifolia* low open-shrubland is the most widespread community of Mungo National Parkand Joulni Station, occupying 24% of the area.

4b. *Maireana pyramidata/M. sedifolia* low open-shrubland

Low open-shrubland dominated by *Maireana pyramidata* is the most extensive community of the lake beds (Fig. 4). It is frequently associated in various proportions with *M. sedifolia*. *Maireana georgei* is also frequently associated. A large number of herbs occur in the ground layer but the most frequent are the exotics *Hordeum marinum, Bromus rubens* and *Medicago polymorpha* and the native *Tetragonia tetragonoides*.

4c. *Atriplex vesicaria* low open-shrubland

An open shrub community dominated by *Atriplex vesicaria* subsp. *vesicaria* is extensive in the lake bed. Frequently associated species include *Dissocarpus paradoxus, Tetragonia tetragonoides* and *Bulbine bulbosa*.

4d. *Atriplex nummularia* low open-shrubland

An open shrub community dominated by *Atriplex nummularia* occurs in localised sites in Lake Mungo. A number of commonly associated species are those associated with moist soils. These include *Atriplex holocarpa, Chenopodium nitrariaceum, Osteocarpum acropterum* var. *deminuta* and *Bulbine bulbosa*. The exotic grass *Hordeum marinum* was recorded from all quadrats.

4e. *Nitraria billardierei* low open-shrubland

Low open shrubland dominated by *Nitraria billardierei* occurs in the lake beds particularly around tanks and also on parts of the lunette. Associated shrubs include *Atriplex holocarpa, A. lindleyi, Chenopodium curvispicatum, C. nitrariaceum, Enchylaena tomentosa* and *Maireana pyramidata*. There is a high percentage weediness with *Bromus rubens, Hordeum marinum, Medicago polymorpha, Sisymbrium irio* and *Sonchus* spp. present in most quadrats.

4f. *Chenopodium nitrariaceum* low open-shrubland

Open shrubland to 2 m tall dominated by *Chenopodium nitrariaceum* occurs in similar situations to the *Nitraria* community. The ground layer consists largely of exotic herbs including *Hordeum marinum* and *Brassica tournefortii* along with native herbs such as *Omphalolapula concava* and *Harmsiodoxa blennodioides*.

4g. *Muehlenbeckia florentula* low open-shrubland

A low shrubland dominated by *Muehlenbeckia florentula* occurs in low lying sites in the Mungo lake bed associated with *Atriplex vesicaria* subsp. *vesicaria*.

4h. *Lycium australe* low open-shrubland

Small areas dominated by *Lycium australe* occur on both Mungo National Park and Joulni.

5. Grasslands/Herblands

5a. *Eragrostis australasica* tussock grassland

Small patches of *Eragrostis australasica* grassland occur in wetter areas of the lake bed generally in the vicinity of the *Atriplex nummularia* community 4d.

5b. *Bromus rubens/Hordeum marinum* herbland

Extensive herbland/open-herbland growing to 0.8 metres tall dominated by the exotic grasses *Bromus rubens* and *Hordeum marinum* with the exotic herbs *Brassica tournefortii, Erodium cicutarium, Medicago minima, Salvia verbenaca* and *Sisymbrium irio* and the native herbs *Tetragonia tetragonoides, Pycnosorus pleiocephalus, Erodium crinitum* and *Omphalolappula concava*.

The relative dominance of species varies dramatically with seasonal conditions, with the extent and seasonal distribution of rainfall being critical in determining relative species abundance.

5c. *Atriplex lindleyi* annual chenopod herbland

On scald areas of the lake beds an annual herbland has developed. This is dominated by *Atriplex lindleyi* but other chenopod species including *Dissocarpus paradoxus, Osteocarpum acropterum* var. *deminuta, Sclerolaena divaricata, Mareana ciliata* and the exotic *Hordeum marinum* are associated.

Discussion

The distribution and species composition of vegetation communities within Mungo National Park is largely determined by variation in topography, landform position and soil type. *Eucalyptus* open-shrubland with a *Triodia scariosa* understorey is associated with sandy soils on the low dunes. *Eucalyptus* open-shrubland with a shrub understorey occurs on the sandy loam, solonised brown soils of the calcareous sand plains. *Casuarina* woodland/low woodland occurs on calcareous plains of loamy solonised brown soils and chenopod shrublands on the calcareous clays of the lake beds. A number of other factors, notably fire and past grazing history, have also played a role in determining the present distribution and floristic composition of the communities present.

Eucalyptus open-shrubland communities are highly flammable and most of those in the Park and Joulni were burnt in the extensive wildfires of 1974/75 (Pickard 1987). Fire leads to an increase in certain species such as *Halgania cyanea, Exocarpos sparteus,* and *Haloragis odontocarpa,* but these species decline as *Triodia* hummocks redevelop (Noble and Mulham 1980). The Park is at the stage of post-fire succession where fire-promoted species are declining.

The pastoral history of the area is reflected in the high percentage weediness (mean 18%) and low native species richness (mean 18 spp.) of much of the *Eucalyptus* open-shrubland (community 2a) and the presence of extensive herblands dominated by exotic grasses and herbs particularly in the vicinity of earth tanks. Mitchell (1991) noted that introduced weed species colonised many of the scald areas left as a result of high grazing pressure prior to the 1950s. The earth tanks and their associated channels support areas that remain wetter or receive greater run-off than would be the case in an unmodified environment. This factor, together with the disturbance

Fig. 5. Whilst only occupying a small proportion of Mungo National Park *Callitris glaucophylla*, Cypress-pine, open woodland is a prominent feature of the dunes to the west of Lake Mungo but is severely degraded with the understorey consisting largely of exotic species.

caused by clearing and grazing, has contributed to the relative high number of weed species in the herblands. Westbrooke (1990) noted the high correlation between weediness and grazing pressure in the vicinity of earth tanks. It appears likely that the herblands originally carried other communities, i.e. chenopod shrublands or arid woodlands. Rabbits, goats and high kangaroo populations, partially sustained by permanent water in tanks, maintain grazing pressure on the herblands, possibly limiting recovery of the original communities. Dense stands of unpalatable *Nitraria billardierei* found around tanks are another effect of past grazing pressure (Cunningham et al. 1981, Scott 1992). Bracken and Gorman (1987) recommended the gradual closing of the majority of the tanks on Mungo National Park. This measure is strongly supported.

The *Dodonaea viscosa* subsp. *angustissima* shrublands (4a) are likely to result from past land-use, particularly the clearing of *Eucalyptus* open-shrubland and subsequent replacement by unpalatable species such as *Dodonaea*. Noble (1984) and Harrington et al. (1984) report an increase of *Dodonaea* spp. in response to grazing and the genus is also reported as an early coloniser following the clearing of mallee (Beadle 1948, Onans & Parsons 1980)

Callitris glaucophylla open-woodland has few native species (mean 7) and a high level of exotic species in the understorey (Fig. 5). Scott (1992), discussing the Balranald area immediately south of Mungo notes evidence for this community being more extensive in the past. Craven (unpubl.) has suggested that the decline of this community is related to a number of factors including harvesting, grazing pressure

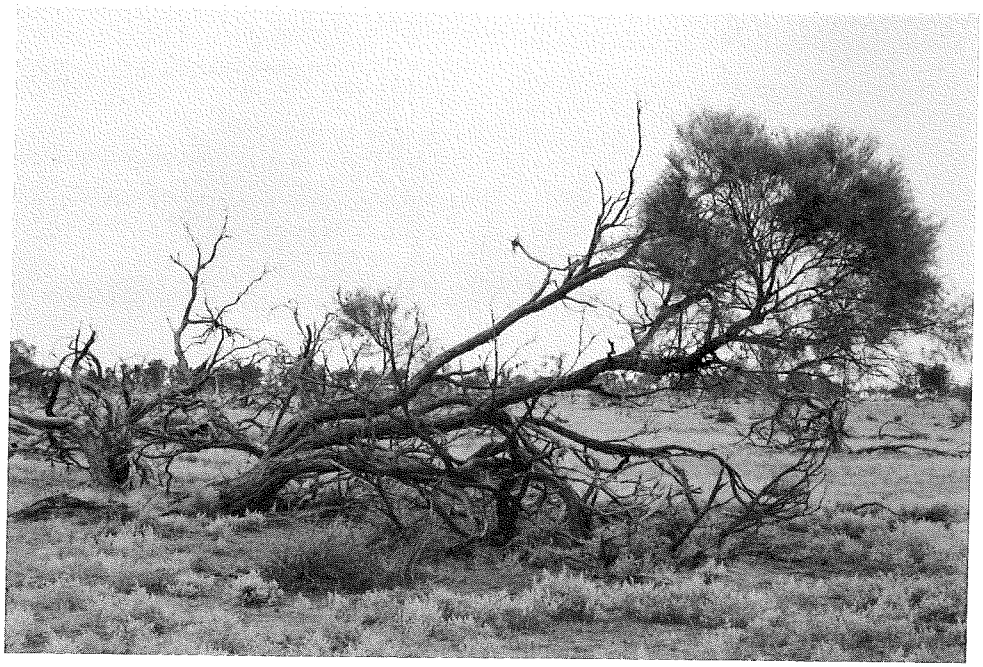

Fig. 6. *Acacia melvillei,* Yarran, tall open-shrubland is in a severely degraded condition with no recruitment. The conservation status of this community should be viewed with concern.

and changes in pasture composition from native grasses and forbs to exotic annual grasses and weeds.

Acacia melvillei tall open-shrubland is severely degraded (Fig. 6). Surviving shrub dominants are senescent, there is no regeneration and the conservation status of this community should be viewed with considerable concern. Scott (1992) and Batty and Parsons (1992) have raised concerns regarding this community elsewhere in the region and Mungo National Park is the only conservation reserve in which it is represented. It is important that steps are taken to protect and ensure rehabilitation of this community.

Whilst the vegetation of Joulni Station has been modified through its long pastoral history there would be a number of benefits from its addition to Mungo National Park. Most important is the complete protection of Lake Mungo and its associated geomorphological and archaeological features. Additionally the inclusion of a number of areas of *Acacia melvillei* shrubland, noted earlier as a community under threat, two patches of *Acacia loderi* and two patches of *Eucalyptus largiflorens* woodland which, whilst not significant in their own right, would add to the diversity of the Park. In the west of Joulni are some of the best examples of *Eucalyptus* open shrubland with *Triodia* understorey and associated with this a number of species not recorded within Mungo. These include *Convolvulus erubescens, Dianella revoluta* var. *revoluta, Eremophila oppositifolia* subsp. *rubra, Jasminum lineare, Lepidium leptopetalum, Olearia subspicata* and *Ptilotus spathulatus.*

Acknowledgements

This work was carried out under Licence A393 of the NSW National Parks and Wildlife Service.

We acknowledge the assistance of staff of the Lower Darling District NSW National Parks and Wildlife Service, particularly George Townsend, for assistance throughout this project. Also to Denham Barnes for allowing access to Joulni. Special thanks are due to Toni Ward for technical assistance with fieldwork and to final year Biological Resource Management students of the University of Ballarat for assistance with data collection.

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Manuscript received 29 October 1993
Manuscript accepted 5 July 1995

Appendix 1

List of vascular plant species recorded from Mungo National Park and Joulni Station September 1992.

Taxonomy according to Harden (1990–1993).
* Denotes exotic species
# Denotes cultural plantings
[ ] Denotes name in Harden that has since changed.

Gymnosperms

CUPRESSACEAE

Callitris glaucophylla
Callitris verrucosa

Ferns and fern allies

ADIANTACEAE

Cheilanthes austrotenuifolia

Monocotyledons

AGAVACEAE

#*Agave sp.

CYPERACEAE

Schoenus subaphyllus

LILIACEAE

*Asphodelus fistulosus
Bulbine bulbosa
Dianella revoluta var. revoluta
*Myrsiphyllum asparagoides
Thysanotus baueri

ORCHIDACEAE

Pterostylis biseta

POACEAE

#*Arundo sp.
*Bromus rubens
*Bromus tectorum
*Hordeum marinum
Eragrostis australasica
*Rostraria pumila
*Schismus barbatus
Stipa spp.
Triodia scariosa subsp. scariosa
*Vulpia bromoides
*Vulpia muralis
*Vulpia myuros

LOMANDRACEAE

Lomandra leucocephala

Dicotyledons

AIZOACEAE

Disphyma crassifolium subsp. clavellatum
*Mesembryanthemum crystallinum
*Psilocaulon tenue
Tetragonia tetragonoides

AMARANTHACEAE

Ptilotus seminudus
Ptilotus spathulatus

ANACARDIACEAE

#*Schinus areira

APIACEAE

Daucus glochidiatus
Trachymene cyanopetala

ASCLEPIADACEAE

Marsdenia australis

ASTERACEAE

Actinobole uliginosum
*Arctotheca calendula
Brachycome ciliaris var. ciliaris
Brachycome lineariloba
Brachycome perpusilla var. tenella
Calotis hispidula
*Centaurea melitensis
Chthonocephalus pseudevax
Gnephosis tenuissima
*Hypochaeris glabra
*Hypochaeris radicata
Isoetopsis graminifolia
Millotia macrocarpa
Millotia perpusilla
Minuria cunninghamii
Minuria leptophylla
Myriocephalus stuartii
Olearia muelleri
Olearia pimeleoides
Olearia subspicata
*Onopordum acaulon

Podolepis capillaris
Pycnosorus pleiocephalus
Rhodanthe corymbiflora
Rhodanthe moschata
Senecio glossanthus
Senecio lautus
*Sonchus asper subsp. glaucescens
*Sonchus oleraceus
Vittadinia cuneata var. hirsuta
Waitzia acuminata

BORAGINACEAE

*Echium plantagineum
Halgania cyanea
Omphalolappula concava
Plagiobothrys plurisepaleus

BRASSICACEAE

Alyssum linifolium
Arabidella nasturtium
*Brassica tournefortii
*Capsella bursa–pastoris
*Carrichtera annua
Geococcus pusillus
Harmsiodoxa blennodioides
Harmsiodoxa brevipes var. brevipes
Lepidium fasciculatum
Lepidium leptopetalum
Lepidium papillosum
Pachymitus cardaminoides
Phlegmatospermum eremaeum
*Sisymbrium erysimoides
*Sisymbrium irio
*Sisymbrium orientale
Stenopetalum lineare
Stenopetalum sphaerocarpum

CACTACEAE

#*Opuntia sp.
#*Cylindropuntia imbricata

CAMPANULACEAE

Wahlenbergia gracilenta

CARYOPHYLLACEAE

*Herniaria cinerea [H. hirsuta]
Scleranthus minusculus
*Silene apetala
*Spergularia diandra
*Spergularia rubra
*Stellaria media

CASUARINACEAE

Casuarina pauper

CHENOPODIACEAE

Atriplex holocarpa
Atriplex lindleyi
Atriplex nummularia
Atriplex spongiosa
Atriplex stipitata
Atriplex vesicaria subsp. vesicaria
*Chenopodium album
Chenopodium curvispicatum
Chenopodium desertorum subsp. rectum
*Chenopodium murale
Chenopodium nitrariaceum
Dissocarpus paradoxus
Einadia nutans subsp. nutans
Enchylaena tomentosa
Maireana appressa
Maireana brevifolia
Maireana georgei
Maireana pentatropis
Maireana pyramidata
Maireana sclerolaenoides
Maireana sedifolia
Maireana trichoptera
Maireana turbinata
Malacocera tricornis
Osteocarpum acropterum var. deminuta
Salsola kali var. kali
Scleroblitum atriplicinum
Sclerolaena brachyptera
Sclerolaena diacantha
Sclerolaena divaricata
Sclerolaena lanicuspis
Sclerolaena muricata var. muricata
Sclerolaena obliquicuspis
Sclerolaena parviflora
Sclerolaena patenticuspis
Sclerostegia tenuis

CONVOLVULACEAE

Convolvulus erubescens

CRASSULACEAE

Crassula colorata var. acuminata
#*Crassula arborescens

CUCURBITACEAE

*Cucumis myriocarpus

FABACEAE – FABOIDEAE

Bossiaea walkeri
*Medicago laciniata
*Medicago minima
*Medicago polymorpha
Templetonia egena

FABACEAE – CAESALPINOIDEAE [CAESALPINACEAE]
Senna artemisioides subsp. filifolia
Senna artemisioides subsp. petiolaris
Senna artemisioides nothosubsp. coriacea

FABACEAE – MIMOSOIDEAE [MIMOSACEAE]
Acacia aneura
Acacia colletioides
Acacia ligulata
Acacia loderi
Acacia melvillei
Acacia montana
Acacia rigens
#Acacia stenophylla
Acacia wilhelmiana

FUMARIACEAE
*Fumaria muralis

GERANIACEAE
*Erodium cicutarium
Erodium crinitum

GOODENIACEAE
Goodenia fascicularis
Goodenia pinnatifida
Goodenia pusilliflora

HALORAGACEAE
Haloragis odontocarpa forma odontocarpa

LAMIACEAE
*Marrubium vulgare
*Salvia verbenaca
Teucrium racemosum
Westringia rigida

LAURACEAE
Cassytha melantha

LORANTHACEAE
Amyema linophylum subsp. orientale
Amyema miquelii
Amyema miraculosum subsp. boormanii
Amyema preissii
Amyema quandong
Lysiana exocarpi subsp. exocarpi
Lysiana linearifolia

MALVACEAE
*Malva parviflora
Sida corrugata

MYOPORACEAE
Eremophila glabra
Eremophila longifolia
Eremophila oppositifolia subsp. rubra
Eremophila sturtii
Myoporum platycarpum
#Myoporum acuminatum

MYRTACEAE
#Eucalyptus cladocalyx
Eucalyptus dumosa
Eucalyptus gracilis
Eucalyptus largiflorens
Eucalyptus leptophylla
Eucalyptus oleosa
Eucalyptus socialis
#Melaleuca armillaris

NITRARIACEAE
Nitraria billardierei

OLEACEAE
Jasminum lineare

OXALIDACEAE
Oxalis perennans
*Oxalis pes-caprae

PITTOSPORACEAE
Pittosporum phylliraeoides

PLANTAGINACEAE
Plantago cunninghamii

POLYGONACEAE
*Acetosa vesicaria
*Emex australis
Muehlenbeckia florulenta
*Rumex crispus
Rumex tenax

PORTULACACEAE
Calandrinia calyptrata
Calandrinia eremaea

PROTEACEAE
Grevillea huegelii
Hakea leucoptera
Hakea tephrosperma

RHAMNACEAE
Cryptandra propinqua

RUTACEAE
Geijera parviflora

SANTALACEAE
Exocarpos aphyllus
Exocarpos sparteus

SAPINDACEAE
Alectryon oleifolius subsp. canescens
Dodonaea bursariifolia
Dodonaea viscosa subsp. angustissima

SCROPHULARIACEAE

Limosella australis
Stemodia florulenta

SOLANACEAE

Lycium australe
*Lycium ferocissimum
*Nicotiana glauca
Nicotiana velutina
Solanum coactiliferum
*Solanum nigrum

STERCULIACEAE

#*Brachychiton populneus subsp. trilobus

TAMARICACEAE

#*Tamarix aphylla

THYMELAEACEAE

Pimelea microcephala subsp. microcephala
Pimelea simplex subsp. continua
Pimelea trichostachya

URTICACEAE

Parietaria debilis
*Urtica urens

ZYGOPHYLLACEAE

Zygophyllum ammophilum
Zygophyllum angustifolium
Zygophyllum apiculatum
Zygophyllum aurantiacum
Zygophyllum crenatum
Zygophyllum eremaeum
Zygophyllum iodocarpum