

The vegetation of Nombinnie and Round Hill Nature Reserves, central-western New South Wales

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Cohn, J.S. (NSW National Parks and Wildlife Service, PO Box 1967, Hurstville, NSW, Australia, 2220) 1995. *The vegetation of Nombinnie and Round Hill Nature Reserves, central-western New South Wales*. *Cunninghamia* 4(1): 81–101. A vegetation survey and a map (1:100 000 scale) of Nombinnie and Round Hill Nature Reserves (33°46'S, 45°48'E) in central-western New South Wales, are presented. Ground survey sites were selected from aerial photos, geological, and land system maps. Floristic data were processed using multivariate analysis (PATN). Nineteen communities were mapped (7 mallee, 12 non-mallee), with a total of 227 taxa (218 native, 9 introduced) recorded. A number of communities are considered to be inadequately conserved and two taxa (*Acacia curranii* and *Lomandra patens*) are of nationally rare and threatened status.

Introduction

Nombinnie and Round Hill Nature Reserves (NR), together with adjoining Yathong NR, form the largest continuous stretch of mallee communities managed by the National Parks and Wildlife Service (NPWS) in New South Wales. Mallee communities are dominated by multi-stemmed species of *Eucalyptus* (Walker & Hopkins 1984). Mallee communities also occur in Victoria and South Australia. Much of the mallee occurring on public land in north-west Victoria has been surveyed and mapped at 1:100 000 scale by Cheal & Parkes (1989). Mallee in South Australia has been surveyed by Sparrow (1989a, b). A number of studies have mapped mallee communities in the south-west of NSW (Morcom & Westbrooke 1990, Fox 1991, Scott 1992).

Nombinnie and Round Hill NRs have been included in a number of previous vegetation surveys and mapping exercises; for example, the vegetation maps of western NSW at a scale of 1 inch:16 miles (Beadle 1948) and Australia at a scale of 1:1 000 000 (Beadle 1981), land system maps at 1:250 000 scale (Soil Conservation Service of NSW 1984, 1986), surveyed sites within the Nombinnie NR during its acquisition (Brickhill et al. undated). None of these surveys, however, provides consistent information on the communities at a scale suitable for conservation management.

The aims of this vegetation survey were to:

- record data for vascular plant species and environmental attributes for a representative sample of the Nombinnie and Round Hill NRs
- define and map plant communities at 1:100 000 scale, compatible with Victorian and South Australian surveys

- produce a map of plant communities readily usable by field managers
- relate plant community distributions to environmental attributes
- assess the conservation status of plant communities and rare plant taxa.

Study area

The study area is located in the south-western plains of NSW, 33°46'S, 145°48'E, about 200 km south of Cobar (Figure 1). It comprises Nombinnie NR (70 000 ha) and Round Hill NR (13 630 ha). Another 57 000 ha of the old Nombinnie and Lysmoyle properties are managed by NSW National Parks and Wildlife Service but are subject to mineral exploration (Wells 1989); a block of this area was not surveyed. A small portion of leasehold land outside and adjacent to Nombinnie NR was also included in the survey.

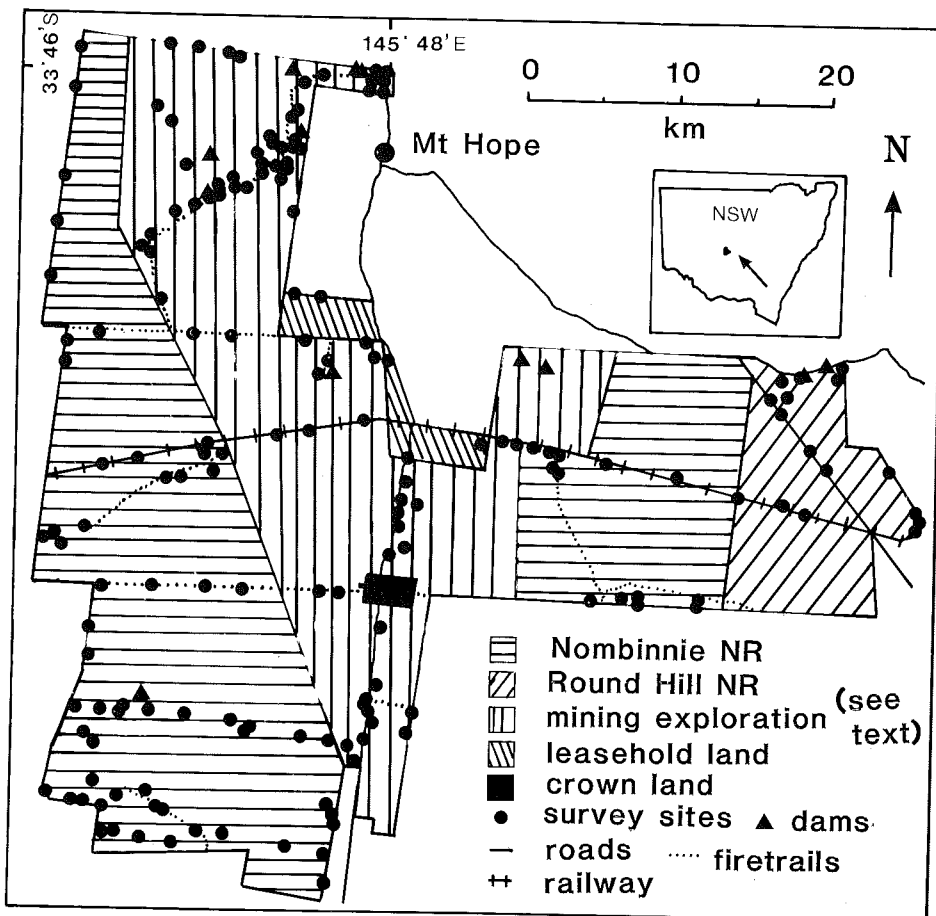


Fig 1. Locality map of Nombinnie and Round Hill Nature Reserves.

The study area lies between the 350–450 mm annual rainfall isohyets. Temperatures range from a mean monthly maximum of 33.2° C in January to a mean minimum of 4.5° C in July (Lawrie & Stanley 1980).

Land systems and geology

Land systems display characteristic and recurring patterns of topography, soils and vegetation (Christian & Stewart 1953). Approximately 80% of the study area is dominated by plains land systems, which include Lachlan Downs (Ld), Nombinnie (Nb), Wylona (Wy), Karwara (Kn), Lysmoyle (Ls, Figure 2). The relief may be as high as 7 m, but is more commonly up to 4 m. Mallee vegetation predominates. Calcareous red earths and solonised brown soils are commonly found on plains, with sandy earths on dunes (Soil Conservation Service 1984, 1986).

Land systems Yackerboon (Yb), Kopyje (Kp) and Peshurst (Ph), included in the landtype rolling downs and lowlands, constitute about 15% of the study area. Relief is up to 20 m. These are typified by non-mallee communities, with red earths and

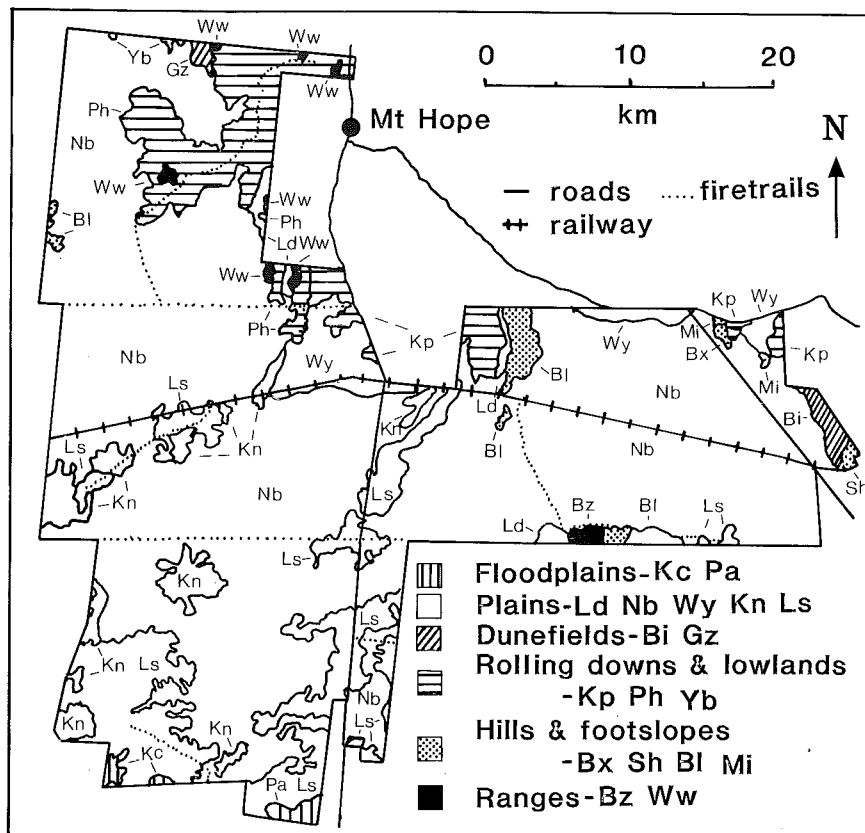


Fig 2. Land systems of the study area (Soil Conservation Service 1984, 1986).

lithosols on higher crests and deep sandy soils on lower slopes (Soil Conservation Service 1984, 1986).

Land systems making up the remaining 5% of the study area are included in the following landtypes: floodplains; dunefields; hills and footslopes; and ranges. The floodplains land systems have relief to 1 m and are covered by Quaternary alluvium. Land system Kiacatoo (Kc) has grey cracking and brown clays and land system Pangee (Pa) has deep calcareous red earths with hardpan at depth. The vegetation consists of non-mallee species (Soil Conservation Service 1984, 1986).

Dunefields to 10 m relief are aligned in an east-west direction and are characterised by Quaternary deposits of red and brown clayey sand, loam and lateritic soils and irregular deposits of aeolian sand; land systems include Bindi (Bi) and Glenlea (Gz). These are dominated by mallee vegetation (Soil Conservation Service 1984, 1986).

The hills and footslopes have relief to 150 m. Sandy lithosols on the upper slopes usually grade into red earths downslope. The vegetation is characteristically mallee (Soil Conservation Service 1984, 1986). The geology of land systems Boppy (Bx), Mineshaft (Mi) and Belford (Bl) is sedimentary, whilst that of land system Shepherd Hill (Sh) is volcanic (Geological Survey of New South Wales 1967, 1968).

The ranges have relief to 200 m, and are covered with sandy lithosols which become deeper down-slope. Vegetation in land system Booroondarra (Bz) is mallee and in land system Wynwood (Ww) non-mallee (Soil Conservation Service 1984, 1986). The geology of Bz is sedimentary and Ww is derived from volcanic material (Geological Survey of NSW 1967, 1968).

Methods

Field survey

The field survey was undertaken from May 1991 to March 1992. At selected sampling sites information on floristics, structure and environmental factors was collected. All vascular plant species were recorded and assigned a cover abundance value based on the Braun-Blanquet scale (Westhoff et al. 1978). Height and percentage projected foliage cover were estimated for each stratum (Specht 1970, 1981; Muir 1977). The description of environmental factors at each site included slope, aspect, soil texture, elevation and physiography (McDonald et al. 1984). The size of the quadrat at each site was 30 m x 30 m (900 m²). Since trees occurred in lower densities in the non-mallee and hill/range mallee communities compared with plains mallee communities, information on the tree stratum within these two broad categories was also collected in an extra 1600 m², nested outside the 30 m x 30 m quadrat (mallee eucalypts are included here as trees).

A total of 184 sites were sampled (Figure 1). One hundred and twenty of these were in the non-mallee and hill/range mallee areas. Sites were positioned to sample homogeneous patterns on aerial photographs which were further stratified by geological and land system information (1:50 000 and 1:60 000 scale black/white

aerial photos; Commonwealth Mapping Authority, 1977, 1987; Geological Survey of NSW, 1967, 1968; Soil Conservation Service 1984, 1986). The number of quadrats allocated to a homogeneous pattern was proportional to the area it covered (Table 1). A pattern $< 0.4 \text{ km}^2$ was considered too small to survey. The remaining 64 sites were positioned in plains mallee vegetation and its six coincident land systems (Ld,Nb,Wy,Ls,Gz,Bi; Soil Conservation Service 1984, 1986). Homogeneous patterns from aerial photos were identified and further stratified by land system information. Topographic, structural and floristic homogeneity of much of the plains mallee, however, made allocation of sites by aerial photographic interpretation (API) too difficult. The number of quadrats were allocated to each homogeneous pattern in proportion to the area covered (Table 1). Although plains mallee vegetation covered most of the study area, the lower number of quadrats compared with the non-mallee and hill/range mallee represents the former's greater homogeneity identified from aerial photos and land system information.

The position of a quadrat within a given homogeneous pattern in the non-mallee and hill/range mallee was decided in the field. Quadrats were placed away from the edges of patterns and in an area where the vegetation appeared floristically and structurally representative of that pattern. The same technique for quadrat positioning was used for plains mallee, which showed structural/floristic differences or topographic relief on the aerial photos. For the remainder of the plains mallee, however, quadrats were positioned to sample a broad range of floristic and structural differences in the understorey.

In a few cases, extra informal surveys were undertaken during the ground truthing phase. These consisted of pacing out quadrats and noting floristic and structural information of the tree and shrub layers.

Ground truthing

Extensive ground truthing of patterns delineated on aerial photos was carried out mostly within the non-mallee and hill/range mallee areas, since the structurally homogeneous nature of most of the plains mallee areas made extensive ground truthing unnecessary.

Data analysis

A numerical classification of the vegetation sites was derived using the Pattern Analysis Package (PATN, Belbin, 1990). The analysis was restricted to perennial native species as defined by Cunningham et al. 1981 (see back of map).

Mallee (plains) and non-mallee (including hill/range mallee) sites were analysed separately, due to the different quadrat sizes employed to sample trees in each group. Floristic composition was analysed using PATN (Belbin 1990). The cover abundance information for the non-mallee was adjusted to include the extra quadrat: a tree species occurring in the 1600 m^2 quadrat and not in the 900 m^2 quadrat was assigned a cover abundance value of 1. As a consequence, cover abundance values for all species recorded in the 900 m^2 quadrat increased by 1, i.e. 1 became 2, and so on. From this point onwards the mallee and non-mallee data were treated the same.

Table 1. Proportion of area for each landtype and land system (see text for codes) showing allocation of sampling quadrats for land systems, geology and topographic position

Landtype and land system	Area (% of total study area)	Proportion of land system in landtype	Geology	Topographic position	Number of quadrats
Floodplains	< 5				2
Kc		0.5	Qcp	plain	1
Pa		0.5	Qd	plain	1
Plains	c. 80				116
Ld		<0.1	Qd	slope	1
			Qrt/Smv		1
			Qrd	dune	1
				swale	1
Nb		0.6	Qd	plain	61
			Qrd	dune	1
				swale	1
			Qcp	depression	1
Wy		<0.1	Qd	plain	1
Kn		0.1	Qd	plain	11
			Qcp	plain	0
Ls		0.2	Qd	plain	36
Dune fields	< 5				3
Bi		0.7	Qrd	swale	1
				crest	1
Gz		0.3	Qd	slope	1
Rolling downs and lowlands	c. 15				48
Kp		0.2	Qrt/Suc	crest	1
				slope	1
				plain	4
Ph		0.8	Qrt/Smv	plain	2
				slope	4
				depression	1
			Qrt/Suc	plain	13
				depression	9
				slope	1
			Qrt	plain	5
				slope	3
			Qd & Qrs	slope	1
Yb		<0.1	Qrd/Smv	plain	1
			Qrt/Scu		1
Hills/footslopes	< 5				6
Bx		0.25	Sub	east slope	1
Sh		0.25	Qrt/Scu	footslope	1
			Scu	east slope	1
Mi		0.15	Sub	knoll	0
Bl		0.35	Qd	plain	2
			Duc	slope	1
Range	< 5				9
Bz		0.3	Duc	crest	1
			Qrt/Duc	plain	1
Ww		0.7	Qrt/Duc	north slope	1
			Smv	crest	1
				east slope	1
				south slope	2
				west slope	1
				north slope	1
Total					184

To weight abundant and uncommon species evenly, cover abundances were standardised between 0 and 1. The Bray Curtis measure was used to compare each site to all others in terms of floristic composition (Bray & Curtis 1957). The UPGMA clustering algorithm was then applied to derive a hierarchical classification of the sites (dendrogram).

The homogeneity algorithm of Bedward et al. (1992; Figures 3a,b) was used in conjunction with the dendrogram, physical information (topography, geology, soil texture), structural information and the aerial photographic mapping base to determine the final plant communities to be mapped.

Formation of mapped communities from groups

Groups resulting from the analyses were mapped as communities only if the mapping base (aerial photos) allowed their delineation. A group identified within a group was mapped separately if it was structurally different or located in different physiographic circumstances with recognisably different floristics.

The homogeneity algorithm (Bedward et. al 1992) showed the plains-mallee to be relatively floristically continuous (Figure 3a). The structural and floristic homogeneity of the plains-mallee on the aerial photographic mapping base restricted the final mapped communities to only those recognisable on this base: Shrub Mallee (P1); Shrub Mallee with Spinifex (P2); Shrub Mallee with Mallee Pine (P3); and Tree Mallee (P4). A two-way table describing the relationships between taxa and communities is shown on the back of the map.

The analysis identified fifteen floristically discrete groups of non-mallee and hill/range mallee (Figure 3b). These original 15 groups are shown in a two-way table on the back of the map. Some of these groups were modified for the purposes of mapping: the first group has been subdivided into three communities, since D1a and D4 are floristically different and occurring in different physiographic circumstances to that of D1; two groups which have been identified as separate have been combined, since they both constitute grassland (F9); one group has been subdivided into two communities (F1, F2), since they are structurally different; community F5 encompasses 3 groups which could not be differentiated on the aerial photographic mapping base; another group has been called two communities since the overstorey species are different (H1, R1); and community P8 describes two groups which are indistinguishable on the mapping base.

Results

Four plains mallee communities and fifteen non-mallee and hill/range mallee communities were mapped. A description of the mapped vegetation communities is given below. Communities are grouped by the landtypes in which they mostly occur and each community is given an alpha-numeric code for quick referral: Alluvial plains (F1-2); Plains (P1-9); Rolling downs and lowlands (D1-4); Hills (H1); Ranges (R1-2). Geological information is taken from Geological Survey of NSW (1967, 1968) and land system information is taken from Soil Conservation Service (1984, 1986).

Descriptions of mapped communities

Alluvial Plains (F1-2)

F1. Black Rolypoly Shrubland

Dominant species: *Sclerolaena muricata*.

Structure: Low open shrubland.

Site numbers: 88.

Land system: Alluvial plain (Kc).

Geology: Floodplains of red and black clayey silt sand and gravel (Qrs).

Soil texture: Heavy clay.

Trees: *Eucalyptus largiflorens*.

Shrubs: *Sclerolaena muricata*.

Herbs and grasses: *Leptorhynchus panaetioides*, *Vittadinia pterochaeta*, *Teucrium racemosum*, *Helipterum floribundum*.

Comments: Occurs in only one small area on the southern boundary of Nombinnie NR. The northern half of the community is dominated by ephemeral grasses, which were unidentifiable at the time of the survey.

F2. Black Box Woodland

Dominant species: *Eucalyptus largiflorens*.

Structure: Low open woodland.

Site numbers: 91.

Land systems: Alluvial plain (Kc).

Geology: Playas, claypans and lakes of black and grey silty clay and silt (Qcp).

Soil texture: Heavy clay.

Trees: *Eucalyptus largiflorens*.

Shrubs: *Solanum esuriale*, *Sclerolaena muricata*, *Pittosporum phylliraeoides*.

Herbs and grasses: *Atriplex spinebractea*.

Comments: Occurs over one small area adjacent to the Black Rolypoly Shrubland. All *Eucalyptus largiflorens* in this community were apparently ringbarked during 1880-1900 and as a result are now multi-stemmed (J. Brickhill, pers. comm.).

Plains (P1-9)

P1. Shrub Mallee

Dominant species: *Eucalyptus socialis*, *E. dumosa*.

Structure: Very open shrub mallee (< 8 m tall).

Site numbers: 23, 13, 100, 105, 156, 158, 73, 98.

Land system: Plains (Nb,Ls).

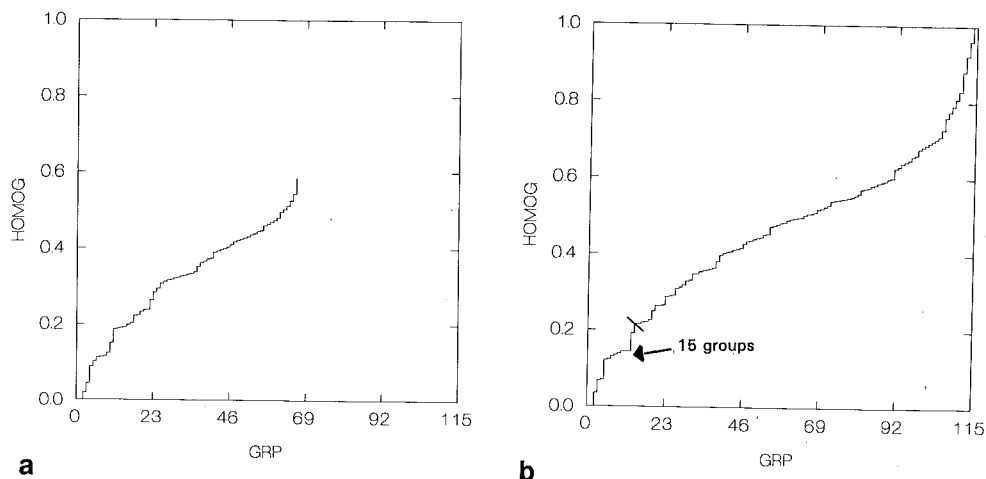


Fig. 3. Homogeneity curves for site classification based on standardised Bray Curtis co-efficient. a. Plains mallee data. b. Hill mallee and non-mallee data.

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd).

Soil texture: Sandy clay-clayey sand.

Trees: *Eucalyptus socialis*, *E. dumosa*.

Shrubs: *Eremophila glabra*.

Herbs and grasses: *Olearia pimelioides*.

Comments: This community, with characteristically little in the understorey, is found:

- on the western slopes of ranges where the soil is sandy
- where the mallee has apparently been cleared and is regenerating
- where there have been fires in quick succession on medium-textured soils (see discussion).

P2. Shrub Mallee with Spinifex

Dominant species: *Eucalyptus socialis*, *E. dumosa*, *Triodia irritans*.

Structure: Very open to open shrub mallee (< 8 m tall).

Site numbers: 26, 48, 52, 99, 101–119, 121–152, 154, 155, 213.

Land system: Plains (Nb, Ls, Wy).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd).

Soil texture: Light medium clay-loamy sand.

Trees: *Eucalyptus socialis*, *E. dumosa*, *E. gracilis*, *E. leptophylla*.

Shrubs: *Acacia tindaleae*, *A. rigens*, *A. brachybotrya*, *A. colletioides*, *A. havilandiorum*, *Melaleuca uncinata*, *Eremophila glabra*, *Bossiaea walkeri*, *Dodonaea viscosa* subsp. *cuneata*, *Senna artemisioides*, *Beyeria opaca*, *Templetonia aculeata*.

Herbs and grasses: *Dianella revoluta*, *Halgania cyanea*, *Lomandra effusa*, *Sclerolaena diacantha*, *Olearia pimelioides*, *Triodia irritans*.

Comments: Compared with the other mallee communities identified in this survey, the understorey in this community has greater floristic diversity and cover. The composition and density of the over and understorey species vary with subtle changes in the topography and soils (see results).

P3. Shrub Mallee with Mallee Pine

Dominant species: *Eucalyptus socialis*, *Callitris preissii* subsp. *verrucosa*.

Structure: Very open shrub mallee (< 8 m tall).

Site numbers: 42.

Land system: Plains (Nb,Ls).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd).

Soil texture: Sandy clay loam.

Trees: *Callitris preissii* subsp. *verrucosa*, *Eucalyptus socialis*, *E. leptophylla*.

Shrubs: *Acacia brachybotrya*.

Herbs and grasses: *Helichrysum apiculatum*.

Comments: *Callitris preissii* subsp. *verrucosa* provides a very dense understorey of approximately 30% cover. The shade and the absence of fire may both contribute to the very low cover and diversity of shrubs, grasses and herbs.

P4. Tree Mallee

Dominant species: *Eucalyptus socialis*, *E. dumosa*.

Structure: Very open tree mallee (> 8 m tall).

Site numbers: 75.

Land system: Plains (Nb,Ls).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd).

Soil texture: Silty clay.

Trees: *Eucalyptus socialis*, *E. dumosa*.

Herbs and grasses: *Einadia nutans* subsp. *nutans*.

Comments: Characteristically very low species richness and cover in the understorey. It appears to have been unburnt for many years (see discussion).

P5. Belah and Wilga Woodland

Dominant species: *Casuarina cristata*, *Geijera parviflora*, *Apophyllum anomalum*, *Alectryon oleifolius* subsp. *canescens*.

Structure: Open woodland.

Site numbers: 38, 79, 94, 208, 85, 30, 86, 57, 56, 87, 19, 12, 37, 211, 205.

Land system: Plains (Kn,Ls), Rolling downs/lowlands (Ph).

Geology: Playas, claypans and lakes of black and grey silty clay and silt (Qcp). Residual and colluvial deposits (Qrt). Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd).

Soil texture: Clay loam-medium clay.

Trees: *Casuarina cristata*, *Geijera parviflora*. *Alectryon oleifolius* subsp. *canescens* and *Apophyllum anomalum* often occur in the overstorey. Occasionally, especially in ecotones *Eucalyptus populnea* subsp. *bimbil* and *E. intertexta* also occur in the overstorey.

Shrubs: The shrub and herb/grass layers are usually very sparsely distributed and species poor. Common species include *Eremophila mitchellii*, *E. sturtii*.

Herbs and grasses: *Sclerolaena diacantha*, *Cheilanthes sieberi*, *Olearia pimelioides*.

Comments: Found on the heavier-textured soils, often in playas and claypans.

P6. Gum Coolibah Woodland

Dominant species: *Eucalyptus intertexta*, *Dodonaea viscosa* subsp. *cuneata*, *Eremophila desertorum*, *E. sturtii*.

Structure: Open woodland.

Site numbers: 31, 35, 77, 32, 78, 83, 63.

Land system: Plains (Kn,Ls), Range (Ww).

Geology: Residual and colluvial deposits overlying Mt Hope Volcanics (Qrt/Smv). Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd); Playas of grey silty clay (Qcp).

Soil texture: Silty clay-clay loam.

Trees: *Eucalyptus intertexta* and occasionally *Callitris glaucophylla*.

Shrubs: The understorey varies from a sparse to a more dense shrub cover of *Dodonaea viscosa* subsp. *cuneata*, *Eremophila desertorum*, *Eremophila sturtii*, *Bertya cunninghamii*, *Senna artemisioides*, *Callitris glaucophylla*, *Helichrysum tuckeri*. At one site the rare *Acacia curranii* occurs rather densely.

Herbs and grasses: *Cheilanthes sieberi*, *Einadia nutans*, and *Harmsiodoxa brevipes* var. *major*.

Comments: Often occurs on the heavier-textured soils adjacent to mallee communities.

P7. Bimble Box Woodland

Dominant species: *Eucalyptus populnea* subsp. *bimbil*, *Eremophila sturtii*, *Digitaria* spp., *Stipa* spp..

Structure: Open woodland.

Site numbers: 60, 76, 89, 90, 97, 98A, 200.

Land system: Plains (Ls) and rolling downs and lowlands (Ph); Floodplains (Pa).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd); Residual and colluvial deposits (Qrt).

Soil texture: Sandy clay-sandy clay loam.

Trees: *Eucalyptus populnea* subsp. *bimbil* and occasionally *Callitris glaucophylla*.

Shrubs: Scattered to dense *Eremophila sturtii*.

Herbs and grasses: *Digitaria* sp., and *Stipa* sp., with scattered *Einadia nutans* subsp. *nutans*.

Comments: Usually located in run on areas with heavier-textured soils and varies from having a dense understorey of *Eremophila sturtii* to an understorey dominated by grasses.

P8. Pine Woodland

Dominant species: *Callitris glaucophylla*, *Abutilon otocarpum*, *Cheilanthes sieberi*.

Structure: Open woodland/woodland.

Site numbers: 72, 209, 95, 2, 29, 14, 6, 11B, 20C, 11C, 24A, 28, 24B, 27, 25, 24C, 71, 92, 81, 82, 84, 58.

Land system: Plains (Ls,Kn), Rolling downs/lowlands (Ph).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd). Residual and colluvial deposits (Qrt); Cobar Group largely obscured by Qrt (Qrt/Suc(?)).

Soil texture: Sandy clay to sandy clay loam.

Trees: Whilst *Callitris glaucophylla* is the dominant overstorey species, *Eucalyptus populnea* subsp. *bimbil*, *E. intertexta* and *Geijera parviflora* may also occur.

Herbs and grasses: The understorey is comprised mostly of herbs and grasses. Common herbs, north of the railway line, are *Abutilon otocarpum*,

Sida corrugata, *Chenopodium desertorum*, *Sclerolaena diacantha*, *Cheilanthes sieberi*, and *Sida cunninghamii*. The understorey south of railway line is mostly of ephemeral grasses, which were unidentifiable at the time of the survey, as were those in the north.

P9. Grassland

Dominant species: *Aristida* spp..

Structure: Grassland.

Site numbers: 40, 41, 80, 201, 202, 19, 12, 47, 22, 71.

Land system: Plains (Ls, Kn) and Rolling downs/lowlands (Ph).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd); Residual and colluvial deposits (Qrt); Cobar Group largely obscured by Qrt (Qrt/Suc?).

Soils: light clay-sandy clay loam.

Trees: Scattered *Geijera parviflora*, *Casuarina cristata*, *Eucalyptus dumosa*, *E. socialis*, *E. intertexta*, *E. populnea* subsp. *bimbil*, *Apophyllum anomalum*, *Alectryon oleifolius*, *Hakea tephrosperma*, *Callitris glaucophylla*.

Shrubs: Scattered *Prostanthera leichhardtii*, *Eremophila longifolia*, *Acacia homalophylla*, *Eremophila mitchellii*, *Dodonaea viscosa* spp. *angustissima*, *Atriplex stipitata*.

Herbs and grasses: Scattered *Einadia nutans* spp. *nutans*, *Helipterum pygmaeum*, *Cuphonotus humistratus*, *Aristida* spp., *Cheilanthes sieberi* spp. *sieberi*, *Heliotropium europaeum*, *Echium plantagineum*, *Erodium cicutarium*, *Oxalis corniculatum*, *Medicago* spp., *Sclerolaena diacantha*, *Maireana* spp..

Comments: Highly variable in its species composition, probably because it has usually resulted from clearing, and has therefore partially adopted the character of its previous community and/or has taken on species from surrounding communities. Many of the grasses were unidentifiable at the time of the survey.

Rolling Downs and Lowlands (D1-4)

D1. Pine and Bimble Box Woodland

Dominant species: *Callitris glaucophylla*, *Eucalyptus populnea* subsp. *bimbil*, *Senna artemisioides*, *Chenopodium desertorum*, *Sclerolaena diacantha*.

Structure: Open woodland.

Site numbers: 20D, 64, 96, 7, 20F, 93, 3, 4, 20G, 44, 20C.

Land systems: Plains (Ls), Rolling downs/lowlands (Ph).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd); Residual and colluvial deposits (Qrt); Mt Hope Volcanics largely obscured by Qrt (Qrt/Smv); Cobar Group largely obscured by Qrt (Qrt/Suc(?)).

Soil texture: Sandy clay-silty loam.

Trees: On the slopes of ranges/hills and undulating plains *Callitris glaucophylla* tends to occur on the higher ground, whilst *Eucalyptus populnea* subsp. *bimbil* is found along creek lines. *Eucalyptus intertexta* may also occur in the overstorey on the higher ground.

Shrubs: The understorey has very scattered shrubs: *Dodonaea viscosa* subsp. *angustissima*, *Eremophila sturtii*, *E. glabra*, *E. longifolia*, *E. mitchellii*, *Senna artemisioides*.

Herbs and grasses: *Chenopodium desertorum*, *Einadia nutans* subsp. *nutans*, *Sclerolaena diacantha*, *Sida corrugata*.

Comments: Much of this community appears to have been cleared, leaving scattered trees only.

D1a. Bimble Box Woodland

Dominant species: *Eucalyptus populnea* subsp. *bimbil*, *Eremophila sturtii*, *Chenopodium desertorum*, *Sclerolaena diacantha*.

Structure: Open woodland.

Site numbers: 17, 10, 21C, 33, 21D, 45, 34A, 34B, 36, 61.

Land system: Rolling downs and lowlands (Ph).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd); Residual and colluvial deposits (Qrt); Mt Hope Volcanics largely obscured by Qrt (Qrt/Smv).

Soil texture: Medium clay-sandy clay loam.

Trees: *Eucalyptus populnea* subsp. *bimbil* and *Callitris glaucophylla*. *Eucalyptus intertexta* may become the dominant overstorey species over small areas especially those closer to the mallee.

Shrubs: *Eremophila longifolia*, *E. glabra*, *E. mitchellii*, *E. sturtii*, *Dodonaea viscosa* subsp. *angustissima*, *Acacia colletoides*, *A. homalophylla*, *Acacia deanei*, *Senna artemisioides*, *Dodonaea*

viscosa subsp. *spatulata*, *D. viscosa* subsp. *cuneata*, *Eremophila desertii*, and *Pittosporum phylliraeoides*.

Herbs and grasses: *Digitaria* sp., and *Stipa* sp., with scattered *Einadia nutans* subsp. *nutans*.

Comments: Occurs in low lying areas on heavier-textured soils.

D2. Gum Coolibah and Pine Woodland

Dominant species: *Eucalyptus intertexta*, *Callitris glaucophylla*, *Eremophila mitchelli*, *E. glabra*, *Sclerolaena diacantha*.

Structure: Open woodland.

Site numbers: 1, 55, 65, 59, 54, 15, 18, 66, 69, 203, 46, 206, 50, 51, 67, 207, 215, 74, 216, 212.

Land systems: Plains (Ls, Ph, Kp); Hills and footslopes (Bl); Ranges (Bz).

Geology: Flat to gently undulating plains of red and brown clayey sand loam and lateritic soils (Qd); Residual and colluvial deposits (Qrt); Cobar Group largely obscured by Qrt (Qrt/Suc); Cocoparra sediments largely obscured by Qrt (Qrt/Duc); Mt Hope Volcanics largely obscured by Qrt (Qrt/Smv); Floodplains of clayey silt, sand and gravel (Qrs); Cobar Group largely obscured by Qrt (Qrt/Suc).

Soil texture: Light clay to sandy clay loam.

Trees: *Eucalyptus intertexta*, *Callitris glaucophylla*, *E. populnea* subsp. *bimbil*, *Casuarina cristata*, *Geijera parviflora*, *Alectryon oleifolius*.

Shrubs: The understorey may have very scattered shrubs to a more dense cover of *Bertya cunninghamii*, *Dodonaea viscosa* subsp. *cuneata*, *Eremophila glabra*, *E. longifolia*, *E. mitchellii*, *Hakea tephrosperma*, *Senna artemisioides*, *Olearia pimelioides*.

Herbs and grasses: *Chenopodium desertorum*, *Sclerolaena diacantha*, *Enchylaena tomentosa*.

D3. Emubush Shrubland

Dominant species: *Eremophila longifolia*.

Structure: Tall open shrubland.

Site numbers: 62.

Land system: Rolling downs/lowlands (Ph).

Geology: Residual and colluvial deposits (Qrt).

Soil texture: Sandy clay.

Shrubs: *Eremophila longifolia* is common and present as a tall shrub (>2m). Other shrub species are *Dodonaea viscosa* subsp. *angustissima*, *Eremophila glabra*, *E. sturtii*, *Callitris glaucophylla*, *Solanum coactiliferum*.

Herbs and grasses: *Maireana humillima*, *Ptilotus obovatus*, *Sclerolaena diacantha*, *Sida cunninghamii*, *Thyridolepis mitchelliana*.

Comments: This community may have been burnt in 1985 and the large cover of *Eremophila longifolia* is a response to that (see discussion). The density of this community made boundary checking too difficult.

D4. Green Mallee Shrubland

Dominant species: *Eucalyptus viridis*, *Dodonaea lobulata*.

Structure: Open woodland/low open shrubland.

Site numbers: 217 and informal survey.

Land system: Rolling downs/lowlands.

Geology: Quartz-feldspar, porphyry, rhyolite, tuff and interbedded sediments (Smv); Residual and colluvial deposits (Qrt).

Soil texture: Loam.

Trees: *Eucalyptus viridis*, *Eucalyptus intertexta*, *E. populnea*, *Callitris glaucophylla*, *Brachychiton populneus* subsp. *trilobus* and *Geijera parviflora* may also occur, especially on the slopes of the knolls.

Shrubs: *Acacia aneura*, *A. decora*, *Dodonaea lobulata*, *Senna artemisioides*, *Eremophila serrulata*, *E. longifolia*, *E. mitchellii*, *Acacia curranii* is sparsely distributed on the side of one knoll.

Herbs and grasses: *Sclerolaena convexula*, *Maireana humillima*, *Atriplex stipitata*.

Comments: Restricted to small rocky knolls in the northern half of Nombinnie NR, occurring as an open shrubland on the knoll tops and becoming an open woodland on the sides.

Hills (H1)

H1. Dwyer's Mallee Shrubland

Dominant species: *Eucalyptus dwyeri*, *Acacia doratoxydon*.

Structure: Very open shrub mallee.

Site numbers: 68, 49.

Land system: Hills and footslopes (Sh, Mi, Bx).

Geology: Rhyolite, rhyolite breccia, quartz

feldspar porphyry, chert and tuff (Scu); Conglomerate, sandstone, orthoquartzite and siltstone (Sub).

Soil texture: Clayey sand.

Trees: This community can be quite variable and there may be an influence of aspect. The tops of these hills are characteristically dominated by *Eucalyptus dwyeri* and *Acacia doratoxylon*. On the slopes other species may include *Brachychiton populneus* subsp. *trilobus*, *Geijera parviflora*, *Eucalyptus intertexta*, *Eucalyptus viridis*, *E. morrisii*, *Pittosporum phylliraeoides*.

Shrubs: The slopes may be similar to the top or dominated by dense short *Callitris glaucophylla*. Other species include *Dodonaea lobulata*, *Acacia aneura*, *A. decora*, *Prostanthera nivea*, *P. striatiflora*, *Indigofera australis*, *Eremophila serrulata*, *E. longifolia*, *Helichrysum bractea*, *Pimelea microcephala*, *Helichrysum viscosum*, *Platysace lanceolata*, *Solanum ferocissimum* var. *ferocissimum*.

Herbs and grasses: *Lomandra patens*, *Diuris maculata*, *Cheilanthes sieberi*, *Pandorea pandorana*.

Ranges (R1-2)

R1. Grey Mallee Shrubland

Dominant species: *Eucalyptus morrisii*.

Structure: Very open shrub mallee.

Site numbers: 214.

Land systems: Range (Bz).

Geology: Cocoparra sediments, largely obscured by Qtz (Qrt/Duc).

Soil texture: Clayey sand.

Trees: *Eucalyptus morrisii* on the top, *E. dwyeri* on the slope and *E. viridis* on the footslopes. Other species include *Callitris glaucophylla*, *Brachychiton*

populneus subsp. *trilobus*, *Eucalyptus populnea* subsp. *bimbil*, *Geijera parviflora*.

Shrubs: On the range footslopes species include *Eremophila serrulata*, *Acacia aneura*, *A. doratoxylon*, *Dodonaea viscosa* subsp. *angustissima* and *Pandorea pandorana*.

Herbs and grasses: *Wahlenbergia stricta*, *Stipa nodosa*, *Goodenia glabra*, *Lomandra patens*, *Cheilanthes sieberi*, *Amphipogon caricinis* var. *caricinis*, *Indigofera australis*, *Sida filiformis*, *Brunonia australis*, *Parsonia eucalyptophylla*, *Thyridolepis mitchelliana*.

R2. Pine and Wattle Woodland

Dominant species: *Callitris glaucophylla*, *Acacia decora*.

Structure: Low open woodland to open woodland.

Site numbers: 5, 9B, 9C, 43, 9A, 8.

Land systems: Ranges (Ww), Rolling downs/lowlands (Ph).

Geology: Quartz-feldspar, porphyry, rhyolite, tuff and interbedded sediments (Smv); Mt Hope Volcanics largely obscured by Qtz (Qrt/Smv).

Soil texture: Sandy clay loam.

Trees: *Callitris glaucophylla*, and occasionally *Eucalyptus intertexta*.

Shrubs: The shrub understorey is dominated by dense low/tall *Callitris glaucophylla* shrubs on the slopes with some *Acacia decora*. The tops of the ranges are more open.

Herbs and grasses: Common species include *Glycine canescens*, *Sida cunninghamii*, *Cheilanthes sieberi* and *C. lasiophylla*. The rare *Lomandra patens* also occurs.

Trends in species and community distribution

Plains mallee

Although much of the plains mallee proved to be floristically continuous, as evidenced by the relatively consistent slope of the homogeneity curve (Figure 3a), there were trends in the occurrence of some species, which were identified by the multivariate analysis and are discussed below (see two-way table on back of map).

In the sandier soils (loamy sand-sandy clay loam), which were found on dune crests and slopes, *Eucalyptus leptophylla* occurred in the overstorey with *E. socialis* and occasionally *Callitris preissii* subsp. *verrucosa*. The understorey consisted of a sparse cover of *Acacia brachybotrya*, and a dense cover of *Triodia irritans*. In the medium- and heavier-textured soils (light medium clay-loamy sand), *Eucalyptus socialis* occurred with *E. dumosa* and *E. gracilis*. The shrub understorey was usually more dense than on sandier soils and was more likely to have *Melaleuca uncinata* present as well as *Acacia* species. In general, *Triodia irritans* contributed less to ground cover than on the sandier soils.

Non-mallee and hill/range mallee

Communities varied in their degree of floristic discretion (see two-way table on back of map). Those dominated by *Casuarina cristata*/*Geijera parviflora* (Belah and Wilga Woodland, P5), *Eucalyptus largiflorens* (Blackbox Woodland, F2), *E. dwyeri*/*Acacia doratoxylon* (Dwyer's Mallee Shrubland, H1) and *E. morrisii* (Grey Mallee Shrubland, R1), which are relatively restricted in their distribution, each had a relatively discrete suite of associated species. Other communities dominated by more widespread trees such as *Callitris glaucophylla*, *Eucalyptus populnea* subsp. *bimbil* and *E. intertexta* were more likely to share common groups of equally widespread understorey species, although there were some exceptions. *Eucalyptus intertexta* dominated communities were more likely to have the following taxa in their understorey *Dodonaea viscosa* subsp. *cuneata*, *Eremophila desertii*, *E. mitchellii*, *Sida cunninghamii*, *Maireana humillima* and *Bertya cunninghamii*. *Eucalyptus populnea* subsp. *bimbil* dominated communities commonly had *Dodonaea viscosa* subsp. *angustissima*, *Acacia colletioides*, *Goodenia glabra*, *Eremophila sturtii*, *Acacia deanii*, *Einadia nutans* subsp. *nutans* and *Abutilon otocarpum* in the understorey. *Callitris glaucophylla* dominated communities were commonly found with *Cheilanthes sieberi* and *Sida corrugata* in the understorey. The more widespread understorey taxa include *Eremophila longifolia*, *E. glabra*, *Hakea tephrosperma*, *Senna artemisioides*, *Chenopodium desertorum* subsp. *desertorum*, and *Sclerolaena diacantha*.

The occurrence of some communities may be partly explained by topography and soil texture. Communities dominated by *Sclerolaena muricata* (Black Rolypoly Shrubland, F1) and *Eucalyptus largiflorens* (Black Box Woodland, F2) were found on heavy clay soils on floodplains. *Casuarina cristata*/*Geijera parviflora* (Belah and Wilga Woodland, P5) and *Eucalyptus populnea* subsp. *bimbil* (Bimble Box Woodlands, P7, D1a) communities occurred in soils of high clay content usually in closed or open depressions. Communities dominated by *Eucalyptus dwyeri*/*Acacia doratoxylon* (Dwyer's Mallee Shrubland, H1) and *Eucalyptus morrisii* (Grey Mallee Shrubland, R1) were restricted to rocky hills in sandy soils, similar to the *Callitris glaucophylla*/*Acacia decora* community (Pine and Wattle Woodland, R2). The occurrences of *Callitris glaucophylla*/*Eucalyptus populnea* subsp. *bimbil* (Pine and Bimble Box Woodland, D1), *Callitris glaucophylla* (Pine Woodland, P8) and *Eucalyptus intertexta* (Gum Coolibah/Pine Woodlands, P6, D2) communities were more difficult to explain. In general they were found on plains and on hills in drier situations. *Eucalyptus intertexta*

woodland (P6) was more likely to be found near and surrounded by plains mallee communities than other communities.

Limitations of the study

Mapping the communities identified by the multivariate analysis was limited by the amount of recognisable detail on the aerial photos. This was particularly so for the plains mallee vegetation where structural and topographic homogeneity made mapping of floristically different vegetation patterns difficult. Aerial photos could not be used to map differences in the lower strata.

Discussion

Comparison with other relevant surveys

Within the plains mallee, changes in the topography and the soil texture were often very subtle in Nombinnie and Round Hill NRs. Most of the mallee occurred on plains, where the gentle undulations (<4 m) were kilometres apart. Parsons & Rowan (1968) have shown that the distribution of some mallee *Eucalyptus* species, in north-western Victoria was related to subtle soil differences. Within Nombinnie and Round Hill NRs *Eucalyptus dumosa* and *E. gracilis* were widespread, but absent from the sandiest soils on dune crests, to which *E. leptophylla* was usually restricted. *Eucalyptus socialis* occurred on a large range of soil types.

Other areas of mallee in NSW have a more clearly defined dune and swale pattern. Morcom & Westbrooke (1989) were able to separately map the communities which dominated the dunes and the swales in Mallee Cliffs NP. Similarly in parts of Yathong NR there are east-west dunes which support mallee communities, whilst the adjacent swales are characterised by *Eucalyptus intertexta* open woodlands (pers. obs). Some surveys of mallee have found the soil to be sufficiently high in clay content in the swales to support *Casuarina cristata*/*Alectryon oleifolius* communities (Morcom & Westbrooke 1990, Fox 1991, Scott 1992, Parker et al. unpub.).

Norris and Thomas (1991) in their survey of vegetation on rocky outcrops adjacent and south of Nombinnie and Round Hill NRs, found that the occurrence of tree species did not appear to be influenced by the rock type. However, results from the present study were mixed. Whilst the *Eucalyptus dwyeri*/*Acacia doratoxylon* community (H1) was found on hills derived from both volcanic and sedimentary origins, *Callitris glaucophylla*/*Acacia decora* community (R2) was restricted to volcanically-derived hills.

Fire

Fire recording for Nombinnie and Round Hill NRs began in 1957 (Brickhill, undated). The most recent extensive fire in January 1985, burnt much of the study area (Brickhill, undated). Because fire history was not one of the factors used in the allocation of sites, its effect on community floristics and structure was noted only at a very coarse level.

Both mallee and non-mallee communities are prone to fires in summer if plentiful rain has promoted the growth of ephemerals, especially grasses, during the spring (Noble 1984). Fires can burn large areas very quickly if the conditions are favourable.

Community P4 (*Eucalyptus socialis*/*E. dumosa*) consists of 'bull mallees', trees (8 m tall), with a few large stems protruding from the lignotuber. This community was found in silty clay on flat land with a very sparse understorey, mainly of herbs. Noble (1982) has found that 'bull mallee' grows in the more open swales where fires are infrequent, only occurring when there is sufficient ephemeral fuel (e.g. *Stipa variabilis*). Cheal and Parkes (1989) describe a similar structured community called 'big mallee' occurring in Victoria. They attribute the structure of their 'big mallee' to the long-term absence of fire, greater soil fertility and favourable moisture status. Similarly, the existence of tall, dense stands of *Callitris preissii* subsp. *verrucosa* (community P3) in sandy soils on dune crests indicate the absence of fire, since it is a fire-sensitive species (Bradstock 1989). Bradstock (1989) predicts that in the long-term if there is an absence of fire for a hundred years, *C. preissii* subsp. *verrucosa* may overtop mallee *Eucalyptus* species and eventually dominate the community.

Widely-spaced whipstick mallee eucalypts (community P1) may result from frequent fires in Autumn (Noble 1984). Only mallee communities on medium-textured soils, capable of a relatively high water-holding capacity and able to support dense swards of spear grass (*Stipa scabra*) at the appropriate time, are capable of this high fire frequency (Noble 1984).

Eremophila longifolia in Emubush Shrubland (D3) may have resprouted from a fire during 1985 when the adjacent mallee burnt (Water Resources Colour Aerial Photos 1990; Brickhill undated). The dominance of *E. longifolia* (5 m tall) may relate to its ability to resprout from the roots and stems both below and above the ground after fire (Hodgkinson & Griffin 1982). Other plants occurring in this community at lower densities, e.g. *Dodonaea viscosa* subsp. *angustissima*, *Senna artemisioides* and *Callitris glaucophylla* are more fire-sensitive (Hodgkinson & Griffin 1982, Harrington et al. 1984).

Clearing, grazing and exotic plants

Although much of the mallee appears relatively undisturbed, some woodland areas have been modified since the advent of grazing by cattle and sheep. Woodlands, especially those dominated by *Callitris glaucophylla* have been thinned or cleared of trees for grazing (pers. obs). Grazing has also prevented regeneration of *C. glaucophylla* seedlings (Harrington et al. 1984). On the other hand, selective grazing can also lead to a higher density of some shrub species, for example, *Acacia aneura*, *Senna artemisioides*, *Dodonaea viscosa*, *Eremophila mitchellii* and *E. sturtii* (Harrington et al. 1984).

The presence of rabbits (*Oryctolagus cuniculus*) and to a lesser extent goats (*Capra hircus*) was noted more often in the non-mallee communities than the mallee. Obvious damage ranged from the ring-barking and severe pruning of some shrubs (*Eremophila* spp., *Acacia* spp.) by rabbits and goats, to browse lines on trees, especially *Geijera*

parviflora by goats. The regeneration of a number of tree and shrub species in semi-arid eastern Australia has been inhibited by the introduction of herbivores (Parsons 1989). Species known to have problems regenerating elsewhere and which occur in Nombinnie and Round Hill NRs, include *Alectryon oleifolius*, *Casuarina cristata*, *Callitris preissii* subsp. *verrucosa*, *Myoporum platycarpum*, *Acacia oswaldii*, *Hakea tephrosperma* and *H. leucoptera* (Parsons 1989).

Exotic plant taxa were uncommon in terms of both richness and cover in the study area at the time of the survey (9 exotic taxa/227 total taxa; see back of map). These exotics are ephemeral, so they may be more common at other times (e.g. after rainfall and after fire). Fox (1989) found that both the number of species and the particular combination represented in both mallee and non-mallee communities were a function of seasonal rainfall. Bradstock (pers. comm) suggests that species richness of ephemerals is greater sooner rather than later after fire, assuming there is adequate rain.

Conservation of communities

Nombinnie, Round Hill and Yathong NRs and Mallee Cliffs NP conserve large areas of the *Eucalyptus socialis*/*E. dumosa*/*E. gracilis* alliance (Benson 1988), and it is therefore considered adequately conserved in NSW (Groves & Parsons 1989). On the other hand, *Eucalyptus morrisii* (R1) and *E. viridis* (D4) communities are considered inadequately conserved in NSW (Groves & Parsons 1989) and it is unlikely that the small areas in Nombinnie and Round Hill reserves will greatly change this status. Little is known of the conservation status of *Eucalyptus leptophylla*, since its occurrence is sporadic (Groves & Parsons 1989); they are scattered throughout Nombinnie and Round Hill NRs on the sandier soils, and have been recorded in Mallee Cliffs NP (Morcom & Westbrook 1989).

Benson (1988) considers communities dominated by *Eucalyptus populnea* (P7, D1, D1a) and *E. intertexta* (P6) as poorly conserved in NSW. The relatively widespread occurrence of these communities in Nombinnie, Round Hill and Yathong NRs (Parker et al. undated), increases their conservation status.

Although *Casuarina cristata* communities occur throughout the Western Division (Benson 1988), the associated subdominant species change. *Casuarina cristata*/*Alectryon oleifolius* communities occur further west (Fox 1991) and are reserved in Mallee Cliffs NP (Morcom & Westbrook 1990), whilst *Casuarina cristata* occurs more commonly with *Geijera parviflora* (P5) further east in the Nombinnie/Round Hill area. This latter community is also found in Yathong NR (Parker et al. undated).

Eucalyptus largiflorens communities (F2) are widespread on alluvial country in southern Australia (Fox 1991). They are found in a number of reserves throughout their range in NSW (Kincheha NP, a small area within Mallee Cliffs, Willandra NP, Macquarie Marshes NR, Narran NR, Goonawarra NR, Kajuligah and Morrisons Lake NR; Brickhill pers. comm.).

Conservation of rare plants

During this survey two rare and threatened plants *Acacia curranii* (3V) and *Lomandra patens* (3RCa), (Briggs & Leigh 1988) were recorded within Nombinnie NR and on adjacent leasehold land (Table 2).

Table 2. Rare or restricted plants recorded in the study area

Family	Species	Ratings	
		A*	B**
Fabaceae	<i>Acacia curranii</i>	3V	3A
	<i>Acacia calamifolia</i>	—	4B
Santalaceae	<i>Choretrum glomeratum</i>	—	3B
Xanthorrhoeaceae	<i>Lomandra patens</i>	3RCa	3A

A* = Ratings according to Briggs & Leigh 1988.

3: range over 100 km, but restricted to highly specific habitats; V: vulnerable species, at risk over a 20–30-year period; R: rare species, not currently considered endangered or vulnerable; Ca: species known to be adequately reserved in a NP or other proclaimed reserve.

B** = Ratings according to Pressey et al. 1990.

3: restricted distribution in the western division (NSW) and also occurring interstate; A: small range and/or few records interstate; B: wide range and/or many populations interstate.

4: disjunct occurrences in the western division; B: main population or a significant part of main population in NSW.

Acacia curranii was found in three localities: two of these on leasehold land (c. 2500 plants over approximately 5 ha) and one within Nombinnie NR (with < 10 plants). All other populations of *A. curranii* are outside the reserve system (Pickard 1993). *Acacia curranii* is found on the northern sides of rocky hills in a low open woodland with a scattered overstorey of *Eucalyptus intertexta*, *E. populnea* subsp. *bimbil* and *Callitris glaucophylla*. At one site, *Acacia curranii* plants (4 m tall) appear to have been killed by fire in 1985, since the resulting post-fire regeneration is approximately 1 m tall (J. Brickhill, pers. comm.). At this site there was also evidence of goat damage to the stems of *Acacia curranii* (J. Brickhill, pers. comm.).

Lomandra patens was found on rocky hills at two sites within Nombinnie NR. It occurred in open woodland with an overstorey of *Callitris glaucophylla* or very open shrub mallee dominated by *Eucalyptus morrisii*. *Lomandra patens* is reserved in Mootwingee NP, Yathong NR, Cocoparra NP, and now Nombinnie NR, and is considered well reserved by Benson (1988).

The occurrence of *Acacia curranii* and *Lomandra patens* in a small number of locations in Nombinnie NR and adjacent leasehold land are unlikely to influence the current distribution and conservation rating for each.

Brickhill et al. (undated) found *Swainsona laxa* during their survey of Nombinnie NR in 1985, but it was not reported during the present survey. *Swainsona laxa* has a rating of 3VCa (Briggs and Leigh 1988). It is well conserved in Victoria, but is considered vulnerable in NSW due to current fire and grazing regimes (Benson 1988).

Pressey et al. (1990) consider *Acacia calamifolia* and *Choretrum glomeratum*, to have restricted distributions (Table 2). The occurrence of these species at one site each within Nombinnie NR is unlikely to change this restricted status.

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