Vegetation and floristics of Warra National Park and *Wattleridge*, Northern Tablelands, NSW

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Abstract: The vegetation of Warra National Park (29° 29′S, 151° 56′E; 2041 ha in area) and *Wattleridge* (29°31′S, 151°54′E; 648 ha in area), located approximately 35 km southeast of Glen Innes and 5 km west of Mount Mitchell, within the Guyra and Severn Shires in the New England Tablelands Bioregion NSW, is described. Nine vegetation communities are defined, based on flexible UPGMA analysis of cover-abundance scores of all vascular plant taxa. These communities have been mapped based on analysis of quadrat data, air photo interpretation, substrate variation and ground-truthing.

Communities described are: (1) *Leptospermum novae-angliae* (New England Tea-tree) – *Bursaria spinosa* (Blackthorn) Riparian Scrub & Heath, (2) *Eucalyptus pauciflora* (Snow Gum) – *Eucalyptus nova-anglica* (New England Peppermint) Woodland, (3) *Haloragis heterophylla* (Variable Raspwort) – *Carex inversa* (Sedge) Herbfield, (4) *Baeckea omissa* (Baeckea) – *Leptospermum gregarium* (Swamp Tea-tree) Closed Wet Heath, (5) *Eucalyptus cameronii* (Die-hard Stringybark) – *Eucalyptus campanulata* (New England Blackbutt) Shrubby Open Forest, (6) *Eucalyptus radiata* subsp. *sejuncta* (Narrow-leaved Peppermint) – *Eucalyptus acaciiformis* (Wattle-leaved Peppermint) Woodland, (7) *Eucalyptus cameronii* (Die-hard Stringybark) – *Eucalyptus caliginosa* (Broad-leaved Stringybark) Grassy Open Forest, (8) *Eucalyptus nobilis* (Manna Gum) – *Eucalyptus obliqua* (Messmate) Tall Open Forest, and (9) *Eucalyptus obliqua* (Messmate) – *Eucalyptus nobilis* (Manna Gum) Tall Open Forest, (10) *Leptospermum novae-angliae – Kunzea obovata – Brachyloma saxicola* Shrubby Open Scrub and Closed Heath.

Of 11 communities within the area, four should be considered as threatened, while 18 taxa are considered to be of conservation significance.

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Introduction

Warra National Park (29°29′S, 151°56′E) and the nearby *Wattleridge* freehold property managed under an Aboriginal trust (29°31′S, 151°54′E) are located within the Northern Tablelands Botanical Division, 35 km southeast of Glen Innes, just north of the township of Backwater. *Wattleridge* and parts of Warra NP south of the Sara River are within the Guyra Shire. Most of Warra NP however, is within the Severn Shire whose boundaries extend to the northern banks of the Sara River. Warra NP covers 2041 ha, most of which was the former Warra State Forest (including Crown Mountain Flora Reserve) and a small Vacant Crown Land holding on the southern side of the Sara River. The Park is bounded on three sides by private freehold land and on the north side by State Forest. A national park within the Backwater area was originally proposed in 1985 by John Benson. Quinn et al (1995) highlighted the importance of this area as a hotspot for endemics and rare and threatened species, and recommended land acquisition for reservation. Further proposals were supported by Richards (1996) and Morgan and Terrey (1999) and Warra NP was gazetted in 1999.

Wattleridge property (648 ha) approximately 2 km southwest of Warra NP, and supporting a large area of natural vegetation, was purchased by the Indigenous Land Corporation on behalf of the Banbai Traditional Owners in 1998. *Wattleridge* was formally listed as the first Indigenous Protected Area in 2001; this process included entering into a Voluntary Conservation Agreement.

This paper is based on a flora survey of Warra National Park for the NSW National Parks Service, and *Wattleridge* for the Banbai Business Enterprises Inc., to provide information for developing appropriate management strategies (Hunter 2001; Hunter 2003d).

Climate

The region receives cold westerly or southwesterly winds in winter, and rain-bearing easterly winds, and cyclonic depressions and thunderstorms in late spring and summer (RACAC 1996). Cold fronts with rain and snow often peak in June. Average yearly rainfall is between 890–970 mm in Warra National Park Areas of high elevation such as Crown

and Nightcap Mountains receive higher rainfall due to fog and cloud cover. At Guyra the average maximum summer temperature in January is 24°C, and the average minimum temperature in July is 0°C. An average of 20 frosts occur annually. Cold air drainage and increased likelihood of frosts occur in river valleys.

Landform

Warra National Park and *Wattleridge* are part of the upper catchment of the Sara River which later joins the Guy Fawkes River. The Sara River runs along the northern boundary of *Wattleridge* and forms the southern boundary of Warra NP (Fig. 1). Creeks flowing north and northeast out of Warra NP are upper catchment tributaries of the Henry River which flows through to the northern sections of the Guy Fawkes River (Fig. 1).

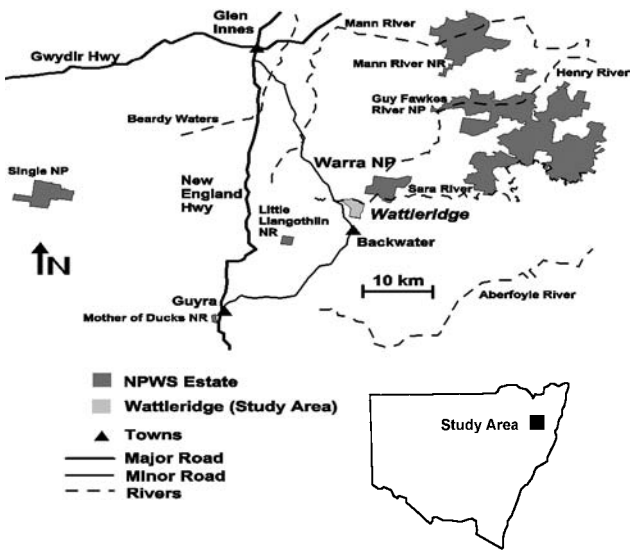

Fig. 1. Locality of Warra NP and *Wattleridge*.

Much of Warra NP is on a high central plateau dominated by Nightcap Mountain in the north at 1372 m and Crown Mountain to the south at 1360 m. Most of the topography is gentle and undulating. Much of the central plateau area is dominated by extensive areas of exposed sheet granite, interspersed with swampy areas. A steep fall occurs on the southern flanks of Crown Mountain, dropping almost 300 m in a kilometre; the northern slopes of the central plateau fall more gradually. The southern flanks of Crown Mountain and Nightcap Mountain are often boulder strewn. The lowest point is in the southeast, around 980 m altitude.

Wattleridge has very similar landscape features to Warra. It is also dominated by a high ridge which runs along the eastern boundary and then extends west following the Sara River. Much of this high ridge is of sheet granite, or is strewn with large boulders. Flatter areas, which have been selectively cleared, run along the western and southern boundaries. Altitude within *Wattleridge* ranges from 1160 m to 1340 m.

Geology

Warra NP is situated within the Central Block (Gilligan & Brownlow 1987) of the southern New England Orogen, west of the Dyamberin Block and the N-S trending Wongwibinda and Demon Faults. There is only one rock type within its boundaries — the Oban River Leucomonzogranite, an I-type leucocratic granite. This unit is comprised of very coarse-grained, leucocratic, equigranular, biotite granite with phases of fine to very fine-grained saccharoidal, pink, equigranular microleucogranite, the finer grained microleucogranite forming a carapace overlying the coarser grained rock (Gilligan et al. 1992).

Landuse and fire history

Mining occurred throughout the region and was particularly prevalent within the Backwater area and especially along the Sara River and its tributaries. Much of the mining was alluvial for tin. Even today sapphires are still worked in the area.

Wildfires are a common feature of this area. High intensity wildfires burnt most of Warra NP in 1988, 1994 and 2001 though *Wattleridge* was not burnt by these fires. When Warra was managed by NSW State Forests, prescribed fire intervals were 3–5 years for plateau areas, 4–7 years for gorge country and more than 10 years for wetter areas at higher altitudes, though how diligently these regimes were adhered to, is not known. Grazing permits existed within Warra at various times while under State Forest management, and though most leases were only lightly grazed, burning to create 'green pick' for cattle, was an integral part of grazing practice.

On much of the better grazing areas, on the more open and less rugged plateau areas, leaseholders probably kept low intensity fire frequency close to every three years.

Wattleridge has always been under private ownership and has been used as a grazing property with sheep, cattle and goats, up to the present. For much of the last 20 years the property has been dually managed as a working grazing property and farmstay. A majority of the property is uncleared, and due to its rugged nature, many areas were not, or at least little, grazed. These uncleared natural areas have been managed informally for conservation for the last thirty years as an attraction for ecotourists, and now more formally as an Indigenous Protected Area.

Previous investigations

In the 1920s and 1930s, the Reverend E.N. McKie, a schoolteacher at Backwater, investigated the flora of the region and a significant number of new species were described (usually in conjunction with W.F. Blakely, a botanist at the National Herbarium of NSW) based on his collections, particularly from areas such as Mushroom Rock (Pheasant Mountain), on the boundary of *Wattleridge*. Investigations into the flora were continued by John Williams of the

University of New England with many field schools taken to Backwater between 1960 and 1990. Williams (1991) produced a preliminary checklist of plants found on *Wattleridge*. Greg Roberts completed a masters preliminary thesis on the vegetation on granite on the Northern Tablelands and North Western Slopes, using Backwater as one of the main study sites (Roberts 1983). Binns (1992) recorded five vegetation survey sites within Warra for a comprehensive assessment of the vegetation under the management of the Glen Innes State Forests. Hunter (1992) described the vegetation and placed belt transects on *Wattleridge* in an investigation of sympatrically growing *Brachyloma* species. Hunter (1999) recorded 46 vegetation survey sites within the Backwater area, all within Warra NP or on *Wattleridge*, for investigation into the biogeography of the granitic outcrop flora of the New England. Benson and Ashby (2000) recorded seven floristic survey sites within Warra NP and a number of others in the Backwater area during vegetation mapping of the Guyra 1: 100 000 map sheet.

Targeted surveys for rare and threatened plants species have also been conducted within Warra NP. Quinn et al. (1995) surveyed for threatened species as did Richards (1996). Hunter (1996) also conducted surveys and produced a draft recovery plan for the threatened species within the Backwater area.

Methods

Existing information was compiled from previous surveys of the two areas including: Williams (1991), Binns (1992), Hunter (1992), Hunter (1996), Richards (1996), Hunter (1999), Hunter (2001) and Hunter (2003d). Records from Hunter (1999) were taken from surveys of granite outcrops only and were of a nested plot design and an area of 33×33 m (see Hunter & Clarke 1998), those of Hunter (1992) were of 120 m x 10 m belt transects, while all other sites were surveyed using the Braun-Blanquet (1982) six point cover abundance scale within a 20 x 50 m plot. An additional 50, 20 x 20 m, sites were recorded in Warra NP over 5 days in January of 2001 (Hunter 2001). A further 15, 20 x 20 m, sites were recorded within *Wattleridge* over 2 days in August 2003 (Hunter 2003) to assess and align vegetation assemblages with those already described for Warra NP by Hunter (2001). In total, data from 157 sites, each 20 x 20 m, 20 x 50 m or 33 x 33 m, were collated along with existing information from all other previous investigations in the region.

This paper presents a summary of all the investigations carried out for these two areas. As the aims and methods of the many of the previous investigations varied greatly only one subset of information was used to formally describe the vegetated systems within the two study areas. The fifty sites from Hunter (2001) are the only ones used in the analysis presented here. These fifty sites were placed using a stratified random method within Warra NP; strata included altitude and physiography. The communities defined from this analysis were extrapolated based on the additional information from the 107 other sites to all areas under investigation. Rock outcrops sites were not part of the stratification of Hunter (2001) as these areas were deemed to have been sufficiently described by Hunter (1999); thus although outcrop communities are mapped and described here, they are based on the work of Hunter & Clarke (1998). In addition to surveying outcrop vegetation, Hunter (1999) placed some sites within the surrounding matrix, and analysed their relationships with communities in the nearby matrix (Hunter 2002c).

Good quality specimens weres retained as vouchers by the New England Tablelands Region, National Parks and Wildlife Service, and by the NCW Beadle Herbarium of the University of New England (NE). Nomenclature follows that of Harden (1993–2002) except where recent changes have been made.

Analysis and data exploration were performed using options available in the PATN Analysis Package (Belbin 1995a, b). For final presentation of results all species (including exotics) and their cover abundance scores were used. Analysis was performed using Kulczynski association measure, which is recommended for ecological applications (Belbin 1995a, b) along with flexible Unweighted Pair Group arithmetic Averaging (UPGMA) and the default PATN settings.

Delineation of community boundaries was based on the location of sites and their position within the multivariate analysis, air photograph interpretation, substrate and ground truthing. The vegetation maps are based on a 1: 25 000 scale. Structural names follow Specht et al. (1995) and are based on the most consistent uppermost stratum.

Results

Vegetation communities

The vegetation communities described for Warra NP and *Wattleridge* are broadly similar to many communities found throughout the central parts of the Northern Tablelands from Ebor to the Queensland border (Binns 1992; Hunter & Clarke 1998; Hunter & Alexander 1999; Hunter et al. 1999; Benwell 2000; Hunter 2000b; Hunter & Sheringham 2002; Hunter 2004bc; Hunter 2004d). Most communities are of a woodland or forest structure, and these may have one or two shrub layers, or be primarily grassy. Heaths occur on rock outcrops, and in areas of impeded drainage where *Sphagnum* may be present.

From the analyses, nine vegetation communities are recognized at the dissimilarity measure of 0.8 in the dendrogram (Fig. 2) which shows three major groups: Communities 1–4 are primarily in waterlogged or periodically waterlogged areas; Communities 5–6 are woodlands to forest with a very shrubby understorey; and Communities 7–9 are primarily taller forests with a grassy understorey.

Within the following summary descriptions extreme values are given in brackets. Exotic species are not listed below but are included within Appendix 1. In all 549 taxa were found from 94 families and 290 genera, of which 495 taxa were recorded in Warra NP and 480 were recorded at *Wattleridge*. Species from each layer are listed in order of decreasing importance (cover x frequency). The number of hectares given is based only on what is formally reserved within Warra NP.

Community 1: *Leptospermum novae-angliae* (New England Tea-tree) — *Bursaria spinosa* (Blackthorn) — *Callitris oblonga* (Tasmanian Cypress)

Distribution: on skeletal soil on exposed granite rocks associated with river banks, with loamy sand and grey-brown soils. This community occurs in both study areas, where it is restricted to the rockier parts of the Sara River.

Structure: riparian scrub and heath, sometimes a low open woodland. Tree layer: 10–15 m tall; 10–15% cover. Tall shrub layer sometimes absent: 8–12 m tall; c. 20%. Low shrub layer: 1–3 m tall; 40–60% cover. Herb layer: > 1 m tall; c. 30% (Fig. 5).

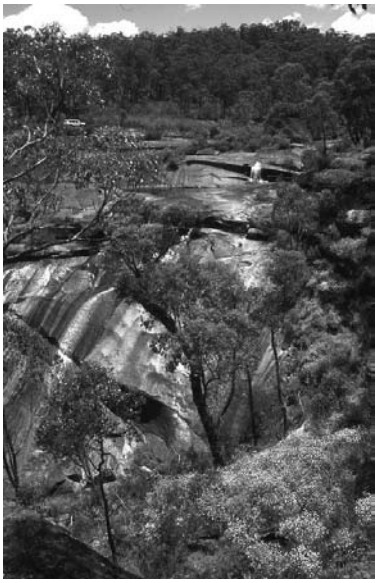

Fig. 5. Community 1: *Leptospermum novae-angliae – Bursaria spinosa* shrubland & heath along the Sara River.

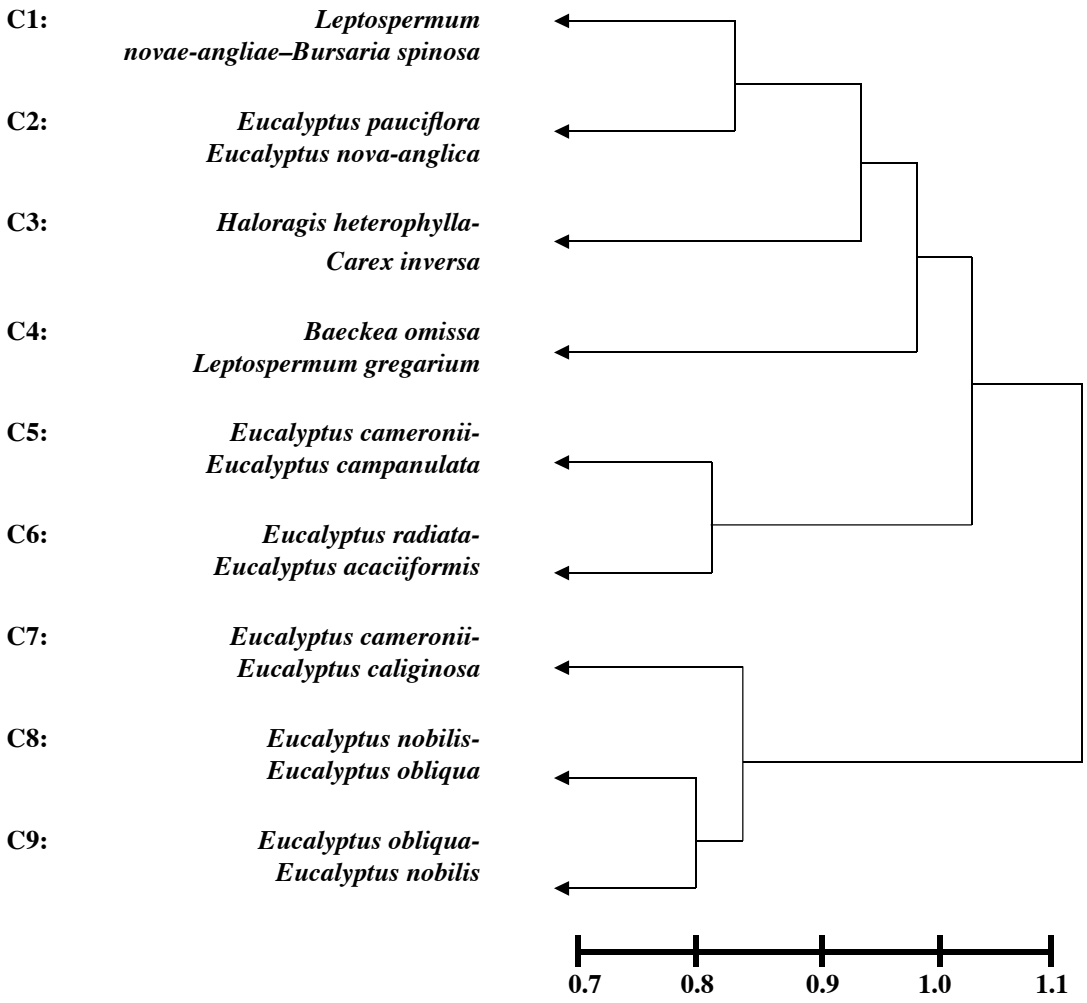

Fig. 2. Summary dendrogram of non-outcrop dataset of sites using Kulczynski association and flexible UPGMA fusion strategy. Communities are defined at a dissociation of 0.8.

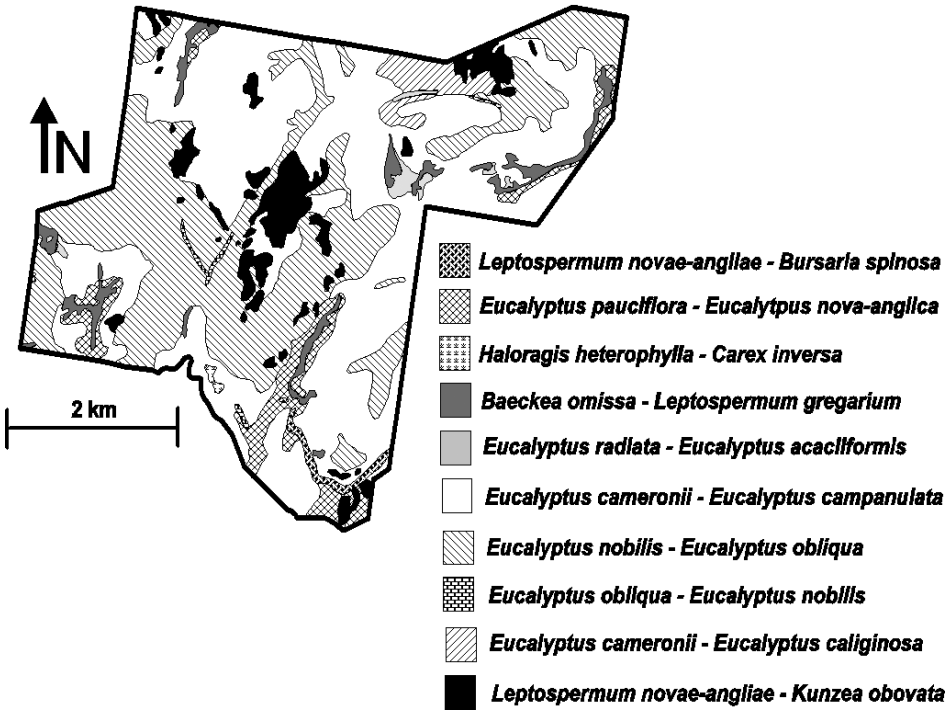

Fig. 3. Map of vegetation communities at Warra National Park.

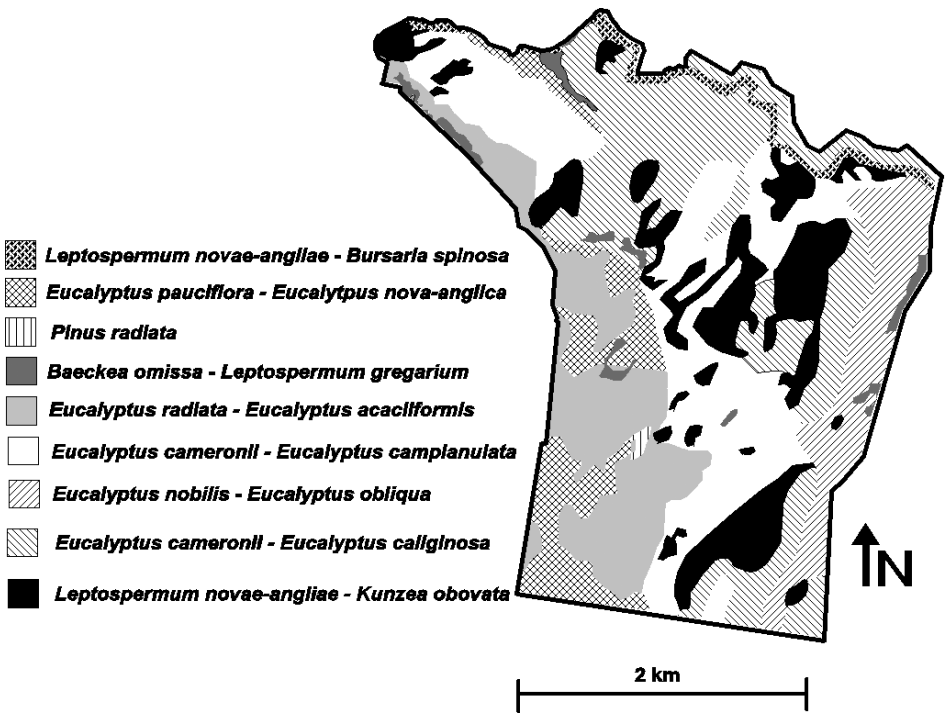

Fig. 4. Map of vegetation communities at Wattleridge.

Trees: *Eucalyptus dalrympleana* subsp. *heptantha, Eucalyptus caliginosa*.

Shrubs: *Leptospermum novae-angliae, Bursaria spinosa, Acacia fimbriata, Callitris oblonga* subsp. *parva, Pomaderris nitidula, Logania albiflora, Leptospermum polygalifolium* subsp. *transmontanum, Leptospermum brevipes, Leucopogon biflorus, Kunzea obovata, Correa reflexa, Brachyloma saxicola*.

Climbers & trailers: *Rubus parviflorus, Persicaria hydropiper.*

Ground cover: *Wahlenbergia communis, Dichelachne crinita, Adiantum aethiopicum, Poa sieberiana, Entolasia stricta, Vittadinia dissecta, Tripogon loliiformis, Thonandia longifolia, Themeda australis, Sporobolus creber, Schoenus apogon, Poa labillardieri, Plectranthus graveolens, Opercularia diphylla, Fimbristylis dichotoma, Euchiton sphaericus, Dichelachne micrantha, Dichelachne inaequiglumis, Dianella caerulea, Cymbopogon refractus, Cheilanthes sieberi, Calandrinia* sp. A, *Austrodanthonia racemosa* subsp. *racemosa, Austrodanthonia monticola, Aristida ramosa*.

Variability: by its nature this community has a large edge to area ratio, and even common dominants may be absent due to the variability in substrate and depth of soil and flooding events, thus giving a variable structure. The riverbanks include extensive sheet granite and boulder strewn areas and many species are shared with community 10 where exposed granite platforms are larger and less exposed to riparian influences. Where alluvium is deeper and drainage is impeded, similarities with community 4 are apparent.

Notes: the floristics are probably reliant on a constant cycle of disturbance by flooding and fire. Benson and Ashby (2000) consider this community type to be endangered locally and at least vulnerable within NSW. They also consider the community to be poorly conserved locally. Based on published floristic analyses this community type does not appear to be represented in other reserves and no synonymous assemblages are described. Hence, it is likely that this grouping of taxa is unique to the Tablelands. [6 sites; 15 ha].

Community 2: *Eucalyptus pauciflora* (Snow Gum) — *Eucalyptus nova-anglica* (New England Peppermint)

Distribution: found primarily on lower slopes and open depressions with moist soils. Soils are primarily loamy sand, but also sandy, grey to yellow brown, shallow or deep.

Structure: woodlands. Tree layer: 15–20 m tall; 20–30% cover. Tall shrub layer sometimes absent: 2–6 m tall; 10–20% cover. Low shrub layer: 1–2 m tall; 20–60% cover. Herb layer: < 1 m tall; 50–80% cover (Fig. 6).

Fig. 6. Community 2: *Eucalyptus pauciflora – Eucalyptus nova-anglica* woodland.

Trees: *Eucalyptus pauciflora, Banksia integrifolia, Eucalyptus nova-anglica, Eucalyptus dalrympleana* subsp. *heptantha, Eucalyptus viminalis, Eucalyptus camphora, Eucalyptus caliginosa*.

Shrubs: *Persoonia procumbens, Leptospermum polygalifolium* subsp. *transmontanum, Aotus subglauca* var. *subglauca, Grevillea scortechinii* var. *sarmentosa, Brachyloma daphnoides* subsp. *glabrum, Monotoca scoparia, Melichrus procumbens, Dillwynia retorta, Bursaria spinosa, Mirbelia confertiflora, Hovea heterophylla, Dillwynia sieberi, Bossiaea neo-anglica, Petrophile canescens, Logania albiflora, Hibbertia riparia, Grevillea juniperina* subsp. *allojohnsonii, Dodonaea viscosa, Choretrum pauciflorum, Bossiaea scortechinii, Baeckea omissa*.

Climbers & trailers: *Glycine tabacina, Rubus parvifolius, Glycine clandestina*.

Ground cover: *Pteridium esculentum, Themeda australis, Lomandra longifolia, Brachyscome nova-anglica, Dichelachne micrantha, Stylidium graminifolium, Imperata cylindrica, Dichelachne inaequiglumis, Poa sieberiana, Lomandra multiflora, Microlaena stipoides, Goodenia hederacea, Austrodanthonia racemosa* var. *racemosa, Adiantum aethiopicum, Wahlenbergia communis, Sorghum leiocladum, Poranthera microphylla, Helichrysum scorpioides, Aristida ramosa, Trachymene incisa, Stackhousia viminea, Opercularia diphylla, Gonocarpus tetragynus, Entolasia stricta, Echinopogon caespitosus, Dichondra repens, Dichelachne crinita, Derwentia arcuata, Calandrinia* sp. A, *Austrostipa rudis* subsp. *nervosa*.

Variability: the height and cover of the tree layer is variable and probably dependent on how exposed the site is to frost. Some localities have an open tree layer that is short to 15 m tall and dominated mainly by *Eucalyptus pauciflora* and *Eucalyptus nova-anglica*, however in less exposed situations, particularly if slightly elevated, *Eucalyptus caliginosa* may become more prominent with an increase in height and density of the trees. This community intergrades with communities 4 and 6, as drainage becomes more impeded, or Community 7 where sites are more elevated.

Notes: this community is associated with low-lying areas, affected by frosts at higher altitudes. Within the study areas it is found associated with low lying-sites adjacent to the Sara River, and also in open frost hollows in broader gullies. Broadly similar associations may occur as far north as the Queensland border and as far south as New England and Coolah Tops National Parks. However, communities most closely allied to this assemblage are probably restricted to sporadic localities in the Guyra area, and potentially as far north as Butterleaf and as far south as Cathedral Rock National Park. Benson and Ashby (2000) considered this assemblage to be one of the most endangered communities both within the local area and within NSW. [7 sites; 100 ha].

Community 3: *Haloragis heterophylla* (Variable Raspwort) — *Carex inversa* (Sedge)

Distribution: previously cleared land on a lower slope associated with the Sara River.

Structure: herbfield. Herb layer: < 50 cm tall; 100% cover (Fig. 7).

Trees: none apparent.

Shrubs: none apparent.

Climbers & trailers: *Rubus parviflorus*.

Ground cover: *Haloragis heterophylla, Carex inversa, Agrostis avenacea, Thonandia longifolia, Scleranthus biflorus, Rumex brownii, Pteridium esculentum, Persicaria decipiens, Juncus vaginatus, Eragrostis elongata, Epilobium billardierianum, Dichondra repens, Austrodanthonia racemosa* var. *racemosa, Alternanthera* sp. A, *Phyllanthus virgatus, Linum marginale, Austrodanthonia induta*.

Variability: an assemblage that has only been sampled by one quadrat, hence no variability noted.

Fig. 7. Community 3: *Haloragis heterophylla – Carex inversa herbfield*

Notes: despite being a derived assemblage due to past clearing some of the components of this open herbfield show affinities to other open grasslands and herbfields from Guy Fawkes River NP and New England NP. [1 site; 3 ha].

Community 4: *Baeckea omissa* (Baeckea) — *Leptospermum gregarium* (Swamp Tea-tree)

Distribution: patchily distributed in open or closed depressions associated with areas of impeded drainage along creeks. Soils are damp to waterlogged, usually loamy sand, but also loam to clay, grey-brown to black and deep.

Structure: mainly heaths, but also low open woodlands and mallee. Tree layer sometimes absent: (3–) 8–15 (–30) m tall; 10–30% cover. Tall shrub layer often absent: 2–6 m tall; c. 30% cover. Low shrub layer usually absent: 1–2 m tall; 30–80% Herb layer: < 1 m tall; 40–100% cover (Fig. 8).

Trees: *Eucalyptus camphora* subsp. *relicta, Eucalyptus pauciflora, Eucalyptus dalrympleana* subsp. *heptantha, Banksia integrifolia, Eucalyptus acaciiformis, Eucalyptus nova-anglica, Eucalyptus caliginosa, Eucalyptus nobilis*.

Shrubs: *Baeckea omissa, Leptospermum gregarium, Epacris microphylla, Callistemon pityoides, Banksia cunninghamii, Hakea microcarpa, Lomatia fraseri, Callistemon pallidus, Hakea eriantha, Scaevola ramosissima, Pimelea linifolia, Hibbertia riparia, Aotus subglauca* var. *subglauca, Petrophile canescens, Monotoca scoparia, Acacia filicifolia*.

Fig. 8. Community 4. *Baeckea omissa – Leptospermum gregarium wet heath*.

Climbers & trailers: *Rubus parvifolius, Glycine* sp. A, *Glycine clandestina*.

Ground cover: *Baloskion fimbriatum, Goodenia bellidifolia, Lepidosperma limicola, Geranium solanderi* var. *grande, Lomandra longifolia, Schoenus apogon, Gonocarpus micranthus, Helichrysum scorpioides, Viola hederacea, Pteridium esculentum, Patersonia fragilis, Lepyrodia anarthria, Entolasia stricta, Dichelachne inaequiglumis, Patersonia glabrata, Juncus vaginatus, Isachne globosa, Hypericum gramineum, Haloragis heterophylla, Goodenia hederacea, Xyris complanata, Utricularia dichotoma, Themeda australis, Stylidium graminifolium, Scirpus polystachyus, Lepidosperma gunnii, Echinopogon caespitosus, Drosera burmannii, Craspedia variabilis, Carex lobolepis, Baloskion stenocoleum, Austrofestuca eriopoda, Xyris operculata, Thelionema caespitosum, Poa sieberiana, Imperata cylindrica, Epilobium gunnianum, Austrodanthonia racemosa* var. *racemosa, Thelionema grande, Poranthera microphylla, Lythrum salicaria, Lepyrodia leptocaulis, Hydrocotyle geraniifolia, Dichondra repens, Cyperus sphaeroideus, Carex inversa*.

Variability: such assemblages are usually isolated, small and generally of limited distribution, and many associated species are variable in their presence. Often zonation occurs into grass and cyperoid-dominated areas, along with situations with a strong shrub component. Such internal variability is due to depth and duration of waterlogging. In a very few localities *Sphagnum* bogs have developed.

Notes: few completely comparable examples of this assemblage can be found within the literature. Similar associations are restricted to higher altitudes on the Tablelands particularly along the eastern margin of the Great Divide. Communities such as these are usually highly divergent across relatively small distances, and as such most occurrences are unique. Benson and Ashby (2000) considered this type of assemblage to be poorly-conserved locally, but moderately conserved within NSW. Similar small isolated occurrences are likely to within most reserves on the escarpment and associated Tablelands areas from the Queensland border to Barrington and Coolah Tops. Broadly similar assemblages are known to be reserved within Gibraltar Range NP, New England NP, Basket Swamp NP, Boonoo Boonoo NP, Bald Rock NP, Girraween NP, Demon NR, Cathedral Rocks NP, Mann River NP, Coolah Tops NP, western Washpool Western NP, Werrikimbe NP, Capoompeta NP and Butterleaf NP (Hunter et al. 1999; Hunter 2000b; Whinam & Chilcott 2002; Hunter 2004bc; Hunter 2005). Despite the above, areas which include *Sphagnum* should be considered endangered on the Tablelands as only a few occurrences survive in good condition. It is likely that only a few hectares of these bogs occur across the whole Tablelands (Whinam & Chilcott 2002). [8 sites; 69 ha].

Community 5: *Eucalyptus cameronii* (Diehard Stringybark) — *Eucalyptus caliginosa* (Broad-leaved Stringybark) — *Eucalyptus campanulata* (Eastern New England Blackbutt)

Distribution: within Warra NP this community is restricted to Nightcap Mountain in the northeastern corner, and in the upper reaches of Comptons Gully. It is more widespread within *Wattleridge* where it is found in a variety of landscape situations, from upper slopes to open depressions and lower slopes. Soils are usually well drained but can be damp to moist and usually shallow. Soils texture and colour are generally loamy sand and dark-brown, or yellow-brown to black.

Structure: open forests. Tree layer: 20–30 m tall; 30–35% cover. Low shrub layer: 1–2 m tall; 20–80% cover. Herb layer: < 1 m tall; 60–80% cover (Fig. 9).

Trees: *Eucalyptus cameronii, Eucalyptus caliginosa, Eucalyptus campanulata, Eucalyptus radiata* subsp. *sejuncta*.

Shrubs: *Dillwynia phylicoides, Lomatia silaifolia, Bossiaea neo-anglica, Banksia cunninghamii, Monotoca scoparia, Leucopogon lanceolatus, Hovea pedunculata, Hibbertia* sp. aff. *obtusifolia*,

Fig. 9. Community 5: *Eucalyptus cameronii – Eucalyptus campanulata* Forest.

Pomaderris lanigera, Acacia ulicifolia, Acacia myrtifolia, Pultenaea linophylla, Platysace lanceolata, Hakea eriantha, Acacia mitchellii, Petrophile canescens, Melichrus procumbens, Grevillea scortechinii, Boronia algida, Acacia buxifolia, Prostanthera scutellarioides, Polyscias sambucifolia, Pimelea linifolia, Maytenus silvestris, Dodonaea triquetra, Bossiaea scortechinii .

Climbers & trailers: *Billardiera scandens, Smilax australis, Hardenbergia violacea*.

Ground cover: *Platysace ericoides, Goodenia hederacea, Austrodanthonia racemosa* var. *racemosa, Pteridium esculentum, Pomax umbellata, Lomandra longifolia, Lepidosperma laterale, Entolasia stricta, Stylidium graminifolium, Poa sieberiana, Patersonia glabrata, Gonocarpus tetragynus, Poa queenslandica, Goodenia bellidifolia, Schoenus melanostachys, Lomandra multiflora, Lindsaea linearis, Dianella caerulea, Calochlaena dubia, Stackhousia monogyna, Patersonia sericea, Microlaena stipoides, Gonocarpus oreophilus, Dianella revoluta*.

Variability: the structure of this community is constant, despite the often changing understorey floristics. These understorey changes are probably due to past fires with varying intensities, promoting some species over others. It is likely that, with a longer absence of fire, the understorey will become denser and taller and form a thick almost impenetrable layer.

Notes: no truly comparable assemblages were found within the literature. Broadly though, it is synonymous with a number of assemblages along the eastern escarpment on coarse granitic soils from Cathedral Rock NP to the Queensland border. This assemblage intergrades with Community 6 particularly where drainage is intermediate and with Community 7. [11 sites; 48 ha].

Community 6: *Eucalyptus radiata* subsp. *sejuncta* (Narrow-leaved Peppermint) — *Eucalyptus acaciiformis* (Wattle-leaved Peppermint)

Distribution: low-lying flats and open depressions particularly around the margins of swamps and wet heaths. Soils are moist to damp, loamy or sandy loam, black to dark brown and deep.

Structure: woodlands. Tree layer: 15–20 m tall; c. 20% cover. Tall shrub layer sometimes absent: 2–4 m tall; 10% cover. Low shrub layer: 1–2 m tall; 70–80% cover. Herb layer: < 1 m tall; 20–80% cover (Fig. 10).

Trees: *Eucalyptus radiata* subsp. *sejuncta, Eucalyptus acaciiformis, Eucalyptus campanulata*.

Fig. 10. Community 6: *Eucalyptus radiata* subsp. *sejuncta – Eucalyptus acaciiformis* woodlands.

Shrubs: *Grevillea scortechinii* subsp. *sarmentosa, Leptospermum brevipes, Banksia cunninghamii, Aotus subglauca* var. *subglauca, Petrophile canescens, Epacris microphylla, Dillwynia phylicoides, Baeckea omissa, Mirbelia pungens, Leptospermum novae-angliae, Callistemon pallidus, Acacia buxifolia, Hibbertia acicularis, Xanthorrhoea glauca, Persoonia procumbens, Lomatia silaifolia, Monotoca scoparia, Acacia ulicifolia*.

Climbers & trailers: *Billardiera scandens*.

Ground cover: *Goodenia bellidifolia, Baloskion fimbriatum, Schoenus melanostachys, Goodenia hederacea, Entolasia stricta, Austrodanthonia racemosa* var. *racemosa, Stylidium graminifolium, Lomandra longifolia, Gonocarpus tetragynus, Gonocarpus micranthus, Dianella revoluta, Austrodanthonia monticola, Pteridium esculentum, Poranthera microphylla, Poa sieberiana, Patersonia sericea, Microlaena stipoides, Juncus vaginatus, Wahlenbergia ceracea, Thysanotus tuberosus, Patersonia fragilis, Lindsaea linearis, Lepyrodia anarthria, Lepidosperma limicola, Lagenifera stipitata, Imperata cylindrica, Hypericum gramineum, Gahnia aspera, Dichelachne micrantha*.

Variability: the major changes associated with this assemblage are the prominence or absence of shrubs in the understorey. Where this community occurs on sandier soils it usually boasts a dense heathy understorey, as in Warra NP, but as soils become heavier the heath is replaced by herbs and grasses, as at *Wattleridge*.

Notes: this community often occurs in areas that may be periodically inundated. Beadle (1981) states that *Eucalyptus radiata* is commonly associated with *Eucalyptus acaciiformis* where rainfall is generally greater than 1000 mm annually, and where soils are of low fertility and especially where drainage is impeded. It is therefore likely that this assemblage is restricted to low-lying areas with impeded drainage, but not areas that are waterlogged. This community naturally intergrades with community 4 where waterlogging is more prolonged, and with community 2 where drainage is better, which is not surprising, as *Eucalyptus pauciflora* replaces *Eucalyptus acaciiformis* where soils are less prone to waterlogging. Some intergradations occur with community 5 which commonly borders this assemblage. Benson and Ashby (2000) consider this community to be vulnerable and poorly conserved across both locally and across NSW. [4 sites; 14 ha].

Community 7: *Eucalyptus cameronii* (Diehard Stringybark) — *Eucalyptus caliginosa* (Broad-leaved Stringybark)

Distribution: sampled primarily from lower slopes, but also on middle to upper slopes. Soils are well-drained to moist, loamy sand to sandy loam, predominantly grey-brown in colour but also yellow-brown, light-brown to dark-brown with a variable depth.

Structure: mainly woodlands to open forests, occasionally tall open forests. Tree layer: 20–40 m tall; 30–40% cover. Tall shrub layer sometimes absent: (3–) 4–8 (–15) m tall; (10–) 20–40 (–70)% cover. Low shrub layer usually not present: 1–2 m tall; (10–) 20–60% cover. Herb layer: < 1 m tall; 60–90% cover (Fig. 11).

Trees: *Eucalyptus cameronii, Eucalyptus caliginosa, Banksia integrifolia, Allocasuarina littoralis, Eucalyptus radiata* subsp. *sejuncta, Eucalyptus nobilis, Eucalyptus nova-anglica, Eucalyptus pauciflora, Eucalyptus dalrympleana* subsp. *heptantha, Eucalyptus viminalis, Eucalyptus obliqua, Eucalyptus stellulata*.

Shrubs: *Monotoca scoparia, Lomatia silaifolia, Bossiaea scortechinii, Acacia filicifolia, Leucopogon lanceolatus, Aotus subglauca* var. *subglauca, Polyscias sambucifolia, Melichrus urceolatus, Melichrus procumbens, Brachyloma daphnoides* subsp. *glabrum, Jacksonia scoparia, Dillwynia retorta, Platysace lanceolata, Persoonia cornifolia, Hibbertia* sp. aff. *obtusifolia*, *Hibbertia riparia, Bossiaea neo-anglica, Hovea heterophylla, Dodonaea triquetra, Banksia cunninghamii, Acacia fimbriata*.

Climbers & trailers: *Desmodium varians, Billardiera scandens, Hardenbergia violacea, Rubus parvifolius, Glycine* sp. A, *Glycine clandestina, Eustrephus latifolius*.

Ground cover: *Imperata cylindrica, Pteridium esculentum, Poa sieberiana, Entolasia stricta, Goodenia hederacea, Lomandra longifolia, Brachyscome nova-anglica, Echinopogon caespitosus, Austrodanthonia racemosa* subsp. *racemosa, Poranthera microphylla, Microlaena stipoides, Lepidosperma laterale, Gonocarpus tetragynus, Oxalis chnoodes, Dichelachne micrantha, Lomandra multiflora, Opercularia hispida, Wahlenbergia communis, Senecio diaschides, Dichelachne inaequiglumis, Viola betonicifolia, Helichrysum scorpioides, Stylidium gramineum, Pratia purpurascens, Patersonia sericea, Dianella revoluta, Austrostipa rudis* subsp. *nervosa, Poa queenslandica, Platysace ericoides, Hybanthus monopetalus, Podolepis neglecta, Lagenifera stipitata, Dianella caerulea, Hypericum gramineum, Dichondra repens, Craspedia variabilis, Lomandra filiformis, Gonocarpus teucrioides, Themeda australis, Pomax umbellata, Patersonia glabrata, Opercularia diphylla, Hydrocotyle peduncularis, Hydrocotyle laxiflora, Goodenia bellidifolia, Galium migrans, Gahnia aspera, Euchiton sphaericus, Austrodanthonia monticola*.

Variability: this is the most widespread community within the study area. A small and taller shrub layer are normally present, however, either may be missing and usually this is the lower shrub layer. This variability may in a large part by due to differences in fire regimes, both frequency and intensity. In some locations where only the upper shrub layer is present, it is rather sparse, and a dense layer of grasses may be prominent (particularly *Imperata cylindrica*).

Notes: this community occurs on more exposed sites than Community 8 with which it often intergrades. This assemblage also intergrades with the 'heathier' communities such as community 5 and 6. It is probably largely restricted to the Backwater area, however similar assemblages occur from as far south as New England NP to the Washpool Western Additions NP. [20 sites; 1058 ha].

Community 8: *Eucalyptus nobilis* (Manna Gum) — *Eucalyptus obliqua* (Messmate)

Distribution: usually on steeper slopes or in protected locations. Sampled on upper to lower slopes, primarily facing south or in protected localities. Floating boulders are common. Soils are generally moist to well drained, loamy sand, brown to dark-brown or grey, and shallow.

Structure: mainly open forest, but also tall open forest and occasionally woodland. Tree layer: (20–) 25–40 m tall; (20–) 30–40% cover. Tall shrub layer often absent: (3–) 5–12 m tall; (10–) 20–40% cover. Low shrub layer rarely present: 1–6 m tall; (10–) 20–60 (–90%) cover. Herb layer: < 1 m tall; 60–100% cover (Fig. 12).

Trees: *Eucalyptus caliginosa, Banksia integrifolia, Eucalyptus nobilis, Eucalyptus obliqua, Eucalyptus campanulata, Allocasuarina littoralis, Eucalyptus radiata* subsp. *sejuncta, Eucalyptus eugenioides, Eucalyptus stellulata, Eucalyptus cameronii*.

Shrubs: *Acacia filicifolia, Leucopogon lanceolatus, Bursaria spinosa, Lomatia silaifolia, Indigofera australis, Solanum campanulatum, Monotoca scoparia, Bossiaea neo-anglica*.

Climbers & trailers: *Rubus parvifolius, Desmodium varians, Glycine clandestina, Billardiera scandens, Hardenbergia violacea, Eustrephus latifolius, Smilax australis, Pyrrosia confluens, Glycine tabacina, Clematis glycinoides*.

Fig. 11. Community 7: *Eucalyptus cameronii – Eucalyptus caliginosa* grassy open forest and woodland.

Fig. 12. Community 8: *Eucalyptus nobilis – Eucalyptus obliqua* open forest.

Ground cover: *Poa sieberiana, Pteridium esculentum, Imperata cylindrica, Dichondra repens, Microlaena stipoides, Senecio diaschides, Geranium solanderi* var. *solanderi, Lomandra longifolia, Hydrocotyle geraniifolia, Dichelachne inaequiglumis, Brachyscome nova-anglica, Austrodanthonia racemosa* var. *racemosa, Pratia purpurascens, Echinopogon caespitosus, Wahlenbergia communis, Poranthera microphylla, Galium migrans, Calochlaena dubia, Arthropodium milleflorum, Veronica calycina, Opercularia hispida, Lomandra filiformis, Hydrocotyle peduncularis, Dianella revoluta, Plantago varia, Lagenifera stipitata, Goodenia hederacea, Austrostipa rudis* var. *nervosa, Viola hederacea, Viola betonicifolia, Oxalis chnoodes, Echinopogon ovatus, Acaena novae-zelandiae, Senecio* sp. E*, Poa queenslandica, Entolasia stricta, Themeda australis, Stackhousia viminea, Ranunculus lappaceus, Podolepis neglecta, Platysace ericoides, Lomandra multiflora, Hydrocotyle laxiflora, Hybanthus monopetalus, Helichrysum scorpioides, Gonocarpus tetragynus, Euchiton sphaericus, Dichelachne micrantha, Adiantum aethiopicum*.

Variability: tree height can be dramatically variable forming low open forests to tall open forests. Shrubs are not a prominent component and a shrub layer is not always present. This may in part be due to variation in fire frequency and intensity, particularly in relation to the germination of cohorts of *Acacia*.

Notes: this community is the second most common assemblage within the study area. Similar assemblages occur in comparable situations in high altitude areas of Capoompeta and western Washpool NPs (Hunter 2000b; Hunter 2005), in high altitude areas around Scott Trig in Butterleaf NP (Binns 1992). Similar assemblages are sporadically distributed at high altitudes (1000–1400 m) between Guyra and Tenterfield, though broadly similar communities are also described for the Barrington Tops and New England NPs (Binns 1995; Clarke et al. 2000). Intergradation occurs with community 7 and the similar community 9. [15 sites; 705 ha].

Community 9: *Eucalyptus obliqua* (Messmate) — *Eucalyptus nobilis* (Manna Gum)

Distribution: only known from very protected sites in upper catchments around Crown and Nightcap Mountains. The soils are damp, loamy, dark brown and often shallow with many floating boulders.

Structure: tall open forest. Tree layer: 35–40 m tall; c. 30% cover. Tall shrub layer: 4–10 m tall; 20–30% cover. Low shrub layer not always present: 2–3 m tall; c.20% cover. Understorey layer: < 1 m tall; c. 90% cover (Fig. 13).

Trees: *Eucalyptus obliqua, Eucalyptus nobilis, Eucalyptus cameronii, Eucalyptus radiata* subsp. *sejuncta, Eucalyptus campanulata*.

Shrubs: *Coprosma quadrifida, Notelaea* sp. A, *Lomatia silaifolia, Solanum elegans*, *Solanum densevestitum, Rapanea variabilis, Acacia melanoxylon, Solanum campanulatum, Notelaea longifolia, Correa reflexa*.

Climbers & trailers: *Desmodium varians, Clematis aristata, Glycine clandestina, Geitonoplesium cymosum, Eustrephus latifolius, Rubus parvifolius, Smilax australis*.

Ground cover: *Calochlaena dubia, Blechnum cartilagineum, Polystichum fallax, Hydrocotyle geraniifolia, Dichondra repens, Pteridium esculentum, Pratia purpurascens, Microlaena stipoides, Dicksonia antarctica, Cyathea australis, Viola betonicifolia, Poa sieberiana, Doodia aspera, Carex inversa, Austrostipa rudis* var. *nervosa, Adiantum aethiopicum, Wahlenbergia communis, Viola hederacea, Veronica plebeia, Plantago varia, Lagenifera stipitata, Imperata cylindrica, Echinopogon caespitosus, Sigesbeckia australiensis, Senecio lautus, Senecio diaschides, Ranunculus lappaceus, Oxalis chnoodes, Oreomyrrhis eriopoda, Luzula flaccida, Gonocarpus teucrioides, Gonocarpus oreophilus, Geranium solanderi* var. *solanderi, Dianella revoluta, Carex incomitata, Xerochrysum bracteata, Blechnum wattsii, Austrostipa aristiglumis, Acianthus exsertus*.

Fig. 13. Community 9: *Eucalyptus obliqua – Eucalyptus nobilis* tall open forest with a mesic understorey.

Variability: this community has many closed forest elements and their abundance and dominance vary according to time since the last fire incursion.

Notes: no directly comparable communities were found in the literature, however similar assemblages were described for the Washpool NP Western Additions. It is likely that under more favourable conditions, particularly a reduced fire regime, a mixed closed forest stand may develop in these localities. Intergradation occurs with community 8, or at times with community 7. [2 sites; 6 ha].

Community 10: *Leptospermum novae-angliae* (New England Tea-tree) — *Kunzea obovata* (Burgan) — *Brachyloma saxicola* (New England Daphne Heath)

Caveat: this community description is based on the work of Hunter (1999) presented in Hunter & Clarke (1998) and was not incorporated in the analyses of the other nine communities described here. Hunter (1999; 2002c) demonstrated by analysis that this assemblage was different from the other assemblages within the area.

Distribution: restricted to exposed granitic outcrops scattered throughout both study areas and particularly well-developed on extensive granite sheets between Crown and Nightcap Mountains.

Fig. 14. Community 10: *Leptospermum novae-angliae – Kunzea obovata – Brachyloma saxicola* open scrub and heath, overtopped here by the mallee *Eucalyptus codonocarpa*.

Structure: structurally they are mainly closed heaths although the mallee *Eucalyptus codonocarpa* may be present forming shrubby open scrubs (mallee). Occasionally other trees species occur, such as *Eucalyptus campanulata, Euclyptus caliginosa, Eucalyptus acaciiformis* and *Euclyptus cameronii*, giving a shrubby low open woodland structure. In some instances *Leptospermum novae-angliae* at its tallest and densest will form closed scrub (Fig. 14).

Trees: *Eucalyptus codonocarpa, Eucalyptus caliginosa, Eucalyptus acaciiformis, Eucalyptus cameronii, Eucalyptus campanulata*.

Shrubs: *Leptospermum novae-angliae, Kunzea obovata, Leucopogon neoanglicus, Allocasuarina rigida* subsp. *rigida, Brachyloma saxicola, Mirbelia confertiflora, Calytrix tetragona, Prostanthera scutellarioides, Hovea pedunculata, Boronia anemonifolia* var. *variabilis, Acacia venulosa, Acacia ulicifolia, Hibbertia acicularis, Leucopogon microphyllus, Acacia falciformis, Dodonaea viscosa, Zieria cytisoides, Dillwynia phylicoides, Hakea laevipes* subsp. *graniticola, Persoonia cornifolia, Monotoca scoparia, Acacia viscidula*.

Climbers & trailers: *Muehlenbeckia costata, Billardiera scandens*.

Ground cover: *Lepidosperma gunnii, Gonocarpus teucrioides, Entolasia stricta, Platysace lanceolata, Schoenus apogon, Brachyscome stuartii, Lomandra longifolia, Monotaxis macrophylla, Gonocarpus micranthus, Gahnia sieberiana, Actinotus gibbonsii, Austrodanthonia monticola, Thelionema caespitosum, Cheilanthes sieberi, Stypandra glauca, Trachymene* sp. 'pilosa', *Dampiera stricta, Empodisma minus, Fimbristylis dichotoma, Dianella tasmanica, Bulbostylis densa, Trachymene incisa, Lepidosperma laterale, Aristida ramosa*.

Variability: highly stochastic. The small population sizes and the harsh environment afforded by rock outcrop habitats, necessarily means that even adjacent occurrences are likely to contain very different species assemblages (Hunter 2000a; Hunter 2002c; Hunter 2003bc; Hunter 2004a). Although a few species may be dominant in most situations they may be inexplicably missing, at least above-ground, from nearby sites. Disturbances such as fire can dramatically change the floristics and structure temporarily as a suite of short-lived disturbance ephemerals establish (Hunter 1995; Hunter 1998a; Hunter et al. 1998; Hunter 2003b).

Notes: this element is restricted to high altitude areas north and south-east of Glen Innes. The community as described here is Element 1 as given by Hunter & Clarke (1999) in their synopsis of the New England granitic outcrop communities. This element is further divided into three communities by Hunter & Clarke (1999) all of which occur in Warra NP and *Wattleridge*. This community type is also reserved at Butterleaf NP, and could be considered sufficiently reserved, but due to the stochasticity in floristics and small population sizes, further inclusions of this assemblage are important. Hunter (2000a; 2002c; 2003c) has shown that because of the nature of naturally fragmented ecosystems, any addition to the reserve network would significantly increase species richness and resilience of this assemblage. [39 sites; 129 ha].

Discussion

Warra NP and *Wattleridge* share a very similar composition of species and communities. Warra NP in general had a greater number of communities and species but this is not surprising as it is more than twice the size of *Wattleridge*. Within the 2689 ha investigated, 549 vascular plant taxa were found. Though this would likely increase with opportunistic sightings, the number found is high, especially considering that only around 8% of taxa were non-natives. The site richness (41 species per 0.04 ha) is similar to that recorded by Benson and Ashby (2000) in the same area.

Phytogeography

Floristic similarity is greatest overall with the floras further south, rather than those north or to the west. This is not surprising considering the number of species that appear to be disjunctions from taxa further south (e.g. *Acacia mitchellii*) or are taxa derived from species now occurring in more southern localities (e.g. *Eucalyptus camphora* subsp. *relicta*). Most communities showed affinities with others that are typical of those found along the higher parts of the eastern escarpment from Ebor to east of Tenterfield.

Although communities dominated by *Eucalyptus obliqua* and *Eucalyptus nobilis* (community 7 & 8) occur throughout the eastern side of the New England Tableland, the prominence of *Eucalyptus nobilis* drops considerably further north and is replaced generally by *Eucalyptus brunnea*. Communities similar to that of 7 and 8 are probably near their northern limits within the study area but are well developed locally.

The heathy/sedgelands (community 4) found within Warra are typical of those found at higher altitudes to the east. Whinam and Chilcott (2002) showed that the *Sphagnum* bogs at Warra NP were floristically grouped with others restricted to the eastern parts of the Northern Tablelands at altitudes above 1050 m. Though Whinam and Chilcott (2002) did not sample them, *Sphagnum* bogs do occur as far north as the Queensland border, such as at Demon NR (Hunter et al. 1999) and Basket Swamp NP (Hunter 2004b). However, those of Warra NP are the most northerly of those that have developed very deep and distinctive hummock and hollow systems, and are of great regional importance.

Conservation issues

Approximately 60% of the woody vegetation in the New England Bioregion has been cleared (Benson 1999) and within the local area more than 70% has probably been cleared (Benson & Ashby 2001).

Two communities identified by Benson and Ashby (2001) as endangered locally, and endangered or vulnerable within NSW, occur within Warra NP. These are the *Leptospermum novae-angliae – Bursaria spinosa,* and the *Eucalyptus pauciflora – Eucalyptus nova-anglica* communities. The *Eucalyptus radiata – Eucalyptus acaciiformis* community was considered to be vulnerable, locally and within NSW (Benson & Ashby 2001). Additionally it is suggested that *Eucalyptus obliqua – Eucalyptus nobilis* is vulnerable, at least locally, and that the *Sphagnum* component of the *Baeckea omissa – Leptospermum gregarium* community should be considered endangered. Thus, of eleven communities within Warra, four should be considered as threatened.

There are 18 taxa considered of conservation significance due to their occurrence on state and federal lists. Five species occur on the *NSW Threatened Species Conservation Act 1995*, one on the Federal *Environment Protection and Biodiversity Conservation Act* and 17 on RoTAP (Briggs & Leigh 1996).

The larger rock outcrops, and more significantly the Sara River Falls (on the south-eastern boundary of Warra NP) were the most significant sites in terms of rare or threatened species occurrences. The Sara River Falls had the highest concentration of significant species in a 10 ha area, many of which were not found anywhere else in the area. Rare or threatened species found within Warra NP and/or *Wattleridge* are:

Acacia brunioides subsp. *brunioides* (3RC-) is known from the Backwater area north to the McPherson Range near Toowoomba. This species has been recorded from Gibraltar Range NP, Mann River NR, Mt Barney NP, Mount French NP, Mt Greville NP and Nymboida NP. It was found in low numbers around the Sara River Falls within Warra NP.

Brachyloma saxicola (3RCa) (Hunter & Williams 1994; Richards & Hunter 1997) is known from Chaelundi north to Torrington. It is reserved within Guy Fawkes River NP, Bolivia Hill NR, Torrington SRA, Butterleaf NP, Gibraltar Range NP, Nymboida NP and Cathedral Rocks NP. This species is very abundant within both Warra NP and *Wattleridge*. The type location for the species is from *Wattleridge*.

Brasenia schreberi (3RC-) is known from a sporadic distribution throughout eastern Australia and also Africa, Asia and America. It is reserved within the nearby Llangotholin Lagoon NR and Crowdy Bay NP. Within Warra it was found only near the Sara River Falls.

Callitris oblonga subsp. *parva* (3VCa; Schedule 2, Vulnerable *TSC Act*) is known from the Mooraback area of Werrikimbe NP to Boonoo Boonoo NP. It is reserved within Werrikimbe NP, Basket Swamp NP and Boonoo Boonoo NP. Within the study areas this species was restricted to the banks of the Sara River where about 300 individuals are known, 50 of which are within Warra NP near the Sara River Falls.

Chiloglottis sphyrnoides (3RCa) (Copeland & Hunter 1999) is an orchid known from Barrington Tops NP in the south to just over the Queensland border. It is reserved within Werrikimbe NP, Guy Fawkes River NP, Barool NP, Gibraltar Range NP, New England NP, Capoompeta NP, Mann River NR, Western Washpool NP and Lamington NP. The species was found opportunistically within Warra NP in moist forest.

Cryptandra lanosiflora (3RCa) has been recorded from the Stanthorpe south to Werrikimbe NP. It is reserved within Girraween NP, Bald Rock NP, Boonoo Boonoo NP, Gibraltar Range NP, New England NP, Werrikimbe NP, Butterleaf NP, Mann River NR, Bolivia Hill NR and Torrington SRA. Populations of this species were found near the Sara River Falls and between Crown and Nightcap Mountains within Warra NP, though it was more common on outcrops on *Wattleridge*.

Eucalyptus camphora subsp. *relicta* (3VC-; Schedule 1, Endangered, *TSC Act*) is restricted to the Backwater area in NSW. Two populations are known within Warra NP with an estimated combined population size of around 10 000 individuals (Hunter 1996).

Eucalyptus codonocarpa (3RCa) (Hunter & Richards 1997) is known from Cathedral Rocks NP in the south to Girraween NP in Queensland. It is reserved within Cathedral Rock NP, Butterleaf NP, Gibraltar Range NP and Girraween NP. It is very abundant on outcrops and rocky river banks throughout both Warra NP and *Wattleridge*.

Eucalyptus dorrigoensis (3RCa) (Copeland & Hunter 1999) is known from the Dorrigo area north to Tenterfield. It is reserved within Boonoo Boonoo NP, Bald Rock NP, Demon NR, Dorrigo NP, Guy Fawkes River NP, Dorrigo White Gum FR, Western Washpool NP, Capoompeta NP and Butterleaf NP. It was found during a previous survey of Warra NP, but not found during this investigation.

Grevillea scortechinii subsp. *sarmentosa* (3VCi; Schedule 2, Vulnerable, *TSC Act*) is known from two areas in NSW, Backwater and Mann River NR, and is very abundant in both Warra NP and *Wattleridge*. It has been noted to germinate en-mass after fires in Warra NP, and some very large and apparently old stands, up to 2 m in height, are known from *Wattleridge*. Possibly as many as 20 000 individuals occur in the study area (Hunter 1996).

Hibbertia sp. aff. *obtusifolia* (2RCa) (Hunter & Clarke 1998) is only known from the Backwater, and the Parlour Mountains and Mt Yarrowyck west of Armidale (Nano 1996). The species was common within the study area and, based on counts made within survey sites and extrapolated, an estimated 10 000 individuals were found.

Kunzea bracteolata (3RC-) has been recorded from Mount Chaelundi north to the Stanthorpe area of Queensland. It is currently reserved within Girraween NP, Bald Rock NP, Boonoo Boonoo NP, Basket Swamp NP, Gibraltar Range NP, Guy Fawkes River NP, Limpinwood NR, Torrington SRA, Western Washpool NP, Butterleaf NP, Nymboida NP and Bolivia Hill NR. A small population was discovered around Nightcap Mountain in Warra NP.

Leionema ambiens (3VC-) (Copeland & Hunter 1999) occurs from the Stanthorpe area in Queensland south to Warra NP. The taxon is reserved within the Torrington SRA, Girraween NP, Bald Rock NP, Boonoo Boonoo NP, Gibraltar NP and the Demon NR. It was found only on Nightcap Mountain, in a few small populations in Warra NP.

Monotaxis macrophylla (Schedule 1, Endangered, *TSC Act*) is a small disturbance ephemeral species (Hunter & Bruhl 1997; Hunter 1998a; Hunter 2003b) with a highly stochastic distribution in NSW, but which is more common in Queensland. It has been found historically at Howell (Hunter 1998b), Torrington NR, Condobolin, Nymagee and Bega. Though not recorded in the original investigation of the *Bornhardtia* VCA (Hunter & Hunter 2003), it has since been discovered there (*pers. obs.*). This species was found in high numbers on two outcrops in Warra NP in 1995 (Hunter 1999).

Muehlenbeckia costata (3VCa; Schedule 2, Vulnerable, *TSC Act*) (Hunter et al. 1998) has a highly disjunct distribution and is only known from a handful of locations which include Mt Kaputar, Bald Rock, Backwater and the Blue Mountains (unconfirmed). This species is another disturbance ephemeral restricted to rock outcrops (Hunter et al. 1998; Hunter 2003b). It was estimated that around 5000 individuals were counted within Warra NP in 1995, however none are known at present due to its short life span and longlived seedbank (Hunter et al. 1998).

Persoonia procumbens (2RC-) is restricted to Backwater and the Round Mountain area east of Armidale. The species is reserved within Cathedral Rock NP. This taxon was found in 25% of all sites, and was abundant in five communities.

Pseudanthus divaricatissimus (3RCa) is known primarily south of Muswellbrook, south to Bega (Halford & Henderson 2003) with some disjunct locations as far north as Urbenville and Dubbo. This species was found on *Wattleridge* in only one location, where only three plants were seen (Hunter & Bruhl 1997).

Thelionema grande (3RCa) (Hunter & Copeland 1999) is known from south of Bundarra north to the Stanthorpe area in Queensland. The species is reserved within Girraween NP, Mt Barney NP, Bald Rock NP, Boonoo Boonoo NP, Gibraltar Range NP, Ironbark NR, Werrikimbe NP, Torrington SRA and Bolivia Hill NR. Within the study area the species was not found within Warra NP, but was found sporadically on rock outcrops within *Wattleridge*.

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Appendix 1: Flora of Warra National Park and *Wattleridge*.

Taxa found within the survey sites are scored according to their presence in each of the ten communities defined. Some taxa were found in previous surveys or opportunistically and therefore are not assigned to a specific community. Some orchid identifications may be identified in a broad taxonomic sense (sens. lat.). Nomenclature follows that of Harden (1990–1993) except where recent changes have occurred. Introduced taxa are indicated by *.

1 = *Leptospermum novae-angliae – Bursaria spinosa* – Riparian Scrub and Heath

2 = *Eucalyptus pauciflora – Eucalyptus nova-anglica* Woodland

3 = *Haloragis heterophylla – Carex inverse* Herbfield

4 = *Baeckea omissa – Leptospermum gregarium* Closed Wet Heath

5 = *Eucalyptus cameronii – Eucalyptus cameronii – Eucalyptus campanulata* Shrubby Open Forest

6 = *Eucalyptus radiata – Eucalyptus acaciiformis* Woodland

7 = *Eucalyptus cameronii – Eucalyptus caliginosa* Grassy Open Forest

8 = *Eucalyptus nobilis – Eucalyptus obliqua* Tall Open Forest

9 = *Eucalyptus obliqua – Eucalyptus nobilis* Tall Open Forest

10 = *Leptospermum novae-angliae – Kunzea obovata – Brachyloma saxicola* Open scrub and Closed Heath

TAXON	
FERNS & ALLIES	
Adiantaceae	
Adiantum aethiopicum	1, 2, 7, 8, 9
Cheilanthes sieberi subsp. *sieberi*	1, 7, 10
Pellaea falcata	10
Aspleniaceae,	
Asplenium flabellifolium	1, 10
Blechnaceae	
Blechnum cartilagineum	9
Blechnum minus	
Blechnum nudum	
Blechnum patersonii subsp. *queenslandica*	
Blechnum penna-marina subsp. *alpina*	4
Blechnum wattsii	1, 2, 4, 9
Doodia aspera	9
Cyathaceae	
Cyathea australis	8, 9, 10
Davalliaceae	
Davallia solida var. *pyxidata*	10
Dennstaedtiaceae	
Calochlaena dubia	5, 8, 9
Hypolepis glandulifera	
Pteridium esculentum	2, 3, 4, 5, 6, 7, 8, 9, 10
Dicksoniaceae	
Dicksonia antarctica	9
Dryopteridaceae	
Polystichum fallax	9
Gleicheniaceae	
Gleichenia dicarpa	10
Sticherus lobatus	
Lindsaeaceae	
Lindsaea linearis	5, 6, 7, 10
Ophioglossaeae	
Botrychium australe	
Polypodiaceae	
Platycerium bifurcatum subsp. *bifurcatum*	
Pyrrosia confluens var. *dielsii*	8
Pyrrosia rupestris	10
MONOCOTYLEDONS	
Anthericaceae	
Arthropodium milleflorum	4, 8, 10
Dichopogon fimbriatus	4
Laxmannia compacta	10
Laxmannia gracilis	10
Thysanotus tuberosus subsp. *tuberosus*	5, 6, 7, 8
Tricoryne elatior	4, 10
Asphodelaceae	
Bulbine bulbosa	
Commelinaceae	
Commelina cyanea	
Cyperaceae	
Baumea nuda	
Bulbostylis densa	10
Carex breviglumis	
Carex fascicularis	4
Carex gaudichaudiana	
Carex incomitata,	9
Carex inversa	3, 4, 7, 8, 9
Carex lobolepis	2, 4
Cyperus gracilis	7
Cyperus polystachyos	1
Cyperus sanguinolentus	1
Cyperus sphaeroideus	4
Cyperus unioloides	4
Eleocharis sphacelata	
Fimbristylis dichotoma	1, 10
Gahnia aspera	6, 7, 10
Gahnia sieberiana	1, 10
Gymnoschoenus sphaerocephalus	10
Isolepis hookeriana	4
Lepidosperma gunnii	4, 7, 8, 10
Lepidosperma laterale	1, 5, 7, 8, 10
Lepidosperma limicola	4, 6
Lepidosperma lineare	
Lepidosperma viscidum	
Rhynchospora brownii	1
Schoenoplectus mucronatus	1
Schoenus apogon	1, 4, 10
Schoenus melanostachys	5, 6
Scirpus polystachyus	4, 10
Eriocaulaceae	
Eriocaulon scariosum	4
Haemodoraceae	
Haemodorum planifolium	2
Iridaceae	
Patersonia fragilis	4, 6
Patersonia glabrata	4, 5, 7, 8, 10
Patersonia sericea	2, 5, 6, 7, 8, 10
**Sisyrinchium* sp. A	1, 3

Juncaceae
**Juncus capitatus* 4
Juncus remotiflorus 10
Juncus subsecundus 2, 4
Juncus usitatus
Juncus vaginatus 2, 3, 4, 6
Luzula densiflora
Luzula flaccida 4, 7, 9, 10

Lomandraceae
Lomandra confertifolia subsp. *pallida* 7, 8
Lomandra elongata
Lomandra filiformis subsp. *coriacea* 8
Lomandra filiformis subsp. *filiformis* 7, 8, 10
Lomandra longifolia 1, 2, 4, 5, 6, 7, 8, 9, 10
Lomandra multiflora subsp. *multiflora* 2, 5, 7, 8

Luzuriagaceae
Eustrephus latifolius 7, 8, 9, 10
Geitonoplesium cymosum 9

Orchidaceae
Acianthus exsertus 9
Bulbophyllum elisae
Caladenia cucullaya
Caladenia fuscata 10
Calaena major
Calochilus campestris 2, 10
Calochilus robertsonii 4, 7
Chiloglottis reflexa 10
Chiloglottis sphyrnoides
Corybas fimbriatus
Cryptostylis subulata 10
Dipodium variegatum 2, 5, 8
Dockrillia teretifolia
Diuris abbreviata
Microtis unifolia 2, 10
Prasophyllum brevilabre 8, 10
Pterostylis decurva 10
Pterostylis fischii 10
Pterostylis longifolia 10
Pterostylis reflexa 8
Pterostylis robusta
Spiranthes sinensis subsp. *australis*
Thelymitra pauciflora

Phormiaceae
Dianella caerulea var. *caerulea* 1, 4, 5, 7, 10
Dianella longifolia var. *stenophylla*
Dianella revoluta var. *revoluta* 2, 4, 5, 6, 7, 8, 9, 10
Dianella tasmanica 10
Stypandra glauca 10
Thelionema caespitosum 4, 10
Thelionema grande 4

Poaceae
Agrostis avenacea var. *avenacea* 2, 3, 4, 7
**Aira cupaniana* 1
Aristida calycina
Aristida ramosa var. *speciosa* 1, 2, 4, 10
Aristida vagans 7
Austrodanthonia induta 3
Austrodanthonia laevis 4
Austrodanthonia monticola 1, 4, 6, 7, 8, 10
Austrodanthonia pilosa var. *pilosa* 10
Austrodanthonia racemosa var. *racemosa* 1, 2, 3, 4, 5, 6, 7, 8
Austrodanthonia tenuior 2
Austrofestuca eriopoda 4
Austrostipa aristiglumis 9
Austrostipa rudis subsp. *nervosa* 1, 2, 5, 7, 8, 9
Austrostipa rudis subsp. *rudis* 4, 7, 8
Austrostipa scabra
Austrostipa setacea 10
**Bromus sterilis* 7
Cymbopogon refractus 1
Cynodon dactylon 7
Deyeuxia gunniana 7, 8
Deyeuxia parviseta var. *parviseta* 1, 7
Dichelachne crinita 1, 2, 7
Dichelachne inaequiglumis 1, 2, 4, 7, 8
Dichelachne micrantha 1, 2, 6, 7, 8
Dichelachne rara
Dichelachne sieberiana
Digitaria breviglumis 10
Digitaria ramularis 1, 8
Echinopogon caespitosus var. *caespitosus* 1, 2, 4, 5, 7, 8, 9, 10
Echinopogon mckiei
Echinopogon ovatus 1, 4, 8
Elymus scaber var. *scaber*
Entolasia marginata 7
Entolasia stricta 1, 2, 4, 5, 6, 7, 8, 10
Eragrostis benthamii
Eragrostis elongata 1, 2, 3, 7
Eragrostis tenuifolia 10
**Hainardia cylindrica* 4
**Holcus lanatus* 2, 4
Imperata cylindrica var. *major* 1, 2, 4, 6, 7, 8, 9
Isachne globosa 1, 4, 8
Joycea pallida
**Lolium multiflorum* 1, 10
Microlaena stipoides var. *stipoides* 1, 2, 4, 5, 6, 7, 8, 9, 10
Notodanthonia longifolia 1, 3
Oplismenus imbecillis 4, 8
Panicum effusum 10
Paspalidium constrictum 10
**Paspalum dilatatum* 1
Paspalum distchum 10
Pennisetum alopecuroides 4
**Phalaris paradoxa*
Phragmites australis 2
Poa labillardieri 1, 2
Poa queenslandica 5, 7, 8
Poa sieberiana var. *sieberiana* 1, 2, 4, 5, 6, 7, 8, 9
Sacciolepis indica 4
Sorghum leiocladum 2, 4
Sporobolus creber 1
Sporobolus elongata
Themeda australis 1, 2, 4, 5, 7, 8
Tripogon loliiformis 1, 10
**Urochloa panicoides* 1
**Vulpia ciliata*

Restionaceae
Baloskion fimbriatum 1, 2, 4, 6, 10
Baloskion stenocoleum 2, 4, 7
Empodisma minus 10
Lepyrodia anarthria 4, 6
Lepyrodia leptocaulis 4

Smilaceae
Smilax australis 5, 7, 8, 9

Xanthorrhoeaceae
Xanthorrhoea glauca subsp. *glauca* 6, 10

Xyridaceae
Xyris complanata 2, 4, 6
Xyris operculata 4

GYMNOSPERMS

Cupressaceae
Callitris oblonga subsp. *parva* 1, 2

DICOTYLEDONS

Acanthaceae
Rostellularia adscendens subsp. *adscendens* 7

Amaranthaceae
Alternanthera sp. A 3

Apiaceae
Actinotus gibbonsii 10
Centella asiatica 4
**Ciclospermum leptophyllum* 3
Daucus glochidiatus 8
Eryngium visculosum
Hydrocotyle geraniifolia 4, 7, 8, 9
Hydrocotyle laxiflora 7, 8
Hydrocotyle peduncularis 4, 7, 8
Hydrocotyle tripartita 8
Oreomyrrhis eriopoda 8, 9
Platysace ericoides 5, 7, 8
Platysace lanceolata 5, 7, 10
Trachymene incisa subsp. *incisa* 2, 4, 7, 10
Trachymene sp. aff. *pilosa* 10

Araliaceae
Polyscias sambucifolia 5, 7, 8, 10

Asclepiadaceae
**Gomphocarpus fruticosus*

Asteraceae
Brachyscome microcarpa 10
Brachyscome nova-anglica 2, 4, 7, 8
Brachyscome scapigera
Brachyscome stuartii 10
Brachyscome tenuiscapa var. *pubescens* 4, 7
**Carduus tenuiflorus* 10
Chrysocephalum semipapposum 2, 4, 7
**Cirsium vulgare* 7, 8
**Conyza albida* 1, 2, 3, 7, 8, 9, 10
**Conyza bonariensis* 3
Craspedia canens
Craspedia variabilis 4, 7, 8
Euchiton gymnocephalus 7
Euchiton involucratus
Euchiton sphaericus 1, 2, 4, 7, 8, 10
**Gnaphalium americanum* 1, 7
Helichrysum elatum 7
Helichrysum rutidolepis 7, 8
Helichrysum scorpioides 2, 4, 5, 7, 8
**Hypochaeris glabra* 3, 4, 7, 8
**Hypochaeris radicata* 1, 2, 4, 6, 7, 8, 9, 10
Lagenifera stipitata 6, 7, 8, 9
Leptochrysum albicans
**Leucanthemum vulgare* 3
Olearia microphylla
Olearia oppositifolia 10
Olearia stellulata 8
Ozothamnus diosmifolius 7
Podolepis jaceoides
Podolepis neglecta 7, 8
Senecio diaschides 2, 4, 7, 8, 9
Senecio hispidulus
Senecio lautus subsp. *lanceolatus* 9
**Senecio madagascariensis* 1, 2
Senecio prenanthoides 7, 8, 10
Sigesbeckia australiensis 9
Solenogyne bellioides 7, 8, 10
Solenogyne dominii 10
**Sonchus asper* subsp. *glaucescens*
**Taraxacum officinale* 1
Vernonia cinerea var. *cinerea* 8
Vittadinia dissecta 1, 10
Xerochrysum bracteatum 7, 8, 9

Cabombaceae
Brasenia schreberi 1

Campanulaceae
Wahlenbergia ceracea 4, 6
Wahlenbergia communis 1, 2, 4, 7, 8, 9
Wahlenbergia gracilis 10
Wahlenbergia luteola 10
Wahlenbergia planiflora subsp. *longipila*
Wahlenbergia stricta subsp. *stricta* 7, 8

Caryophyllaceae
**Petrorhagia nanteuilii*
Scleranthus biflorus 3, 8
Stellaria angustifolia 4
Stellaria flaccid a
**Stellaria media*

Casuarinaceae
Allocasuarina littoralis 7, 8
Allocasuarina rigida subsp. *rigida* 10
Allocasuarina torulosa 5

Celastraceae
Maytenus silvestris 5, 7, 8

Chenopodiaceae
Chenopodium pumilio 10

Chloanthaceae
Chloanthes parviflora 10

Clusiaceae
Hypericum gramineum 2, 4, 6, 7, 8
Hypericum japonicum

Convolvulaceae
Dichondra repens 2, 3, 4, 7, 8, 9
Dichondra sp. A 10

Crassulaceae
Crassula sieberiana 1, 10

Dilleniaceae
Hibbertia acicularis 4, 6, 10
Hibbertia aspera
Hibbertia monogyna 10
Hibbertia obtusifolia
Hibbertia riparia 2, 4, 7
Hibbertia rufa 7
Hibbertia scandens
Hibbertia serpyllifolia 10
Hibbertia sp. B 5, 7, 8
Hibbertia vestita
Hibbertia villosa 10

Droseraceae
Drosera binata 4
Drosera burmannii 4
Drosera peltata 4, 10
Drosera spatulata

Epacridaceae
Brachyloma daphnoides subsp. *glabrum* 2, 7, 10
Brachyloma saxicola 1, 10

Epacris breviflora	
Epacris microphylla var. *microphylla*	2, 4, 6, 10
Epacris obtusifolia	
Leucopogon biflorus	1
Leucopogon lanceolatus var. *lanceolatus*	5, 7, 8, 9, 10
Leucopogon microphyllus	10
Leucopogon neoanglicus	1, 10
Lissanthe strigosa	
Melichrus procumbens	2, 4, 5, 7
Melichrus urceolatus	1, 7, 8
Monotoca scoparia	2, 4, 5, 6, 7, 8, 10
Escalloniaceae	
Quintinia sieberi	
Euphorbiaceae	
Monotaxis macrophylla	10
Phyllanthus virgatus	3, 7, 10
Poranthera microphylla	2, 4, 5, 6, 7, 8, 10
Pseudanthus divaricatissimus	10
Fabaceae	
Acacia brunioides subsp. *brunioides*	1
Acacia buxifolia subsp. *buxifolia*	5, 6
Acacia dealbata	
Acacia falciformis	5, 10
Acacia filicifolia	2, 4, 7, 8
Acacia fimbriata	1, 2, 7, 8
Acacia melanoxylon	9
Acacia mitchellii	5
Acacia myrtifolia	5
Acacia penninervis	
Acacia rubida	2, 7
Acacia siculiformis	1, 2
Acacia stricta	
Acacia ulicifolia	5, 6, 7, 8, 10
Acacia venulosa	10
Acacia viscidula	10
Aotus subglauca var. *subglauca*	2, 4, 6, 7, 10
Bossiaea neo-anglica	2, 5, 7, 8, 10
Bossiaea rhombifolia	10
Bossiaea scortechinii	2, 5, 7, 10
Cullen tenax	
Desmodium varians	1, 4, 7, 8, 9
Dillwynia phylicoides	4, 5, 6, 7, 8, 10
Dillwynia retorta	2, 4, 7
Dillwynia sieberi	1, 2, 4
Glycine clandestina	1, 2, 4, 5, 7, 8, 9
Glycine microphylla	7, 8
Glycine sp. A	4, 7
Glycine tabacina	2, 7, 8
Glycine tomentella	
Gompholobium huegelii	7
Hardenbergia violacea	5, 7, 8
Hovea purpurea	
Hovea heterophylla	2, 7
Hovea lanceolata	
Hovea pedunculata	1, 5, 10
Indigofera australis	8, 9
Jacksonia scoparia	7
Lespedeza juncea subsp. *sericea*	
Lotus cruentus	1
**Medicago arabica*	1, 3
**Medicago lupulina*	
**Medicago polymorpha*	
**Melilotus indicus*	1
Mirbelia confertiflora	1, 2, 10
Mirbelia pungens	6
Mirbelia rubiifolia	7
Pultenaea altissima	
Pultenaea linophylla	5, 8
Pultenaea myrtioides	
Sphaerolobium vimineum	
**Trifolium arvense*	
**Trifolium repens*	
**Trifolium subterraneum*	
Gentianaceae	
**Centaurium erythraea*	1, 3, 4, 8
**Centaurium tenuifolia*	
Geraniaceae	
Geranium neglectum	
Geranium potentilloides	
Geranium solanderi var. *grande*	4
Geranium solanderi var. *solanderi*	4, 7, 8, 9
Pelargonium inodorum	
Goodeniaceae	
Dampiera stricta	10
Goodenia bellidifolia subsp. *argentea*	10
Goodenia bellidifolia subsp. *bellidifolia*	4, 5, 6, 7
Goodenia hederacea subsp. *hederacea*	2, 4, 5, 6, 7, 8, 10
Scaevola hookeri subsp. *ramosissimus*	4
Velleia paradoxa	10
Haloragaceae	
Gonocarpus micranthus subsp. *micranthus*	10
Gonocarpus micranthus subsp. *ramosissimus*	2, 4, 6
Gonocarpus oreophilus	5, 9
Gonocarpus tetragynus	2, 4, 5, 6, 7, 8, 10
Gonocarpus teucrioides	2, 4, 7, 8, 9, 10
Haloragis heterophylla	3, 4, 8
Myriophyllum crispatum	1
Lamiaceae	
Ajuga australis	8, 10
Mentha diemenica	7, 8
Mentha satureioides	
Plectranthus graveolens	1, 8, 10
Prostanthera howelliae	
Prostanthera saxicola	
Prostanthera scutellarioides	5, 10
**Prunella vulgaris*	3, 4, 8
Teucrium corymbosum	
Lauraceae	
Cassytha glabella	
Lentibulariaceae	
Utricularia dichotoma	4
Linaceae	
Linum marginale	1, 3
Lobeliaceae	
Isotoma axillaris	10
Lobelia gracilis	
Pratia purpurascens	7, 8, 9
Loganiaceae	
Logania albiflora	1, 2
Loranthaceae	
Amyema miquelii	
Amyema pendulum	8
Muellerina eucalyptoides	
Lythraceae	
Lythrum salicaria	4

Malvaceae
**Modiola caroliniana* 3

Myrsinaceae
Rapanea howittiana
Rapanea variabilis 8, 9

Myrtaceae
Baeckea gunniana
Baeckea omissa 2, 4, 6, 7
Callistemon pallidus 4, 6, 10
Callistemon pityoides 2, 4
Calytrix tetragona 1, 10
Eucalyptus acaciiformis 4, 6, 10
Eucalyptus caliginosa 1, 2, 4, 5, 7, 8, 10
Eucalyptus cameronii 5, 7, 8, 9
Eucalyptus campanulata 5, 6, 8, 9
Eucalyptus camphora subsp. *relicta* 2, 4
Eucalyptus codonocarpa 10
Eucalyptus dalrympleana subsp. *heptantha* 1, 2, 4, 7, 10
Eucalyptus dorrigoensis
Eucalyptus eugenioides 8
Eucalyptus laevopinea
Eucalyptus nobilis 4, 7, 8, 9
Eucalyptus nova-anglica 2, 4, 7
Eucalyptus obliqua 7, 8, 9
Eucalyptus pauciflora 2, 4, 7
Eucalyptus radiata subsp. *sejuncta* 5, 6, 7, 8, 9
Eucalyptus stellulata 7, 8
Eucalyptus viminalis 2, 7
Kunzea bracteolata
Kunzea obovata 1, 10
Leptospermum arachnoides
Leptospermum brevipes 1, 4, 6, 10
Leptospermum gregarium 2, 4
Leptospermum novae-angliae 1, 6, 10
Leptospermum polygalifolium subsp. *montanum*
Leptospermum polygalifolium subsp. *transmontanum* 1, 2, 4, 8

Oleaceae
Notelaea linearis 2, 10
Notelaea longifolia 9
Notelaea microcarpa var. *microcarpa*
Notelaea ovata 2
Notelaea sp. A 8, 9, 10

Onagraceae
Epilobium billardierianum subsp. *billardierianum* 3, 8
Epilobium gunnianum 1, 4

Oxalidaceae
Oxalis chnoodes 2, 7, 8, 9
Oxalis perennans
**Oxalis radicosa*

Pittosporaceae
Billardiera scandens var. *scandens* 5, 6, 7, 8, 10
Bursaria spinosa subsp. *obovata* 10
Bursaria spinosa var. *microphylla* 7
Bursaria spinosa var. *spinosa* 1, 2, 7, 8
Pittosporum multiflorum
Rhytidosporum procumbens

Plantaginaceae
Plantago debilis 7, 8
Plantago hispida
**Plantago lanceolata*
Plantago varia 8, 9

Polygalaceae
Comesperma ericinum 4, 10
Comesperma sphaerocarpum 4

Polygonaceae
**Acetosella vulgaris* 3, 10
Muehlenbeckia costata 10
Persicaria decipiens 1, 3, 4
Persicaria hydropiper 1
Rumex brownii 3

Portulacaceae
Calandrinia sp. A 1, 2, 10
Portulaca bicolor 10

Potamogetonaceae
Potamogeton ochreatus

Primulaceae
**Anagallis arvensis*

Proteaceae
Banksia cunninghamii subsp. *cunninghamii* 4, 5, 6, 7, 8
Banksia integrifolia subsp. *integrifolia* 1, 2, 4, 5, 7, 8
Banksia spinulosa var. *collina* 10
Grevillea juniperina subsp. *allojohnsonii* 2, 4
Grevillea scortechinii subsp. *sarmentosa* 2, 5, 6
Hakea eriantha 4, 5, 8
Hakea laevipes subsp. *graniticola* 10
Hakea microcarpa 4
Lomatia fraseri 2, 4, 10
Lomatia silaifolia 2, 5, 6, 7, 8, 9, 10
Persoonia cornifolia 2, 4, 7, 10
Persoonia oleoides 5, 7, 8
Persoonia procumbens 2, 4, 6, 7
Persoonia sericea 7, 8
Petrophile canescens 2, 4, 5, 6, 7, 8

Ranunculaceae
Clematis aristata 8, 9
Clematis glycinoides var. *glycinoides* 8
Ranunculus lappaceus 7, 8, 9

Rhamnaceae
Cryptandra amara var. *amara* 1
Cryptandra amara var. *longiflora* 10
Cryptandra lanosiflora 1, 10
Pomaderris andromedifolia
Pomaderris lanigera 5
Pomaderris nitidula 1, 5, 10

Rosaceae
Acaena novae-zelandiae 3, 4, 8
Acaena ovina
**Rosa rubiginosa*
**Rubus chloocladus* 1
Rubus parvifolius 1, 2, 3, 4, 7, 8, 9

Rubiaceae
Asperula conferta
Coprosma quadrifida 7, 8, 9
Galium binifolium 7, 8
Galium ciliare
Galium gaudichaudii
Galium migrans 2, 4, 7, 8
Galium propinquum 7
Opercularia aspera 7, 10
Opercularia diphylla 1, 2, 7, 8
Opercularia hispida 4, 7, 8, 10
Pomax umbellata 5, 7, 8, 10

Rutaceae	
Boronia algida	5, 10
Boronia anemonifolia subsp. *variabilis*	10
Boronia microphylla	
Correa reflexa var. *reflexa*	1, 2, 9, 10
Leionema ambiens	10
Phebalium ozothamnoides	10
Zieria cytisoides	10
Zieria fraseri subsp. *compacta*	1, 10
Zieria laevigata	10
Zieria smithii subsp. *smithii*	8
Santalaceae	
Choretrum candollei	
Choretrum pauciflorum	2, 7
Exocarpos cupressiformis	10
Sapindaceae	
Dodonaea triquetra	5, 7
Dodonaea viscosa var. *angustissima*	1, 2, 10
Scrophulariaceae	
Derwentia arcuata	2
Gratiola peruviana	1, 2, 4
Stemodia glabella	
**Verbascum thapsus* subsp. *thapsus*	
**Verbascum virgatum*	
Veronica calycina	7, 8
Veronica plebeia	4, 9
Solanaceae	
Cyphanthera albicans subsp. *albicans*	10
Solanum aviculare	
Solanum brownii	
Solanum campanulatum	7, 8, 9
Solanum densevestitum	7, 8, 9
Solanum elegans	8, 9
Solanum linearifolium	
Solanum nobile	8
Solanum opacum	10
Solanum prinophyllum	
Stackhousiaceae	
Stackhousia monogyna	5, 10
Stackhousia viminea	2, 7, 8, 10
Stylidiaceae	
Stylidium graminifolium	2, 4, 5, 6, 7, 8
Thymelaeaceae	
Pimelea linifolia subsp. *linifolia*	2, 4, 5, 10
Pimelea neo-anglica	
Urticaceae	
Urtica incisa	
Verbenaceae	
**Verbena bonariense*	
**Verbena officinalis*	
Violaceae	
Hybanthus monopetalus	7, 8
Viola betonicifolia	7, 8, 9
Viola hederacea	2, 4, 8, 9
Winteraceae	
Tasmannia insipida	10