Cumberland Plain Woodland in the Sydney Basin Bioregion - proposed critically endangered ecological community listing

NSW Scientific Committee - preliminary determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Preliminary Determination to support a proposal to list the Cumberland Plain Woodland in the Sydney Basin Bioregion as a CRITICALLY ENDANGERED ECOLOGICAL COMMUNITY on Part 2 of Schedule 1A of the Act and as a consequence, to omit reference to Cumberland Plain Woodland from Part 3 of Schedule 1 (Endangered Ecological Communities) of the Act. The listing of Critically Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Cumberland Plain Woodland was listed as an Endangered Ecological Community under the *Threatened Species Conservation Act* 1995 in June 1997 (NSW Scientific Committee 1997). Since this listing, a large volume of new data and analyses have become available. In addition, a nomination to change the status of Cumberland Woodland to Critically Endangered status has been received. This Determination addresses additional information now available in accordance with current listing criteria under the *Threatened Species Conservation Regulation* 2002.

2. Cumberland Plain Woodland is the name given to the ecological community in the Sydney Basin bioregion associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain, a rainshadow area to the west of Sydney's Central Business District. The mean annual rainfall of this area is typically in the range of 700-900 mm, and is generally lower than that received on more elevated terrain that partially surrounds the Plain. The community typically occurs on flat to undulating or hilly terrain up to about 350 m elevation but may also occur on locally steep sites and at slightly higher elevations. Cumberland Plain Woodland is characterised by the assemblage of species listed in paragraph 3 and typically comprises an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees. Shrubs may sometimes occur in locally dense stands. Less disturbed stands of the community may have a woodland or forest structure. Small trees or saplings may dominate the community in relatively high densities after partial or total clearing, and the groundcover may be relatively sparse, especially where densities of trees or shrubs are high. The community also includes ‘derived’ native grasslands which result from removal of the woody strata from the woodlands and forests.

3. Cumberland Plain Woodland is characterised by the following assemblage of species:

Acacia implexa
Aristida ramosa
Arthropodium milleflorum
Asperula conferta
Austrodanthonia racemosa var. *racemosa*
Bossiaea prostrata
Bothriochloa macra
Bursaria spinosa
Centaurium spicatum
Cheilanthes distans
Chloris truncata
Chorizema parviflorum
Clematis glycinoides var. *glycinoides*
Crassula sieberiana
Cymbopogon refractus
Daucus glochidiatus
Desmodium brachypodium
Dianella longifolia
Dichelachne micrantha
Dichondra repens
Dichopogon strictus
Dillwynia sieberi
Echinopogon caespitosus var. *caespitosus*
Einadia hastata
Einadia polygonoides
Elymus scaber var. *scaber*
Eremophila debilis
Eucalyptus crebra
Eucalyptus moluccana
Euchiton sphaericus
Fimbristylis dichotoma
Galium propinquum
Geranium solanderi var. *solanderi*
Glycina clandestina
Glycine tabacina
Hardenbergia violacea
Hypoxis hygrometrica
Indigofera australis
Lachnagrostis avenacea var. *avenacea*
Lomandra multiflora subsp. *multiflora*
Microlaena stipoides var. *stipoides*
Oxalis perennans
Paspalidium distans
Plantago debilis
Plectranthus parviflorus
Pratia purpurascens
Rubus parvifolius
Scutellaria humilis
Ajuga australis
Aristida vagans
Arthropodium minus
Austrodanthonia caespitosa
Austrodanthonia tenuior
Bothriochloa decipiens
Brunoniella australis
Carex inversa
Centella asiatica
Cheilanthes sieberi subsp. *sieberi*
Chloris ventricosa
Chrysocephalum apiculatum
Commelina cyanea
Cymbonotus lawsonianus
Cyperus gracilis
Daviesia ulicifolia
Desmodium varians
Dichanthium sericeum
Dichelachne parva
Dichopogon fimbriatus
Digitaria diffusa
Dodonaea viscosa subsp. *cuneata*
Echinopogon ovatus
Einadia nutans
Einadia trigonos
Eragrostis leptostachya
Eriochloa pseudoacrotricha
Eucalyptus eugenioides
Eucalyptus tereticornis
Exocarpus cupressiformis
Galium migrans
Geranium homeanum
Glossogyne tannensis
Glycine microphylla
Goodenia hederacea subsp. *hederacea*
Hypericum gramineum
Hypoxis pratensis var. *pratensis*
Juncus usitatus
Lomandra filiformis subsp. *filiformis*
Mentha diemenica
Opercularia diphylla
Panicum effusum
Phyllanthus virgatus
Plantago gaudichaudii
Poa labillardieri var. *labillardieri*
Pultenaea microphylla
Scleria mackaviensis
Senecio diaschides

Senecio hispidulus var. *hispidulus*
Solanum cinereum
Sorghum leiocladum
Sporobolus elongatus
Themeda australis
Vernonia cinerea var. *cinerea*
Wahlenbergia gracilis
Wurmbea dioica subsp. dioica
Sida corrugata
Solanum prinophyllum
Sporobolus creber
Stackhousia viminea
Tricoryne elatior
Veronica plebeia
Wahlenbergia stricta subsp. *stricta*
Zornia dyctiocarpa var. *dyctiocarpa*

Other tree species occurring less frequently in this community include:

Angophora bakeri
Angophora subvelutina
Eucalyptus amplifolia
Eucalyptus bosistoana
Eucalyptus globoidea
Eucalyptus paniculata
Syncarpia glomulifera
Angophora floribunda
Corymbia maculata
Eucalyptus baueriana
Eucalyptus fibrosa
Eucalyptus longifolia
Eucalyptus punctata

4. The total species list of the community is larger than that given above, with many species present in only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including grazing, land clearing and fire) history. The number and relative abundance of species will change with time since fire, and may also change in response to changes in fire frequency or grazing regime. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. Benson and Howell (2002) and Benson & von Richter (2008) document the temporal variability in the species composition of the community. The list of species given above is mainly of vascular plant species, however the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. The mammalian and avian components of the fauna have been described by Leary (*in litt.* August 2007) and Farrell (*in litt*. June 2007). Other components of the community are poorly documented (although see Benson & von Richter 2008).

5. Cumberland Plain Woodland is characterised by an upper-storey that is usually dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Grey Ironbark), *E. eugenioides* (Narrow-leaved Stringybark), *Corymbia maculata* (Spotted Gum) or other less frequently occurring eucalypts, including *Angophora floribunda, A. subvelutina* (Broad-leaved Apple), *E. amplifolia* (Cabbage Gum) and *E. fibrosa* (Broad-leaved Ironbark). The community may have an open stratum of small trees that may include any of these eucalypts, as well as species such as *Acacia decurrens* (Black Wattle), *A.*

parramattensis (Parramatta Wattle), *A.implexa* (Hickory Wattle) or *Exocarpos cupressiformis* (Native Cherry). Shrubs are typically scattered in the understorey but may be absent or locally dense as a result of clearing activity or changes in grazing or fire regimes. *Bursaria spinosa* (Blackthorn) is usually dominant, while other species include *Daviesia ulicifolia* (Gorse Bitter Pea), *Dillwynia sieberi, Dodonaea viscosa* subsp. *cuneata* and *Indigofera australis* (Native Indigo). The ground cover is dominated by a diverse range of grasses including *Aristida ramosa* (Purple Wiregrass), *A. vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass), *Dichelachne micrantha* (Plumegrass), *Echinopogon caespitosus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass), and with graminoids *Carex inversa* (Knob Sedge), *Cyperus gracilis, Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush) and *L. multiflorus* subsp. *multiflorus* (Many-flowered Mat-rush). The ground cover also includes a diversity of forbs such as *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Dianella longifolia* (Blue Flax Lily), *Dichondra repens* (Kidney Weed), *Opercularia diphylla*, *Oxalis perennans* and *Wahlenbergia gracilis* (Australian Bluebell), as well as scramblers, *Glycine* spp. and *Hardenbergia violacea* (Native Sarsaparilla) and the fern *Cheilanthes sieberi* (Poison Rock Fern).

6. The structure of the community varies depending on past and current disturbances, particularly clearing, fire and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover. At some sites, mature trees may exceed 30m tall, although regrowth stands may be shorter than 10 m tall. After total or partial clearing, the tree canopy may remain sparse or may regrow to form dense stands of saplings and small trees, which are typically associated with a ground layer of reduced cover and diversity. Either or both of the upper-storey and mid-storey may be absent from the community. Native grasslands derived from clearing of the woodland and forest are also part of this community if they contain characteristic non-woody species listed in paragraph 3.

7. Cumberland Plain Woodland includes: ‘Shale Hills Woodland’ (map unit 9) and ‘Shale Plains Woodland’ (map unit 10) of Tozer (2003); ‘Spotted Gum Forest’ (map unit 9b), ‘Grey Box Woodland’ (map unit 10c) and ‘Grey Box – Ironbark Woodland’ (map unit 10d) of Benson (1992); and ‘Cumberland Plain Woodlands’ of Benson & Howell (1990a; b). Tindall *et al.* (2004) and Tozer et al. (2006) subsequently reproduced Tozer’s (2003) classification and mapping, re-labelling map units 9 and 10 as ‘Cumberland Shale Hills Woodland’ (map unit GW p28) and ‘Cumberland Shale Plains Woodland’ (map unit GW p29), respectively. Cumberland Plain Woodland belongs to the Coastal Valley Grassy Woodlands vegetation class (Keith 2004).

8. Several other ecological communities listed under the *Threatened Species Conservation Act* 1995 may intergrade with Cumberland Plain Woodland. These include Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion; Moist Shale Woodland in the

Sydney Basin Bioregion; Shale / Sandstone Transition Forest; Shale Gravel Transition Forest in the Sydney Basin Bioregion; and Sydney Turpentine-Ironbark Forest. While Tozer (2003) provides information on the features that distinguish these communities, some transitional stands will be difficult to assign to a single community with a high level of confidence (Keith in press). Transitional stands between Cumberland Plain Woodland and other communities listed under the *Threatened Species Conservation Act* 1995 are considered part of a listed community, and should be assigned to the community with which they share greatest resemblance in species composition and other properties.

9. The following threatened species have been recorded from Cumberland Plain Woodland:

Invertebrates		
Cumberland Land Snail	*Meridolum corneovirens*	Endangered
Birds		
Gang Gang Cockatoo	*Callocephalon fimbriatum*	Vulnerable
Glossy Black-cockatoo	*Calyptorhynchus lathami*	Vulnerable
Brown Treecreeper	*Climacteris picumnus*	Vulnerable
Painted Honeyeater	*Grantiella picta*	Vulnerable
Swift Parrot	*Lathamus discolour*	Endangered
Square-tailed Kite	*Lophoictinia isura*	Vulnerable
Hooded Robin	*Melanodryas cucullata cucullata*	Vulnerable
Black-chinned Honeyeater	*Melithreptus gularis gularis*	Vulnerable
Turquoise Parrot	*Neophema pulchella*	Vulnerable
Barking Owl	*Ninox connivens*	Vulnerable
Powerful Owl	*Ninox strenua*	Vulnerable
Speckled Warbler	*Pyrrholaemus sagittatus*	Vulnerable
Diamond Firetail	*Stagonopleura guttata*	Vulnerable
Masked Owl	*Tyto novaehollandiae*	Vulnerable
Sooty Owl	*Tyto tenebricosa*	Vulnerable
Regent Honeyeater	*Xanthomyza phrygia*	Endangered
Mammals		
Large-eared Pied Bat	*Chalinolobus dwyeri*	Vulnerable
Spotted-tail Quoll	*Dasyurus maculata*	Vulnerable
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Vulnerable
Eastern Bent-wing Bat	*Miniopterus schreibersii*	Vulnerable
Eastern Freetail Bat	*Mormopterus norfolkensis*	Vulnerable
Large-footed Myotis	*Myotis adversus*	Vulnerable
Yellow-bellied Glider	*Petaurus australis*	Vulnerable
Squirrel Glider	*Petaurus norfolkensis*	Vulnerable
Koala	*Phascolarctus cinnereus*	Vulnerable
Grey-headed Flying Fox	*Pteropus poliocephalus*	Vulnerable
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	Vulnerable
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Vulnerable

Plants

Downy Wattle	*Acacia pubescens*	Vulnerable
Juniper-leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*	Vulnerable
Native Pear	*Marsdenia viridiflora* subsp. *viridiflora*	Endangered Population
Narrow-leaved Geebung	*Persoonia nutans*	Endangered
Spiked Riceflower	*Pimelea spicata*	Endangered
Matted Bush-pea	*Pultenaea pedunculata*	Endangered
Sydney Plains Greenhood	*Pterostylis saxicola*	Endangered

10. Cumberland Plain Woodland is restricted to the Sydney Basin bioregion and is currently known to occur within the local government areas of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly, but may occur elsewhere within the bioregion. Using map data from Tozer (2003), Cumberland Plain Woodland was estimated to occur within an extent of occurrence of 2810 km2, and an area of occupancy of just under 2 100 km2 based on 2 x 2 km grid cells, the spatial scale recommended by IUCN (2008) for assessing species' areas of occupancy.

11. Small areas of Cumberland Plain Woodland have been recorded from Kemps Creek, Mulgoa and Windsor Downs Nature Reserves, Scheyville National Park, and Leacock, Rouse Hill and Western Sydney Regional Parks.

12. Based on aerial photography flown in November 1998, Tozer (2003) estimated the total extent of woody vegetation referred to Cumberland Plain Woodland was 11 054 (±1 564) ha (upper and lower plausible bounds), representing 8.8 (±1.2)% of the pre-European distribution of the community. For that part of the community's distribution to the east of the Hawkesbury-Nepean River, earlier mapping at coarser resolution by Benson & Howell (1990b) suggests a similar level of depletion, with an estimated 6 420 ha of 'Cumberland Plain Woodlands', representing 6% of the pre-European distribution east of the Hawkesbury-Nepean River. An update of Tozer's (2003) map, based on interpretation of imagery flown in January-March 2007 shows that the extent of Cumberland Plain Woodland east of the Hawkesbury – Nepean River had declined by 442±46 ha, a reduction of 5.2±0.6% in 9 years (NSW Scientific Committee & Simpson 2008). These estimates indicate that the geographic distribution of the community has undergone a very large reduction over a time frame appropriate to the life cycle and habitat characteristics of its component species.

13. Some areas of Cumberland Plain Woodland subjected to a history of partial clearing and grazing have recently undergone a change in management to conserve the community. Examples include Mt Annan Botanic Garden, Scheyville National Park, Western Sydney Regional Park, Elizabeth Macarthur Agricultural Institue, Orchard Hills Defence Site and the former Australian Defence Industries site at St Marys. Experience from these areas suggests

that the community is capable of some recovery, provided the soil has not been disturbed by earthworks, cultivation, fertiliser application or other means of nutrient or moisture enrichment (Benson & Howell 2002; Pellow 2003; Keith *et al.* 2005; J. Howell *in litt*. August 2007; J. Sanders *in litt*. January 2008). In contrast, restoration of Cumberland Plain Woodland has proved to be problematic on sites that have been exposed to such soil disturbance. At Western Sydney Regional Park, for example, Wilkins *et al*. (2003), Nicholls (2005) and Nichols *et al*. (2005) studied the recovery of abandoned pastures that had been planted with more than 20 native tree and shrub species of Cumberland Plain Woodland. Over 10 years they found no evidence of convergence in species composition with nearby remnant stands of the community and the species composition of restored areas remained indistinguishable from untreated pastures. There was some evidence that restored vegetation had begun to develop more species-rich assemblages of moths and butterfiles compared to untreated pastures, although after 10 years, it lacked a number of species characteristic of remnant woodland (Lomov *et al*. 2006). Ant communities also showed marked differences between restored and remnant vegetation although some ecological processes, such as pollination and seed dispersal, showed some evidence of development at restored sites (Lomov 2005). These results suggest that sites with a history of soil disturbance will be extremely slow to recover characteristics of Cumberland Plain Woodland, if at all, and that experimentation with alternative restoration technologies is required. As a large proportion of the former distribution of the community has either undergone similar histories of soil disturbance or are now occupied by urban development, opportunities for restoration of the community across significant areas appear limited.

14. The reduction in the geographic distribution of Cumberland Plain Woodland was initially due to tree-felling for timber and clearing for crops and pastures (Benson & Howell 1990a). Benson & Howell (1990b) estimated that the community had been reduced to approximately half of its pre-European extent by 1850. Following World War II, there was a marked acceleration in urban and industrial development, which continues to deplete the distribution of the community to the present day. These trends appear likely to continue into the future as the urban area continues to expand to accommodate Sydney's increasing population, which is projected to grow by 1.0-1.1 million people during the 20 years 2007-2026 and 2.2-3.3 million during the 50 years 2007-2056 (Australian Bureau of Statistics 2008). Recent draft plans to develop growth centres in north-west and south-west Sydney, for example, identify staged release of land for residential and employment development over the next 25 years. These areas contain approximately 2000 ha (one-fifth) of the remaining Cumberland Plain Woodland, of which about two-thirds will be available for development, the loss of which is planned for offsetting through restoration of the community at other sites (Growth Centres Commission 2007). While important examples of Cumberland Plain Woodland are represented within conservation reserves, much of the remaining area of the community occurs on private land or on public easements, where it is at risk from small-scale clearing associated with housing, industrial development and transport infrastructure. The logistic and technological constraints and time lags associated with restoration of the community are likely to limit the success of plans to offset any further losses of Cumberland Plain Woodland that may occur (Wilkins *et al*. 2003; Nicholls 2005; Nichols *et al.* 2005). 'Clearing of native vegetation' is listed as a Key Threatening Process under the *Threatened Species Conservation Act* 1995.

15. Fragmentation of habitat associated with clearing has resulted in a very large reduction in the ecological function of Cumberland Plain Woodland. The remaining area of the community is severely fragmented, with more than half of the remaining tree cover mapped by Tozer (2003) occurring in patches of less than 80 ha and half of all mapped patches being smaller than 3 ha (Tozer *in litt*. October 2007). The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations (Young *et al*. 1996, Young & Clarke 2000). The impacts of fragmentation and associated processes are most evident in the loss of vertebrate fauna from the community (Farrell 2005; Farrell *in litt*. June 2007; Leary 2005; *in litt*, August 2007). As well, some invertebrate species, such as the Endangered Cumberland Land Snail appear to be in decline, at least in the smaller fragments (M. Shea *in litt*. June 2007). The dieback of eucalypt canopies observed in stands of Cumberland Plain Woodland at Scheyville (D. Keith pers. comm. October 2008) may be a result of complex interactions involving insect attack, weed invasion, nutrient enrichment and drought, in which fragmentation also plays a role (Reid & Landsberg 2000; Wardell-Johnson *et al.* 2006). Despite their history of fragmentation, some very small and apparently degraded remnants may contain a surprisingly high diversity of species and important examples of rare species, particularly plants (James *et al.* 1999; Benson & Keith 1984; McBarron *et al*. 1988; Benson & Howell 1990a; Kirkpatrick & Gilfedder 1995). However, clearing and continuing degradation of these patches reduces the likelihood that all of these species will persist, particularly because a large proportion of species are known from very few locations which are not clustered in predictable ways (Benson & Howell 2002; Tozer 2003). Fragmentation also results in reduced fire frequencies within some patches, which may reduce the viability of some native plant populations, and hence the diversity of species within the patches (Clarke 2000; Watson 2005).

16. Changes in structure contribute to a very large reduction in the ecological function of Cumberland Plain Woodland. Almost all of the remaining area of the community is regrowth forest and woodland from past clearing activities (Benson & Howell 1990a). Mean tree densities in contemporary stands of the community were found to be substantially higher than historical estimates and tree sizes were thought to be smaller (Benson 1992). Large trees approximating the stature of the community prior to European settlement occur very sparsely within remnant patches of vegetation or remain as isolated individuals within paddocks or urban areas. Scheyville National Park, for example, which contains the largest remaining example of Cumberland Plain Woodland (*c*. 1000 ha), was extensively logged and partially cleared over many decades prior to its reservation and is thought to contain as few as five large old trees likely to date from pre-European times (J. Sanders, *in litt.* January 2008). Loss of these large trees, which provide habitat resources for a range of fauna, is associated with declines and local extinctions of numerous birds and mammals that were once more common on the Cumberland Plain (Farrell 2005; T. Leary *in litt.* August 2007). Changes in understorey are difficult to assess, as responses to anthropogenic disturbances are confounded with responses to climatic variability (Benson & Howell 2002). Nevertheless, other structural changes to the community include the removal of fallen woody debris and standing dead trees, the removal of woody understorey plants, or conversely the development of regrowth stands with very high densities of eucalypt saplings or shrubs, notably *Bursaria spinosa*, which may suppress the ground flora. Botanist, Allan Cunningham noted high densities of *B. spinosa* in farmland near Liverpool as early as 1817 (Lee 1927; Benson 1992), while similar

phases of high shrub abundance have been observed recently at Mt Annan and Scheyville in response to abandonment of farming practices (Benson & Howell 2002; J. Sanders, *in litt*. January 2008). Some areas of the community now devoid of woody plant species may retain a substantial suite of native grasses and herbs in the ground layer. The Orchard Hills Defence Site includes outstanding examples of this phenomenon (Pellow 2003; Keith *et al*. 2005). 'Loss of hollow-bearing trees' and 'Removal of dead wood and dead trees' are listed as Key Threatening Processes under the *Threatened Species Conservation Act* 1995.

17. While a sample of the original fauna of Cumberland Plain Woodland persists, some components have already been lost and others continue to decline (Leary 2005; *in litt.* Aug. 2008). The original mammal fauna of the Cumberland Plain was estimated to include approximately 60 species (NPWS 1997), of which less than 40 were detected in recent intensive surveys and only 14 species are now considered to be relatively common and widespread (Leary 2005; *in litt*. August 2008). The majority of these latter species are micro-bats, while small ground-dwelling mammals are unexpectedly scarce. A systematic survey involving 22 000 trap nights and 14 000 hair tube nights across conservation reserves containing Cumberland Plain Woodland failed to detect any native rodents or dasyurids, except at sites on the periphery of the plain, close to larger vegetated areas on sandstone (Leary 2005; *in litt*. August 2008). Long-nosed Bandicoots have recently been recorded in inner western Sydney (NSW Scientific Committee 2008), but remain scarce and have not been recorded during the systematic fauna surveys of Cumberland Plain Woodland. A number of bird species have also disappeared from or markedly declined on the Cumberland Plain (Keast 1995; Farrell 2005; Leary 2005; *in litt*. August 2008). A sequence of repeated surveys in Scheyville National Park, the largest remnant of Cumberland Plain Woodland, have documented disappearance of the Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Zebra Finch, Hooded Robin, Red-capped Robin, Scarlet Robin, Flame Robin and Black-eared Cuckoo, while declines have been observed in populations of the Speckled Warbler, Fuscous Honeyeater, Jacky Winter, Weebill and Buff-rumped Thornbill (Farrell 2005; *in litt*. June 2008). Repeated surveys of Nurragingy Reserve near Blacktown indicate that all of these species have also been lost from the reserve, except for the Fuscous Honeyeater and Weebill (Farrell 2005; *in litt.* June 2008). Many of these species either feed or nest on or near the ground. Declines of reptiles and amphibians on the Cumberland Plain have been less well documented, but include at least three species of frog, one species of turtle, one skink, possibly two species of goanna and one species of snake (Leary 2005; *in litt*. August 2008). Two species of plants, *Swainsona monticola* and *Thesium australe*, are presumed to have gone extinct in Cumberland Plain Woodland, (Benson & Howell 2002), while James *et al*. (1999) list many other species that have undergone substantial declines, including threatened species such as *Acacia pubescens*, *Pimelea spicata* and *Pterostylis saxicola*. In addition to these losses and declines across a wide range of biota within the community, Benson & Howell (1990a; 2002) describe other changes in species composition that indicate a very large reduction in the ecological function of Cumberland Plain Woodland.

18. Weed invasion also poses a major threat to Cumberland Plain Woodland. While very large numbers of weed species have invaded many different areas of the community, principal weed species include (Benson 1992; Tozer 2003; Benson & von Richter 2008):

Anagallis arvensis	Scarlet Pimpernell
Araujia serciflora	Moth Vine
Asparagus asparagoides	Bridal Creeper
Aster subulatus	Wild Aster, Bushy Starwort
Centaurium tenuiflorum	
Chloris gayana	Rhodes Grass
Cyclospermum leptophyllum	Slender Celery
Cirsium vulgare	Thistle
Conyza sumatrensis	Tall Fleabane
Ehrharta erecta	Panic Veldtgrass
Eragrostis curvula	African Lovegrass
Heliotropium amplexicaule	Blue Heliotrope
Hypochaeris radicata	Catsear
Leontodon taraxacoides subsp. *taraxacoides*	Lesser Hawksbit, Hairy Hawkbit
Olea europea subsp. *cuspidata*	African Olive
Paspalum dilatatum	Paspalum
Plantago lanceolata	Lamb's Tongue, Plantain
Richardia stellaris	
Senecio madagascariensis	Fireweed
Setaria gracilis	Slender Pigeon Grass
Sida rhombifolia	Paddy's Lucerne
Solanum spp.	Nightshades
Sonchus oleraceus	Common Sowthistle
Sporobolus africanus	Parramatta Grass

Several of these species, particularly grasses, form a dense ground layer capable of smothering indigenous plants, reducing both reproduction and survival, and inhibiting emergence and establishment of their seedlings. The propagules of weeds are spread into Cumberland Plain Woodland by stormwater, dumping of refuse, frugivorous birds and wind (Benson & Howell 1990b), making it difficult to abate the invasion process, especially for those species capable of establishing in sites that have been exposed to relatively little disturbance (J. Sanders, *in litt*. January 2008). Hill *et al*. (2005) found that high species richness and abundance of weeds was associated with remnants that either had a history of clearing and grazing, were in close proximity to creeks or downslope from sealed roads. They also found some relationship between weeds and elevated total soil phosphorus, conductivity and water retention capacity, but relationships with these soil properties were weak and varied between sites with different types of disturbance history. The dramatic recent expansion of African Olive poses the greatest invasive threat to Cumberland Plain Woodland. Initially introduced to south-western Sydney in the 1820s, it was generally confined to the Camden-Picton area until the 1970s and now occurs frequently throughout the distribution of

the community (Tozer 2003; Cuneo & Leishman 2006). Roberts (1999) mapped approximately 1000 ha of Cumberland Plain Woodland (c. 10% of total remaining) which had a dense understorey of African Olive that was visible on aerial photographs flown in November 1997. Tozer (2003) recorded African Olive in 43% of 198 plots surveyed throughout the distribution of Cumberland Plain Woodland. The species is highly fecund, with fleshy fruit spread widely by a range of frugivorous birds, and seedlings establish readily in relatively undisturbed bushland, as well as fragmented edges (Cuneo & Leishman 2006). As shrubs grow, their canopies cast deep shade and shed copious leaf litter which suppress and ultimately eliminate most native shrub and groundcover species. Cook *et al*. (2005) and Tozer (*in litt*. October 2007, based on data from Tozer 2003), both recorded strong inverse relationships between the cover abundance of African Olive and the diversity and cover of native ground layer species. Other weeds that pose future threats to the community include *Asparagus asparagoides, Acer neguno, Gelditsia triacanthos* and *Nasella neesiana* (Benson & Howell 2002; J. Howell *in litt*. August 2007; J. Sanders *in litt*. January 2008). The invasion and establishment of exotic weeds is resulting in a very large reduction in the ecological function of Cumberland Plain Woodland. 'Invasion of exotic perennial grasses' and 'Invasion and establishment of exotic vines and scramblers' are listed as Key Threatening Processes under the *Threatened Species Conservation Act* 1995.

19. Moderate to heavy grazing of Cumberland Plain Woodland by livestock and rabbits results in the decline and disappearance of palatable plant species, including shrubs and herbs, and compaction and erosion of topsoil, making re-establishment of a diverse native understorey problematic. The effects of such overgrazing may be exacerbated under drought conditions. Habitat degradation associated with overgrazing and erosion contributes to a large reduction in ecological function of the community.

20. The soils of Cumberland Plain Woodland have undergone chemical and structural modification associated with agricultural land uses. Trampling by livestock has resulted in localised areas of soil compaction, primarily around watering points. Research carried out at the University of Western Sydney found that mean soil inorganic nitrogen levels were two to three times higher in areas of former agricultural land use than in remnant woodland, but was unable to detect differences in other soil properties (E. C. Morris *in litt*. June 2007). Addition of carbon and burning reduced soil inorganic nitrogen and reduced growth of exotic ground layer species relative to native species, suggesting that elevated soil inorganic nitrogen could favour exotics to the detriment of natives in Cumberland Plain Woodland (E. C. Morris *in litt*. June 2007). Hill *et al*. (2005) found elevated levels of phosphorus and conductivity in former agricultural areas compared to remnant woodland, but did not examine soil nitrogen. The sources of nutrient addition to soils of Cumberland Plain Woodland include addition of fertilisers during previous agricultural land use, deposition of livestock dung, rubbish dumping and stormwater runoff from urban areas. Expansion of urban land uses across the Cumberland Plain is likely to increase urban runoff from sealed surfaces into remaining bushland fragments, resulting in further nutrient enrichment of soils and associated replacemernt of native flora by exotic species. Disruption of ecological processes and degradation of habitat associated with nutrient enrichment contributes to a very large reduction in ecological function of the community.

21. Fire regimes influence the plant species composition and vegetation structure of Cumberland Plain Woodland (Benson & Howell 2002; Watson 2005) and are also likely to influence other components of the biota. Based on a study of Cumberland Plain Woodland remnants with varying fire histories, Watson (2005) found that variable intervals of 4 - 12 years between successive fires are likely to maintain populations of most understorey species in the community, including resprouting and obligate-seeding shrubs, grasses and herbs. Fragmentation of Cumberland Plain Woodland may exclude fire from some patches for extended periods by reducing fire spread. The consequent reduction in fire frequency sometimes leads to increased dominance of shrubs and associated declines in diversity of grasses and herbs (Watson 2005), as well as increased abundance of woody exotic species, such as African Olive (Benson & Howell 2002; Watson 2005; von Richter *et al*. 2005), which is likely to further reduce the flammability of the community. Conversely, high frequencies of fires may result where fragmentation increases the interface between urban areas and bushland, as this results in increased arson, car dumping, planned fuel-reduction fires and accidental ignitions. High fire frequencies are associated with reduced diversity of native plant species in Cumberland Plain Woodland (Watson 2005). 'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the *Threatened Species Conservation Act* 1995. The season of fire, which may be altered as a consequence of hazard reduction fires, may also influence the species composition of the grassy woodland understorey (Knox & Clarke 2006; Benson & von Richter 2008). Disruption of ecological processes associated with alteration of fire regimes contributes to a very large reduction in ecological function of the community.

22. Cumberland Plain Woodland in the Sydney Basin Bioregion is eligible to be listed as a critically endangered ecological community as, in the opinion of the Scientific Committee, it is facing an extremely high risk of extinction in New South Wales in the immediate future, as determined in accordance with the following criteria as prescribed by the *Threatened Species Conservation Regulation* 2002:

Clause 25

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

(a) a very large reduction in geographic distribution.

Clause 27

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

(a) a very large reduction in ecological function,

as indicated by any of the following:

(d) a change in community structure

(e) a change in species composition

(f) disruption of ecological processes

(g) invasion and establishment of exotic species

(h) degradation of habitat

(i) fragmentation of habitat

Professor Lesley Hughes

Chairperson

Scientific Committee

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