Establishment and Management of

the "Grassy White Box Woodlands Reserve"

Phase 2 (1995/6)

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Project Summary

Grassy White Box Woodlands once covered several million hectares in the wheat-sheep belt of NSW, but are now one of the most poorly conserved ecosystems in Australia. Less than 0.05% of these woodlands remain in near-original condition. High quality remnants are small (usually <5 ha) and geographically disparate. As no large, high-quality sites remain, we have proposed that the small, high-quality remnants, and selected larger remnants of poorer quality, can together form a single "Grassy White Box Woodlands Reserve". Establishment of this reserve was initiated in 1994, and negotiations with Councils and other landholders have continued in 1995, resulting in the protection or intended protection of 13 significant remnants through scheduling on Local Environment Plans. An important next step is to link these sites into a single reserve, to provide an over-seeing management and auditing body, and towards this aim, we have evaluated current structures that might be used for the gazettal of such a "Grassy White Box Woodlands Reserve".

Burning is believed to be important for maintaining species diversity in grassy woodlands. Management of sites of the proposed "Grassy White Box Woodlands Reserve" is being addressed through long term (10 year) burning and mowing experiments at two of the significant sites. Eighteen months after application of the first treatments, effects on species composition and diversity were generally weak, suggesting that remnants are relatively robust with respect to a single burn. There was, however, a significant increase in weed abundance after burning, and it will be important to determine whether this effect is temporary or longer-term. Beneficial effects of fire (e.g. an increase in native species richness) were noted after a hot fire during drought conditions at a remnant that had not been burnt for over fifty years.

A limited study of the introduced perennial grass *Hyparrhenia hirta* indicated that the species poses a significant threat to woodland vegetation in south-eastern Australia. Records indicate a considerable spread since its introduction, with areas within about 100 km of the site of introduction (Coolatai) now seriously overrun by the species, and with numerous more recently invaded areas of considerable size as far south as Cassilis (near Mudgee). Recent, isolated records from southern New South Wales and northern Victoria suggest that the species is capable of invading these southern woodland areas as well.

Achievements against scope items

1. *Continue establishment of the proposed Grassy White Box Woodlands Reserve*

1.1 Ongoing liaison with Councils and implementation of management plans

We visited twelve significant cemetery remnants (Monteagle, Woodstock, Canowindra, Toogong, Garra, Molong, Stuart Town, Baldry, Geurie, Wallabadah and Winton) between October 22 and November 14 1995. Most remnants were in good condition, with good growth and flowering after the drought, although weeds were also more abundant. Following suggestions given in our management plans (sent to Councils in May 1995), spoil heaps have been removed from most sites, remnants at Wallabadah and Molong have been fenced, horses have been removed from Canowindra, and a burning strategy and management plan prepared for Geurie. Other of our recommendations are still to be implemented, eg. partial burning of sites; some sites would still benefit from less frequent, higher mowing. Information and recommendations from the management plans are being used by Councils for incorporation into their State of Environment Reports and Local Management Plans.

We visited all Councils responsible for significant sites (except Parry Shire, as relevant personnel were away), and discussed progress with management and protection of sites. Further liaison in June 1996 indicated that progress regarding the listing of sites on Local Environment Plans has been made in some shires. Cowra Shire Council has created an 'Environment Protection Zone (7a)' within its Local Environment Plan to accommodate the listing of Woodstock Cemetery; Cabonne Shire Council already has this zoning and intends to use it for the listing of cemeteries at Toogong and Canowindra. Wellington Shire Council has listed Geurie Cemetery under Zone 7a, with Euchareena and Stuart Town Cemeteries still under consideration. Negotiations for a Conservation Agreement to protect the Monteagle Cemetery have been initiated by the Young Shire Council in association with the NSW National Parks and Wildlife Service. Listing of significant sites is still intended by the Quirindi and Parry Shire Councils.

1.2 Longer-term issues

While the process of scheduling sites on LEP's is continuing and will eventually see all sites listed within their Councils, we do not feel that LEP scheduling achieves our full conservation objectives for the Grassy White Box Woodlands. LEP scheduling is important for raising the necessary flags within Councils when a planning issue concerning the sites arises, thus providing a base level of protection for preventing destruction of the sites through active processes such as fencing and leasing to adjoining graziers. Sites are still threatened in the long term by destruction through passive processes, particularly neglect, and other than ourselves, there is no management body to provide advice and coordination for the management of sites. While all Councils are, at present, favourably disposed towards managing these sites for their conservation values, normal turnover of Councillors and Council officers may see the sites neglected in the future.

Our intention is to facilitate the formal gazettal of a single reserve (the Grassy White Box Woodlands Reserve) to protect and link these sites. The reserve would have a novel structure: it would comprise a number of dispersed sites, which would remain under their current tenure rather than being acquired by a state conservation authority; it would be based upon an ecosystem, rather than a particular spatial region; it would be flexible, with a formal process allowing incorporation of other qualifying sites in the future; and it would necessarily involve a dispersed, decentralised management structure, based upon cooperative agreements between local authorities, community groups and state and federal conservation bodies. While day-to-day management would be dispersed, coordination of management would need to be centralised in a state or federal conservation body. Further, we feel that it is important that the sites are awarded full recognition, at both state and federal levels (as part of the National Reserve System), for their significance as the last intact remnants of an entire, and nationally significant, ecosystem. Such recognition would make it harder for these small and isolated sites to become "lost in the system" and thus neglected over the long term.

The proposed structure would thus provide the basis for coordinated management and appropriate recognition and auditing for these sites, while maintaining local ownership and day-to-day management. It appears, from discussions with NSW NPWS and ANCA, that no formal structures currently exist to meet all of these aims. We are holding discussions with NSW NPWS to find ways in which such a reserve may be facilitated, and at the recommendation of members of the NSW NPWS Advisory Committee, we are preparing a discussion paper which describes and evaluates current structures that might be used for the gazettal of a Grassy White Box Woodlands Reserve (a draft of this paper is included in Appendix 1). Structures considered include scheduling on Local Environment Plans, Conservation Agreements, Nature Reserves, listing as an Endangered Community under state and federal legislation, and listing on the National Estate.

The concept of a "national reserve network", and the need for increased representation of ecosystems from agricultural areas in Australia's conservation estate, are issues of increasingly recognised importance in state and federal conservation bodies. The question of how to approach conservation in fragmented ecosystems is becoming a critical one for the fulfilment of such goals. A structure such as we have proposed for the Grassy White Box Woodlands may provide a useful working model for conservation of fragmented ecosystems, and indeed for an ecosystem-based system of national reserve auditing and management.

1.3 Miscellaneous extra sites

Cargo Town Common: We visited the Secretary of the Board of the Cargo Town Common and provided information regarding the significance of the site. Response was favourable; however, tenure of the land is more complex than we first believed. Part of the original Common, including part of the significant site, has been leased to a grazier. The significant area within this lease is unfenced (from the road reserve) and in no immediate danger from grazing. Another part of the significant site is now road reserve (the original road has been diverted). This part is under little threat from grazing, but could be threatened by quarrying. An active road-metal quarry is immediately adjacent to the site. The remainder of the significant site is an unused portion of the Common, and is unlikely to be used for grazing in the near future.

Canobolas Regional Parkland Trust site: We visited this site, known as Canomodine Gate, with the Trust Secretary, Jennifer Kenna. The site is valuable as a large stand of mature white box trees with good regeneration. We recorded about 40 native plant species in the understorey, however, most of these were natives typical of grazed sites. The understorey was generally degraded, being dominated by introduced plants such as Rye Grass (*Lolium* sp.), Ripgut Brome (*Bromus diandrus*) and Paterson's Curse (*Echium plantagineum*), thus, at this stage, we do not intend to take further action regarding this site.

Muttama Cemetery: In 1995, we informed the Cootamundra Shire Council of a significant site at the Muttama Cemetery. As about half of this site is seriously invaded with annual weeds, we have not yet recommended listing of the site on the Local Environment Plan. However, through the initiatives of Ms Bindi Vanzella (a contact at the Department of Land and Water Conservation, Cootamundra) locals of the Muttama area have recently formed a Land Care group with this site as one of its foci. We intend to meet with the group, as well as relevant local authorities, in spring 1996. One topic of discussion will be the potential for rehabilitation of the degraded parts of this site.

2. *Optimum management regimes for the proposed Grassy White Box Woodlands Reserve*

2.1 Management regimes for high quality remnants

Experimental plots of our ongoing experiments at the Monteagle and Woodstock Cemeteries (Fig. 1) were scored for their floristic composition during November 1995, 18 months after the first experimental burning and mowing treatments were applied. Further burning and mowing treatments were applied in

May 1996, with the assistance of the Young Headquarters Bush Fire Brigade and the Woodstock Bush Fire Brigade. Quantitative floristic data from experimental plots were processed and analysed using the DECODA package (Minchin 1989) and NMDS (non-metric multi-dimensional scaling) ordination. Vectors of maximum correlation (Rmax) of experimental treatments with the distribution of sites on the ordination were calculated using DECODA. Analysis of variance was used to analyse data on native and introduced species diversity and relative abundance. Results are summarised below:

1) Effects on general species composition. Ordination analysis of the 1995 data sets indicated significant effects of burning treatments at Monteagle (Rmax=0.74, p=0.004, Fig. 2), and at Woodstock (Rmax=0.56, p=0.13, Fig. 3). At Monteagle, this effect was little changed from the 1994 data set (1994 Rmax=0.70, p=0.02), while at Woodstock, the effect had increased (1994 Rmax=0.39, ns). From Figs. 2 and 3 it is clear that effects of burning were small: some burnt plots still fell among unburnt plots on the ordination, and vice-versa. Nevertheless, there was a tendency for burnt plots to group towards one area on the ordination. Species contributing to this trend are summarised in Tables 1 (Monteagle) and 2 (Woodstock). At Monteagle, species apparently favoured by burning included the native species *Wurmbea dioica, Acaena agnipila, Microtis unifolia* and *Drosera peltata* and the introduced species *Trifolium scabrum, Trifolium arvense, Juncus capitatus, Aira elegantissima* and *Trifolium campestre.* At Woodstock, species apparently favoured by burning included the native species *Leptorrhynchos squamatus, Hypericum gramineum, Microseris lanceolata, Luzula meridionalis, Ranunculus lappaceus, Linum marginale, Cymbonotus lawsonianus* and *Themeda australis* and the introduced species *Briza minor, Trifolium arvense,* and *Trifolium campestre.* Few species appeared to be favoured in control or mown plots at either site. It is interesting that native species apparently affected by burning at Monteagle are different from those at Woodstock. This may be due to differences between sites (particularly in original species composition), or it may simply be that results are unreliable at this early stage of the experiment.

Mown plots tended to group with control plots at Monteagle, indicating that burning has a greater effect than mowing on species composition at this site. While differences between fenced and unfenced plots at Woodstock were visually striking, this was largely due to a higher biomass in fenced plots, and there were no apparent effects on species composition.

2. Effects on weed species richness. By spring 1995, weed species richness had not been significantly affected by burning, mowing or fencing treatments at either Monteagle or Woodstock (Fig. 4a&b). In 1994, weed species richness decreased by about 50% in plots of all treatments owing to drought conditions. By spring 1995, under more normal moisture conditions, weed species richness had fully recovered to pre-drought levels (or greater) at both sites (Fig. 4a&b).

3. Effects on weed abundance. 1995 data indicated a highly significant increase in weed abundance in burnt plots at Monteagle, with a smaller but still significant increase in mown plots (Fig. 4c). At Woodstock, differences due to burning or fencing treatments were not significant, although the trends of mean values do suggest that weeds are increasing on burnt plots (Fig. 4d). At Monteagle, weed abundance on control plots had recovered to levels greater than observed before the 1994 drought, although the increase was markedly less than on burnt plots (Fig. 4c). Weeds had recovered to pre-drought levels on control plots at Woodstock (Fig. 4d). Weed abundance at Woodstock remained significantly lower than at Monteagle, with burnt plots at Woodstock not yet reaching the pre-burn weed abundance levels of Monteagle.

4. Effects on native species richness. By spring 1995, native species richness had not been significantly affected by burning, mowing or fencing treatments at either Monteagle or Woodstock (Fig. 4e&f). At both sites, native species richness had recovered to at least pre-drought levels, after a temporary decline due to the 1994 drought.

5. Effects on native species abundance. A decline in native species abundance due to burning was observed at both Monteagle and Woodstock in 1994. At Monteagle, this effect was no longer significant

in 1995, while at Woodstock, the effect remained significant on unfenced plots only (Fig. 4g& h). This indicates that native species have largely regained their pre-burn abundances in a period of 18 months, except at plots affected by kangaroo and rabbit grazing at Woodstock.

Conclusions: As these experiments are still at a very early stage (planned experimental period is 10 years), it is not surprising that effects of experimental treatments on both native and introduced species composition and diversity are as yet weak. The low response so far does indicate, however, that the ecosystem is relatively robust with respect to a single burn.

The only major effect of burning to date has been a marked increase in weed abundance at Monteagle. This is important with regard to the conservation of remnants of native grassy vegetation, and is analogous to effects observed for Victorian grasslands (Lunt 1991). However, we feel it is too early to suggest that burning is detrimental owing to this increase in weed abundance. Previous studies have largely been short term ones, with no indication as to whether this increase is temporary or long term. A longer term study indicating the period required for weed abundance to return to pre-burn levels would be valuable for estimating optimal burning intervals. Similarly, changes in native species composition are likely to become clearer over a longer term.

2.2 Recovery of a long-unburnt, high quality remnant after a hot burn during drought conditions

We surveyed the flora of Winton Cemetery in November 1995, noting its recovery since a hot fire during severe drought conditions in Winter 1994 (Table 3). Ground cover at the site was still only about 50% (originally nearly 100%), as conditions were still dry in the area. Nevertheless, it appears that interstitial herbaceous native species (herbs and grasses occurring between tussocks of the dominant grasses) benefited from the fire. Fourteen native species not recorded before the fire were found, including *Aristida calycina, Chrysocephalum apiculatum, Convolvulus erubescens, Cymbonotus lawsonianus, Dichelachne micrantha, Dichopogon fimbriatus, Einadia nutans, Enteropogon acicularis, Erodium crinitum, Gnaphalium sphaericum, Lomandra multiflora, Maireana enchylaenoides, Solenogyne dominii* and *Stipa aristiglumis*. Given the low abundances of many species in the thick grass cover befor the fire, most of these species were probably present then, but missed. Three native species, *Mentha satureioides, Vittadinia cervicularis* and *V. pterochaeta*, were recorded before and not after the fire; only subsequent visits will be able to indicate whether these species are now locally extinct, or were missed. Although we have no comprehensive records of abundance and flowering of each species before the fire, we did note that *Microseris lanceolata* had not produced flowers during the 1992 season. After the fire the species was flowering well.

Another important observation was that weed abundance remained low after the fire, although there was a small increase in weed species richness. Seven new introduced species (*Ciclospermum leptophyllum, Hypochaeris radicata, Linaria arvensis, Medicago minima, M. orbicularis, Rostraria cristata* and *Silybum maireanum*) were observed at low abundance after the fire, while four introduced species (*Conyza bonariensis, Lactuca serriola, Tragopogon porrifolius* and *Verbena officinalis*) were observed before but not after the fire.

These observations suggest that even under the extreme condition of a hot fire during severe drought in a long-unburnt, small remnant, fire can be beneficial to these sites.

2.3 Management regimes for rehabilitation of degraded remnants

Owing to the very small size and number of high quality remnants of Grassy White Box Woodland, we see rehabilitation of degraded remnants as an important option for improving the conservation status of this ecosystem. Methods for rehabilitating degraded remnants are poorly known. Through the interests of a local resident of Young, Mr. Bob Speers, we are establishing a new experiment, comparing different techniques for the rehabilitation of a degraded remnant at the Showground Travelling Stock Reserve, Young.

3. *Assessment of likelihood of spread of* Hyparrhenia hirta

We have collated records of *H. hirta* from herbaria at Melbourne, Sydney, Canberra, Tamworth and Armidale. Although there are few early records, the data indicate extensive southward spread of this species since the 1940s (see Fig. 5). In particular, all but one of the 11 records prior to 1960 are from the Warialda—Inverell—Yetman region, records prior to 1980 are mostly north of Tamworth, and later records are from as far south as Sydney, Bundanoon, Cootamundra and central Victoria.

We recorded the current distribution of *H. hirta* along much of the route traversed by Mr. E. J. Bailey in 1955, as well as along several major roads further south (Fig. 5). Within the bounds of Bailey's route, the spread of *H. hirta* in the last 40 years has been substantial. For example, Bailey recorded only two isolated plants along the roadside between Bundarra and Inverell; now the plant blankets wide stock routes, and extends in large swards into paddocks, along most of the route. We noted large stands of *H. hirta* far to the south of most early records. The plant appears to be spreading from several new foci, e.g. along the New England Highway centred around Wallabadah, and along the road between Merriwa and Cassilis. It was observed on various soil types, including basalt soils, although it appeared most invasive on poorer soils and on well-drained and seasonally dry ridge tops.

There appear to be three main phases to invasion by *H. hirta*. First, single plants or small, linear patches establish (presumably from seed) on bare ground on the immediate road verge, particularly where this has been recently scalped. When populations become well established along the verge, plants spread onto the road reserve, extensively invading the vegetation there (native or introduced). Finally, *H. hirta* is able to invade surrounding vegetation (usually pastures) and in poorer country is known to dominate large grazing properties (G. Lodge, pers. comm.). We have yet to determine whether *H. hirta* is able to invade undisturbed native vegetation, or whether it requires some disturbance from grazing etc. to establish. However, we suspect that it may be able to, once established in a dense sward along a disturbed road verge. Field observations suggest that the establishment phase may be critical for this species, and that it is highly susceptible to competition at this stage, although subsequently it is able to out-compete most native species. Slashing rather than grading road verges close to significant remnants may minimise the chance of *H. hirta* establishing and subsequently invading the remnant.

This limited study indicates that *H. hirta* poses a significant threat to woodland vegetation in south-eastern Australia. Records indicate a considerable spread since its introduction, with areas within about 100 km of the site of introduction (Coolatai) now seriously overrun by the species, and with numerous more recently invaded areas of considerable size noted as far south as Cassilis. Recent, isolated records from southern New South Wales and northern Victoria suggest that the species has the potential to invade these southern woodland areas as well. With regard to the Grassy White Box Woodlands Reserve, the species is not presently known to occur within any of the significant remnants. However, it occurs directly adjacent to the Winton Cemetery remnant and we recommend that these plants be removed. It also occurs in the near vicinity of the Wallabadah Cemetery remnant, so this site should be monitored for appearance of the species.

References

Lunt, I. (1991) Management of remnant lowland grasslands and grassy woodlands for nature conservation: a review. *Victorian Naturalist* **108**, 56-66.

Minchin, P. R. (1989) 'DECODA User's Manual.' Research School of Pacific Studies, Australian National University, Canberra.

Expenditure

	Total	
	$	
Salary	4 800.00	(32 days)
Field Expenses	1 726.10	
Travel	3 696.50	(8956.5km)
Other	359.40	
Total	10 582.00	

Table 1. Arrangement of species along the vector best representing the differentiation between burnt plots and mown plots and unburnt plots at Monteagle (B=burnt, M=mown, C=unburnt control). Species are ordered to highlight the differences between treatments; numerals 1-5 represent relative abundance estimates. All species with 4 or more records are shown.

Plot number:	BBBBMBBBBBBCBMMCBCMC 1 111 1 111 2 11 16869872173024903545
Wurmbea dioica	122-111-2----------
Acaena agnipila	1--122----------
Trifolium scabrum	222-122121----1-1-2-
Trifolium glomeratum	-2------2---21------
Microtis uniflora	1221121112-----2----
Trifolium arvense	234423433332322232222
Drosera peltata	122122-2221-2--2--1-
Juncus capitatus	23331322233-32212222
Tricoryne elatior	22122222-22-1-21-12-
Hypochoeris glabra	--1---1-1--1-1------
Dichopogon fimbriatus	212323121221--12122-
Thysanotus tuberosus	1212-2111-211-1-1111
Stackhousia monogyna	212221--222221121-112
Aira elegantissima	554555544554345244443
Galium divaricatum	-1-222-223--1--2212-
Trifolium campestre	444354444444454434333
Sebaea ovata	--1--1---22-2---1---
Avena fatua	-1--1---1------11---
Ranunculus pachycarpus	-21-----2----1---1-1
Lomandra filiformis	1222222112--21-1121-
Leptorhynchos squamatus	2-1-1-2-2-12211-2--2
Briza minor	12-12-122--12122221-
Glycine tabacina	-21-22-1-21--122-21-
Themeda australis	55555555555555555555
Convolvulus erubescens	1-2122-12222---2--22
Wahlenbergia luteola	111222222222122212222
Luzula meridionalis	1-----1----1--2--1--
Poa sieberiana	32333332233322232333
Cynoglossum suaveolens	-----2--1-2-1---12--
Chrysocephalum apiculatum	222--22-2232322-2313
Bulbine bulbosa	-11211111--122112221
Geranium retrorsum	111222222221222222222
Wahlenbergia stricta	-11-11----12--21112-
Hypochoeris radicata	11-2212212121122-122
Plantago varia	11---1-2-12-1----121
Dianella longifolia	------1-2-12-1--11-1
Vulpia bromoides	1----11-----1212-11-
Petrorhagia nanteuilii	-112-2222221222223-
Microseris lanceolata	2111222212222222221
Linaria pelisseriana	------1111-21211-112
Orobanche minor	--------1--1--1-1 1-

Table 2. Arrangement of species along the vector best representing the differentiation between burnt plots and unburnt plots at Woodstock (B=burnt, C=unburnt control). Species are ordered to highlight the differences between treatments; numerals 1-5 represent relative abundance estimates. All species with 4 or more records are shown.

Plot number:	BBBBBBBBCBBBBBBBBBBCBBBCBBBCCCCC 34332254334344333224224324454225 86429202509715139154630648723781
Leptorhynchos squamatus	21----2-1--1--------------------
Hypericum gramineum	22----211-2--12-----1-----------
Briza minor	211--21--111-2-1--1------------
Microseris lanceolata	1--2111--1-1------1--1----------
Luzula meridionalis	22111-212222111112111--1---11---
Ranunculus lappaceus	1113222-22121121--2-2-1----1----
Linum marginale	2--22---11-11--1-----1-2--------
Cymbonotus lawsonianus	2----1--2----1---11-1--1--------
Themeda australis	553344425433242322242223332422
Trifolium arvense	33223232223213233321322111 22--1-
Picris sp.	---1--111-1-1---1-----1---------
Trifolium campestre	33221231213222222231212112 2211-1
Dichopogon fimbriatus	21243223131321322233321111 1-2121
Aira elegantissima	212---2-2----2-1212-2--2---2----
Senecio quadridentatus	-1-1-21---1-11-121-11-1---1-----
Tricoryne elatior	----2---12----------1-----1---
Vicia sativa	--2-2----1-----2--2-3---2-------
Carex inversa/breviculmis	22222112222122112 22-212222112-11
Chrysocephalum apiculatum	212-22212221121211111122-1-121-1
Hibbertia riparia	-----1--1--------1-----1--------
Dichelachne micrantha	11--2-21111121--1-1-1---2-------
Leptorhynchos elongatus	1-11----1---------1-2-1-2-------
Pimelea curviflora	--1--2-21---1-1--21-11-12----1--
Cynoglossum suaveolens	21--1--2-1---2111-1-11-111111---
Hypochoeris radicata	----1--1-1--1--11--1-1------1---
Trifolium glomeratum	11-12112-121211 21-1-2-11-21-11--
Petrorhagia nanteuilii	-22-11---11--2-121---11----2---2
Dianella longifolia	-2--1-1--111211---2-2----111--2-
Bulbine bulbosa	11222212222212112113112-22122111
Lomandra filiformis	111-1122222-211212112222211-1-1-
Bromus molliformis	-1-----21----1--11-21--1---12---
Daucus glochidiatus	1-1--11-211-12-2211-1112-1112--1
Poa sieberiana	55555555555555555445555545555555
Arthropodium minus	---111---1--121---1-11--1-12-1--
Geranium solanderi	11122222222211221222222122231222
Desmodium varians	-----12---1------2--1-1-----1--1
Cirsium vulgare	----1----1----1----2--------1-1-
Stackhousia monogyna	---111-211-11-1--1-2121211---22-
Asperula conferta	------22--1-2---------2-1-1-11--
Acaena agnipila	-1---111--1111--2-----1-121-1-1-
Vulpia bromoides	--------1---1---111-11-21--1----
Wahlenbergia stricta	--------1--1-1--1-1-1--11--11---
Glycine tabacina	--12-----1----122--2111-221-11-1
Plantago varia	---3-2-2-2-22-2-2231332133-22321
Medicago minima	--1-------------------1--1----1--
Lomandra multiflora	---------11211-11122122-221-211-
Eucalyptus albens	22-224-1511-52221551552552325 54-
Swainsona ?reticulata	---1-------------1--2---21---1--
Convolvulus erubescens	----2--------212---11--1--21-1-2
Elymus scaber	-1111-1--12212-22--1111112122222
Dianella revoluta	11-1-2-121112-112211231312222222
Wahlenbergia luteola	11-2--12111112211122222232222232
Lolium spp.	-----1--112--1-1-1212-1112122112
Hydrocotyle laxiflora	1-----32--2-22--2-3-2-3--322-233
Tragopogon porrifolius	------------------2--2-----1--1
Danthonia racemosa	------------------------1112----
Danthonia spp.	---1--1---1-2---21---11--22-2212
Chondrilla juncea	----------------------11----1--1
Bromus diandrus	----------------------21--1-1-12

Table 3. Species recorded before (November 1992) and after (November 1995) a hot fire during drought conditions of winter 1994 at the Winton Cemetery. Abundances given are a visual estimate ranging from 1 (rare) to 5 (very common).

Native species	Abundance 1992	1995
Aristida calycina var. *calycina*	-	1
Arthropodium minus	2	2
Asperula conferta	3	2
Asperula cunninghamii	2	3
Brachychiton populneus (cult.)	1	1
Brachychome ciliaris	3	2
Brunoniella australis	2	2
Bulbine bulbosa	1	3
Callitris glaucophylla (cult.)	1	1
Calotis lappulacea	2	2
Carex inversa	2	2
Cheilanthes distans	2	1
Cheilanthes sieberi	3	2
Chloris truncata	2	3
Chrysocephalum apiculatum	-	2
Convolvulus erubescens	-	2
Cymbonotus lawsonianus	-	1
Danthonia spp.	3	3
Dianella longifolia	3	3
Dichanthium sericeum	3	1
Dichanthium setosum	1	3
Dichelachne micrantha	-	2
Dichondra repens	2	3
Dichopogon fimbriatus	-	3
Einadia nutans	-	2
Elymus scaber	2	3
Enteropogon acicularis	-	2
Eremophila debilis	4	3
Erodium crinitum	-	1
Eucalyptus albens	3	3
Geranium solanderi	2	2
Glycine clandestina/tabacina	1	1
Gnaphalium sphaericum	-	2
Goodenia pinnatifida	1	2
Ixiolaena tomentosa	2	1
Jasminum suavissimum	3	3
Juncus (subg. Genuini)	3	1
Lomandra longifolia	4	2
Lomandra multiflora	-	1
Maireana enchylaenoides	-	2
Mentha satureioides	2	-

Native species *(cont.)*	Abundance 1992	1995
Microseris lanceolata	2	3
Oxalis perennans	2	2
Poa sieberiana	5	5
Psoralea tenax	1	2
Pycnosorus globosus	3	1
Rostellularia adscendens	2	3
Rumex brownii	2	2
Sida corrugata	2	3
Solenogyne dominii	-	1
Stipa aristiglumis	-	1
Templetonia stenophylla	2	2
Themeda triandra	5	4
Vittadinia cervicularis var. *cervicularis*	1	-
Vittadinia pterochaeta	3	-
Wahlenbergia communis	2	2
Wahlenbergia luteola	2	2
Introduced species		
Avena fatua/barbata	1	2
Bromus molliformis	1	1
Ciclospermum leptophyllum	-	2
Centaurea melitensis	2	1
Conyza bonariensis	1	-
Hypochaeris radicata	-	1
Iris germanica	2	2
Lactuca serriola	1	-
Lepidium africanum	2	3
Linaria arvensis	-	1
Lolium sp.	1	2
Medicago minima	-	2
Medicago orbicularis	-	2
Medicago polymorpha	2	1
Petrorhagia nanteuillii	1	2
Rostraria cristata	-	1
Silybum maireanum	-	2
Sonchus oleraceus	1	2
Tragopogon porrifolius	2	-
Trifolium campestre	1	2
Trifolium glomeratum	2	2
Verbena officinalis	2	-

FIGURE CAPTIONS

Figure 1. Details of experimental layout. Treatment codes: 2- 2 year burns, 4- 4 year burns, 8- 8 year burns, M- slashing to about 15cm once every 2 years, C- control (unburnt, unmown). Solid lines indicate fenced plots, dashed lines indicate unfenced plots.

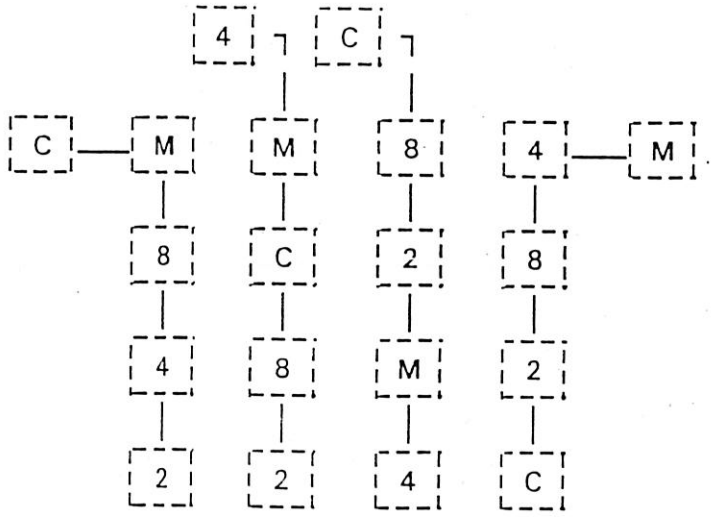
Figure 2. Ordination of 1995 floristic data for Monteagle. The ordination result shows the arrangement of plots in 3 dimensions: axes one and two are shown, size of circle indicates relative position of sites along axis 3 (the closer plots are together on the ordination diagram, the more closely related they are in floristic composition). Closed circles indicate control plots, half closed circles indicate plots mown in autumn 1994, and open circles indicate plots burnt in autumn 1994.

Figure 3. Ordination of 1995 floristic data for Woodstock. The ordination result shows the arrangement of plots in 3 dimensions: axes one and two are shown, size of circle indicates relative position of sites along axis 3 (the closer plots are together on the ordination diagram, the more closely related they are in floristic composition). Closed circles indicate control plots, open circles indicate plots burnt in autumn 1994.

Figure 4. Effects of burning (dark grey) and mowing (pale grey) treatments compared with controls (mid-grey) on native and introduced species richness and relative abundance at Monteagle (a,c,e,g) and Woodstock (b,d,f,h) over the experimental period (1993=pre-burn, 1994=6 months post-burn, 1995=18 months post-burn). Significance levels are given for comparisons within years (*$p<0.05$, **$p<0.01$, ns=not significant).

Figure 5. Records of *Hyparrhenia hirta* in south-eastern Australia.

Monteagle



Woodstock

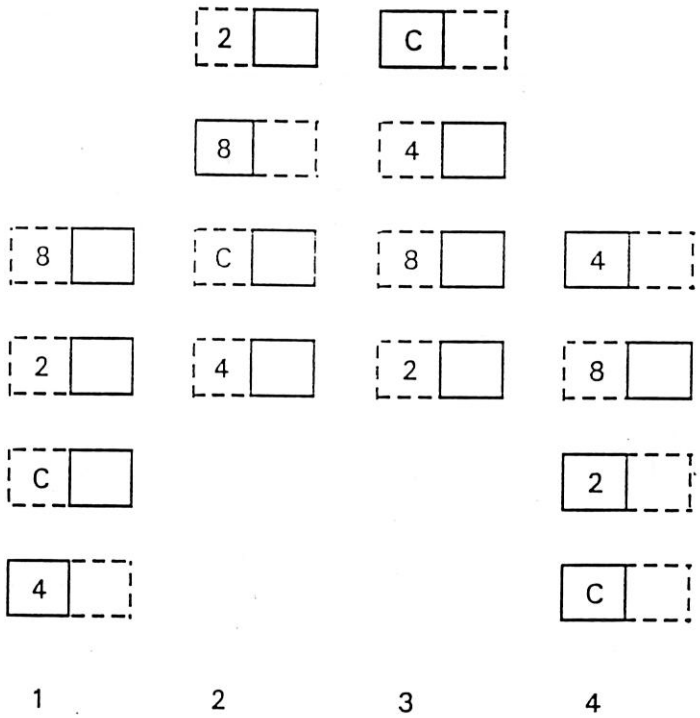
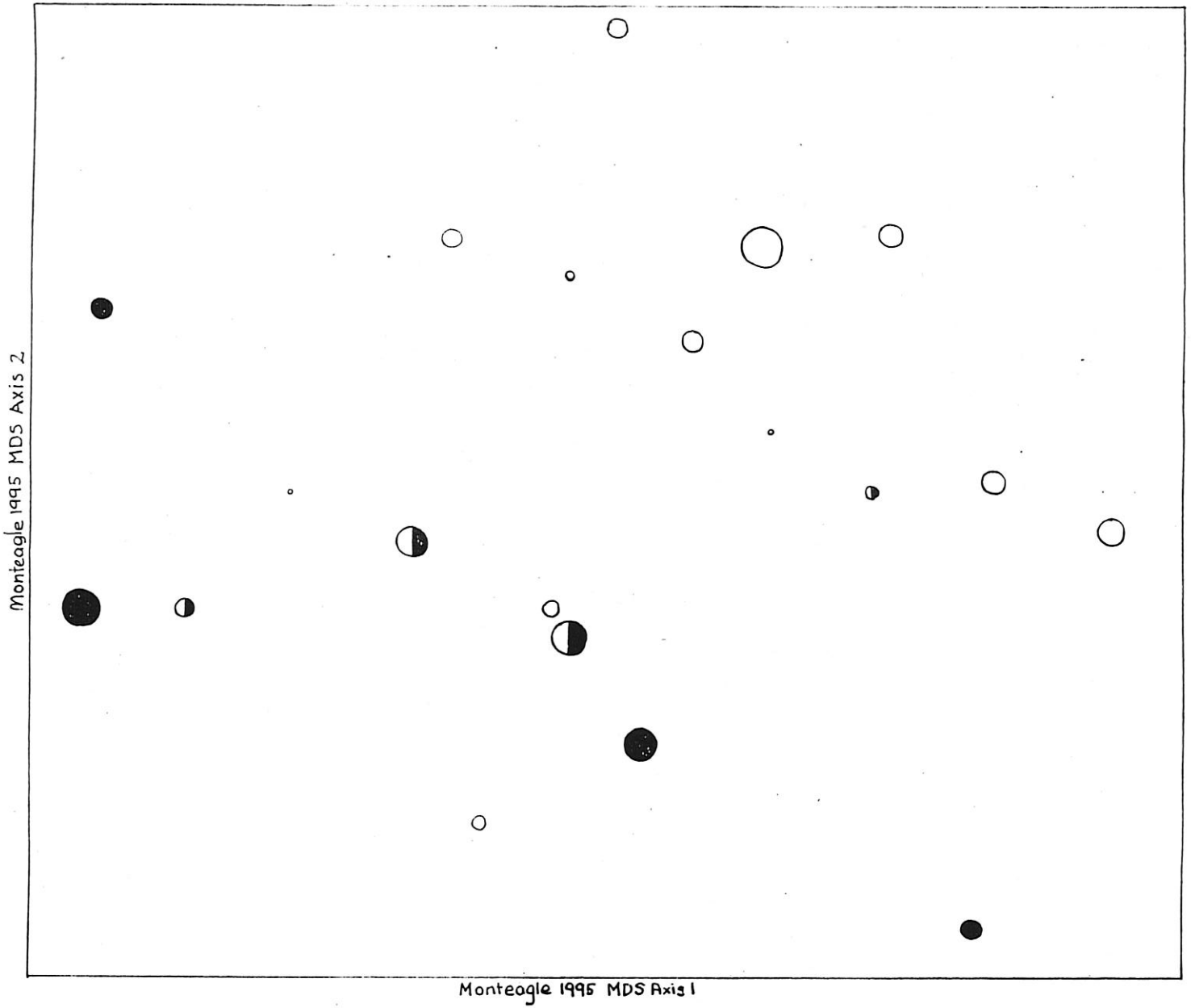


Figure 1. Details of experimental layout. Treatment codes: 2- 2 year burns, 4- 4 year burns, 8- 8 year burns, M- slashing to about 15cm once every two years, C- control (unburnt, unmown). Solid lines indicate fenced plots, dashed lines indicate unfenced plots.

Figure 2.



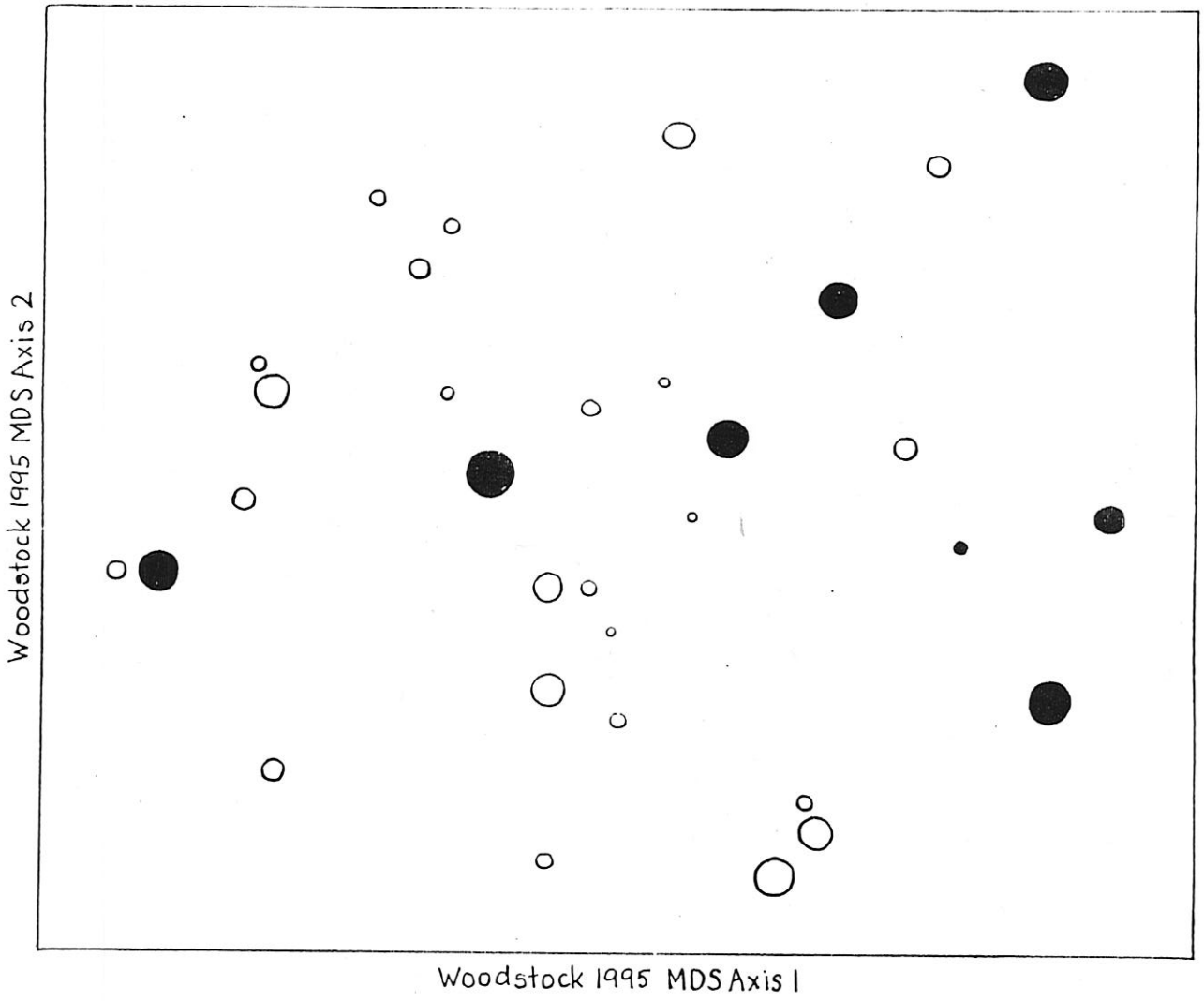
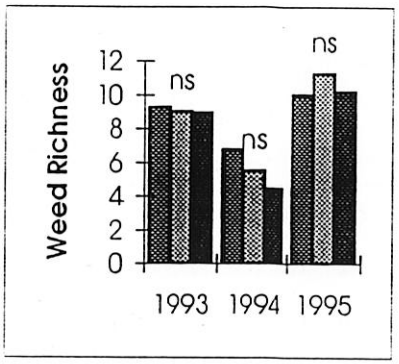
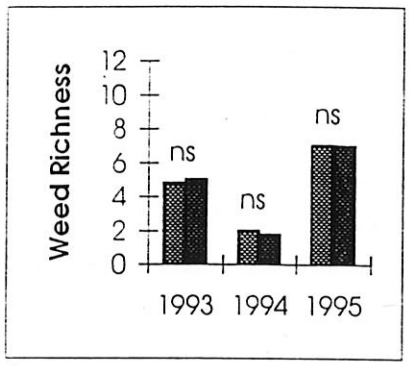


Figure 3.

Figure 4.



a



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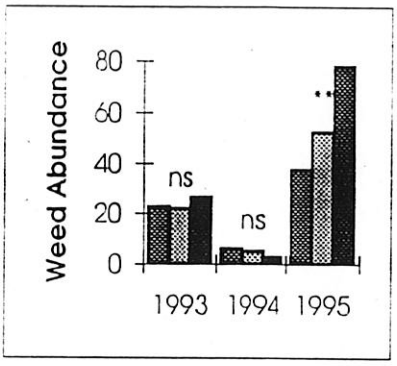
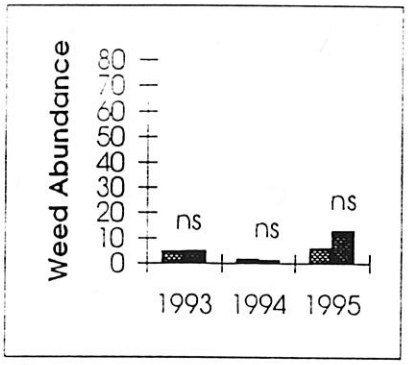
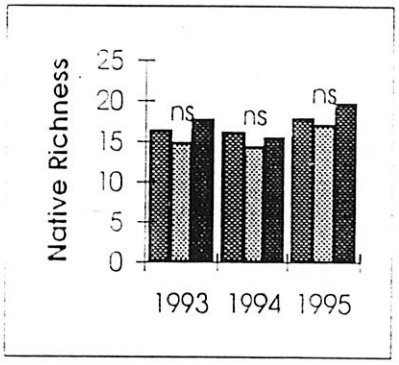


c



d



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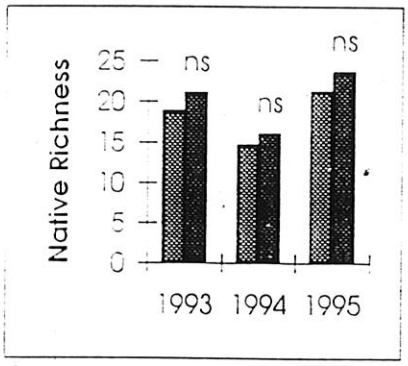
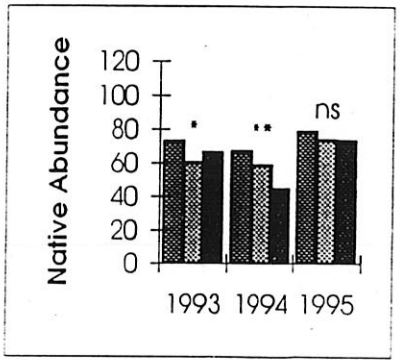
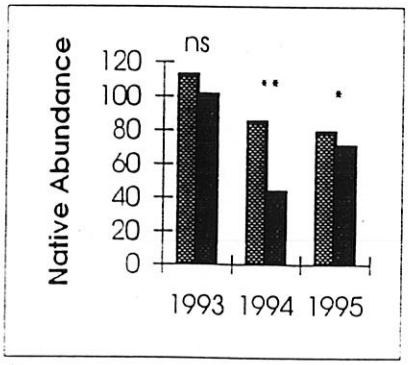


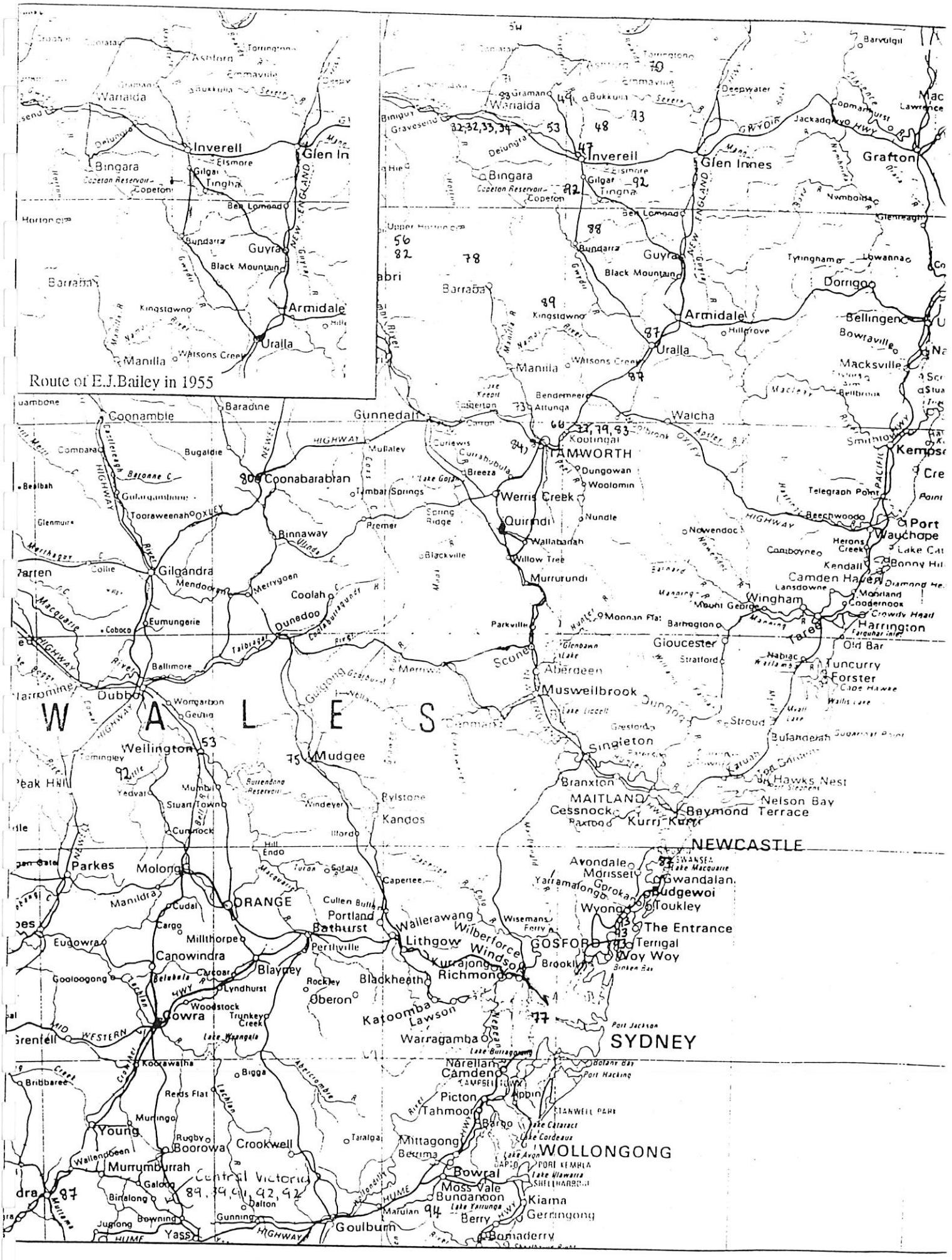
f



g



h



Traversed, *Hyparrhenia* absent

Herbarium records (with years)

1930s–60s

1960s–70s

1980s–90s

Hyparrhenia present, scattered

Hyparrhenia present, abundant

APPENDIX 1

Reserve Concepts and Conceptual Reserves:

The Grassy White Box Woodlands and Beyond

A Discussion Paper

Suzanne Prober & Kevin Thiele

Centre for Plant Biodiversity Research
CSIRO Division of Plant Industry

-Draft Only-
July 1996

Summary

- The grassy white box woodlands in New South Wales survive today as small, isolated remnants totalling less than 0.05% of their original range. Existing remnants are not well represented in conservation reserves, and are in urgent need of conservation.

- The usual model for reservation - establishment of a contiguous reserve tenured to a centralised conservation agency - is inappropriate for conserving the grassy white box woodlands.

- Reservation of each of the remnants in isolation is also inappropriate, given the wide scatter of sites and the need for a unified approach to their conservation.

- The optimal reserve structure for the grassy white box woodlands remannts would be a single reserve with sites retaining their existing tenure and management bodies, but with an overarching management and policy structure provided by a centralised agency.

- No existing reservation frameworks provide for such a reserve structure.

- If a reserve framework like this could be established, it would have implications beyond the grassy white box woodlands, to other similarly fragmented and critically under-represented ecosystems, and beyond these towards the establishment of a representative reserve system for all Australian ecosystems.

Introduction

Expanding the conservation estate to provide better representation and protection of poorly-conserved ecosystems is an important challenge facing conservation managers in Australia today. There is a growing recognition that current state and national reserve systems are incomplete. Partly, this incompleteness results from historical biases in the dedication of reserves. Biases operate at geographic, social and ecological levels: natural areas that are scenically spectacular, remote or worthless for other purposes, and ecosystems and species that have been a focus for public concern, such as rainforests and koalas, are relatively well-represented in the conservation estate. Natural areas, ecosystems or species that are less visible, less popular, or less spectacular, are often relatively poorly represented.

Another cause of bias lies in our working model of what constitutes a reserve. Australia historically has used a model of conservation - the National Parks model - in which large, contiguous, natural areas tenured to a centralised agency are favoured for reservation. These requirements, for large size, contiguity and centralised tenure, probably arise from our European cultural history, with its strong notions of land ownership (it would be interesting to speculate as to what solutions to conservation problems would arise from a culture without a strong land-ownership tradition).

In the National Parks model, conservation is considered first in strictly spatial terms: we draw a spatial map and delineate our National Park boundaries on the map. Other models of conservation are less spatial, such as the Man in the Biosphere initiative, in which boundaries are not sharp, and closed-season conservation of game species in which time is more important than space. Of course, the reduced emphasis on space and spatial boundaries in these approaches does not mean that space is absent from them. Clearly, all biodiversity occurs in space and needs spaces. Rather, the reduced spatial emphasis reduces spatial constraints on their application to conservation problems.

Another alternative approach to conservation would place more emphasis on habitat than space or other parameters. A reserve network designed with a habitat, or ecosystem, emphasis would comprise sets of ecological reserves individually designed to conserve each of Australia's ecosystems. This approach would ensure conservation of ecological processes, and of the particular combinations of species within each ecosystem, and at the same time would provide for the conservation of most species and their genetic diversity without individual attention to them. Such an 'ecological' approach to conservation is not a new idea: over 20 years ago, Specht *et al.* (1974) and Fenner (1975) recommended a national system of ecological reserves in Australia. These ideas are still to be put into consistent practice.

Application of the spatial, National Parks model of reservation has provided Australia with a world-class system of National Parks, and has been effective in conserving some ecosystems - those that fit its requirements of scale and contiguity. However, it is proving a hindrance in expanding the conservation estate to cover all ecosystems, and in providing for representative conservation of all elements of biodiversity. It is particularly inappropriate, because of its constraint of spatial contiguity, for conserving ecosystems that have become fragmented in a largely anthropogenic landscape.

One set of ecosystems that have historically been neglected by government conservation authorities and other bodies, partly because of the biases of the National Parks model, are the grasslands and grassy woodlands of south-eastern Australia. These are generally unspectacular from a landscape perspective, and until recently have rarely been a focus for public concern or action. Since they occurred on some of the most agriculturally productive lands in Australia, they have suffered one of the largest reductions in extent of any ecosystem, and exist today only as small, fragmented remnants in a largely agricultural landscape. Their conservation needs are high, yet they are very poorly represented in the conservation estate (Specht, 1981). Providing for the conservation of these ecosystems requires a different approach from the historical one under which they were neglected.

Since 1990 we have been studying one of these ecosystems, the grassy white box woodlands, with the aim of designing and implementing a reserve system to provide for their conservation. The implementation

phase of this work has highlighted a number of inadequacies in existing legal and administrative reservation frameworks that need to be addressed if the goal of adequate conservation for this ecosystem is to be met. In this paper, we discuss options for the conservation of the grassy white box woodlands, in the context of a wider goal of conservation of all Australian ecosystems within a National Reserve System.

The Grassy White Box Woodlands Case Study.

Before European settlement, grassy white box woodlands occupied an area of several million hectares along the western slopes of the Great Dividing Range, extending also into Queensland and Victoria. To the west, on heavier soils of the plains, were found yellow box (*E. melliodora*), grey box (*E. microcarpa*) and bimble box (*E. populnea*) woodlands, while to the east at higher elevations were yellow box/red gum (*E. blakelyi*) woodlands. The understoreys of these woodlands were broadly similar, dominated by grasses such as kangaroo grass (*Themeda triandra*), snow grass (*Poa sieberiana*), wallaby grasses (*Danthonia spp.*) and spear grasses (*Stipa spp.*) with a rich and diverse assemblage of herbaceous plants and sparse shrubs occupying interstices between the grass tussocks.

Once European settlement had penetrated the Great Divide, the grassy box woodlands were found to be highly suited to cropping and grazing, since they occurred on productive soils on gently undulating land. Very soon after exploration, almost all of the area of the grassy box woodlands was taken up for agriculture (Prober and Thiele, 1993). As a result, very few areas remain in public ownership, and very few areas retain an unmodified vegetation.

Our studies on the grassy white box woodlands have encompassed an assessment of their current status, rangewide surveys of floristic and genetic variation, assessment of effects of management regimes (grazing and burning) on floristic composition and of fragmentation on floristic and genetic diversity, and studies of their ecology. Current knowledge is provided in Prober & Thiele 1993, Prober & Brown 1994, Prober & Thiele 1995, Prober 1996 and Prober *et al.* in prep. Critical characteristics of the grassy white box woodlands that are directly relevant to their conservation are:

- *Status*: less than 40 ha (0.05% of the original area) of grassy white box woodlands in 12 sites remains in near-original condition.

- *Distribution*: remaining high-quality remnants occur as small (1-6 ha) remnants, widely scattered over the original range of the ecosystem in a largely agricultural landscape; larger remnants have a partially to completely modified understorey.

- *Tenure*: most high-quality remnants are in country cemeteries, on land held in trust from the Crown by Local Councils; other important remnants are in Travelling Stock Reserves, on rail reserves and roadsides; few important remnants occur on freehold or leasehold land.

- *Variation*: floristic and genetic variation across the range of the grassy white box woodlands is relatively low, although some broad geographic patterns (particularly a north-south trend in floristic variation) are evident.

- *Effects of fragmentation (floristic effects)*: floristic richness, in general, decreases with decreasing remnant size; however, even very small remnants (<1 ha) may have high richness (>70 native spp.) if they have not been grazed by livestock.

- *Effects of fragmentation (genetic effects)*: very small remnants (<0.2 ha) may adequately capture genetic variation of many understorey herbs (such as *Microseris lanceolata*). Larger remnants (>20 ha) are needed to capture genetic variation in white box (*E. albens*).

- *Faunal vs. floristic values*: small remnants may adequately provide for the conservation of floristic, and possibly invertebrate faunal elements, but larger remnants may be needed to provide for larger (especially vertebrate) faunal elements.

- *Adequacy of current reserves*: existing reserves within the region are strongly biased towards hilly sites of low natural fertility, and do not adequately capture the variation in the grassy white box woodlands.

A Proposal for a Grassy White Box Woodlands Ecosystem Reserve

We propose here that the grassy white box woodlands should be reserved in the following way:

- All of the high-quality remnants should be reserved.

- In addition, a selection of larger (lower quality) remnants should be reserved to better capture genetic diversity of some floristic components (such as *E. albens*) and to better provide for conservation of woodland fauna and the woodland landscape.

- These disparate sites should be linked together into a single "Grassy White Box Woodlands Reserve", rather than being reserved separately and in isolation

- Tenure and day-to-day management of all sites should, where appropriate, be retained by the current tenure-holder.

- A management and policy umbrella should be provided by a central body, to disseminate management advice, encourage communication between relevant local bodies, periodically visit and monitor sites, and to assist in the initial establishment of the reserve.

This system would have several key advantages. It would:

- Improve the capture of biological and genetic variation of the ecosystem.

- Encourage an integrated view of management (this would be difficult if every significant site were reserved in isolation).

- Allow flexibility, such that other sites found to meet predefined criteria could easily be added to the reserve.

- Allow reservation of high quality sites even though they may be too small to be otherwise considered, and of lower-quality sites even though they may not meet conventional conservation criteria.

- Allow and encourage significant and increasing local participation and awareness.

- Minimize establishment and ongoing costs, since no initial capital for would be required for land acquisition, and day-to-day management needs could be channeled through the existing tenure-holder's infrastructure.

Possible frameworks for establishing the Grassy White Box Woodlands Reserve

Various administrative and legislative frameworks exist that may, separately or in conjunction, be used to establish the Grassy White Box Woodlands Reserve. This section explores how effectively these

frameworks could be used. A summary is provided in Table 1. Each possible framework is assessed against the following necessary criteria:

- **Level of Protection:** The highest possible level of legal protection should be afforded the sites of the Grassy White Box Woodlands Reserve, as they are of national significance, and together will conserve a nationally endangered ecosystem.

- **Links and Coordinated Management:** The framework should provide a formal linking mechanism which allows all sites to be audited and managed as parts of a single reserve.

- **Flexibility:** The framework must allow sites satisfying qualifying criteria to be easily added to the Reserve. It must be possible to include a selection of larger, poorer quality sites, as well as highly significant, high quality (but generally small) remnants.

- **Maintenance of Local Tenure and Management.** The framework must take account of the value of local participation and management, and reduce the potential for current landholders and local communities to feel threatened by the reservation process (as may happen, for example, through an acquisition program).

- **Inventory and Auditing:** The above proposal for the Grassy White Box Woodlands Reserve has been designed to provide the best possible representation of this ecosystem, and to contribute to a national system of ecosystem reserves in Australia. As such, the framework should allow that the sites be audited as a part of Australia's National Reserve System.

- **Generality:** With a view to establishment of an ecosystem reserve network in Australia, the framework should be applicable across Australia to any ecosystem, or at least any fragmented ecosystem. It should not, for example, be limited to those ecosystems that are classed as endangered. State based systems are limited geographically, but this may be partly overcome by establishing a similar system in each state. In such a case, ecosystems that cross state boundaries would still need to be treated separately within each state.

Currently Available Frameworks

Local Environment Plans: Local Environment Plans (LEP's) operate under the NSW Environmental Planning and Assessment Act, 1979. LEP's are prepared by local councils and are generally concerned with development controls within the local area. Significant sites can be listed on a Local Environment Plan through amendment: an amendment requires an environment study (unless waived by the minister), formal public consultation, and approval by the Minister for Planning. Once gazetted, LEP's are legally binding and may be revoked only by the Minister in consultation with the Council (Dept. of Planning 1980).

Listing on a LEP provides a high level of legal protection for individual sites while still maintaining local tenure and management. Being an integral part of a local government planning system, it is particularly valuable for providing 'flags' to those responsible for the site on a day-to-day basis. However, there is no allowance in this system for the linking and coordinated management of sites from different shires, and sites protected for the conservation values by a LEP would not be audited as part of the National Reserve System. Progressive addition of high quality sites is possible, through repeated amendment of the LEP. Poorer quality remnants that are individually less significant but critical to the overall reserve may be more difficult to list; similarly, it may be difficult to prepare a case for the listing of sites from less critically endangered ecosystems.

Listing of 12 high quality remnants of Grassy White Box Woodland on LEP's is currently proceeding after our recommendation to the six local Councils concerned. We see the listing of these sites as a

valuable first step towards the Grassy White Box Woodlands Reserve, but feel that they are inadequate alone.

Conservation Agreements: Conservation Agreements (CA's) are part of a relatively new system established by the New South Wales National Parks and Wildlife Service. A CA is a voluntary agreement between a landholder and the Minister for Conservation, and are established under the National Parks and Wildlife Act 1974. Terms for each agreement are individually negotiated by the landholder and officers of the New South Wales National Parks and Wildlife Service. Once entered into, the agreement is registered onto the title of the land, is legally enforceable, and binds all future owners of the land. In the case of public land, a CA would take the form of a Memorandum of Understanding between the Minister for Conservation and the Minister responsible for the land. Agreements may be varied or terminated at the discretion of the Minister for Conservation (Smart, 1993).

The level of protection provided by a Conservation Agreement is high. They allow for local participation in negotiating the agreement and allow maintenance of local tenure and management. Protection of new sites is possible through the negotiation of new agreement, and poorer sites can be listed under different categories, e.g. Land for Wildlife, Wildlife Refuge. There is currently no facility for providing links and coordinated management, although it may be possible to set up an information network among relevant landholders and managers. Sites protected by CA's are not currently audited as part of the National Reserve System. The system is restricted to sites in New South Wales, but similar systems are available in other states (e.g. through the Victorian Conservation Trust in Victoria). CA's can be applied to remnants of any ecosystem.

Nature Reserves: A Nature Reserve is an area of high conservation value protected under the New South Wales National Parks and Wildlife Act 1974. For declaration of a Nature Reserve, land must be acquired by the New South Wales National Parks and Wildlife Service, and the Service is required to prepare and implement appropriate management plans. Nature Reserves are revocable only by the Minister for Conservation.
Nature Reserves are audited as part of the National Reserve System. They are treated separately, with no formal facilities for links between sites, and the requirement for land acquisition and management by the New South Wales National Parks and Wildlife Service can be both expensive and potentially threatening to local stakeholders. Acquisition for Nature Reserves of both small, high-quality sites and large, low-quality sites of the Grassy White Box Woodlands is unlikely. A new Nature Reserve is required for each new site. Nature Reserves are a state based system, but similar systems are available in other states. They can be applied to sites of any ecosystem.

Threatened Community Listing (NSW): The New South Wales Threatened Species Conservation Act (1995) provides for the listing of 'threatened ecological communities'. Areas considered critical for the survival of a threatened community are declared by the Minister for Conservation as critical habitat, after a period of public consultation. Under the National Parks and Wildlife Act (1974), it is an offence to damage critical habitat. A declaration of critical habitat is revocable by the minister after consideration of advice from the Director General (New South Wales National Parks and Wildlife Service). Other conservation measures are also possible, including interim protection orders and negotiation of Conservation Agreements. Under the Act, a recovery plan must be prepared and implemented for each listed community.

Listing of the Grassy White Box Woodlands as a threatened community would have several important advantages. The degree of protection is high and the ecosystem is treated as a whole, allowing coordinated management of sites. Maintenance of local tenure and day-to-day management should be possible, with management guidelines being provided by the recovery plan. New sites could be added through amendment to the list of critical sites. A disadvantage of this system is that sites are not audited as part of the National Reserve System. Further, the system cannot be applied to all ecosystems, rather,

only to those that are defined as 'threatened'. The system is a state based one, so similar systems would be needed in each state, and ecosystems would need to be treated separately in each state.

Endangered Community Listing (Federal): The Endangered Species Protection Act (1992) provides for the listing of 'endangered ecological communities'. Areas occurring on Commonwealth land are directly affected by the Act, with the option to apply conservation orders to prohibit or restrict specified activities, and the requirement to prepare and implement recovery plans. For other areas, the Commonwealth must not act in a way that contravenes an approved recovery plan, threatens the listed community or impedes its recovery, and must cooperate with relevant States or Territories. Obligations under the Endangered Species Protection Act can be waived by the Governor General (ANCA 1994).

Although this system allows the ecosystem to be treated as a whole and applies throughout Australia, the level of protection provided for areas outside Commonwealth Crown land is low, excluding it as a single method for the protection of the Grassy White Box Woodlands.

National Estate Listing: Significant natural areas can be listed on the Register of the National Estate under the Australian Heritage Commission Act (1975). Listing alerts governments, planners, decision-makers and the community to the value of these areas, so they can take action to conserve them. It gives the Commonwealth no rights to acquire, manage or enter places on private property. The Commonwealth Government is the only body whose actions are constrained by listing: under the Act, the Commonwealth should take no action which adversely affects listed places unless there are no 'feasible and prudent alternatives' (Australian Heritage Commission 1994).

Listing of sites on the National Estate Register thus meets only a few of the criteria for the Grassy White Box Woodlands Reserve, namely, maintenance of local tenure and management, and applicability to any ecosystem Australia wide. Level of protection is poor, sites are not audited as part of the National Reserve System, and there is no facility for coordinated management across sites. Addition of a new site requires a new listing, and it may be more difficult to include poorer quality sites.

Conclusions regarding current frameworks

None of the currently available frameworks fulfil all of the criteria desirable for the establishment of the Grassy White Box Woodlands Reserve (Table 1). The three that are most applicable are Conservation Agreements, listing on Local Environment Plans, and listing under the New South Wales Threatened Species Conservation Act as a threatened community. All of these are State based frameworks, which provide a high level of protection for sites while maintaining local tenure and management. The first two lack provision for links and coordinated management across sites, but potentially allow inclusion of sites from any ecosystem. Listing as a Threatened Community treats the community as a whole and provides for coordinated management of sites, but can only be applied to sites that qualify as part of a threatened community. This is appropriate for the present case of the Grassy White Box Woodlands, but limits the generality of the framework in the context of an ecosystem reserve network in Australia. None of the three systems allows sites to be audited as a part of the National Reserve System.

A possible new framework

Given the limitations of the above frameworks, consideration should be given to establishing a new legislative and management framework that fulfils all of the desired criteria. Despite the difficulty of treating ecosystems on a State by State basis, there would be advantages to a State-based framework (but with matched frameworks in each State), as a Federally-based framework would be limited in its powers of protection. In New South Wales, the New South Wales National Parks and Wildlife Service would be an appropriate body to administer such a framework, which may be most easily established through modification of an existing framework within that body. Thus, one possibility would be to modify the

Conservation Agreements Scheme so that listed sites are audited as part of the National Reserve System, and to provide links and coordinated management across sites. Another possibility would be to create a new category of Nature Reserve, that allows continuance of local tenure and day-to-day management, and provides for links and coordinated management among sites.

Beyond the Grassy White Box Woodlands Reserve

Our goal is to establish an ecosystem reserve for the grassy white box woodlands. We recognise, however, that these woodlands provide a model for many other poorly conserved and fragmented ecosystems in Australia, such as other woodland and grassland communities in southern Australia, mallee and shrubland remnants in the wheat belt of Western Australia, brigalow scrubs, the "Big Scrub" rainforests and dry, inland rainforests in New South Wales and Queensland, and many wetland communities. A framework developed for the grassy white box woodlands should be applicable to these as well.

A suitable framework, with flexibility, potential for linkages between sites and provisions for coordination of management, could sigificantly increase the comprehensiveness and effectiveness of the National Reserve System. It could also provide an important aspect of State and Federal inventory and auditing initiatives.

Inventory and auditing of the natural estate has historically been dominated by spatial concepts, and has generally occurred at large spatial scales, particularly at the level of the Commonwealth and of individual States. Recently, attempts have been made to reduce the scale of inventory and auditing by exploring finer-grained spatial resolutions, such as bioregions and catchments (e.g. Creswell & Thackeray, 199#; and the establishment of Catchment Management Committees). The proposal here for a properly audited ecosystem reserve for the grassy white box woodlands may be used as a starting point for an ecosystem, rather than spatial, audit of the entire conservation estate. This need not be limited to fragmented ecosystems, rather, it should be applied to all ecosystems to lead to a comprehensive ecosystem reserve network for Australia.

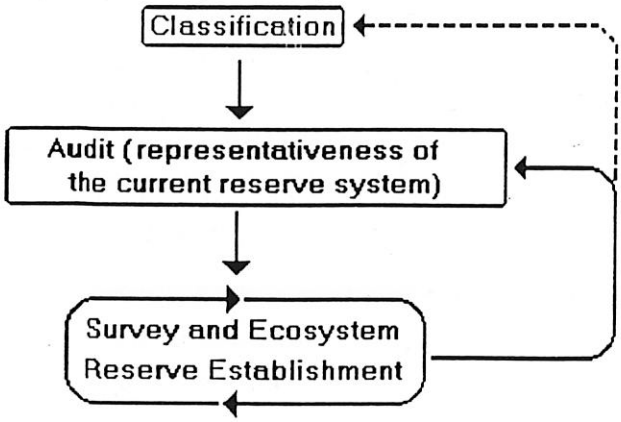
Establishment of a comprehensive ecosystem reserve network could develop in the following way:

1. *Classification.* Define a comprehensive set of ecosystems at an appropriate scale of resolution. The most appropriate classification would probably be based on vegetation communities, at least initially. Defining ecosystems will always be problematical, since few ecosystems have sharp boundaries, and indeed, attempts at such classifications to date have been controversial (Specht *et al.* 1974, Specht *et al.* 1995). It would be important that definitional problems be acknowledged, but not allowed to dominate the process.

2. *Auditing (Phase 1).* Once an appropriate classification has been derived, the current reserve system should be audited for representativeness of the ecosystems. From this audit could be derived a coarse-scale priority list of ecosystems that are clearly under-represented.

3. *Ecosystem survey and reserve establishment loop.* Beginning first with under-represented ecosystems, surveys should be initiated to identify sites of the ecosystem that could be added to the reserve estate. Each ecosystem should be covered by a separate survey team (with provisions for links and formal communication between teams). The work of each team should encompass both survey and reserve establishment phases (a cradle-to-grave approach)

4. *Ongoing auditing.* As ecosystems are progressively covered by survey teams, and ecosystem reserve networks for each ecosystem established, progressive auditing would be needed to test representativeness, and possibly to refine the ecosystem classification.



Spatial and ecosystem approaches to audit and management would not be mutually exclusive. Clearly, each site of a reserve established on an ecosystem basis will have spatial boundaries, and a reserve defined spatially will include one or more ecosystems. Spatial and ecosystem audits, rather, would reinforce each other, and the two systems of audit and management should be established side-by side. For instance, a given National Park may include sites of one or more Ecosystem Reserves. Other sites of the Ecosystem Reserve may be in other National Parks, on other Crown lands, on freehold or leasehold land. Management objectives for the National Park would be informed by management objectives set for each of its included Ecosystem Reserves, and *vice versa*.

References

ANCA (1994) Endangered Species Protection Act 1992: An Outline. Australian Nature Conservation Agency booklet.

Andrews, A. (1920) The First Settlement of the Upper Murray, 1835-1845. D. S. Ford, Sydney.

Australian Heritage Commission (1994) The Register of the National Estate. Australian Heritage Commission leaflet.

Department of Planning (1980) Environmental Planning in New South Wales. A Guide to the Legislation. NSW Department of Planning.

Fenner, F. (ed.) (1975) A National System of Ecological Reserves in Australia. Australian Academy of Science Report No. 19.

Lodge, G. M. and Whalley, R. D. B. (1989) Native and natural pastures on the Northern Slopes and Tablelands of New South Wales. NSW Agriculture and Fisheries Technical Bulletin No. 35.

Moore, C. W. E. (1953). The vegetation of the south-eastern Riverina, New South Wales. II. The disclimax communities. Australian Journal of Botany **1**, 548-567.

Moore, R. M. (1959) Ecological observations on plant communities grazed by sheep in Australia. In 'Series Monographiae Biologicae'. Vol. 8. (Eds. A. Keast, R. L. Crocker and C. S. Christian.) pp. 500-513. Junk, The Hague.

Prober, S. M. (1996) Conservation of the grassy white box woodlands: rangewide floristic variation and implications for reserve design. Australian Journal of Botany **44**, 57-77.

Prober, S. M., and Brown, A. H. D. (1994) Conservation of the grassy white box woodlands: Population genetics and fragmentation of *Eucalyptus albens*. Conservation Biology **8**, 1003-1013.

Prober, S. M., Spindler, L. and Brown, A. H. D. (in prep.) Conservation of the grassy white box woodlands: effects of remnant population size on genetic diversity of the outcrossing, allotetraploid herb, *Microseris lanceolata*.

Prober, S. M., and Thiele, K. R. (1995) Conservation of the grassy white box woodlands: Relative contributions of size and disturbance to floristic composition and diversity of remnants. Australian Journal of Botany **43**, 349-366

Prober, S. M., and Thiele, K. R. (1993) The ecology and genetics of remnant grassy White Box woodlands in relation to their conservation. The Victorian Naturalist **110,** 30-36.

Smart, J. (1993) Conservation Agreements. New South Wales National Parks and Wildlife Service leaflet.

Specht, R. L. (1981) Conservation of vegetation types. In 'Australian Vegetation'. (Ed. R. H. Groves) pp. 394-410. Cambridge University Press, Cambridge.

Specht, R. L., Roe, E. M., and Boughton, V. H. (1974) Conservation of major plant communities in Australia and Papua New Guinea. Australian Journal of Botany Supplement No. 7.

Specht, R. L., Specht, A., Whelan, M. B., and Hegarty, E. E. (1995) Conservation Atlas of Plant Communities in Australia. Centre for Coastal Management in association with Southern Cross University Press, East Lismore, NSW.

Table 1. Existing frameworks for establishing the Grassy White Box Woodlands Reserve, assessed against desirable criteria.

	Level of Protection	Coordinated Management and Links	Flexibility	Allows local tenure and management ?	Inventory and auditing	Generality
Local Environment Plans	High	Poor	Poor-quality sites difficult	Yes	No	State based; any ecosystem
Conservation Agreements	High	Currently Poor	Allows for any appropriate site	Yes	No	State based; any ecosystem
Nature Reserves	High	Poor	Poor-quality sites may be difficult	No	Yes	State based; any ecosystem
Threatened Community Listing (NSW)	High	Good	Allows for any appropriate site	Yes	No	State based; threatened ecosystems only
Endangered Community Listing (Fed)	Low	Good	Allows for any appropriate site	Yes	No	Federally based; threatened ecosystems only
National Estate Listing	Low	Poor	Poor-quality sites difficult	Yes	No	Federally based; any ecosystem
Ideal Ecosystem Reserve	*High*	*Good*	*Allows for any site meeting defined criteria*	*Yes*	*Yes*	*Applicable Australia wide; any ecosystem*

Grassy White Box Woodlands Update Spring 1996

The Project Team

The project team working together to improve conservation of Grassy White Box woodlands comprises

- Jane Elix and Dr Judy Lambert from the consultancy partnership, Community Solutions
- Fred Gulson, Conservation & Resource Management Director, NSW Farmers' Association
- Jamie Pittock, Nature Conservation Manager, World Wide Fund for Nature
- Associate Professor David Goldney, Head of Environmental Studies Unit, Charles Sturt University, Bathurst.

Each of the members of the project team has an ongoing interest in rural nature conservation, but each also brings to the project a different interest and expertise.

Community Solutions works extensively in rural nature conservation and in bringing the views of landholders, conservationists and others to government decision-makers. Community Solutions is undertaking the majority of the actual project work, including the community consultation.

Jane Elix's past experience includes working within the Australian Conservation Foundation to assist in establishing national Landcare, co-authorship of the rural land management study 'Recovering Ground' and representation of conservation views on both the ESD Working Group on Agriculture and the Murray Darling Basin Advisory Committee.

Judy Lambert worked for many years as a research scientist, before moving to fulltime work as an environment consultant to a former Minister for the Environment. She has studied extensively and been closely involved in the development of national and international strategies on biodiversity and in other aspects of rural nature conservation.

Who are we talking to?

Jane Elix and Judy Lambert are interviewing and meeting with a variety of stakeholders including

- botanists, ecologists and other scientists
- public land managers as diverse as Rural Lands Protection Board rangers, local Shire Environmental Management Officers, Officers from the National Parks and Wildlife Service and other government agencies
- groups such as the Roadside Environment Committee
- Landcare and Total Catchment Management groups
- individual landholders
- beekeepers.

Timeline

Early 1997 - follow-up roundtable meetings in each of the three project areas

Fred Gulson is an experienced advocate who joined the NSW Farmers' Association (NSWFA) in 1992. As Director of Conservation & Resource Management, he is closely involved in issues affecting the lives of farmers across the commodity spectrum, and also works with the NSWFA's Conservation & Resource Management Committee, which is headed by Ian McClintock. Fred is also a Board member of Greening Australia (NSW) Inc.

Jamie Pittock trained as an ecologist and has worked with conservation organisations in Victoria and the Northern Territory prior to joining the World Wide Fund for Nature (WWF). As Nature Conservation Manager at WWF, Jamie has both rural nature conservation and biodiversity programs among his responsibilities.

David Goldney is Head of the Environmental Studies Unit at Charles Sturt University's Bathurst campus. Over many years David has combined teaching in environment studies with practical research on species and ecological communities at risk in the Central West. In recent years, David's work, and that of his graduate students has focused on remnant vegetation.

The project team from left Jamie Pittock (WWF), Fred Gulsen and Ian McClintock (NSWFA), Judy Lambert and Jane Elix (Community Solutions)
from NSW Farmers, Vol 3, No 4 May 1996 p 13

Grassy White Box Woodlands Update Spring1996

What are we trying to conserve?

Little-used country cemeteries, railway easements and travelling stock routes contain some of the last fragments of grassy woodlands native to south-eastern Australia. Scientists Suzanne Prober and Kevin Thiele have done a lot of work identifiying important areas where Grassy White Box woodlands remain, and these tend to be scattered along the western slopes of New South Wales.

The White Box trees themselves are becoming less plentiful than in the past, and many of those remaining are mature trees with little or no regeneration. In the past, White Box trees have been cleared for cropping, or have failed to regenerate due to continued grazing (some farmers suggest that sheep have a real taste for White Box saplings). White Box trees are, however, better able to withstand drought than are many other trees found on the western slopes.

But it is not just the trees which are important. The native understorey of Kangaroo Grass, Wallaby Grasses, Snow Grass, and abundant wildflowers such as Yam Daisies and Chocolate Lilies is also part of the whole system.

Beneath this understorey live soil organisms which are essential to productivity. Among the relatively drought resistant native grasses and wildflowers live insects likely to assist in control of other pest species.

Hard to identify

In the first part of this project we have experienced first hand the difficulties in distinguishing White Box trees from other related species, (especially Grey Box). Even experienced botanists have been seen peering towards the high branches of a tree in search of fruit which might confirm for them whether they are looking at a Grey or White Box.

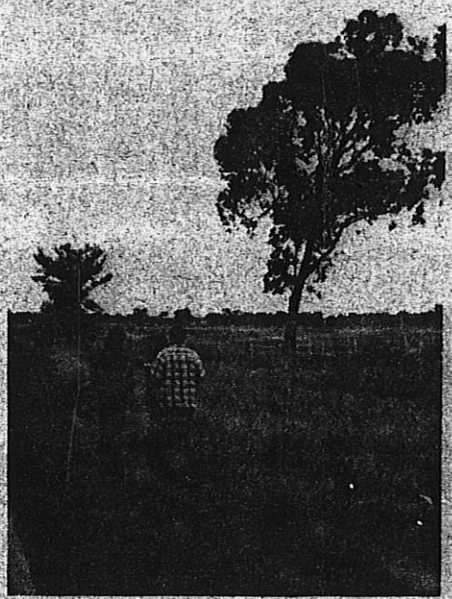
Later in this project we'll be looking at ways to help landholders and others on the western slopes identify any remaining White Box trees. But, in the meantime, it is safe to say that mature White Box have broader leaves than their Grey Box cousins, and their fruits are larger, more plump and often have an almost oily sheen at the base of the fruit cup.

White Box not "sexy"

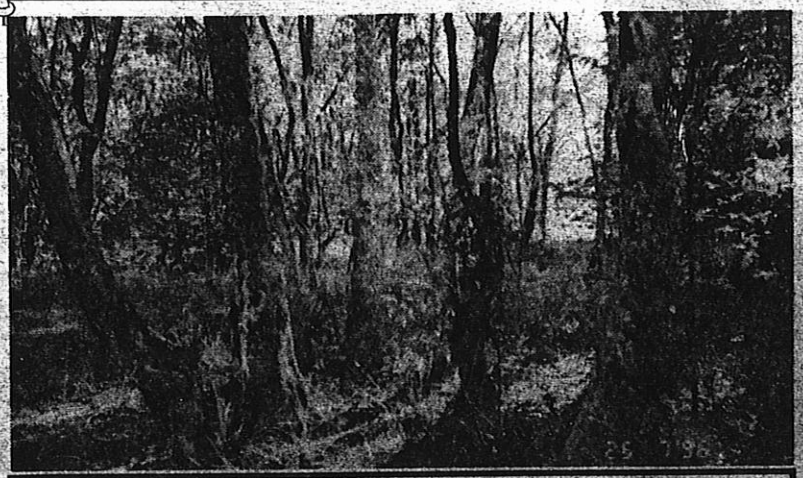
Because White Box trees are still widely scattered across the landscape on the western slopes and are perhaps not as aesthetically appealing as other eucalypt species, they receive little attention and many people are unaware of their plight.

While the White Box tree itself is not endangered, the whole ecological community is rapidly becoming so. Furthermore, White Box trees form an important part of the habitat of the endangered Superb Parrot and Regent Honeyeater.

A pair of Superb Parrots
from Simpson and Day Field Guide to the Birds of Australia, Penguin Books Australia Ltd (1989) p 139



On a field trip, in Lockhart Shire near Wagga Wagga, identifying a lone White Box tree



Intact Grassy White Box woodlands in the Wallabadah cemetery near Tamworth. This area has been fenced out by young people employed under the LEEP program, with the support of the local Quirindi Shire Council

Grassy White Box Woodlands Update

Spring 1996

Grassy White Box woodlands have largely disappeared throughout New South Wales. Although they are an important natural habitat, only small fragments remain on rural properties and on Local Government and other public land, primarily on the western slopes of the state.

Many of these woodlands have been cleared for cropping as they are found on relatively fertile soils. Others have been grazed extensively. Since both the White Box trees and the native understorey (the grasses and other vegetation growing beneath the trees) are sensitive to grazing, to ploughing and to fertilisers, little remains. Scientists Prober and Thiele estimate that as little as 0.01% of White Box woodlands remain in relatively unmodified condition.

A project team has been established to work with rural communities on the western slopes of New South Wales to halt the decline in White Box woodlands. Jane Elix and Judy Lambert from the small consultancy partnership Community Solutions brought together the project team (see box on page 4) to explore incentives and barriers to the conservation of this important ecological community.

This newsletter is the first of several to be produced by the project team during its 15 month long project funded by the Land and Water Resources Research and Development Corporation in Canberra.

Working with the community

All of the work previously carried out by members of the project team, tells us that if we are to make progress in conserving Australia's rich diversity of species and ecosystems, and at the same time address the serious environmental problems facing our rural industries, then we must work collectively to find solutions.

Those who make their living working on the land and others in rural communities often have detailed on-the-ground knowledge. At the same, time our scientists, and in particular ecologists, have an in depth understanding of the complex interactions between plants, animals and the soil, water and nutrient cycles on which they depend.

There are also those in the community who are committed to providing a voice for the environment - the local, state and national conservation organisations.

As our awareness grows about the impacts that activities in one part of a catchment have on other areas, and as the problems of land degradation and loss of productivity also escalate, it is becoming increasingly important that all who have something to contribute come together to provide information and to listen to each other.

Before European settlement, grassy box woodlands covered millions of hectares between southern Queensland and northern Victoria. The woodlands were made up of a number of different eucalypt species, including Yellow Box (Eucalyptus melliodora), Grey Box (Eucalyptus microcarpa) and White Box (Eucalyptus albens) with an understorey of Kangaroo Grass, Snow Grass, Wallaby Grasses and abundant wildflowers such as Yam Daisies and Chocolate Lilies.
Suzanne Prober and Kevin Thiele 1995

Research
Policy Advice
Community Consultation
Organisational Planning
Campaign Strategies
Advocacy

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Grassy White Box Woodlands Update Spring1996

Incentives for rural nature conservation - from theory to practice

During 1994 and 1995, project coordinators Jane Elix and Judy Lambert worked with CSIRO economist Mike Young and the head of the Australian National University's Centre for Environmental Law, Professor Neil Gunningham and others to prepare a national report on incentives for the conservation of biodiversity. This report was commissioned by the Commonwealth Department of the Environment and has been published as a two-volume report entitled 'Reimbursing the Future'.

The report examines the broad range of motivational, voluntary, price-based, property-right and regulatory incentives which might be used for conserving Australia's rich diversity of species and ecosystems.

Recognising that a national system of national parks and other protected areas will not, by itself, be adequate to protect the major ecosystems for which Australia is internationally renowned, 'Reimbursing the Future' brings some order to the complex array of voluntary, educational, monetary and regulatory mechanisms which might help in conserving biodiversity on both public and private land.

Because private landholders are responsible for the management of so much of the land across Australia (more than two-thirds of Australia's land mass - around 500 million hectares), much of Australia's habitat loss has occurred within the agricultural and pastoral lands. At the same time it is becoming increasingly clear that conservation-oriented management has benefits to sustainable agriculture as well as to the broader community.

Among the available incentives for conserving biodiversity, 'Reimbursing the Future' examines

- various aspects of tax policy
- financial assistance through grants, subsidies and rate rebates
- the place of cross-compliance and conditional grants
- a range of property rights, including covenants and management agreements
- voluntary and motivational activities such as Landcare and Land for Wildlife schemes
- information, education, research and monitoring programs
- the role of awards and prizes, and
- enforcement through fines or other mechanisms.

Some conclusions from Reimbursing the Future

- *the importance of our biodiversity and its various components is poorly understood in the community*
- *no single incentive is adequate to ensure the conservation of biodiversity, with more than one mechanism necessary in almost all circumstances*
- *preference should be given to mixes which motivate communities, individuals and industry to conserve biodiversity, with less interventionist measures being preferred over more interventionist ones*
- *while individuals benefit directly from some aspects of biodiversity conservation and should reasonably be expected to pay for those, the whole community also benefits and must contribute its share*
- *regulatory incentives provide an essential safety-net to protect against the few who are not persuaded by other measures and to avoid losses which are irreversible*
- *the precise nature of the mix of incentives used for a particular purpose will depend on the suite of environmental and resource management problems being addressed at the time.*

From theory to practice

However, 'Reimbursing the Future' was very much a national (and therefore, of necessity, a theoretical) study which looked at the conservation of biodiversity in areas as diverse as Australia's ocean fisheries, semi-arid rangelands, and the wheat-sheep belts of Western Australia and the Macquarie Marshes in New South Wales.

Now, Community Solutions has brought together a team of people interested in working with landholders and land managers responsible for on-the-ground management of remaining grassy White Box woodlands. Our aim is to determine the most practical and appropriate incentives for the conservation of these disappearing communities.

* Written by MD Young, N Gunningham, J Elix, J Lambert, B Howard, P Grabosky and E McCrone. 'Reimbursing the Future' is available from the Commonwealth Biodiversity Unit, Department of the Environment, Sport and Territories, Canberra.