Report from
Parks, Conservation and Lands

to the

ACT Commissioner for Sustainability and the Environment

for the

INQUIRY INTO MANAGEMENT OF LOWLAND NATIVE GRASSLANDS

Parks Conservation and Lands
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1 Background - the grassland inquiry

An inquiry is being conducted into the management and protection of lowland native grasslands by the ACT Commissioner for the Environment and Sustainability under the following terms of reference:

1. Review existing management arrangements and if necessary, identify comprehensive conservation management principles and immediate actions to ensure the protection and long-term sustainability of native lowland grasslands and their vulnerable ecosystems.

2. Identify the causes of the deterioration of lowland native grasslands. In doing this, the impact of eastern grey kangaroos, both in the long and short term, is to be explicitly addressed.

3. Identify any impediments to implementing short and long-term management practice for conservation of lowland grasslands within the ACT. In doing this, identify any deficiencies (including development controls, data collection, monitoring and reporting programs) which need to be remedied to further protect native lowland grasslands, their vulnerable ecosystems and associated fauna adequately.

4. Identify ways for ensuring effective communication with stakeholders, whose actions potentially, indirectly or directly, affect threatened grasslands.

5. Determine whether any policy or legislative changes are needed for the protection of threatened lowland native grasslands.

Particular grassland sites identified by the Commissioner are those at Majura, Belconnen, Jerrabomberra and Gungahlin.

Following release of the above terms of reference, the Commissioner sought clarification from the Minister regarding the scope of the investigation, in particular with regard to the Grassland Earless Dragon, the Striped Legless Lizard and the Golden Sun Moth, which are well known examples of several species whose survival is dependent on the protection of the remaining grassland fragments. The Minister for the Environment and Climate Change in a letter dated 29 November 2007, stated that the:

investigation of Lowland Native Grasslands includes their associated threatened communities and species, as well as threats to, and identification of measures for protecting, these and other species are an inherent part of the terms of reference.

This report has been prepared by Parks Conservation and Lands, the part of ACT Government responsible for (among other things) management of conservation reserves such as Namadgi National Park, and for management of populations of wild plants and animals in the Territory. The submission includes background material for the Commissioner’s consideration, and advice in relation to the terms of reference.

2 Topical aspects of grassland ecology

2.1 Species going and gone: how the threat of extinction is operating now

A number of species are now missing from the grassy ecosystems of the Southern Tablelands. The best known example is probably the Australian bustard, which declined because it was conspicuous, common near Canberra (Frith 1969) and a favourite target of European hunters. The brolga is another example, which was shot as a pest by settlers. With the exception of such large and easily identified animals it is difficult even to ascertain which species have been lost. Small hopping animals, referred to as 'rat-kangaroos', were so abundant in historic times that a bounty was paid for their scalps (Schumack and Schumack 1977). They were probably bettongs - one or more of the three likely species, but at present even their identity is unknown.

Significantly, the major mammalian predators have been removed from the grasslands. Thylacines and Tasmanian devils disappeared from mainland Australia approximately at the same time as the dingo arrived, and the dingo disappeared from lowland areas of the ACT following the arrival of sheep graziers (the dingo remains a significant predator of kangaroos, other native mammals, and feral animals, in parts of Namadgi National Park). A number of other grassland plant and animal species have also disappeared from the Southern Tablelands in response to human-induced changes. The species most likely to disappear next are those that have been declared threatened (i.e. either 'endangered' or 'vulnerable') with extinction.

Extinction typically has multiple causes. Natural temperate grassland (NTG) has been subjected to three extinction processes, namely alienation, fragmentation and degradation. These three processes are subdivided into their component activities in later sections of the submission.

- Alienation is the most serious of the three threats, meaning conversion from NTG to other uses such as housing, infrastructure or cropping. Examples where this is occurring, or proposed, are given in later sections.

- The fragments of NTG that have so far survived alienation are subject to ongoing effects of former fragmentation (explained below), and planned development will result in further fragmentation.

- Degradation refers to the effects of processes operating within a fragment, which reduce its conservation value, including weed invasion, over grazing, excessive mowing, fertilizer application, activities of feral animals, etc.

It is worth outlining the key steps of habitat fragmentation and small population size in the process leading to extinction. For many species, the quality of habitat is not uniform across the species' range. Individuals occupying higher quality habitat areas will breed succesfully more often than those in poorer quality habitats (which might breed only in years when environmental conditions are favourable). In very poor (or 'marginal') quality habitats, there might be sufficient resources for individuals to live, but not to successfully breed. Thus habitats can be 'source' (breeding and dispersal) or 'sink' (populations maintained by immigration from better habitats). In very poor years (such as drought), the species may not be able to survive in the lower quality or marginal habitats, and thus the range of the species

in these years contracts to the higher quality habitats. Higher quality habitat that serves as 'drought' refuges are critical to a species' long-term existance. When favourable conditions return, poorer quality habitats are recolonised through dispersal from better quality habitats. Similarly, wildfire or disease can affect populations at a local level and can evan cause extinction of local populations (for example, loss of all individuals in a burnt area). These areas may be recolonised by individuals dispersing from nearby populations (known as the 'rescue effect'). Thus, extinction of local populations is not of critical importance to the species as a whole when populations are widespread and well-connected across the landscape, because areas can be recolonised. The 'rescue effect', drought refuges, source/sink populations and other ecological principles are part of Metapopulation Theory.

Numerous ecological studies and ecological theory indicate that when habitat is reduced in area and fragmented into small disconnected patches, the small populations of animals and plants dependent on that habitat face a higher risk of extinction, even when the reason for their initial decline (such as habitat clearing) has ceased. The fragmentation / small population steps in the extinction process are outlined in Figure 1. There are two main factors involved:

(a) Firstly, following loss and fragmentation of habitat, some or all of the remaining habitat patches by chance might not be high quality. Compared to individuals in high quality habitats, individuals in poorer quality habitats are likely to have lower survival and breeding rates and be more suceptible to any disturbance (natural or human-indiced) that results in less favourable conditions. The probability of survival in marginal habitats during poor years might be low, particularly with additional disturbance such as wildfire, overgrazing or higher predation rates.

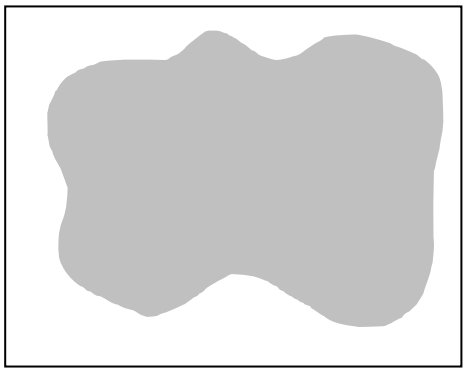
(b) Secondly, small populations (whether they are in good or poor habitats) are inherently more 'fragile' than large widespread and well-connected populations because they are now suceptible to a range of environmental events such as wildfires and local drought, as well as a number of other problems that affect small populations such as demographic stochasticity and genetic problems (such as genertic drift and inbreeding), which further exacerbate their predicament. Once an *isolated* local population becomes extinct, it is unable to be 'rescued' (recolonised) by other populations. The inherent vulnerability of small populations to extinction has been termed the 'small population paradigm' and the process of extinction by which species are reduced to small, vulnerable, isolated populations that then become extinct one-by-one has been called 'the extinction vortex' (see Caughley and Gunn 1996, and Caugley and Sinclair 1994 for some species case histories and summaries of ecological theories).

As a result of historical (and more recent) clearing and fragmentation, and the vulnerability of small populations, natural temperate grassland is an ecological community in dire straits and the most endangered ecological community in Australia with less than 1% remaining (Kirkpatrick et al. 1995). This grassland community now consists of highly fragmented and isolated small patches, with very few remaining patches greater than 100 ha. Many plant and animal species are found only in these native grasslands and are wholly dependent on these remnant patches for their survival. These species have become threatened as a direct consequence of the loss, degradation and fragmentation of native grasslands. Because the remaining patches are small and isolated, the small populations of threatened species within these patches are highly vulnerable to extinction. And because such small populations are inherently more 'fragile' than large populations, any disturbence or factors that lead to less favourable conditions for these species are likely to increase the risk of extinction.

ACT Government ecologists studying the biology of threatened lizards in these grasslands believe that maintaining adequate grass cover is important to (a) minimise predation on these lizards (which are cryptic and rely on camoflage whilst sheltering in grass tussocks) and (b) to provide an adequate invertebrate food resource. A grass sward supports a diversity of invertebrate herbivores (such as beetles, grasshoppers and crickets that eat the grass sward) which then support invertebrate predators (such as spiders and ants), all of which are a food resource for lizards. If the grass sward is almost completely removed, much of the invertebrate biomass (and food source for lizards) dependent on this grass sward also disappears. Therefore, ACT government ecologists are of the opinion that removal of most of the grass sward, particularly during periods drought when environmental conditions are already unfavourable for these lizards, is a habitat disturbence that will increase the risk of local extinction of these populations. The same reasoning applies to other grassland-dependent fauna such as the Golden Sun Moth (whose larvae eat native grass species) and the perunga grasshopper (whose adults eat native grasses and rely on grass cover as protection from predators).

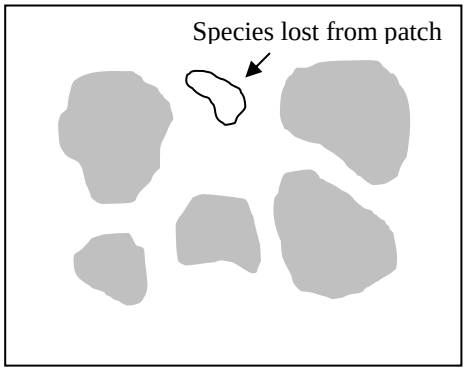
The conservation of some of the remaining species of the natural temperate grassland will need to be given exceptional priority if those species are not to follow the others which have previously disappeared. The remaining fragments of natural temperate grassland deserve special conservation protection. In general, management should be conservative. Extremes of fire frequency, mowing, and grazing pressure, should be avoided, and management changes should be undertaken cautiously.

Figure 1 Diagram of the fragmentation process of species extinction

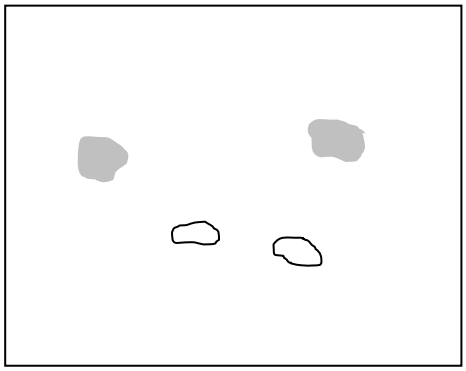


HABITAT

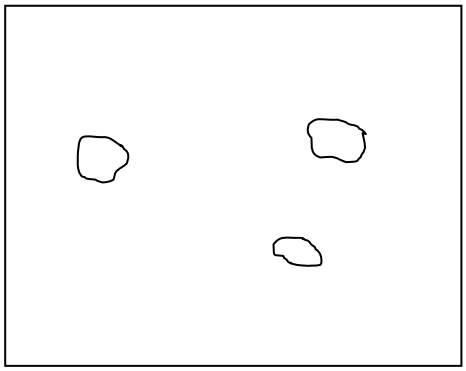
Widespread and connected. Populations inherently robust to disturbence.



Fragmented large and small patches, limited connectivity. Small populations inherently vulnerable to local extinction. Species lost from smaller isolated patches.



Further loss and fragmentation resulting in smaller and fewer patches, isolated, species lost from many patches.



Fewer isolated small patches, species lost from all patches.

SPECIES STATUS

Widespread and abundant

Less abundant

Uncommon

Rare and restricted distribution

Threatened (vulnerable)

Threatened (Endangered)

Threatened (Critically Endangered)

Extinct

2.2 Ecosystem function, keystone species, and ecosystem engineers

Clearing of natural vegetation (habitat) is the main cause of decline and loss of species (including the loss of 99% of NTG). Ecologists have stated that, in some situations, continued grazing by high numbers of kangaroos can also pose a threat to native ecosystems. At first glance this concept sounds counter-intuitive – how can one native species (such as a kangaroo) pose a threat to another native plant or animal when both have occupied the same ecosystem for a long time? The Commissioner has asked for an answer to be provided to this question.

The species in an ecosystem can be categorised into 'trophic levels'. The lowest tropic level comprises the plant (or 'producer') species, which supports the next level (the herbivore or 'consumer' species), which in turn supports the predator trophic level at the top of the trophic pyramid. An understanding of trophic levels is important for conservation management because the main flows of energy and material which enable an ecosystem to persist in a particular form occurr between, not within, trophic levels. If all the species comprising a trophic level were to be removed, the ecosystem is likely to function very differently (and look very different), whereas removal of one species whilst leaving many others in a trophic level may not greatly alter ecosystem function. Some important ecosystem processes are 'top-down' (originating at the predator trophic levels) such as dingoes preying on kangaroos, which in turn affects the extent to which plants are grazed. Other processes are 'bottom up' (originating in the producer trophic level), such as plant growth limiting numbers of hrbivores such as kangaroos.

The concept of trophic levels relates to kangaroos and grassy ecosystems in two ways. Firstly, in natural conditions eastern grey kangaroo populations in natural temperate grasslands are responsible for almost the entire function of the herbivore trophic level. Where the grasslands are used for agriculture, introduced livestock replace kangaroos. Native grasslands have evolved under grazing and ecologists studying native grasslands consider removal of the herbivore trophic level altogether (that is, no grazing at all) to be detrimental to these grasslands. Thus native grassland lightly or moderately grazed by kangaroos (or livestock) in general will be in better condition than a native grassland that is not grazed for a long time. Secondly, the predator trophic level in Australia (and particularly in the ACT) has been largely removed. Neither Thylacines, Tasmanian devils, dingoes, Aboriginal hunters, nor European hunters now remain to regulate the abundance of kangaroos in lowland grassland and woodlands (although there are exceptions in some parts of Namadgi National Park where dingoes still occur).

In ecosystems around the world the loss of the predator trophic level is frequently of profound importance to an ecosystem. In Australia, research has shown that dingoes are capable of having major effects on kangaroo abundance (Caughley *et al*. 1980, Shepherd 1981, Thompson 1992) and have on occasions even extirpated entire populations of eastern grey kangaroos (Robertshaw and Harden 1989). Thylacines and Tasmanian Devils may well have had a similar effect prior to the arrival of dingoes on the Australian continent. Shooting by modern humans can also have strong effects on kangaroo density (ACT Kangaroo Advisory Committee 1997) in that the abundance of eastern grey kangaroos on rural properties in the south east region has been estimated at 11 per square kilometre (Cairns 2004) and 50 per square kilometre in some parts of the ACT (ACT Kangaroo Advisory Committee 1997),

compared to densities of 450-510 per square kilometre in the grassy valleys in ACT reserves and national parks (Fletcher 2006a, 2007a) where regular shooting does not occur.

Because eastern grey kangaroos comprise almost the all of the herbivore trophic level for natural temperate grasslands, their effect on the ecosystem function of grasslands can be profound. For this reason they have been labelled both 'keystone species' and 'ecosystem engineers' (Fletcher 2006a). The first label refers to the finding that it is desirable to have a large grazing mammal (kangaroo) as part of the ecosystem to avert the risk of a cascade of plant species being extirpated from a site. This point is expanded in the next paragraph. The second label refers to the finding that grazing by large numbers (high density) of kangaroos can also have a profound effect on whether other species can persist on a site, such as ground frequenting birds (Neave and Tanton 1989). In the latter study, kangaroos were found to be much more significant grazers than rabbits and reduced the vegetation to such a degree that ground nesting birds could not persist. This also appears to be the case for Majura Training Area, where heavy grazing in drought conditions removed almost all of the grass and the local population of grassland earless dragons plummeted, while dragon numbers remained high in a nearby valley at site that was lightly grazed and retained substantial grass cover.

Keystone species are those species whose presence or activities enable other species to also exist. Plant species in grasslands have a range of growth forms (e.g. tall tussocks, rosette forming flowers, tiny herbaceous species). This structural variation provides habitat for a variety of plant and animal species. But in the absence of some form of herbage reduction (grazing, mowing or burning) the dominant grasses can become large and dense to the extent that many other plants species are out-competed and disappear, reducing the natural diversity of plant species in the grassland. Prior to the introduction of agricultural practices it is likely that the herbage was reduced by kangaroo grazing and burning. Since the 1820s these practices have largely been replaced by domestic stock grazing, rabbit grazing and slashing, though some areas formerly grazed by stock have returned to kangaroo grazing. The effect of long-term herbage reduction is demonstrated in a large grassland exclosure thatexcludes grazing in Namadgi National Park where only seven plant species persist, compared to 32 species in the grazed area immediately outside the exclosure. Removal of some of the herbage mass appears to be a major requirement to maintain plant species diversity and can be done by mowing, burning or grazing by livestock or kangaroos. However, the selective grazing of kangaroos is different to that of livestock and so on a long time scale (tens to hundreds of years) it seems likely that kangaroos grazing is preferable to livestock grazing.

Over the past 200 years many ecosystems have been altered to the extent that they no longer retain all of the 'natural' (or pre-european) ecological processes. In fully-functioning (pre-european) ecosystems with the full compliment of co-evolved species whose populations are widespread and well-connected, it is highly unlikely that one native species could cause the extinction of another native species. Even if a particular area was heavily grazed during drought resulting in the local loss of a native species, that area could eventually be recolonised from surrounding populations during more favourable years (which is often not possible in fragmented ecosystems and so a local species loss may mean extinction from that fragment). There are numerous published examples which show that when ecosystem processes become 'unbalanced' through human-induced changes (such as clearing and fragmentation) one native species can pose a threat to the existence of other native species. A previously mentioned example is the extirpation of populations of eastern grey kangaroos through predation by dingoes. Other examples include high-density populations of eastern grey kangaroos (where predation has been removed) grazing grasslands to low levels that

prevented certain native grassland bird species from occupying these areas. The dramatic increase in white-tailed deer populations in some areas of north-America followed the suppression of natural deer predators (bears and wolves), which has resulted in grazing impacts on native plant communities. Another example of the effects of reducing natural predation is the reduction of predation by coyotes on skunks, raccoons and opossums, which lead to an increase in predation by these species on certain bird species (this effect is known as Mesopredator release'). The reduced effect of coyotes on the raccoons, opossums and skunks is due to habitat fragmentation. The coyotes require larger areas than do the raccoons, skunks and opossums, so the impacts of the three nest-predator species in small fragments are not controlled by coyote predation. An example well known to many Canberrans is the increased nestling predation on smaller native birds by pied currawongs, which normally migrate annually to the coast for winter and spring but are now resident in the city year-round, probably due to planted fruit trees (such as Cotoneaster) and urban warming. Aggressive or predatory bird species such as noisy miners and currawongs prefer the edges of woodlands and forests to their interior and so have been favoured by fragmentation of these vegetation types (small patches have more edge for their area), which has caused the decline of smaller native bird species through competition or nestling predation. In some cases, noisy miners have agressively excluded small insectivorous birds normally inhabiting woodland and forest patches, which in turn has resulted in tree die-back of these patches from insects. The most authoritative recent book on wildlife damage control (Hone 2007) states that native species can have undesirable effects on other native species, requiring management intervention for conservation, and draws attention to the many examples reviewed by Goodrich and Buskirk (1995) of native species impacting other native species.

2.3 Carrying capacity

In common with many debates about overgrazing, the recent debate about kangaroo culling involved the notion of 'carrying capacity' for kangaroos of grassland sites such as Belconnen Naval Transmitting Station and Majura Training Area. It is clear that carrying capacity means different things to different people. For some people it means the number of kangaroos in an area where no shooting occurs. For other people it is the value recommended for local grazing land by regional NSW Rural Lands Protection Boards (RLPB), which is usually expressed in terms of Dry Sheep Equivalents (DSE). Sheep numbers will naturally increase to above the recommended DSE and so farmers keep the flock size at or below it by selling sheep at the market. Similarly, kangaroo numbers will naturally increase and eventually exceed the recommended DSE and so shooting (or some other population control method) would be needed to keep numbers below this DSE value.

In ecological terms, Carrying capacity has been defined and described best by Caughley (1979). His figure 4 is reproduced below, with the points for 'no herbivores' and 'long-grass-reptile carrying capacity' added here to his figure. The caption is based on his text.

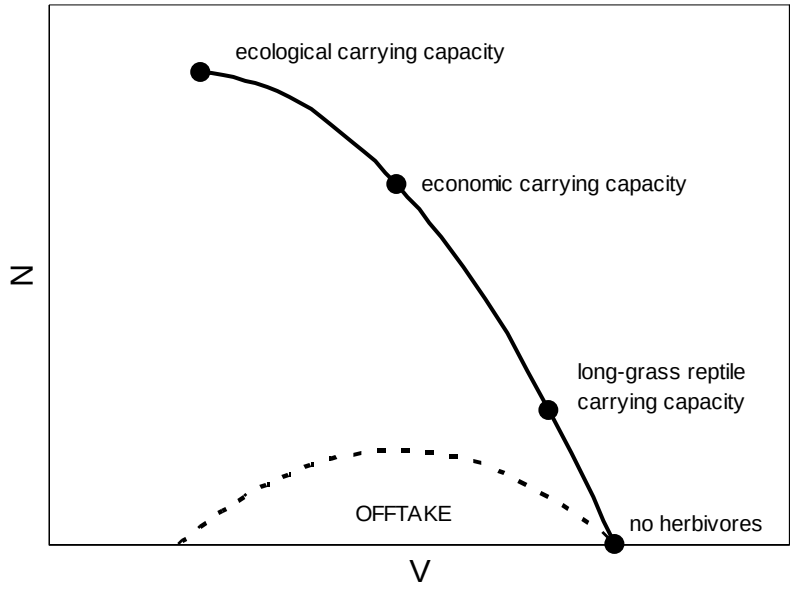


Figure 2: The solid line represents the zero isocline of vegetation (V), marking the position of all possible equilibria between plants and herbivores (N). The dashed line indicates the level of harvesting required to achieve the corresponding equilibrium. Based on Figure 4 in Caughley (1979).

In Figure 2, the bottom left corner is the zero point for number of herbivores (N) and amount of vegetation (V). The number of herbivores increases towards the top and the amount of vegetation food increases to the right. The upper point (ecological carrying capacity) is the point that will eventually be reached by any herbivore population that is not limited by predation or other form of control (shooting) and represents the limit of the growth rate of the population due to a limit in food resources (growth rate of the vegetation). A farm with livestock in this position would be considered to be 'overgrazed' and livestock would be suffering because of the starvation which brings about that equilibrium.

The 'economic carrying capacity' shown in Figure 2 is the position of maximum sustainable yield (the peak of the dashed line), the level of animals where the offtake is maximised – i.e. the maximum culling rate. In the real world, it is wiser to farm slightly down the curve from that position. How far down depends on extraneous factors such as the economic 'risk taking' behaviour of the farming community, the predictability of the local rainfall and the tolerance of bank managers. This is the 'carrying capacity' of interest to RLPBs and the farming community generally. It has nothing to do with wildlife management, except if the goal is to maximise the long-term profit from harvesting the animals.

'Long-grass-reptile carrying capacity' represents a point on the herbivore-vegetation curve where the amount of grass higher than the economic or carrying capacity points, but at which some grazing still occurs to maintian grassland condition. This point has a low harvesting/culling rate – just sufficient to prevent the herbivore population increasing from a level which is suited to a plant or animal species which happens to be favoured by light grazing.

3 Grassy ecosystems of the ACT lowlands

Throughout much of temperate Australia, grassy woodlands and natural temperate grasslands (NTG) occur side-by-side in the landscape. The treeless grassland areas resulted from the effects of cold air draining at night from higher areas. The low temperatures prevented the germination and maturation of woody vegetation. Woodlands occur at slightly higher elevation than the grasslands and merge with them. It is desirable to maintain connectivity between these two ecosystems where they occurr together and it is appropriate to consider their management collectively. It is the ground layer of vegetation which determines the significance and condition of both communities, and it is the ground layer where eastern grey kangaroos, the primary native herbivore, have an influence.

It is likely that the grassland and woodland communities were important to Aboriginal people, producing a high proportion of the plant protein in their diet. The grassy communities also proved highly attractive to Europeans. Early in the 19th century the large grassy, treeless plains and grassy woodlands attracted European settlers intent on establishing pastoral properties. As a consequence of European land use, both woodlands and grasslands have been degraded to varying degrees by tree clearing, intense grazing pressure, introduced plants and animals, addition of fertiliser and ploughing. In recent decades suburban development has led to a reduction in the extent of woodlands and grasslands in and around Canberra leading to both woodland and grasslands ecosystems and several associated species being threatened with extinction.

The floristic integrity of these grassy ecosystems compared with their pre-1750 status is unknown. However, surveys have shown that many of the remaining remnant patches in the ACT are floristically and structurally diverse and provide irreplaceable habitat for the survival of a number of flora and fauna species. Despite fragmentation and degradation there also remain nationally important corridors of woodland, particularly across northern ACT and from north to south on the eastern side of the ACT. The Majura and Jerrabomberra valleys retain large areas of native grassy ecosystems in varying degrees of condition, including links between grassland and woodland, which provide significant habitat for native species and possibilities for animal movement.

3.1 Lowland grassy woodlands in the ACT

The distribution of lowland woodland in the ACT is in a north-south pattern along the hills and ridges that flank the urban and rural areas of the Territory. They include Yellow Gum – Red Box Grassy Woodland (YBRG) (endangered in the ACT and critically endangered nationally) which occur at an altitudinal range between 600–900 metres. The woodland alliance addressed in this submission is primarily the threatened YBRG woodland, although other lowland woodland communities frequently provide habitat for woodland threatened species, which are a part of the inquiry. Secondary grassland, which is woodland that has been cleared of trees, is also identified.

Of its pre-1750 cover, 38% of YBRG woodland remains in the ACT. While the remaining lowland woodland area in the ACT is not large (12 000 ha), a much higher proportion is relatively intact than is the case in NSW or nationally. The regional extent of this ecological community is not readily quantifiable because available information is incomplete. However, it is estimated that White Box/Yellow Box/Red Gum grassy woodland occurring in NSW has been reduced to less than 10% of its pre-European extent. The ongoing protection and

management of the remaining areas of woodland is important for the long-term survival of this ecological community and associated species, particularly a number of threatened and declining species that depend on these habitats.

More detailed information about the management of the flora and fauna of the ACT's woodlands is provided by Action Plans 27 and 28 (ACT Government 2004, 2005).

3.2 Lowland native grasslands

Natural Temperate Grassland (NTG) is recognised as a threatened ecological community wherever it occurs in south-eastern Australia. Natural Temperate Grassland of the Southern Tablelands of NSW and ACT has been declared endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and is listed as endangered in the ACT.

The ACT has approximately 1000 ha (10 sq km) of natural temperate grassland, which is 5% of its estimated original extent. Less than 1% of this community remains nationally. Sites containing this community exist only as small remnants (sometimes less than one hectare, seldom more than 100 hectares). They are highly fragmented and to some extent degraded, as a result of modification by agricultural use, urbanisation and infrastructure development. The natural temperate grasslands contain a number of dependent threatened species. Sites which were of the same origin but which are now somewhat more degraded floristically, are classified as 'native pasture' (NP). They are dominated by native grasses, and retain some native forbs, but no longer have the floristic diversity of sites that are classified as true natural temperate grassland sites. It is important to recognise that many of the NP sites contain populations of threatened species. Map 1 shows the location and extent of the Lowland NTG and NP sites in the ACT.

Lowland Native Grasslands have been assessed on the basis of their conservation value (ACT Government 2005). The sites that are identified as having the highest conservation value (Conservation Category 1, or Core Conservation Sites) represent the core group of areas needed to ensure conservation of the best quality natural temperate grassland and the major habitats for threatened grassland species. They warrant the highest level of protection. Sites in this category meet the following criteria:

- High botanical significance rating (BSR of 1 or 2) but may contain or adjoin areas of lower rating; or
- Key threatened species habitat; or
- Large sites (more than 100 ha) with a BSR of 3.

Map 2 shows the location and extent of the Category One, Two and Three grassland conservation sites. (Categories Two and Three are explained below.)

The core conservation sites (Category One) and, where relevant, their current protection status are:

1. Dunlop Grassland Nature Reserve (81.9 ha): Nature Reserve
2. Mulanggari Grassland Nature Reserve (68.5 ha): Nature Reserve
3. Gungaderra Grassland Nature Reserve (187.3 ha): Nature Reserve
4. Crace Hill Grassland Nature Reserve (136 ha): Nature Reserve

5. Future Jerrabomberra West Nature Reserve ('Woden Station') (116.9 ha) Planned Nature Reserve
6. Possible Future Jerrabomberra East Nature Reserve('Woden Station' east) 70 ha) Planned Nature Reserve
7. Majura West (133.3 ha). Contiguous with Campbell Park (proposed for reserve)
8. Belconnen Naval Transmitting Station (Designated land) (120.3 ha); proposed for reserve
9. Harman-Bonshaw South (105.7 ha) (Designated land)
10. Harman-Bonshaw North (114.6 ha) (Designated land)
11. Majura Valley East (Majura Training Area) (126.6 ha) (Designated land)
12. Campbell Park (11.7 ha): designated land
13. Isabella Pond, Monash (1.2 ha): urban open space
14. Caswell Drive (5.8 ha): rural lease
15. Glenloch Interchange (2.2 ha): urban open space
16. Australian Centre for Christianity and Culture, Barton (1.9 ha): National land, leased
17. 'Callum Brae' lease 162.7 ha: Planned nature Reserve, rural lease
18. Majura Valley East (Air Services Beacon) (10.7 ha). Contiguous with Majura Training Area grassland.
19. Majura Valley East (Airport) (203.6 ha). Contiguous with MajuraTraining Area; some of this area has been built on since the Grassland Conservation Strategy was published.

The list above demonstrates the efforts made by the ACT Government to protect natural temperate grassland on land under its jurisdiction, by declaring significant areas as nature reserve. It also indicates the importance of Designated / Commonwealth land, particularly Defence and airport land, for the protection of large areas of grasslands. Of particular note is the large area contained at Canberra Airport and its vulnerability due to its lack of protection and private ownership. Other areas of highly modified native grassland also remain, and while they have lost a significant level of diversity, they provide habitat for grassland species such as the Grassland Earless Dragon and the Striped Legless Lizard. Larger sites of NTG are often surrounded by 'native pasture' that provides extensive and important habitat for threatened species.

Sites in Conservation Category 2 (Complementary Conservation Sites) are characterised by having a lower floristic diversity, but may support populations of threatened species. While not considered 'core' habitat, their retention is important to ensure the conservation of the species and community, and are important for connecting higher quality areas. These sites are typically smaller, and/or with smaller populations. Such remnant sites typically occur on roadsides, in cemeteries, on crown reserves, travelling stock reserves and areas that have been set aside for other land uses. Sites also still exist on rural land subject to grazing.

There is also a number of very small grassland sites in and around Canberra that fall under the jurisdiction of either the ACT (rural lease, rural agistment, unleased land including urban land) or the Commonwealth e.g. National Capital Authority, CSIRO or Defence. A high proportion of these sites contain threatened species, in particular the Golden Sun Moth and Button Wrinklewort. Some of these sites, despite their small size, are identified as core conservation sites (e.g. St Mark's Grassland, Barton, a site leased by the Anglican church).

Table 1 lists all the lowland native grassland sites in the ACT, their size, botanical significance, conservation category, and threatened species they contain. Map 3 shows the land tenure of the remaining areas of natural temperate grassland and native pasture.

Table 1. Native Grassland in the ACT: List of sites grouped by land use and Conservation Category. See also maps 1 – 3.

Name of site	Site No.	Land use	Area (ha)	Grassland type	Area (ha)	BSR	Thr. Spp	Cons'n Cat.
Crace Nature Reserve	GU03	Nature Reserve	136.0	NTG NP EP	61.5 41.1 33.3	3(5)	BW SLL PG	C1
Gungaderra Nature Reserve	GU02	Nature Reserve	187.3	NTG NP EP	41.9 115.2 30.2	5(2,4)	SLL KS PG	C1
Mulanggari Nature Reserve	GU01	Nature Reserve	68.5	NTG NP EP	58.6 9.4 0.5	2(3)	GSM PG SLL	C1
Dunlop Nature Reserve	BE02	Nature Reserve	81.9	NTG	81.9	3(2)	GSM	C1
Jerrabomberra West Reserve	JE03	Nature Reserve	116.9	NTG NP	115.2 1.7	3	AP GED GSM PG	C1
'Callum Brae' *	JE02	Nature Reserve, Rural lease	162.7	NP	162.7	5	GED GSM	C1
Jerrabomberra East Reserve	JE05	Nature Reserve	72.0	NTG NP EP	62.2 7.8 2.0	4(3)	GED GSM PG	C1
'Mugga Mugga' Homestead	JE01	Special Purpose Reserve	15.0	NTG	15.1	4(3)		C2
Air Services Beacon	MA02	Airport Services Australia (Designated Area)	10.7	NTG	10.7	2(4)	GED GSM PG SLL	C1
Canberra International Airport	MA03	Canberra International Airport (Designated Area)	203.6	NTG NP EP	73.6 62.9 67.1	3(1,2,5)	GED GSM PG	C1
Majura Training Area	MA01	Dept. Defence	126.6	NTG NP EP	113.7 5.8 7.1	2(1)	BW GED GSM PG SLL	C1
Campbell Park	MA05	Dept. Defence	11.7	NTG EP	10.9 0.8	3(2)	BW GED GSM PG SLL	C1
Harman Bonshaw North	JE07	Dept. Defence, Rural lease	114.6	NTG NP	46.3 68.3	5(4)	GED SLL	C1
Harman Bonshaw South *	JE06	Dept. Defence, Rural lease	105.7	NP	105.7	5	BW SLL PG	C1
Belconnen Naval Transmitting Station	BE08	Dept. Defence (proposed reserve)	120.3	NTG	120.4	2(3,4)	GSM LG PG SLL	C1
'Malcolm Vale' *	MA04	Dept. Defence	155.4	NP	155.4	5	GED	C2

Name of site	Site No.	Land use	Area (ha)	Grassland type	Area (ha)	BSR	Thr. Spp	Cons'n Cat.
CSIRO Headquarters, Campbell	CC01	CSIRO	3.0	NTG	3.0	3	GSM	C2
Ginninderra Experimental Station	BE01	CSIRO	19.4	NTG EP	18.9 0.5	4		C2
Lady Denman Drive, Yarralumla	CC07	Roadside	0.4	NTG	0.4	3	GSM	C2
Woods Lane	JE04	Roadside	10.3	NTG	10.3	3	BW	C2
Wells Station Road	GU07	Roadside	0.2	NTG	0.2	4		C3
Kama South	BE12	Rural (agisted) (proposed reserve)	38.5	NTG	38.5	2		C1
Tennant St, Fyshwick	JE10	Rural (agisted)	0.3	NTG	0.3	3	BW	C2
'Jarramlee'	BE03	Rural (agisted)	52.0	NTG	52.0	4(3)		C2
Kaleen east paddocks	BE09	Rural (agisted)	28.2	NTG NP	4.0 24.2	5(3)		C3
Lawson Territory	BE07	Rural (agisted)	59.2	NTG NP EP	3.3 46.9 9.1	5(3)		C3
Majura West *	MA06	Rural lease (proposed reserve)	133.3	NP	133.3	5	SLL	C1
Caswell Drive	BE10	Rural lease	4.8	NTG	4.8	2		C1
'Cookanalla' *	JE08	Rural lease	81.5	NP	81.5	5	GED	C2
Belconnen Pony Club	GU06	Rural lease	0.3	NTG	0.3	4		C3
Glenloch interchange	BE11	UOS	2.2	NTG	2.2	2		C1
Isabella Pond, Monash	TU01	UOS	1.2	NTG	1.2	2		C1
North Mitchell	GU04	UOS	15.9	NTG EP	15.8 1.2	3(4)	SLL	C2
Black St, Yarralumla	CC11	UOS	3.6	NTG	3.6	3	GSM	C2
Constitution Ave, Reid	CC02	UOS (Designated Area)	0.7	NTG	0.7	3	GSM	C2
Dudley St, Yarralumla	CC08	UOS	2.2	NTG EP	1.5 0.7	3	GSM	C2
Yarramundi Reach	CC06	UOS (Designated Area)	21.2	NTG	21.2	4(3)	GSM SLL	C2
York Park, Barton	CC05	UOS (Designated Area)	0.4	NTG	0.4	4	GSM	C2
Umbagong Park South, Florey	BE04a	UOS	2.8	NTG	2.8	3		C2
Lake Ginninderra	BE06	UOS	1.9	NTG	1.8	3		C2
Umbagong Park North, Florey	BE04b	UOS	12.7	NTG NP EP	7.2 1.8 4.7	4(5)		C3
Evatt Powerlines	BE05	UOS	1.1	NTG	1.1	3		C3
Nicholls	GU08	UOS	0.3	NTG	0.3	4		C3
Novar St, Yarralumla	CC10	UOS	0.2	NTG	0.2	4		C3
ACC&C, Barton	CC04	Urban Lease (Designated Area)	1.9	NTG	1.9	1	BW GSM	C1
St Johns Church,	CC03	Urban Lease	0.9	NTG	0.9	4	GSM	C2

Name of site	Site No.	Land use	Area (ha)	Grassland type	Area (ha)	BSR	Thr. Spp	Cons'n Cat.
Reid		(Designated Area)						
Amtech	JE09	Vacant	18.0	NTG	18.0	4	GED	C2
Kintore St, Yarralumla	CC09	Vacant (Designated Area)	0.8	NTG	0.8	3	BW	C2
Mitchell	GU05	Vacant	1.6	NTG	1.6	3	GSM	C3
Total			2212	NTG NP EP	1031 1024 134			
GUNGAHLIN Total native grassland area: 410.1 ha. Area of natural temperate grassland: 179.2 ha								
MAJURA VALLEY Total native grassland area: 641.3 ha. Area of natural temperate grassland: 208.9 ha.								
JERRABOMBERRA VALLEY Total native grassland area: 697.1 ha. Area of natural temperate grassland: 267.4 h								
BELCONNEN Total native grassland area: 426 ha. Area of natural temperate grassland: 338.6 ha.								
CANBERRA CENTRAL and **TUGGERANONG** Total native grassland area: 36.5 ha. Area of natural temperate grassland: 35.8 ha.								

Notes:

1) Site No: In the *Strategy*, site numbers have been assigned to all native grassland sites (including sites containing natural temperate grassland and native pasture) to identify the geographic region in which they occur.

2) Conservation Category (Cons'n Cat.)

3) UOS = Urban Open Space

4) AP: *Aprasia parapulchella*; BW: Button Wrinklewort; GED: Grassland Earless Dragon; GSM: Golden Sum Moth; GP: Ginninderra Peppercress; KS: *Keyacris scurra*; PG: Perunga Grasshopper; SLL: Stiped Legless Lizard.

5) Natural Temperate Grassland (NTG) contains areas with a Botanical Significance Rating (BSR) of 1 to 4. Native Pasture (NP) has a BSR of 5 and is not defined as the endangered ecological community (refer to section 2.1.8, Table 3.1). Where a site contains small patches of vegetation with a higher or lower BSR than the majority of the site, these ratings are indicated in brackets. Exotic Pasture (EP) has no botanical significance rating.

6) * – Denotes native grassland sites that do not contain natural temperate grassland.

7) Designated Area: Planning measures are the responsibility of the National Capital Authority, not the ACT Government.

Because of the many pressures on such fragments, and their susceptibilty to disturbence (such as 'edge' effects, weed invasion etc) conservative management is essential. In many cases conservation management is compatible with management for other purposes, including as fire control, agricultural grazing, and weed control, as long as the management does not include soil disturbance or clearance of native species and allows for natural regeneration of the vegetation.

Monitoring of the status of populations of threatened species preferably needs to be quantitative, of good quality, capable of identifying whether the population is increasing, declining, or unchanging (and in a timely manner - before it is actually extinct).

3.3 Threatened grassland species

Lowland native grasslands and grassy woodlands in the ACT region provide habitat for a number of threatened animal and plant species (Table 1, Table 2). In particular, many of the lowland grassland species are found *only* in native grassland and are wholly dependent on this vegetation community for their survival. These species have become threatened as a direct

consequence of the loss, degradation and fragmentation of native grasslands. Whilst loss of habitat due to urban development or crop establishment is obvious, the more subtle and insideous degradation of grassland habitat by invasion of weeds or pasture improvement species is less obvious yet can render a patch of grassland uninhabitable to these threatened species.

Table 2: ACT threatened species in lowland native grasslands and grassy woodlands.

Name	Cwlth	ACT	NSW	Vic
LOWLAND NATIVE GRASSLAND				
Striped Legless Lizard	E	V	V	T
Grassland Earless Dragon	E	E	E	T
Golden Sun Moth	CE	E	E	T
Perunga Grasshopper		V		
Pink-tailed Worm Lizard*	V			
Button Wrinklewort	E	E	E	T
Ginninderra Peppercress	V	E		
Golden Moths	E		E	
Hoary Sunray (white form)	E			
GRASSY WOODLAND				
Hooded Robin		V	V	
Brown Treecreeper		V	V	
White-winged Triller		V		
Varied Sittella		V		
Painted Honeyeater		V	V	V
Regent Honeyeater	E	E	E	CE
Superb Parrot	V	V	V	E
Swift Parrot	E	V	E	E
Speckled Warbler	NT		V	
Tarengo Leek Orchid	E	E	E	
Small Purple Pea	E	E		
Silky Swainson-pea			V	
Austral Toadflax	V		V	

*More commonly inhabiting rocky outcrops along river banks.

Status key:

CE: Critically Endangered; **E:** Endangered; **V:** Vulnerable; **T:** Threatened; NT Near Threatened

Legislation:

Commonwealth: *Environment Protection and Biodiversity Conservation Act 1999*

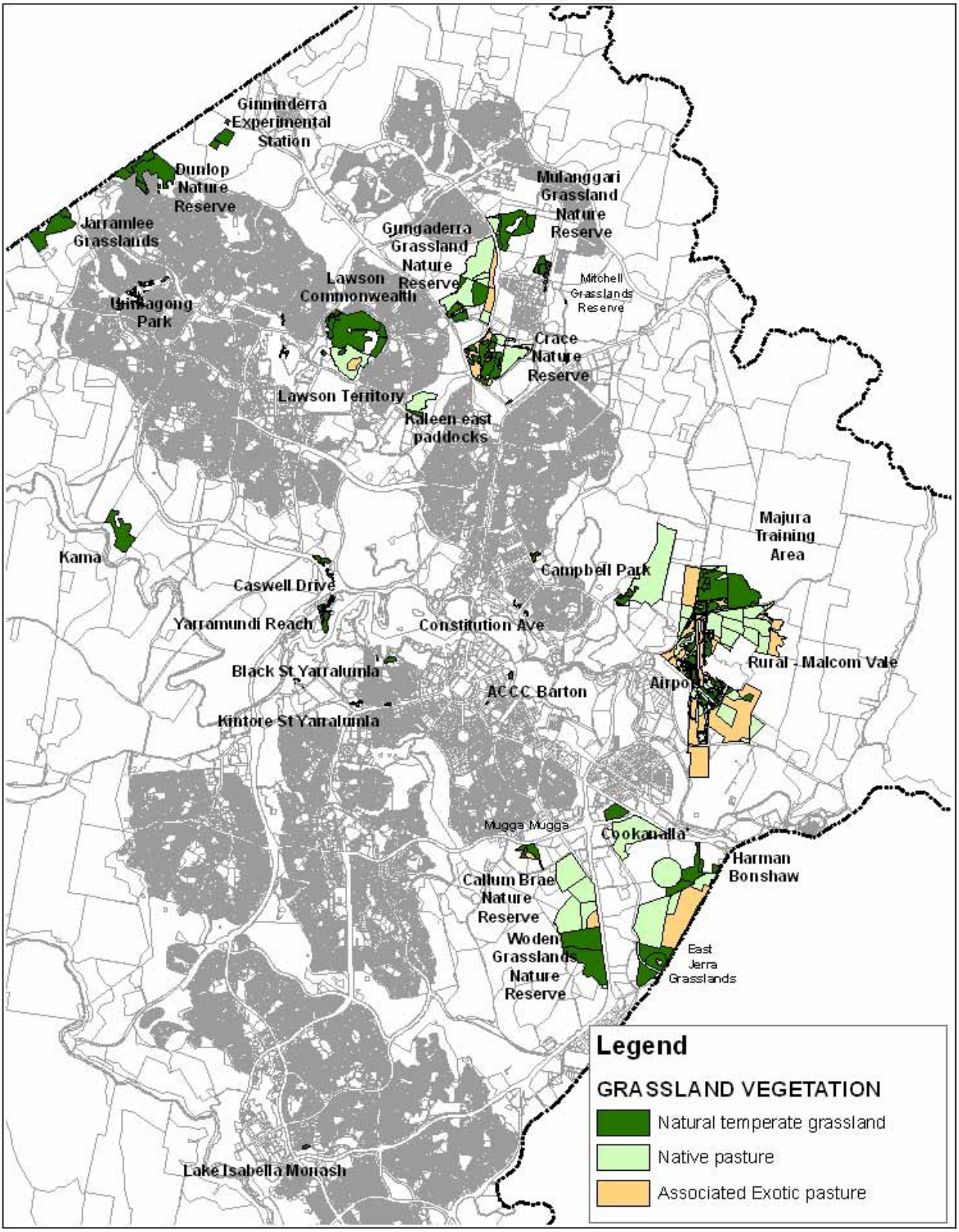
ACT: *Nature Conservation Act 1980*

NSW: *Threatened Species Conservation Act 1995*

Vic: *Flora and Fauna Guarantee Act 1988* (Note that under this Act, species are listed as 'threatened' and specific conservation status (e.g. endangered) is applied in lists prepared by the Victorian Department of Sustainability and Environment.)

Table 2: Threatened grassland species at Majura Training Area and Belconnen Naval Transmitter Station, ACT (does not include woodland birds).

Threatened Species	**Majura**	**Belconnen**
Striped Legless Lizard	✓	✓
Grassland Earless Dragon	✓	
Golden Sun Moth	✓	✓
Perunga Grasshopper	✓	✓
Button Wrinklewort	✓	
Ginninderra Peppercress		✓



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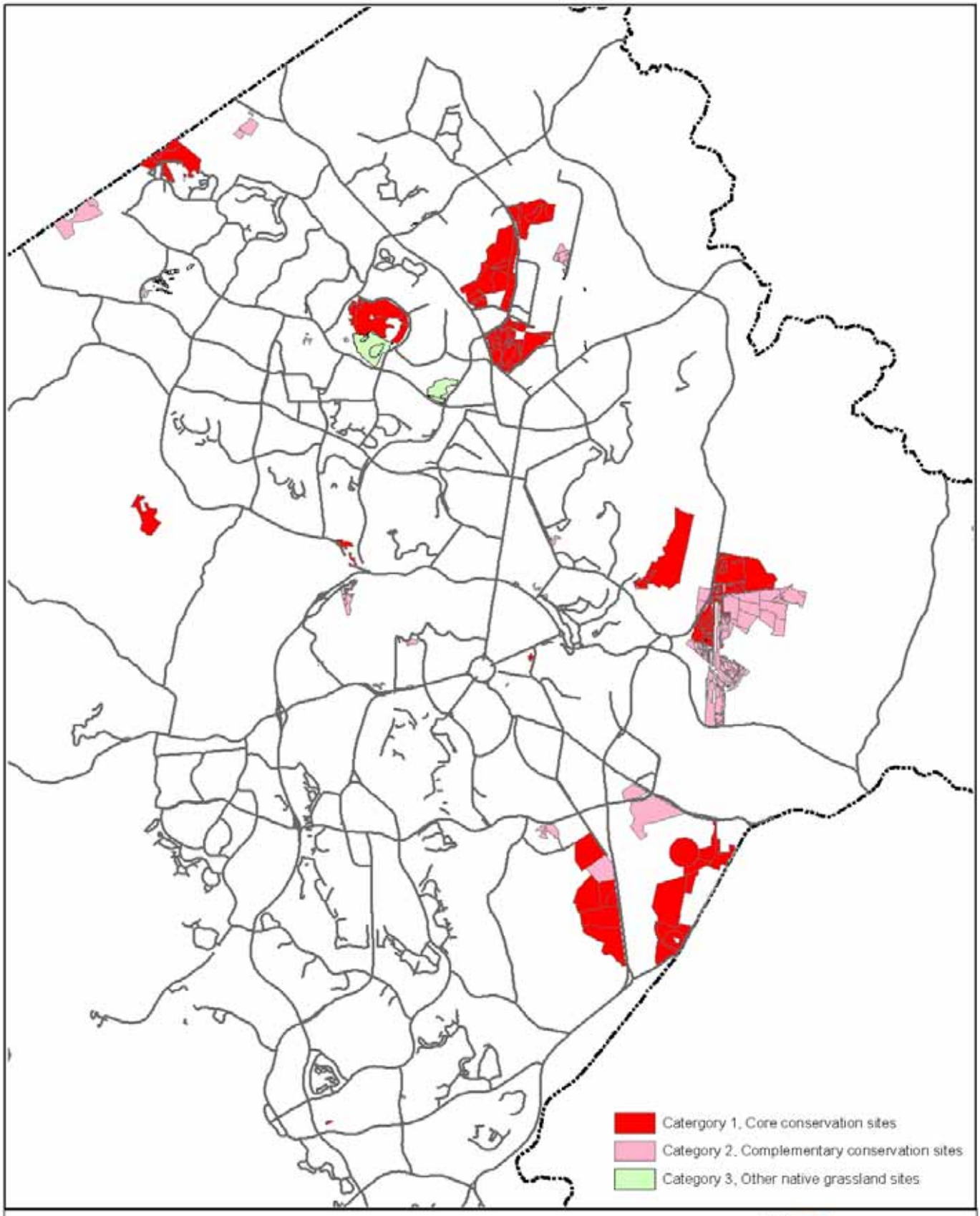
Disclaimer: PCL does not warrant that the data is free from errors.

Map 1 Natural Temperate Grassland Vegetation communities

Date : March 08

0 1.25 2.5 5 Kilometers



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Map 2 Lowland Native Grasslands Conservation Categories

Date: March 08

0 1 2 4 Kilometers

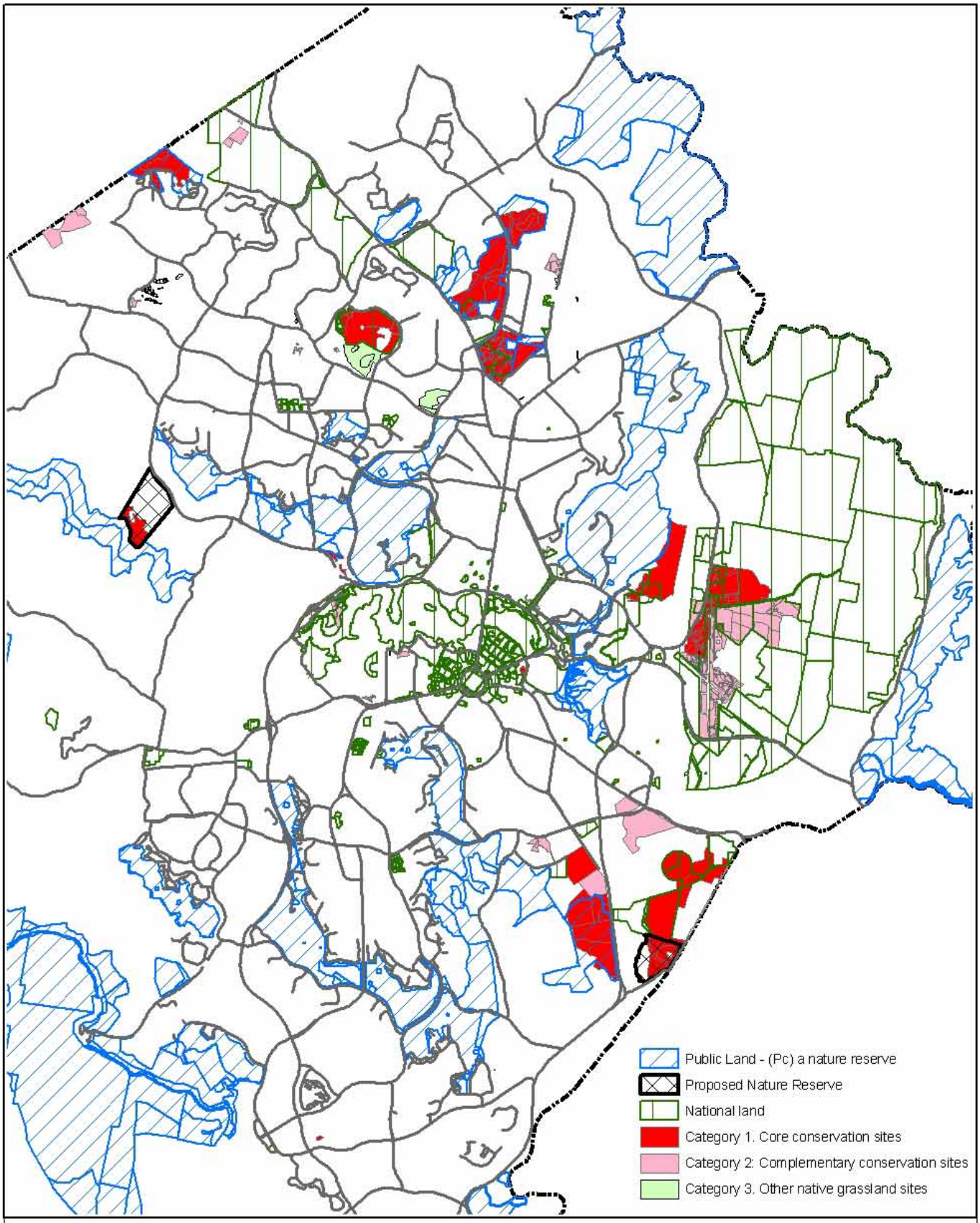

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Figure 1 Land Tenure and Conservation Categories

Disclaimer: PCL does not warrant that the data is free from errors.

Date: 12 March 08

0 1 2 4 Kilometers

3.4 Conclusion to sections 2 and 3

Lowland Natural Temperate Grassland is not 'just grass', but a special ecological community distinct from other grassland, with less than 1% remaining in small fragments of generally less than 100 ha in area. Natural Temperate Grassland, together with all of their associated species, deserves exceptionally high conservation priority. A significant proportion of the ACT's declared threatened species are associated with native grasslands and grassy woodlands.

Many species have become extinct in ACT grasslands and some of those that remain are in tenuous circumstances. Natural Temperate Grassland is considered the most endangered ecological community in Australia (Kirkpatrick *et al*. 1995). The ecological function has been altered (for example by the loss of all of the main predators) to the extent that special measures will now be needed to conserve all of the remaining species. Conservation of native grassland sites in the ACT with significant conservation value, including buffer areas of appropriate dimensions, will depend on giving them the highest priority for protection from development, including 'minor' developments such as communications facilities, underground cables and pipelines. Conservation of the remaining grassland fragments will also depend on a high priority being given to cautious and conservative management, including management of grazing pressure, fire frequency, mowing, and weeds. The natural connections between grasslands and adjoining woodlands have mostly been severed, but should be retained where possible, eg at Majura Training Area and Callum Brae, especially in the context of expected climate change.

Eastern grey kangaroos are a keystone species of naturally functioning grasslands, and have an important positive role in grassland conservation. When kangaroos are in high abundance they are also 'ecosystem engineers', capable of altering the habitat and even to the complete exclusion of some other native species. As the major native herbivore, eastern grey kangaroos have a central place in the flows of energy and nutrients within the ecosystem, a place which is wholly or partly filled in some cases by domestic livestock. Humans control the livestock grazing pressure by sending them to abbatoir. In the absence of natural predators such as Thylacines and dingoes, if the remaining component species of the natural temperate grasslands are to be conserved, humans must also control the grazing pressure from kangaroos.

4 Response to Terms of Reference

4.1 Terms of Reference 1

Review existing management arrangements, and, if necessary, identify comprehensive conservation management principles and immediate actions to ensure the protection and long-term sustainability of native lowland grasslands and their vulnerable ecosystems.

4.1.1 Existing Management Arrangements

Management requirements for lowland natural temperate grasslands are provided in Chapter 3 of Action Plan 28 (ACT Government 2005).

A range of statutory and non-statutory measures are in place to protect threatened grasslands and woodlands in the ACT, as follows.

1.1.1.1 Action Plans for Threatened Ecological Communities and Associated Species

Threatened ecological communities or species are declared under the ACT *Nature Conservation Act 1980* to be 'vulnerable' or 'endangered' (i.e. threatened with extinction), based on defined criteria. Once declared, the Government is obliged under the Act to prepare an Action Plan (known in some jurisdictions as a recovery plan) that sets out strategies for reducing threats to the species and strengthening protection measures. The ACT Government's adopted policies and actions for the protection of threatened grassland and woodland communities are defined in Action Plan 27, the *ACT Lowland Woodland Conservation Strategy* (ACT Government 2004) and Action Plan 28, the *ACT Lowland Native Grassland Conservation Strategy* (ACT Government 2005).

Protection measures identified in the action plans include the establishment of protected areas as core conservation areas, MOUs with relevent agencies with custodial management responsibility, and management agreements with the lessees of small sites with high conservation values.

1.1.1.2 Plans of Management

Grassland and woodland areas in nature reserve are also managed in accordance with the objectives of the *Land (Planning and Environment) Act 1991* and a plan of management prepared under the Act. The Canberra Nature Park Management Plan (1999) is the relevant plan of management for lowland grassy ecosystems (both lowland woodlands and natural temperate grasslands) protected in nature reserves. The Canberra Nature Park Plan of Management does not address the specific requirements of the new grassland and woodland reserves announced since 1999 but the strategic directions of the plan are relevant and management is also guided by Action Plans 27 and 28.

In other cases, site specific, non-statutory, operational management plans have been developed. These management plans address vegetation biomass removal, type of management to be applied, weed control, fire management and other relevant issues.

1.1.1.3 Memoranda of Understanding

A 'Memorandum of Understanding' (MOU) – a written agreement – has been prepared in relation to the management of natural temperate grasslands in the ACT with the Department of Defence, National Capital Authority, and CSIRO, and in each case the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) is a third party to the agreement.

1.1.1.4 Land Management Agreements

Land Management Agreements (LMAs) are mandatory under the Land (Environment and Planning) Act for all long-term rural leases in the ACT. A LMA defines the natural values of a lease with a map and description of the values and sets out terms and conditions for maintaining or improving those values whilst enabling the operation of a rural enterprise.

1.1.1.5 Conservator's Directions

The Nature Conservation Act provides for the Conservator of Flora and Fauna to issue directions to the lessee in relation to the protection of significant natural values. Conservator's Directions have been issued to some leases that contain natural temperate grassland and/or woodland, including properties in the Jerrabomberra Valley that cover a significant proportion of the valley, to ensure the protection of Grassland Earless Dragon habitat.

4.1.2 Long-term sustainability of lowland native grassland ecosystems

Natural temperate grassland is threatened because 99% of it has been alienated for other purposes, and the remaining fragments have been degraded to varying degrees. Both alienation and degradation are continuing.

The major threats to grasslands identified in Action Plan 28 are:

- urban and infrastructure development
- pastoral and agricultural development
- weed invasion
- changed or inappropriate fire regimes
- introduced predators
- a range of other disturbance factors including inappropriate grazing regimes, use of fertilisers, mowing and slashing, tree planting and potentially, soil salinisation

A more recent report (Sharp *et al* 2007) prepared for the Natural Resource Management Advisory Committee (an advisory body to the ACT Minister for the Environment), identified additional threats:

- changes in native species abundance (which included kangaroos) and
- climate change.

More detail is provided below in regard to the threats considered the most pressing, except kangaroo grazing, which is detailed elsewhere.

1.1.1.1 Urban Development

Some developments involve the destruction of large areas of land. These impacts are extensive and obvious. Continual destruction of small areas for infrastructure such as tracks,

cables, communications towers and sewage lines is also occurring. Some current development proposals have been singled out for individual comment, as follows.

Northern Access Road to the Airport

The proposed northern access road will link the Fairbairn precinct of the airport to Majura Road immediately north of the airport. Currently, land to the north of the airport is owned by Defence (Majura Training Area).

The Commonwealth Government intends to transfer 38 ha of land adjoining the northern boundary of the airport from the Majura Training Area to the Department of Transport and Regional Services, for subsequent on-sale to the airport corporation, for the road. The potential consequences of the sale and transfer of the land are significant. Clearly, the transfer and sale of any body of land does not itself, directly impact threatened species, but this transfer and sale will preclude serious consideration of alternative route options for the road, therby effectively determining that the road will cut through the core conservation area. Therefore, the land transfer is a key planning step that should be reconsidered.

The planned route for the road cuts through a core conservation area in the ACT, comprising the largest remaining patch of endangered natural temperate grassland, an area which provides habitat for populations of several threatened species, including the Grassland Earless Dragon (affecting one of only two key populations in the ACT), Golden Sun Moth, Striped Legless Lizard and Perunga Grasshopper. The road will destroy some of the grassland area for road construction and earthworks associated with drainage and piping to avoid runoff onto the airport, and will fragment the remaining areas. The road jeaopardises the long-term viability of this core conservation area. Alternatives to reduce impacts are:

a. re-evaluate the need for the road, and preferably not build a second access onto Majura Road;
b. but if the road is needed as a higher priority than meeting conservation obligations, shift the route approximately 0.8 -1.0 km further north to pass around the core conservation area, preferably, or
c. build the road under a landbridge.

Proposed Molonglo Urban Development

The preliminary assessment for the Draft Variation to the Territory Plan for Molonglo and North Weston documents that the development will impact 655 ha of endangered Yellow Box–Red Gum Grassy Woodland (YBRG). This includes 8.2 ha of high conservation value woodland, 581 ha of moderately modified woodland, and 65 ha of YBRG secondary grassland (woodland with tree cover removed). Other types of woodland and secondary grassland (184 ha) would also be directly affected.

The ACT Government has recently announced a 20-year moritorium over development in central Molonglo. However, if the development proceeds in the future as initially proposed, it would result 6% of the ACT's YBRG woodland being destroyed and would reduce it to 32% of its pre-1750 cover. While the remaining lowland woodland area in the ACT is not large, a much higher proportion is relatively intact than is the case in NSW or nationally. The loss of 655 ha of woodland in the ACT could therefore be viewed as nationally significant.

Grassland Earless Dragon, the Striped Legless Lizard and the Golden Sun Moth are not known to occur in the Molonglo Valley, but several threatened and declining woodland birds have been recorded and the area contains extensive habitat for the threatened Pink-tailed Worm Lizard.

The Draft Variation proposes the protection of partially modified woodland (the highest conservation value woodland) as the Kama woodland reserve comprising 125 ha (90 ha partially modified woodland and 35 ha natural temperate grassland). Concerns have been raised by the Flora and Fauna Committee that the reserved area will not be sufficient to retain its ecological value as habitat for woodland bird species, especially threatened species such as the Brown Tree Creeper. Research is needed to define appropriate buffers for the proposed reserve and ascertain a suitable size for the long-term sustainability of its habitat values. The landscapes surrounding reserves can critically affect biodiversity conservation within the reserve (eg Mackey *et al*. 2007).

Eastern Broadacre Planning Study

The Eastern Broadacre Planning Study is investigating the potential of the eastern broadacre area for employment generating development. The study aims to develop a strategic direction for the area for the next 30 years and beyond, consistent with the objectives of the Canberra Spatial Plan (2004). Land uses identified for this area in the Spatial Plan include industry, broadacre, commercial, tourism, recreation and transport related activities. Focussed on the Jerrabomberra and Majura Valleys, it is an important opportunity for the ACT Government to demonstrate a commitment to biodiversity conservation.

The study includes an investigation of land capability, which incorporates conservation and ecological issues. Of particular importance within the eastern broadacre study area is the retention of the core conservation areas, which include those areas identified in the Lowland Grassland Conservation Strategy as core grassland conservation sites and woodland sites of high conservation value. Of high importance also is the protection of complementary conservation sites, which provide buffers to core areas, protect populations of threatened species and/or ensure connectivity between areas of ecological importance.
Refer to Maps 1–3.

1.1.1.2 Pastoral and agricultural development

Native grasslands evolved under the influence of grazing herbivores (ACT Government 2005), including Eastern Grey Kangaroos, other macropods, birds and insects. Stock grazing has significantly impacted grasslands in terms of composition and structure (Lunt 1991) and physical condition of the soil. Grazers, whether stock or native herbivores, selectively choose food plants, thereby influencing composition and structure. Stock graze differently to eastern grey kangaroos, which consume a higher proportion of grass (Jarman and Philips 1989). In addition, stock compact the ground or churn up soft ground to a greater degree than native herbivores. More intensive pasture improvement practices introduced after 1945 accelerated the loss and disturbance to agricultural lands (Benson and Wyse Jackson 1994). Some native plant species are less common in commercially grazed sites than those managed by other means, which may be as a result of preferential grazing, soil disturbance, nutrient modification, increase in acidity, competition by other species and/or failure to set seed.

It is not considered appropriate to introduce stock grazing to sites that have not been grazed previously by stock, or where the species diversity is very high. However, in sites that have

previously been impacted by stock grazing, certain grazing practices may be used to reduce biomass, control weeds (i.e. utilising the fact that they graze selectively on some plants at particular times) and/or maintain certain structural conditions for habitat.

The ecological effects of grazing depend on the intensity and timing of the grazing (ACT Government 2005). Grazing and grazing exclusion may have positive, negative or neutral impacts on plant diversity. Appropriate grazing is seen to include some form of resting to allow for natural regeneration of plants, maintenance of structural features for habitat, prevention of activities that will disturb soil (e.g. ploughing) or increase nutrient levels in the soil. One advantage of using stock grazing is the ease by which stock can be moved in or out of a site as required to allow for recovery of the system and regeneration of plants. This factor is difficult to control with kangaroo grazing.

Inappropriate stock grazing has long been recognised as a threat to natural temperate grasslands and dependent species. However, stock grazing has been applied, under careful management, for the conservation of grasslands and for fire fuel management purposes in sites that have been grazed for long periods of time. Action Plan 28, *Natural Temperate Grasslands Conservation Strategy* identifies grazing, in general, as being capable of having a major positive or negative impact on the ecological integrity and function of the natural temperate grasslands, depending on the circumstances and attributes of particular sites and how the grazing is applied. Subsequent to the preparation of Action Plan 28, overgrazing specifically by eastern grey kangaroos has emerged as a serious risk to the grasslands.

A range of other agricultural practices including the regular use of fertilisers, ploughing, cropping and soil salinisation are significant threats to native grassy ecosystems.

1.1.1.3 Weed invasion

There are no lowland native grassland sites in the ACT that do not contain a number of weed species. While some species remain in low numbers and are not considered a threat to the ecology of the grasslands, there are some species that are highly invasive even of sites that are relatively undisturbed, and others that with disturbance, can become highly dominant. Weeds are favoured by soil disturbance, changes to drainage and nutrient levels, and in some instances fire (ACT Government 2005).

4.2 Terms of Reference 2

Identify the causes of the deterioration of lowland native grasslands. In doing this, the impact of eastern grey kangaroos, both in the long and short term, is to be explicitly addressed.

This submission does not address ACT kangaroo management issues such as rural culling, commercial kangaroo harvesting, the management of kangaroo populations in the upland areas of Namadgi and Tidbinbilla, and the humaneness of various means of managing kangaroos. The focus of this submission in relation to TOR 2 is the management of kangaroo grazing pressure on lowland grassy ecosytems. Control of kangaroo grazing pressure and of kangaroo population density, to optimise conservation benefits, is one of the central issues for the future management and protection of grassy ecosystems in the ACT.

4.2.1 Grazing pressures by eastern grey kangaroos

As outlined in the Background, eastern grey kangaroos are important for native grassland conservation, and either too few or too many could be deleterious for the conservation of threatened species. Sustained heavy grazing pressure can lead to deleterious impacts on native grassland communities and the animals and plants that depend on these grasslands for habitat. There is no evidence to suggest that the impact to grasslands from overgrazing by livestock is much different from overgrazing by high numbers of kangaroos. Overgrazing is of particular concern where impacts occur to the endangered natural temperate grassland community or native pasture providing habitat for threatened grassland animals and plants, because any reduction in the suitability or quality of their habitat places them at higher risk of extinction.

Such impacts to threatened grassy ecosystems have already occurred in the ACT (Majura Training Area), where sustained heavy grazing over several years by kangaroos has removed almost all of the grassland vegetation, leaving mostly bare ground (Figure 5) in an area of endangered natural temperate grassland, which is also habitat for threatened species that depend upon grassland cover such as the Grassland Earless Dragon, Striped Legless Lizard Golden Sun Moth and Perunga Grasshopper. Heavy grazing at another site (Belconnen Naval Transmitting Station) has also lead to concerns that the natural temperate grassland is at the point of being deleteriously impacted.

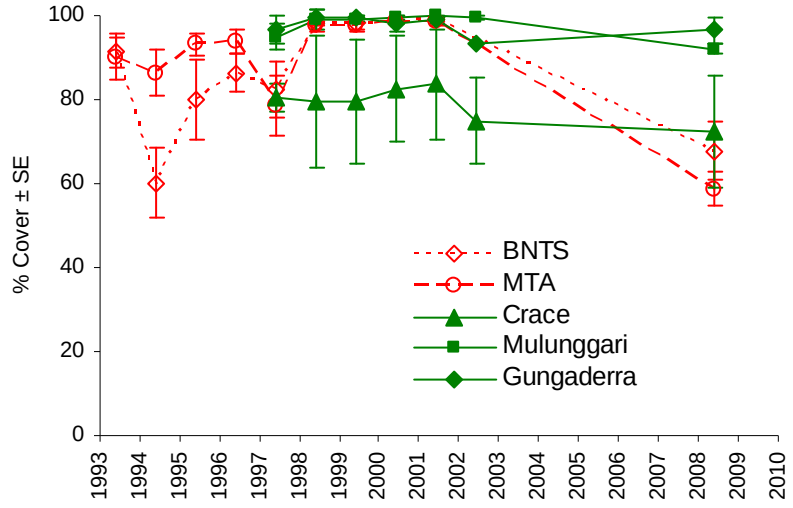


Figure 3. Groundcover measured at the five largest natural temperate grasslands in north Canberra, as part of a long-term monitoring project. Solid symbols and continuous lines mark the sites where grazing pressure is low to moderate. Hollow symbols and dashed lines mark the Defence sites where grazing pressure has been heavy since about 2004. The error bars (± SE) are obscured by the symbols in some cases. ± SE means plus or minus one Standard Error. The Standard Error is a measure of variability familiar to scientists. It is equal to 1/1.96 of the '95% Confidence Interval' which is an alternative measure of the variability of the estimate.

Figure 3 shows ground cover trends from long term grassland monitoring undertaken by ACT Gvoernment ecologists. Over this period there was little change in ground cover at three sites with low to moderate grazing pressure. At sites with heavy grazing pressure (red), ground cover is now lowest and it declined more rapidly during the drought than the other sites. At one of these sites (BNTS) the lowest groundcover was recorded in 1995, a time when the site

was being heavily grazed by sheep for fire hazard reduction, a practice discontinued soon after. Afterwards, it took four years for groundcover at BNTS to recover to the previous level.

Figure 4 shows the *change* in groundcover between the summers of 2001/02 and 2007/08. Ground cover, declined at all sites, but the loss of groundcover was greatest at MTA and BNTS (and was statistically significant, whereas the decline at Crace and Gungaderra was small and not statistically significant. MTA and BNTS are heavily grazed by kangaroos, whereas the other three grasslands have lower kangaroo density though cattle are still introduced occasionally to reduce herbage mass. The combination of drought plus heavy grazing has caused groundcover declines three to 17 times greater at BNTS and MTA than the other sites.

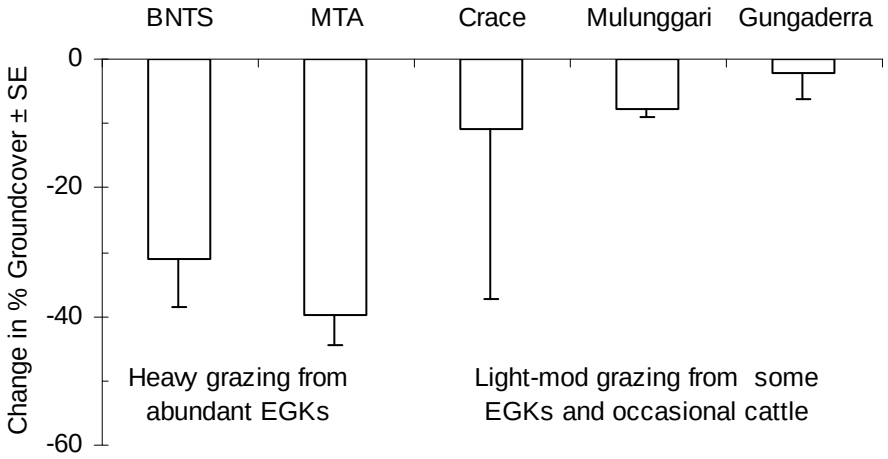


Figure 4: Values show by how much the groundcover declined between visits in 2001/02 and 2007/08 at the long-term monitoring sites in the lowland natural temperate grasslands at BNTS, MTA and three other monitored lowland natural temperate grasslands. The amount by which groundcover declined is the amount by which bare ground increased.

More direct investigation of the relationship between loss of groundcover and the number of kangaroos per hectare can be seen by statistically examining the relationship between these two variables. As the indicator of the number of kangaroos per hectare at each site, the number of kangaroo faecal pellets recorded by the grassland botanist in the quadrats along each transect was used. A quadrat is a defined unit of measurement such as a frame enclosing 1 square metre, and a transect is a line along which the measurements are made. In this case, the positions of transects and quadrats are identical between visits.

The data were statistically examined explained as follows. Count data (e.g. faecal pellet counts) often conform to a 'poisson distribution', rather than the 'normal distribution' required for some statistical procedures, so the natural logarithm ($\log_e$) of the pellet counts was examined, which has a distribution sufficiently close to normal to be used appropriately. Because groundcover is a ratio, the natural logarithm ($\log_e$) of groundcover was also used as the variable of statistical interest. Using the log of the values enables the statistical examination of the data to be based on a linear pattern and to be more reliable. The regression is a statistical procedure that examines the strength of any relationship between two variables,

and the probability that the relationship could arise by chance alone. There was a highly significant regression of $\log_e$ of the increase in bare ground against $\log_e$ of the number of kangaroo faecal pellets counted on each transect (SE = 0.67; F = 6.898; df = 1, 16; p = 0.018; $R^2 = 0.30$) so;

$$\log B = 0.46 \log P + 1.676 \qquad \text{(Equation 1)}$$

where B = increase in bare ground, and P = count of kangaroo faecal pellets.
The Standard Error (SE) is a defined measure of variability that was explained above. The other regression statistics, F, df, p and R^2, are familiar to readers of scientific literature and definitions can be readily found in statistical sources. The intercept term was significantly different from zero, meaning some other factor was probably also responsible for the reduction in groundcover, perhaps related to the drought, but the measure of kangaroo abundance (number of kangaroo faecal pellets in the vegetation assessment quadrats on each transect) was also a significant explanatory factor.

Grazing pressure by eastern grey kangaroos should be of conservation concern not only at MTA and BNTS, but also for the grassland and woodland reserves managed by the ACT Government and some other public land in Canberra. That is because the current difference between the military sites and the other sites (Figures 3, 4) is only temporary. Kangaroo populations are increasing rapidly in the other sites, and in a few years from now they may be in the same condition as the Defence sites, if kangaroo populations continue to be unregulated.

A more succinct way of describing the results presented above is to state that bare ground increased on all sites between 2001/02 and 2007/08, and the extent of the increase was a function of the density of kangaroo pellets. This was statistically highly significant relationship. The increase in bare ground on sites with light to moderate grazing pressure was small, and was not statistically significant in all cases. Thus, the drought alone could not explain the increases in bare ground.

Kangaroos occur, often in high densities, throughout much of the ACT, including the areas protected primarily for conservation of grassy ecosystems. The former natural environment included a predator trophic level which is now missing. Without regulation by these predators, or significant levels of human hunting, kangaroo populations can increase to higher levels, until they are limited mainly by the food supply (Fletcher 2006). In that case, the grassland herbage mass may be reduced to a point where shelter is lacking for animals such as ground nesting birds, striped legless lizards and grassland earless dragons.

4.2.2 Kangaroo populations in the ACT and population growth

In some parts of the ACT, such as at Tidbinbilla Nature Reserve and grassy valleys in Namadgi National Park, kangaroo density is in a high and relatively stable state where kangaroo abundance is regulated by the limits of the food supply. In contrast, kangaroo populations in and around Canberra have not reached a balance with their food supply and tend to be increasing at varying rates dependent upon factors such as mortality due to shooting (rural properties) or motor vehicles (urban area), or competition from live stock. In general, populations in the protected, grassy, upland valleys of the ACT reached a high density that is in equilibrium with the pasture (their food supply) some time ago and most of the lowland populations (in and around Canberra) have not and are still increasing. The

equilibrium condition is also referred to as ‘ecological carrying capacity’. It is incompatible with conservation of species of plants or animals that depend on substantial grass cover or intact tussock structure, such as the Striped Legless Lizard and Grassland Earless Dragon.

In the lowland areas where threatened ecological communities and species occur, uncontrolled kangaroo population growth and therefore grazing pressure is likely to be inconsistent with conservation objectives. In the longer term, it can be expected that kangaroo population increases will be at the expense of other species and their long-term survival.

Whether an abundance of kangaroos is a problem or an asset depends on land management objectives. Objectives may differ between upland areas (such as native grasslands in Namadgi) and the lowlands (grasslands in and around Canberra). From a conservation and road user perspective, it would not be desirable for the Canberra urban area to have the exceptionally high kangaroo densities that exist in parts of Namadgi National Park (more than 4 per hectare).

In the endangered natural temperate grasslands, heavy grazing to the point where it modifies the grassland structure and habitat for threatened species is of concern. An ecological model of kangaroo populations in the Queanbeyan region was presented at the Fenner Conference on the Environment in December 2007 (Fletcher 2007b). Based on measurements of real ACT kangaroo populations and vegetation, the model showed that culling a kangaroo population to about 1 per per hectare results in herbage mass levels that are likely to be associated with higher ground cover and better habitat for grassland fauna.

a **b**

Figure 5: (a) Habitat of striped legless lizards and grassland earless dragons at Majura Training Area in January 2007; (b) Habitat of grassland earless dragons at the Jerrabomberra Grassland Reserve at the same time.

a **b**

c **d**

Figure 5: An abandoned pollination research plot at Majura Training Area now functions informatively as a semi-permeable kangaroo exclosure. Some kangaroos graze inside the plot, but the intensity of grazing is lower than outside the plot; (a) plot layout; (b) inside and outside the plot (outside to the right); (c) detail inside the plot (note kangaroo pellets); (d) detail outside the plot.

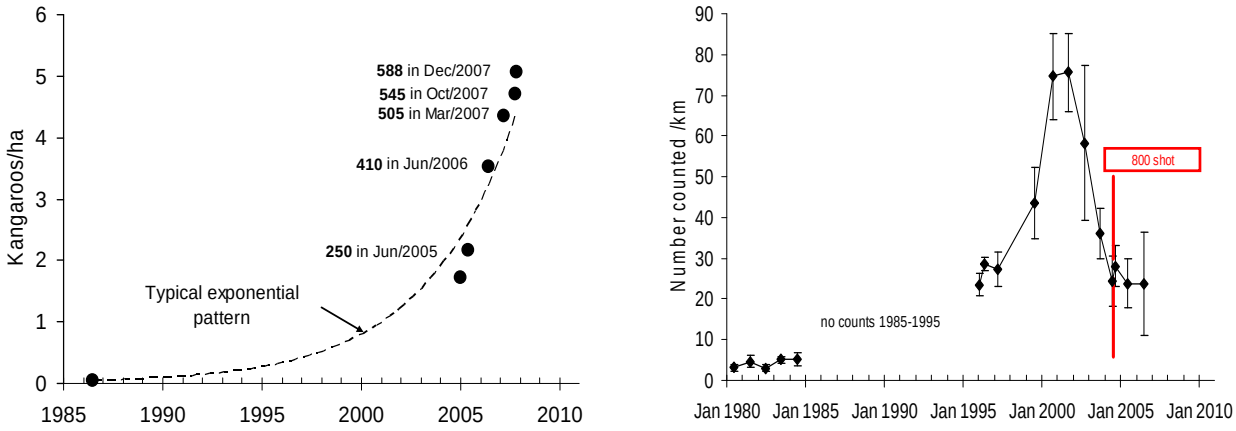
The density of kangaroos in the natural temperate grassland and woodland reserves at Jerrabomberra and Gungahlin is increasing and management of kangaroo populations may be required at some stage to prevent degradation of habitat from overgrazing. Because there are so few natural temperate grassland sites remaining in the region, management of grazing pressures is of critical importance for the long-term viability of this ecological community. The fragmentation of grasslands means that once a species disappears from a site, recolonisation from other sites may not be possible.

Figure 5 contrasts the drought affected and heavily grazed habitat of striped legless lizards and grassland earless dragons at Majura in January 2007 with the drought affected and lightly grazed habitat at the Jerrabomberra East Grasslands Nature Reserve during the same period. The density of grassland earless dragons plummeted at Majura but declined only slightly (most likely due to drought) at Jerrabomberra. The difference in trends in abundance of grassland earless dragons between heavily grazed and lightly grazed sites combined with knowledge of the habitat requirements of grassland earless dragons and ecological principles related to small populations and fragmented habitats suggests that over grazing (removal of almost all of the grass cover) will increase the risk of extinction of local populations of the species.

Majura Training Area: The effective density of kangaroos in the grassland and woodland areas of Majura Training Area (MTA) is more than 3 kangaroos per hectare. Grazing impacts in the woodland and grassland have become severe. There is evidence that endangered species are at risk as a result. Only two substantial populations of Grassland Earless Dragons remain in the ACT—one at MTA and the other in the Jerrabomberra Grassland Nature Reserve. The MTA population was formerly regarded as the best local site for the species, and produced high catch rates, but in 2006 the catch rate at Jerrabomberra was more than fifteen times higher than Majura because Jerrabomberra had better grass cover, due to lower grazing pressure. In the summer of 2006-07, 208 individual grassland earless dragons were caught at Jerrabomberra compared to 11 at MTA, with the same trapping effort.

Belconnen Naval Transmission Station: Most of the BNTS site is enclosed by a security fence (116 ha). Effectively, the only mammalian herbivores are eastern grey kangaroos (there are virtually no hares or rabbits). Grazing is having some adverse impact on the grasslands. The population of eastern grey kangaroos inside the fence has increased rapidly in the last decade (Figure 6a) and appears to exemplify the first stage of a herbivore irruption (Forsyth and Caley 2006) similar to one recorded previously at Googong Foreshores (Figure 6b). At last count there were 588 kangaroos at BNTS, i.e. 5.07 ha. This is likely to be almost the peak of the irruption, ie phase two is imminent (but may be delayed by good rainfall and hence grass growth), in which the kangaroo population is predicted to decline by starvation and there will be an extreme impact on the vegetation.

An irruption is not an effect of the weather, but a deterministic pattern arising from the different growth rates of plant and animal populations on the site, which is why the trend on BNTS and Googong was in opposite directions from 2002 to 2005 (Figure 6) although these sites experienced the same weather. In order to prevent stage two commencing at BNTS, Defence obtained a licence to cull up to 400 kangaroos when the population was significantly lower.



a **b**

Figure 6: (a) The number of eastern grey kangaroos inside the fence at BNTS has increased in the first stage of a herbivore irruption. (the vegetation would have exhibited a corresponding exponential decline); (b) the changing population of eastern grey kangaroos at Googong Foreshores has gone through both the increase (breeding) phase and decrease (starving) phase of a herbivore irruption. The decrease phase was associated with concerns about soil erosion and loss of vegetation.

4.2.3 Kangaroo Management in the ACT

The ACT Government continues to use the recommendations of the ACT Kangaroo Advisory Committee as its policy framework for kangaroo management (ACT Kangaroo Advisory Committee 1996a, 1996b, 1997). While these reports were prepared some time ago, they are considered to be current and relevent to today's circumstances i.e. the policies and recommendations of the reports are consistent with current knowledge and national standards.

The ACT Code of Practice for the Humane Destruction of Kangaroos defines methods that are acceptable on animal welfare grounds for kangaroo culling and euthanasia practices.

Kangaroo research completed by the ACT Government since 1997 is reported in Fletcher (2006a). Useful summaries of parts of that work are contained in Fletcher (2006b, 2007a). The results presented in these documents have been integrated into a dynamic ecological model useful for solving management problems concerning kangaroo grazing and pasture. A powerpoint presentation (Fletcher 2007b) which explains the model is available on request.

4.3 Terms of Reference 3

Identify any impediments to implementing short and long-term management practice for conservation of lowland grasslands within the ACT. In doing this, identify any deficiencies (including development controls, data collection, monitoring and reporting programs) which need to be remedied to further protect native lowland grasslands, their vulnerable ecosystems and associated fauna adequately.

4.3.1 Information and communication barriers to implementation of kangaroo management

Divided responsibilities for planning and management of land containing lowland grasslands and threatened species between Commonwealth and ACT agencies are an inevitable difficulty which require ongoing commitment to overcome. Administrative mechanisms such as the

existing MOUs are potentially available to formally identify the need for intergovernmental cooperation, but the critical requirement is staff time allocated by the respective government agencies to environmental management.

The issue of overgrazing of some grasslands by kangaroos has exposed a lack of understanding among stakeholders about the local environment, kangaroo biology, kangaroo/pasture interactions, the available methods of kangaroo control, the practicalities of achieving animal welfare, and the role of kangaroos in a dynamic grassland ecosystem. Several expert panels have been convened by both Commonwealth and ACT government agencies to help provide 'independent' advice. The administrative process of assembling the panels exposed the scarcity of experts with knowledge of the ecology of the relevant threatened species, the population dynamics of kangaroos in temperate Australia, and with experience in the application of kangaroo management methods. It might have been useful to the independent scientists if an avenue had been provided for local experts to present their detailed data and other information to these scientists, who then assess and report on that information as well as on their inspection of the sites.

4.3.2 Practical barriers to implementation of kangaroo management

To maintain the ecological condition of conservation reserves, kangaroo populations require management so that they do not attain densities that cause impacts to grasslands. All of the ACT grassland reserves are close to suburbs or development sites such as the Alexander Machonachie Correctional Centre. Firearms safety issues limit the areas of ACT grassland reserves where culling kangaroos by shooting can be implemented and so alternative methods to manage kangaroo grazing are needed. Fencing (eg Mulligans Flat NR) to exclude some or all kangaroos, and capture darting (eg Belconnen Naval Transmitting Station) are costly and there are also questions about whether they are practical. Research is underway to develop an orally delivered fertility control but there are significant obstacles to overcome before it is successful. Even if developed, it is likely that practical considerations mean that fertility control will be only an adjunct to other methods. Simpler alternative possibilities could be to identify a humane toxin, such as that being trialled for feral pigs or a tranquillizer which makes the kangaroos more approachable for darting, or a capture drug which can be administered in food or water (such as alpha chloralose used by kangaroo researchers in Western Australia in the 1980s). Any such new technology would require research, development and assessment in terms of animal welfare criteria.

4.3.3 Administrative, political and legal barriers

Grasslands occur on lands owned and managed by the ACT and the Commonwealth. Whilst each jurisdiction has its own laws and policies, the goals for conservation of these grasslands and their threatened species are similar. Recent different perspectives on the urgency for kangaroo culling between the relevent Commonwealth and Territory agencies has resulted in conflict regarding management of kangaroo grazing, with the ACT urging the Commonwealth to take action to reduce grazing at Belconnen Naval Base and Majura Training Area. However, continued dialogue between the Commonwealth and the ACT agencies and advice received from expert panels and other scientists has led to consistent viewpoints between the agencies on management of kangaroo grazing in endangered grasslands.

There is some uncertainty on whether ACT law over-rides Commonwealth law on Commonwealth lands, particularly with respect to conservation matters. The legal advice

received by the ACT Government is that ACT laws formed under the Commonwealth *ACT Self-government Act* and Regulations, such as the Nature Conservation Act 1980, bind the Commonwealth in the ACT. This has not been tested.

There have been formal agreements (Memoranda of Understanding) between Commonwealth and ACT Governments and the Airport to facilitate cooperation, coordination and information sharing relating to the mangement of threatened grasslands. Whilst not legally binding, these MOU's express management intent and a clarification of roles and responsibilities. They thus form a strong basis for cooperative management of grasslands. These MOU's are now more than 10 years old and it would be appropriate for them to be reviewed and updated.

4.3.4 Knowledge limitations and what is being done about them

The ACT Government has contributed significantly to the knowledge of how to effectively manage a wild herbivore population for various conservation goals. In particular, the ACT Kangaroo Model (the result of a three year PhD research project; Fletcher 2007b) produces data useful for guiding management strategies and research designs. The model is based on measurements of local pastures and kangaroo populations and will be continuously refined as additional data becomes available.

Table 3 provides outputs of the model for three alternative management scenarios, each based on 10 'runs' of 100 years, using Queanbeyan rainfall and temperature. In the first scenario, no management treatment is applied to the kangaroo population, which is limited by the natural variations in the weather as expressed through variable pasture (food) availability. The other two scenarios are two different management treatments that reduce the number of kangaroos, each according to different prescriptions; one management prescription is the commercial harvesting process and the other management prescription is based on reducing impacts to vegetation.

From the model (Table 3), the commercial harvest provided a sustainable yield of kangaroos but had marginal benefit for the vegetation, while the 'impact reduction' formula resulted in higher amounts of pasture. An advantage of using models such as this is that the interactions between kangaroo numbers and vegetation is clearly observable and a better understanding can be gained of the likely effects of various hypothetical or real management scenarios, with the potential to improve and refining management strategies and proposals. For example, the model could also be used to assess the effects of predicted climate change. Which of the three management alternatives is 'best' depends on management goals for kangaroos and/or vegetation. The model results provide support for the simple kangaroo management guidelines advanced by Coulson (2001), in particular that if the kangaroo population is held below 1/ha, impacts to vegetation (such as endangered native grasslands) will are likely to be minimised.

Table 3: Modelled output for three management alternatives.

	Management Strategy		
	Natural	**Commercial**	**Impact Reduction**
No. EGKs shot /sq km /yr	0	30	32
(SE)	(0)	(4.4)	(1.5)
No. EGKS left/sq km	240	200	60
(SE)	(27)	(38)	(0.67)
Green herbage density (kg/ha)	809	910	1858
(SE)	(225)	(276)	(208)
Green herbage gained (kg/ha)	0	102	1050
Green herbage eaten (kg/ha/yr)	4483	3846	2143
(SE)	(1035)	(1767)	(148)

Further data from field research will enable refinement of the model. Given the pressure of other kangaroo issues and the need for monitoring and research on other species than kangaroos, these potential improvements remain a challenge for the years ahead. Another desirable activity is to test model predictions against real kangaroo and pasture populations, which will involve field-based research over a number of years under varying annual rainfall (pasture growth) conditions.

Table 4 lists a number of desirable research topics for eastern grey kangaroos in the ACT to help inform management of kangaroos and grasslands, and are based on the 'evidence based management' principle of the KAC reports.

Table 4 Current and desirable research on EGKs in the ACT

Research Topic	**Research Partner (Potential or Actual)**	**Status (C=complete, U= underway, D= desirable)**
Model the population dynamics of EGKs in temperate grasslands Stage I, as a strategic basis for management	Uni of Canb. Marsupial CRC.	C
Evaluate oral fertility control agents, Stages I, II	Marsupial CRC.	C
Evaluate oral fertility control agents, Stage III	Marsupial Research Lab.,	U
Evaluate oral fertility control agents, Stage IV	Marsupial Research Lab., CSIRO	D
Gather basic information about the urban EGK population Stage I (home range & movements, using GPS collars)	None Future NRMA?	U
Improve ACT kangaroo model	To be decided	D
BSc Honours project to evaluate a proposed new method to estimate kangaroo density from faecal pellet counts, which is possibly more efficient than the normal method.	Fenner School, ANU	U
Develop procedures for estimation of kangaroo abundance and impact in LNT grassland reserves, and implement monitoring program	none	D
GIS analysis of data collected with PDAs to determine predictor factors for areas with high kangaroo roadkill. Predict high roadkill sections on planned roads such as Majura Parkway, so measures such as underpasses and fences, as used on GDE, can be well targeted.	NRMA?? ACT roads?? ACTPL??	D
Evaluate alternative structures to reduce motor-vehicle accidents with kangaroos - roadside fence designs, underpass designs etc.		D
Effects of woodland management, including kangaroo density control, on small fauna (Fenner school) - current ANU project.	Fenner school	U
Rural kangaroo issues – density estimates, quantify flow from source populations onto rural land, assess male-only culling, economics of commercialisation.	none	D

4.3.5 Population control methods

Shooting is still regarded as the most effective and humane method to reduce kangaroo numbers (ACT Kangaroo Advisory Committee 1996a, 1997). Shooting is the method used by the kangaroo havest industry, which operates throughout much of the rangelands of Australia, and is subject to criteria for animal welfare standards through a national Code of Practice. There is little doubt that the shooting of kangaroos in the ACT for damage mitigation is generally achieved to high animal welfare standards, partly due to the higher than normal standard set in the ACT for shooter testing, and the imposition of a kangaroo shooting season in the ACT.

As well as shooting, for enclosed populations capture darting is also an acceptable method, although less humane than shooting, due to the much lower precision of the projectile. The captured kangaroos (rendered unconscious by the capture drug) can then be injected with lethal poison, identical to the way pet dogs and cats are euthanased. Lethal injection is considered by veterinarians to be a humane method to kill animals, including kangaroos.

Translocation of kangaroos involves capture by darting, and thus is subject to the concerns for capture darting kagnaroos. Once the kangaroo has been captured by darting and is sedated or unconscious, it is then traslocated to a new area. The translocation process (physical transport) and the process of release to a new and unfamiliar area, are both likely to cause significant stress to the animal. The additional translocation and release stress to the animal is avoided if the animal is euthanased following capture darting. The preference for translocation by some is not based on the philosophical principle of animal welfare (minimising stress) but on the principle of animal-right-to-life. Of these two principles, animal welfare enjoys wide community support. Because the translocation of an abundant species such as the eastern grey kangaroo does not serve any conservation benefit (the species is widespread and abundant to the extent that it is harvested throughout much of its range) and because translocation causes stress to animals, the current policy of the ACT Government is that translocation is not an appropriate management method for reducing numbers of kangaroos. There is consequently little imperative to undertake research into the translocation of eastern grey kangaroos, due to the limited application of the resulting knowledge. Higher research priorities into the conservation of threatened species should take precedence.

An alternative form of control that shows promise for kangaroos in certain situations is to reduce the overall fertility of the population at some locations. The general aim of fertility control is not to prevent all breeding at sites, but to reduce the overall fertility of the population to slow down the increase in population size. Alternative forms of fertility control for macropods are being developed by four groups of researchers in Australia, but all approaches are still in a research and development phase and unlikely to be effective for large populations, or non-captive populations, for several years. Table 5 provides an overview of some of the fertility control alternatives.

Table 5: Summary of fertility control alternatives.

Class of Method	Method	Estimated effective life	Notes
Surgery	Castration of males	Permanent	Loss of male behaviours
	Vasectomy of males	Permanent	Normal male behaviours retained. Used at Government House so mature vasectomised males would seek to prevent breeding by and invading males.
	Ovariectomy of females	Permanent	Equivalent to castration but requires abdominal incision (major surgery). Never attempted in EGK?
	Tubal ligation of females	Permanent	Equivalent to vasectomy but requires endoscopic surgery or abdominal incision. Has had some use at ADI but no information has become available.
Implant	GnRH agonist – Suplorelin/ Deslorelin®	15? Months	Proven method. Annual to biannual retreatment needed, requiring darting. Being researched @ UNSW.
	Steroid – Levonorgestrel®	3 years	Retreatment required at 3-5 year intervals, (captue-darting). Being researched @ Uni of Melbourne.
Vaccination	ZP vaccine	3 years?	Can be administered on inside of mouth or by injection. Potential for future delivery in food. Potential for delivery as peptide rather than whole protein. Being researched @ Marsupial Research Lab, Uni of Newcastle.
	GnRH vaccine – GonaCon®	3 years?	Potential for future delivery in food. Being researched @ IACRC
Chemical Sterilisation	Vinyl Cyclohexene Dioxide (VCD)	Permanent?	Potential for future delivery in food. Being researched @ IACRC

A simple model (available to the Commissioner on request) indicates that the success rate of treatment in the range of published fertility values, is less important than the life of the infertility, in determining how often the population must be treated to maintain it at set limits. In other words, it would be better to use, for example, a method that had a 70% success rate and lasted 3 years than one which blocked fertility in 99% of females for one year.

Permanent options such as vasectomy will require kangaroos from elsewhere to be introduced to the site to offset ageing and mortality. An easily overlooked advantage of methods that require re-treatment is that some breeding can be allowed occasionally to offset natural mortality.

4.3.6 Application of conservation management to grasslands

Conservation burning

For many grassland sites the application of occasional mosaic burns is probably the optimal management regime to achieve conservation outcomes. Impediments to applying conservation burns include:

- lack of knowledge about the responses of species that occur in less than optimal habitat and in fragmented sites;
- limitations to the seasons in which burns can occur safely;
- cost (monetary and resources) in the application of burns; and
- application of too frequent burns where they are used for wildfire control purposes.

Burning is used where ever possible, however, particularly in smaller sites, where there are no threatened fauna species present.

Grazing by domestic stock

Grazing by domestic stock is considered an appropriate method to assist in the conservation management of sites as long as:

- Grazing has been applied for long periods in the past (ie the remaining species are likely to be resilient to grazing pressure);
- Grazing is only undertaken when the biomass is high enough to prevent soil or plant damage or loss of structural characteristics important for habitat;
- Grazing is undertaken in some form of rotation, to allow for natural regeneration of native plant species;
- There is insuffiecient grazing by native herbivores such as kangaroos
- No stock feed is taken onto the site; and
- Minimal or ideally no fertiliser is added.

Impediments include:

- Lack of detailed knowledge of whether grazing prevents the recovery of species apparently ‘lost’ to the site;
- Lack of public support towards stock grazing in reserves; and
- Lack of knowledge as to whether grazing can be used to target and control particular weed species (preliminary trials are currently being undertaken to determine if this should be further researched).

Current research being undertaken by Lindenmeyer *et al.* at Mulligans Flat and Goorooyarroo (the National Woodlands Initiative) includes investigating the results of applying conservation burns, enhancement of habitat structure, removing kangaroo grazing on a range of fauna and flora species.

4.4 Terms of Reference 4

Identify ways for ensuring effective communication with stakeholders, whose actions potentially, indirectly or directly affect, threatened grasslands.

There should be a forum for regular dialogue about management of lowland native grasslands between the relevant Commonwealth agencies and ACT agencies involved in native grassland

mangagement. Re-establishment and updating of MOUs between ACT and various Commonwealth bodies may be a productive mechanism.

4.5 Terms of Reference 5

Determine whether any policy or legislative changes are needed for the protection of threatened lowland native grasslands

Threatened species and their habitat continue to be damaged and destroyed in the ACT. Development is planned for a number of natural temperate grassland sites, either on ACT land or land owned by the Commonwealth. Of particular concern is the proposed northern access road to the airport, which jeopardises the viability of one of the two remaining key populations of grassland earless dragon. The remaining areas of natural temperate grassland, particularly those that support viable populations of threatened species, should be given the highest priority for conservation.

Strong policy positions are needed to protect and conserve the remaining areas of natural temperate grasslands and component threatened species, and to progress positive management actions as outlined in Action Plan 28 Natural Temperate Grassland Conservation Strategy (ACT Government 2005). The extent and condition of the natural temperate grassland should be assessed by the Commissioner and reported in the State of Environment report.

5 References

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SUCCCINCT (ONE PAGE) SUBMISSION TO THE INQUIRY INTO GRASSLANDS BY THE COMMISSIONER FOR THE ENVIRONMENT AND SUSTAINABILITY

The central issue for the inquiry is the conservation of the lowland native grasslands and grassy woodlands of conservation significance. The ACT government's adopted policy on this issue is expressed in the ACT Lowland Woodland Conservation Strategy (ACT Government (2004) and the ACT Lowland Native Grassland Conservation Strategy (ACT Government (2005). The Belconnen and Majura sites are specifically mentioned.

Also, kangaroos are mentioned in one of the TOR for the inquiry. The ACT Government continues to use the recommendations of the ACT Kangaroo Advisory Committee as its policy framework for kangaroo management (ACT Kangaroo Advisory Committee 1996a, 1996b, 1997). Kangaroo research by the ACT Government since 1997, is reported in Fletcher (2006a). Useful summaries of parts of that work are contained in Fletcher (2006b, 2007a). The results presented in these documents have been integrated into a dynamic ecological model useful for solving management problems concerning kangaroo grazing and pasture. A powerpoint presentation (Fletcher 2007b) is also available on request which explains the model.

TOR 1: Review existing management arrangements

The ACT lowland native grassland conservation strategy (ACT Government 2005) is an 'Action Plan' in the meaning of the Nature Conservation Act 1980. It contains the ACT Government's official statement, as at 2005, of what management goals are appropriate and how they can be achieved. Also see the woodlands strategy (ACT Government 2004).

TOR 2: Identify the causes of deterioration

As above, the government's statement on this matter is contained in (ACT Government 2004, 2005). However the ecological role of eastern grey kangaroos – the dominant fauna of lowland grasslands – was an unfortunate omission – and this is now acknowledged to have been a mistake. A useful outcome of this inquiry could be to 'correct the record'. Putting it simply, eastern grey kangaroos are central to grassland conservation. Either too few or too many could be harmful for conservation of threatened species. However many experts on the threatened species and the endangered grassland community (not only the authors of ACT Government 2004, 2005), did not appreciate the central role of eastern grey kangaroos, and therefore did not identify abundant kangaroo populations as a potential threat. For example, ACT Government (2005) indicates kangaroo grazing at MTA to be compatible with the conservation of grassland earless dragons, where this was clearly incorrect. In hindsight it can now be seen more easily that a broader perspective, focussed on ecological processes, would have been more appropriate than one focussed mainly on the species categorised as threatened. Thus the grasslands inquiry is one of the opportunities to correct the record. It is time for a more integrated scientific view of the elements of an ecosystem, whether they are flora or fauna, native or exotic, threatened or common. Ecosystem function cuts across such categories, which have a valuable administrative role, but also can sometimes obscure ecological realities.

TOR 3: Impediments to short and long-term management

The ACT Government maintains the highest standards of management of its conservation assets through a range of science-based mechanisms, including planning by ACTPL of future

developments, from caravan parks to town centres; and management of bushfire issues, weeds, and pests, to provide excellent science-based management of all land under its control.

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