

National Recovery Plan

for

**Natural Temperate Grassland of the Southern
Tablelands (NSW and ACT):
An Endangered Ecological Community**

January 2006



ACT Government

environment ACT



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Australian Government

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ABBREVIATIONS

ACT	Australian Capital Territory
ANZECC	Australian and New Zealand Environment and Conservation Council (A council of Australian Government, State, Territory and New Zealand Ministers responsible for Environment and Conservation)
CAMBA	China-Australia Migratory Bird Agreement
CMA	Catchment Management Authority (NSW)
CMN	Conservation Management Network
Cth	Commonwealth
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for the Conservation of Nature and Natural Resources (Gland, Switzerland)
JAMBA	Japan-Australia Migratory Bird Agreement
JMA	Joint Management Agreement (NSW)
MOU	Memorandum of Understanding
NCA Act	<i>Nature Conservation Act 1980</i> (ACT)
NSW DEC	New South Wales Department of Environment and Conservation (formerly NSW National Parks and Wildlife Service)
NTG–ST	Natural Temperate Grassland of the Southern Tablelands of New South Wales and the Australian Capital Territory
NVC Act	<i>Native Vegetation Conservation Act 1997</i> (NSW)
NVIS	National Vegetation Inventory System
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
TSR	Travelling Stock Reserve
VCA	Voluntary Conservation Agreement (NSW)
WWF	World Wide Fund for Nature

Executive Summary

This document constitutes the National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT). The Plan considers the conservation requirements of the ecological community across its known range. It identifies the actions to be taken to ensure the long-term viability of the community and the parties involved in undertaking these actions.

Natural Temperate Grassland of the Southern Tablelands is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). The community is characterised by a very diverse flora and is dominated by moderately tall (25–50 cm) to tall (50 cm–1.0 m), dense to open tussock grasses. There are also many native forb species, especially in drier areas supporting the community. The community may contain up to 10% projective foliage cover of trees, shrubs or sedges. The community is found in valleys influenced by cold air drainage and on open plains, and occurs within the geographical region of the Southern Tablelands of New South Wales and the Australian Capital Territory. Natural Temperate Grassland occurs on both public and private land, under a range of tenures.

The remaining Natural Temperate Grassland is a small fraction of its estimated original extent. Clearance has occurred as a result of urban, rural and infrastructure development. The conservation value of remaining areas has been reduced by changes to soils and drainage patterns, by plant introductions, and inappropriate defoliation practices. These activities, in particular, continue to pose threats to remnant areas.

The aim of this Recovery Plan is to arrest the decline in extent and quality of Natural Temperate Grassland of the Southern Tablelands region. The Plan sets out the steps to achieve this, involving the establishment and maintenance of an information base, protection and management arrangements, community involvement, and integration of Natural Temperate Grassland conservation into regional planning processes.

It is intended that the Plan will be implemented over a five-year period, using resources from Australian Government, State and Territory agencies, together with Australian Government and other funding and the assistance of community organisations and landholders.

PART A: BACKGROUND INFORMATION

1 Overview of the National Recovery Plan

1.1 Legislative Context

This *National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)* is prepared under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). In developing this recovery plan consideration has been given to the objects of the act as set out in Section 3(1) of the act.

Natural Temperate Grassland of the Southern Tablelands (NTG–ST) is recognised as a threatened ecological community under Australian Government and ACT legislation but is not listed as threatened in NSW –

Australian Government:

- Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory: an endangered ecological community (1999) (Australian and New Zealand Environment and Conservation Council (ANZECC)).
- Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory: an endangered ecological community (2000) (*Environment Protection and Biodiversity Conservation Act 1999*) (EPBC Act).

Australian Capital Territory:

- Natural Temperate Grassland: an endangered ecological community (1996) (*Nature Conservation Act 1980*) (NCA Act).

New South Wales:

- ‘Native grassland’ is recognised as an ecological community under the *Native Vegetation Conservation Act 1997* (NVC Act). Under the Act, native grassland communities are afforded protection under the definition of ‘groundcover’.
- While NTG–ST is not listed as threatened in NSW, it can receive some protection under the *Threatened Species Conservation Act 1995* (TSC Act) Act, where it provides habitat for plant and animal species that are listed as threatened under Act and are found within grassland communities.

Species occurring in NTG–ST that are listed as threatened under Australian Government and State/Territory legislation are shown in Table 1.

Natural Temperate Grasslands are not specifically the subject of international agreements but may provide habitat for species that are (see s.2.1). Actions outlined in this recovery plan will enhance the conservation of such species.

Table 1: Species occurring in Natural Temperate Grassland of the Southern Tablelands that are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), the *Nature Conservation Act 1980* (ACT), the *Threatened Species Conservation Act 1995* (NSW), the *Flora and Fauna Guarantee Act 1988* (Vic.) or contained in the IUCN Red List¹.

Species	Common Name	Cth	ACT	NSW	Other
Flora					
<i>Calotis glandulosa</i>	Mauve Burr-daisy	V		V	
<i>Dillwynia glaucula</i>	Michelago Parrot-pea			E	
<i>Diuris pedunculata</i>	Golden Moths	E		E	
<i>Dodonaea procumbens</i>	Creeping Hop-bush	V		V	
<i>Lepidium ginninderrense</i>	Ginninderra Peppercross	V	E		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Hoary Sunray (white form)	E			
<i>Prasophyllum petilum</i>	Tarengo Leek Orchid	E	E	E	
<i>Rulingia prostrata</i>	Dwarf Kerrawang	E		E	
<i>Rutidosis leiolepis</i>	Monaro Golden Daisy	V		V	
<i>Rutidosis leptorrhynchoides</i>	Button Wrinklewort	E	E	E	T (Vic.)
<i>Swainsona sericea</i>	Silky Swainson pea			V	
<i>Thesium australe</i>	Austral Toadflax	V		V	
Fauna					
<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard	V		V	
<i>Delma impar</i>	Striped Legless Lizard	V	V	V	T (Vic.) V (IUCN) ¹
<i>Perunga ochracea</i>	Perunga Grasshopper		V		
<i>Stagonopleura guttata</i>	Diamond Firetail			V	
<i>Suta flagellum</i>	Little Whip Snake			V	
<i>Synemon plana</i>	Golden Sun Moth	CE	E	E	T (Vic.)
<i>Tympanocryptis pinguicollis</i>	Grassland Earless Dragon	E	E	E	T (Vic.) V (IUCN) ¹

E: endangered; **V:** vulnerable; **T:** threatened (as defined under Victorian legislation)

1 IUCN (International Union for the Conservation of Nature and Natural Resources) 2000 Red List of Threatened Species (Hilton-Taylor 2000). Note that *Tympanocryptis pinguicollis* is listed by the EPBC Act and the IUCN as *Tympanocryptis lineata* subsp. *pinguicollis*.

1.2 The National Recovery Plan

The National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory provides the basis for a strategic, regional and local community-based approach to conserving the NTG–ST community and its component threatened species.

The Recovery Plan addresses the conservation issues that currently threaten the ecological community. The Plan aims to ensure that landholders are actively involved in the conservation of the community through participation in the establishment and promotion of a network of conservation areas. The Recovery Plan takes an integrated regional approach based on the ecological boundaries of the community, rather than reflecting jurisdictional boundaries (Sharp and Shorthouse 1996).

The Recovery Plan builds upon, and is consistent with, information in other State and National Recovery Plans and ACT Action Plans for Natural Temperate Grassland and species associated with grasslands. The Recovery Plan takes a multi-species approach to the recovery of the ecological community and its component species. It does not replace National or State Recovery Plans or ACT Action Plans prepared for threatened species and communities.

The Recovery Plan is also consistent with management plans for conservation reserves that exist under NSW and ACT legislation. It also has links to NSW, ACT and Australian Government plans and programs related to catchment management, vegetation management, salinity and sustainable agriculture. These links need to be strengthened to ensure that there is consistency between the strategies, adequately addressing Natural Temperate Grassland conservation from the social, economic, legislative and biodiversity viewpoints.

Implementation of the plan will aim to achieve compatibility with the National Vegetation Inventory System (NVIS), including the collection of nationally consistent data. This will allow the cross-referencing of data within and between national and more detailed regional vegetation databases.

1.3 Interests Potentially Affected by the Recovery Plan

Natural Temperate Grassland in the Southern Tablelands occurs on public and private land under a range of tenures. Remnants are located on grazing properties, properties in rural subdivisions, nature reserves, village commons, road and railway easements, cemeteries, urban parks and other open space, travelling stock reserves and special purpose sites (e.g. Defence Department land). Consequently, potential interest in the Recovery Plan is wide ranging.

The Plan has direct links to the targets set in the Catchment Blueprints in regions covered by the four CMAs in the Southern Tablelands of NSW (Southern Rivers, Murrumbidgee, Hawkesbury-Nepean and Lachlan) and the targets identified in the ACT Natural

Resource Management Plan. The CMAs have the role of administering and delivering the Property Vegetation Plan (PVP) process in NSW.

Actions within the Plan include extensive liaison with a range of on-ground NGO officers such as Landcare Coordinators (ACT) and CMA project officers (NSW) dedicated to terrestrial and riparian biodiversity conservation issues. Strong association with these representatives will ensure wider dissemination of information relating to NTG. The involvement of landholders and other interest groups will be essential to the successful implementation of the Recovery Plan. Stakeholder involvement is aimed at developing a greater sense of ownership of the recovery process. This should assist in improved management of sites, encouraging an adaptive approach to land management, which recognises conservation objectives as well as other land use goals. A significant proportion of the remaining NTG–ST community occurs on private rural land. Voluntary participation of graziers and other landholders in implementation of the Recovery Plan will be central to achieving its objectives.

1.4 Social and Biodiversity Benefits

Conserving the remaining NTG–ST will result in a number of social and biodiversity benefits.

The main social benefits of conserving representative examples of NTG–ST are:

- the meeting of community concerns that further loss or extinction of significant ecological communities be prevented;
- the recognition of cultural values: (a) the amenity and recreation values of grasslands with their distinctive Australian landscape character, and (b) the possible importance of grasslands to Aboriginal culture through both continuing contact and the presence of archaeological deposits; and
- the tourism and environmental education potential of a successful program to protect an endangered ecological community and component threatened species.

Biodiversity and other conservation benefits provided by NTG–ST, including environmental services that may also benefit agriculture, include:

- provision of habitat for a range of species and protection of biodiversity;
- maintenance of natural vegetation within catchments;
- maintenance of soil health;
- contribution to management of salinity;
- contribution to maintenance of water quality;
- provision of a carbon sink;
- contribution to biological control of agricultural pests by providing habitat for insectivorous birds and predatory insects; and
- provision of groundcover in areas of acid soils and during droughts (erosion, weed control and productivity).

These benefits are promoted in many existing policies. The Recovery Plan identifies actions aimed at ensuring that conservation of NTG–ST is addressed in existing and future policies.

2 The Ecological Community

2.1 Description of the Community

In the declaration as an endangered ecological community under the EPBC Act, NTG–ST is described as follows:

The community is dominated by moderately tall (25-50 cm) to tall (50 cm-1.0 m), dense to open tussock grasses with up to 70% of the species being forbs. The community may be treeless or contain up to 10% cover of trees, shrubs or sedges. In the Southern Tablelands, Natural Temperate Grasslands are located at altitudes between 560 and 1200 metres in valleys influenced by cold air drainage and in broad plains. The community occurs within the geographical region of the Southern Tablelands of NSW and ACT, which extends southwards from the Abercrombie River to the Victorian Border, from Boorowa and Jindabyne to the west and Goulburn to Braidwood and Bombala to the east (Environment Australia 2000a).

Examples of the community are shown in Photos 1 and 2. A more detailed description of the ecological community follows.

DEFINITION OF NATURAL TEMPERATE GRASSLAND

Natural Temperate Grassland is a native ecological community that is dominated by native species of perennial tussock grasses. The dominant grasses are *Themeda triandra*, *Austrodanthonia* species, *Austrostipa* species, *Bothriochloa macra* and *Poa* species. The upper canopy stratum generally varies in height from mid-high (0.25-0.5 m) to tall (0.5-1.0 m). There is also a diversity of native herbaceous plants (forbs), which may comprise up to 70% of species present. The community is naturally treeless or has less than 10% projective foliage cover of trees or shrubs in its tallest stratum. The ecological community that makes up NTG–ST is defined by the vegetation structure thought to have been present at the time of European settlement.

COMPOSITION

In addition to a wide variety of grasses, native grasslands in their natural state contain a high diversity of forbs including sedges, rushes, orchids, lilies and broad-leaved herbs such as daisies. About 700 species of native herbs have been identified in grasslands of south-eastern Australia, the majority of which are not grasses (Eddy 2002). 'Bare ground' in grasslands may be covered by a layer of lichens and mosses (the 'cryptogamic crust'). The community is naturally treeless, reflecting limits to the natural growth of trees in

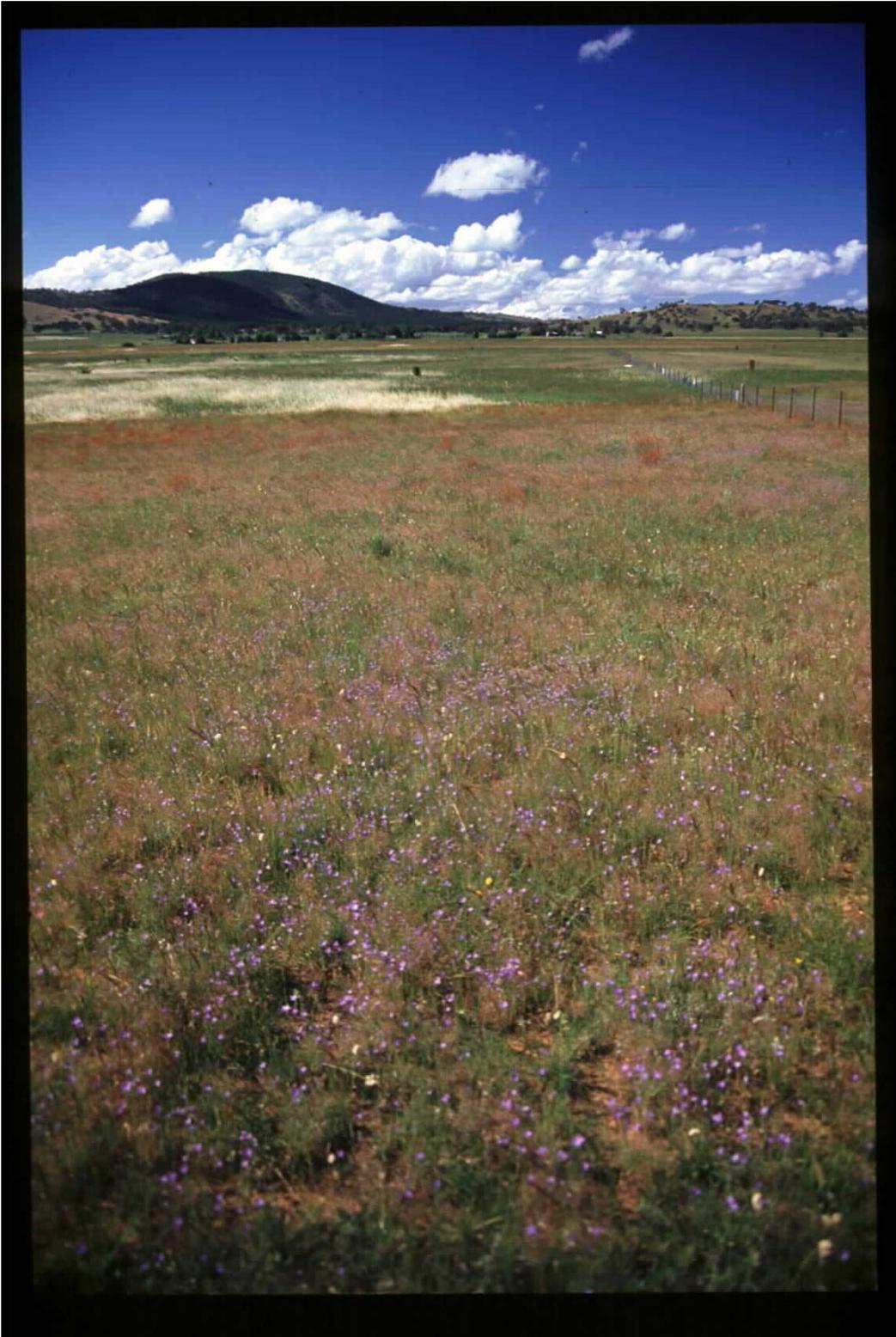


Photo 1: Natural Temperate Grassland at the Majura Field Firing Range, ACT.
(ph. Sarah Sharp)



Photo 2: Grassland in full flower at Top Hut TSR near Adaminaby in December
(ph. David Eddy)

valleys subject to cold air drainage, but may contain very sparse trees or shrubs (up to 10% projective foliage cover) (Moore 1964; Kirkpatrick 1993). To simplify assessment, Lunt *et al.* (1998) estimated that this cover is equivalent to a tree cover of less than one mature tree per hectare. The degree of tree cover remains a contentious attribute in defining the range of native grasslands (Carter *et al.* 2003).

Natural Temperate Grassland intergrades on slopes at slightly higher elevations with grassy woodland (defined as having a tree cover greater than 10% projective foliage cover). Natural Temperate Grassland may contain poorly drained areas, and in low parts of the landscape, wetlands or drainage lines with a characteristic flora (including wetland species such as sedges and rushes) (Moore 1964). These wetlands and the fauna associated with the moister conditions are a component of the grassland community.

STRUCTURE

Perennial tussock grasses impart a characteristic structure to Natural Temperate Grassland. The tussocks are often closely spaced, forming an upper stratum of loosely interlacing leaf canopies (Costin 1954; Sharp 1997). This upper canopy stratum generally varies in height from mid high (0.25–0.5 m) to tall (0.5–1.0 m), and in cover from open to dense (greater than 70% ground cover) (Walker and Hopkins 1984).

A second, lower stratum may be discernible, typically comprising shorter perennial and annual grasses and forbs growing between the taller tussocks. At ground level, there may also be a third discontinuous stratum of dwarf forbs and grasses, with occasional mosses and lichens also present on 'bare ground' forming a 'cryptogamic crust' (Costin 1954; Lunt *et al.* 1998). The community often includes areas of embedded rocks, which provide habitat for animals.

FLORISTICS

Natural Temperate Grassland vegetation types that form part of the listed ecological community have been described in detail for the southern South Eastern Highlands bioregion (Benson 1994) and for the Australian Capital Territory (Sharp 1997, ACT Government 2005). Benson distinguished six different communities on the Monaro Tableland. In the Australian Capital Territory five communities have been identified (Sharp 1997). The latter communities broadly correspond with five of Benson's communities. Field studies in grasslands north and east of the ACT have shown that their dominant species are the same as the communities described by Benson (1994) and Sharp (1997) but differences exist in their forb and associated tree species (R. Rehwinkel pers. comm.). These northern and eastern communities are yet to be formally classified.

The presence of these associations is related to both intrinsic site factors and land use practices since European settlement. In particular, drainage patterns related to slope and landform, soil characteristics, and intensity of land use appear to influence these floristic associations. These factors also affect the plant species present in sites, their

characteristic life and growth form, and the degree of invasion by exotic species (Sharp 1997).

In the Southern Tablelands of NSW and the ACT, dominant grasses include Kangaroo Grass *Themeda triandra*, wallaby grasses *Austrodanthonia* spp., spear grasses *Austrostipa* spp., Red Grass *Bothriochloa macra* and tussock grasses *Poa* spp. (Benson and Wyse Jackson 1994; Benson 1994; Sharp 1997).

Themeda triandra and Snow Grass *Poa sieberiana* are co-dominant in a variety of landscape positions and soil types. In wetter areas, such as moist flats, *Themeda* dominates the grassland with Pinrush *Juncus filicaulis*, while River Tussock *Poa labillardieri* is dominant along drainage lines, seepage areas, creeks and river flats. *Poa sieberiana* is dominant on the undulating basalt plains of the Monaro. The upper slopes, hill crests and ridges with well drained soils are generally dominated by Corkscrew *Austrostipa scabra* subsp. *falcata* and Tall Speargrass *A. bigeniculata*, while species of *Austrodanthonia* and *Bothriochloa macra* dominate gentle slopes, ridges and flats with well drained, shallow to skeletal soils. Present grass species dominance is thought to have changed significantly since European settlement because of past land uses. Other grasses such as Common Wheat Grass *Elymus scaber* and Nineawn Grass *Enneapogon nigricans* may also be present frequently, in the inter-tussock spaces.

Forbs present in the tussock grasslands include many species able to regenerate by vegetative means from buds buried in the soil, present at the ground level where they are protected by surrounding soil or litter, or on aerial shoots to 25 cm above ground level (Costin 1954). The graminoid and forb species composition at any one site is thought to be influenced by the amount of litter present, the amount of bare ground and inter-relationships between particular exotic species and native species and the dominant grasses.

Native forb species frequently forming part of the ecological community are outlined in Eddy *et al.* (1998). They include rushes and sedges (e.g. Knob Sedge *Carex inversa*, Common Bog Sedge *Schoenus apogon*), mat rushes (e.g. Wattle Mat-rush *Lomandra filiformis*), lilies (e.g. Early Nancy *Wurmbea dioica*, Bulbine Lily *Bulbine bulbosa*), orchids (e.g. Golden Moths *Diuris chryseopsis*, Common Onion Orchid *Microtis unifolia*), ferns (e.g. Rock Fern *Cheilanthes austrotenuifolia*), and other forbs (e.g. Sheep's Burr *Acaena ovina*, Common Woodruff *Asperula conferta*, Caustic Weed *Chamaesyce drummondii*, Common Everlasting or Yellow Buttons *Chrysocephalum apiculatum*, Australian Bindweed *Convolvulus erubescens*, Austral Bears-ear *Cymbonotus lawsonianus*, Slender Tick Trefoil *Desmodium varians*, Billy Buttons *Craspedia variabilis*, Leafy Daisy *Brachyscome rigidula*, Tufted Bluebell *Wahlenbergia communis*, Austral Bugle *Ajuga australis*, Blue Devil *Eryngium ovinum*, Native Geranium *Geranium solanderi*, Variable Plantain *Plantago varia* and Kidneyweed *Dichondra repens*) (Purdie, pers. comm.).

Trees and shrubs are usually absent from the vegetation, but when present have a projective foliage cover of 10% or less. Tree species that occur are mainly those found in

adjacent woodlands e.g. Blakely's Red Gum *Eucalyptus blakelyi*, Yellow Box *E. melliodora*, Apple Box *E. bridgesiana*, Snow Gum *E. pauciflora*, Candlebark *E. rubida* and Silver Wattle *Acacia dealbata*. Trees commonly associated with NTG–ST in the eastern part of its distribution are Black Gum *E. aggregata*, Swamp Gum *E. ovata*, Snow Gum *E. pauciflora*, Candlebark *E. rubida* and Manna Gum *E. viminalis*. *Eucalyptus pauciflora*, *E. rubida*, *E. stellulata* (Black Sally) and *E. viminalis* are commonly associated with grasslands on the Monaro (R. Rehwinkel pers. comm.).

Shrubs found in the ecological community include Daphne Heath *Brachyloma daphnoides*, Peach Heath *Lissanthe strigosa*, Urn Heath *Melichrus urceolatus*, Bitter Cryptandra *Cryptandra amara*, Broom Bitter Pea *Daviesia genistifolia*, Gruggly Bush or Tree Violet *Hymenanchera dentata*, Grey Guinea Flower *Hibbertia obtusifolia*, Creeping Hop-bush *Dodonaea procumbens* and Small-fruited Hakea *Hakea microcarpa* (Eddy *et al.* 1998).

FAUNA

An integral part of the NTG–ST community is the fauna, ranging from large herbivores such as kangaroos to a multitude of invertebrates. Many small mammals (e.g. bandicoots, bettongs, rat kangaroos, rats) are known to have occupied the grasslands and may have been important agents of disturbance (Whalley 2003). The rapid transformation of the grasslands by pastoral activity from the early 1800s resulted in the decline or extinction of many species (Lunt *et al.* 1998).

Animals are intrinsic to the overall functioning of grassy ecosystems. Animals are essential for pollination and dispersal of many grassland plants and are involved in nutrient recycling and maintenance of soil condition. Grasslands provide habitat for animals and are a source of food for both herbivores and predators. Invertebrates are the dominant faunal element in grasslands and are involved in most ecological processes (Sharp and Dunford 1994; Yen 1995).

Australian grasslands have evolved under grazing from a range of animals, including kangaroos, wallabies, wombats and other herbivores such as termites. The population sizes (or densities) of grazing animals are determined largely by seasonal abundance of the grassland plants upon which they feed. In turn, plant species composition and abundance of grassland vegetation are affected by the population size of grazers (grazing intensity) and seasonal conditions (rainfall and temperature). Thus grazers and grasslands are linked in a complex feedback loop driven by fluctuating seasonal conditions.

Surveys of threatened fauna indicate a strong correlation between grassland floristic associations and habitat for certain species. This is possibly because of the different structural environments that are provided in terms of the amount of litter, solar radiation, moisture and humidity. For example, the threatened reptile Striped Legless Lizard *Delma impar* appears to favour grasslands dominated by either *Themeda triandra* or *Austrostipa bigeniculata* that have a relatively intact grass sward and a moderate extent of grass litter through the paddocks (Osborne 1994, Sharp 1995). In contrast, the threatened Grassland

Earless Dragon *Tympanocryptis pinguicolla* and Golden Sun Moth *Synemon plana* require short, more open grasslands dominated by *Austrodanthonia* species (Sharp 1995; Osborne *et al.* 1995). Where threatened species are present, management regimes for grassland should take account of their individual habitat and life cycle requirements.

The fauna found in NTG–ST typically includes a rich diversity of invertebrates, reptiles, amphibians and birds (including several specialist grassland species). The more common grassland species include Delicate Skink *Lampropholis delicata*, Spotted Marsh Frog *Limnodynastes tasmaniensis*, Spotted Burrowing Frog *Neobatrachus sudelli*, Richard’s Pipit *Anthus novaeseelandiae*, Brown Quail *Coturnix ypsilophora* and Stubble Quail *C. pectoralis*. Latham’s Snipe *Gallinago hardwickii*, a species protected under migratory bird agreements with Japan (JAMBA) and China (CAMBA), utilises wetlands in NTG–ST sites (ACT Government 1997). Generalist species such as the Australian Magpie *Gymnorhina tibicen* and Eastern Grey Kangaroo *Macropus gigantea* use the grassland community for foraging. Some characteristic grassland fauna species are no longer found within NTG–ST including the Emu *Dromaius novaehollandiae*, Australian Bustard *Ardeotis australis* and Little Button-quail *Turnix velox* (Frith 1969).

Little is known about the past and present distribution and ecology of many of the grassland fauna, particularly invertebrates, though some species have been the subject of detailed studies in recent years (especially the Grassland Earless Dragon, Striped Legless Lizard and Golden Sun Moth). Further studies are required to investigate abundance, distribution and habitat use of a range of grassland faunal species. Appropriate management strategies also need to be developed to ensure the species are adequately conserved as part of the NTG–ST community.

Given the lack of information on distribution and abundance of the wide range of grassland fauna, the diversity of plants and structure of the community is taken to be a surrogate for the continued presence of the typical native grassland fauna.

WEEDS

Weeds are now a significant component of the floristics of most Natural Temperate Grassland sites (for more detail, see Section 3.1). Surveys show that exotic species comprise over 35% of the flora at most native grassland sites in the Monaro region of the Southern Tablelands (Benson 1994; Sharp 1997). The majority of these exotic species are annuals (Sharp 1997). Exotic species have either invaded through natural processes, often assisted by human activity, or have been sown as pasture species e.g. clovers *Trifolium* species and Phalaris or Canary Grass *Phalaris aquatica*. In the ACT, even the remaining grassland considered to be only partially to moderately modified may have more than 20% cover of exotic plants (ACT Government 2005).

Frequent weed species include grasses: hairgrasses *Aira* spp., bromes *Bromus* species and Rat’s Tail Fescue *Vulpia myuros*; and forbs such as Sorrel *Acetosella vulgaris*, Chickweed *Cerastium glomeratum*, Black Thistle *Cirsium vulgare*, Catsear *Hypochaeris radicata*, Erect Chickweed *Moenchia erecta*, Ribwort Plantain *Plantago lanceolata* and

clovers, Chilean Needlegrass *Nassella neesiana* and Patterson's Curse *Echium plantagineum* are more characteristic of northern and eastern grasslands, while Serrated Tussock *Nassella trichotoma*, Viper's Bugloss *Echium vulgare* and African Lovegrass *Eragrostis curvula* are more characteristic of grasslands in the south. Shrubby weed species include Sweet Briar *Rosa rubiginosa*, Hawthorn *Crataegus* spp. and Firethorn *Pyracantha* spp..

KEY DEFINING CHARACTERISTICS OF NATURAL TEMPERATE GRASSLAND OF THE SOUTHERN TABLELANDS

Following on from the description of the community above, the key defining characteristics to identify NTG–ST in the field are:

- a. Occurrence within the temperate lowland zone of the Southern Tablelands where tree growth is climatically limited (elevation up to approximately 600 m in the central and northern areas and up to 1200 m in the south);
- b. Treeless or containing up to 10% projective cover of trees, shrubs or sedges;
- c. Dominated by native grasses and/or native forbs (more than 50% total vegetative cover, excluding introduced annuals); and
- d. A diversity of native forbs present, or if disturbed, having components of the indigenous native species (including both existing plants and reproductive propagules in the soil e.g. soil seed banks) sufficient to re-establish the characteristic native groundcover.

Sites that meet the defining characteristics of Natural Temperate Grassland encompass those that clearly demonstrate the natural ecological function of grasslands and those that may be deficient in some respects, but which are also considered recoverable. However, the distinction between what constitutes the ecological community and what are degraded remnants that are beyond recovery may not always be readily apparent. Further ecological survey and assessment (an action identified in this plan) may be necessary to clarify which sites warrant protection or recovery action

In addition to the ecological attributes that characterise Natural Temperate Grassland, an assessment of rarity is also important when determining the extent to which a site might be protected. The Monaro and ACT sub-regions of the Southern Tablelands have a number of grassland sites, including those of a reasonable size (greater than 10 ha), that have retained the essential characteristics of Natural Temperate Grassland. Few such sites remain in the North-western and Eastern sub-regions, where much of the remaining extent of NTG has been subject to a relatively higher degree of disturbance such as ploughing, cropping, fertiliser application and grazing pressure. Therefore, they show a lower degree of diversity and integrity and they may be the only remaining representatives of the pre-1750 distribution Natural Temperate Grassland.

Sites that do not have the characteristics of the Natural Temperate Grassland ecological community may have significant value in the landscape, for example, as habitat for grassland fauna, as ecological buffers for more diverse remnants, and as important

corridors between remnants or they may represent all that remains of the former ecological community in a sub-region. These values may be used to support protection, even though in their own right these areas do not retain the defining characteristics of the community.

Detailed guidelines that take these factors into account are being prepared by NSW and ACT agencies for use in field assessment of individual sites.

2.2 Past and Present Distribution of the Community

Natural Temperate Grassland of the Southern Tablelands (ACT and NSW) is geographically and climatically isolated from natural temperate grassland elsewhere in south-eastern Australia and is recognised as an ecological community that is distinguishable from other natural temperate grassland communities (McDougall and Kirkpatrick 1993; Benson 1994; Kirkpatrick *et al.* 1995). The community is located in the 'Southern Tablelands' region of south-eastern NSW and ACT. This area is bounded by the Snowy Mountains and Brindabella Range in the south-west, coastal ranges (including the Kybeyan and Budawang Ranges and the escarpments to the east) and extends north to the Abercrombie River. The north-western boundary extends from Burrinjuck Dam to Boorowa, then east to the Lachlan River and north to Wyangala Dam (Figure 1). NTG–ST occurs within the 'South Eastern Highlands region' as defined in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995). This region now includes part of north-eastern Victoria (Environment Australia 2000b).

Three sub-regions are recognised within the Southern Tablelands, reflecting the biogeographic range of component species, and differences in temperature and rainfall. These climatic factors influence the composition and structure of NTG–ST. While the ACT is climatically similar to the north-western sub-region, it is regarded as a sub-region on the basis of significant differences in levels of disturbance, land uses, management and threats. The sub-regions overlap at their boundaries and are defined as:

1. **Monaro sub-region:** Victorian border to south-eastern border of ACT and west to Kosciuszko National Park (includes Michelago, Cooma, Jindabyne and Bombala).
2. **Eastern sub-region:** area east and north-east of the ACT covering the upper Wollondilly River, upper Shoalhaven River and Lake George catchments (includes Taralga, Goulburn, Bungendore and Braidwood).
3. **North-western sub-region:** area north of the ACT covering part of the Murrumbidgee and Lachlan River catchments (includes Boorowa, Crookwell, Yass, Gunning and Queanbeyan).
4. **ACT:** defined by the political boundary.

PAST DISTRIBUTION

The pre-European distribution of Natural Temperate Grassland in the Southern Tablelands is believed to have been influenced by a combination of environmental factors, including low temperatures due to cold air drainage in winter, periods of low soil moisture availability in summer associated with the heavy clay soils, and low rainfall in some areas. At the time of European settlement, NTG–ST was widespread as part of a woodland – grassland mosaic (Benson 1994, Fallding 2002) (Figure 1). However, lack of knowledge of the characteristics of this mosaic means that an accurate assessment of the area of NTG–ST prior to European settlement is not possible. Estimates of the former extent of NTG–ST range from approximately 360 000 ha or less (Thomas *et al.* 2000) to approximately 480 000 ha or more (Rehwinkel 1997). NTG–ST was common on the broad plains at lower elevations (500 m to about 1000 m) that are subject to cold air drainage including the Monaro, Bungendore, Gundary, Yass and Limestone Plains (Canberra area) (Pryor 1938, Costin 1954, Rehwinkel 1997). Additionally, smaller areas occurred on various substrates and topographical locations from Crookwell to the upper Shoalhaven River, and in the Boorowa and Yass regions (Rehwinkel 1997).

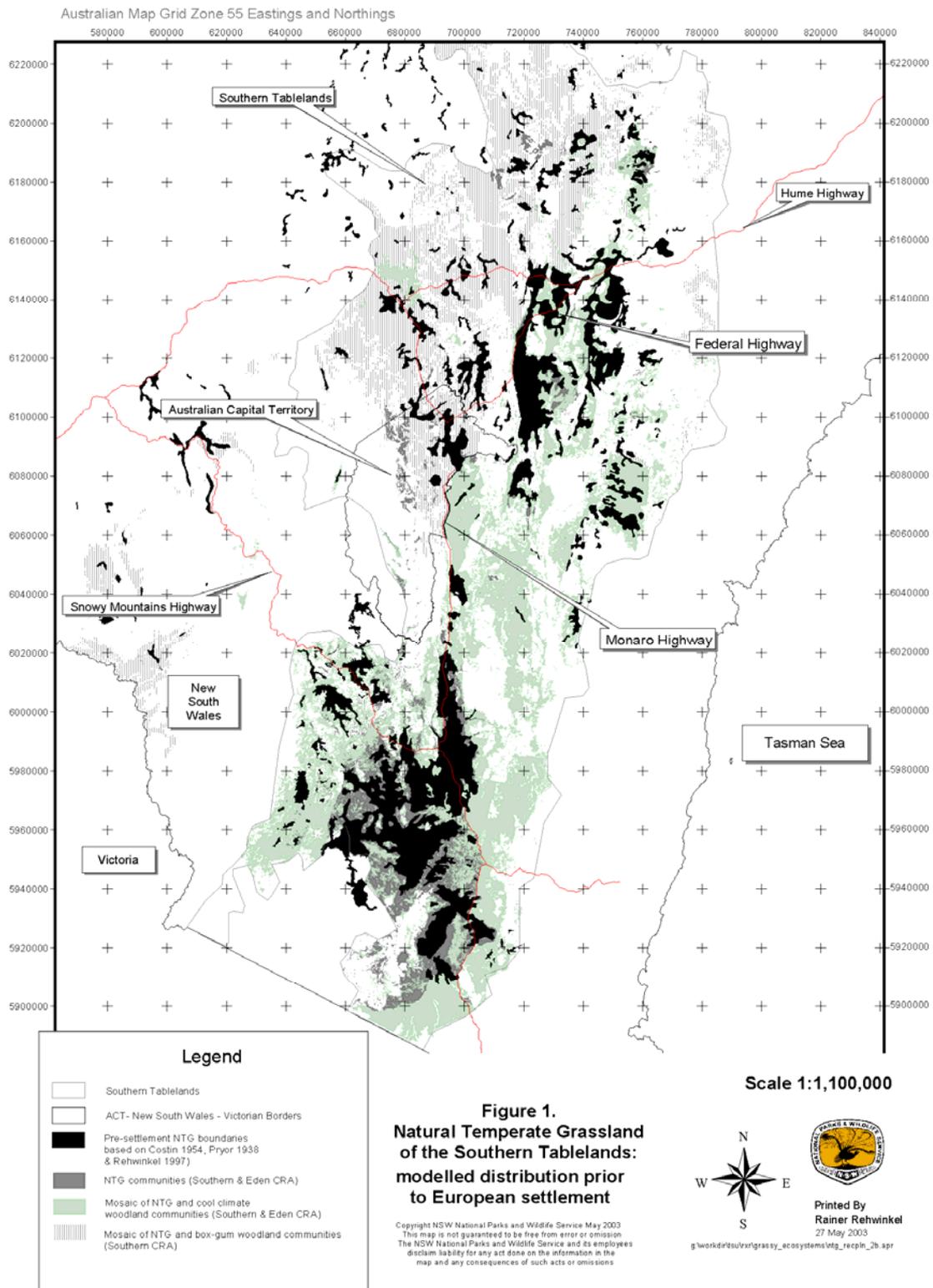
PRESENT DISTRIBUTION

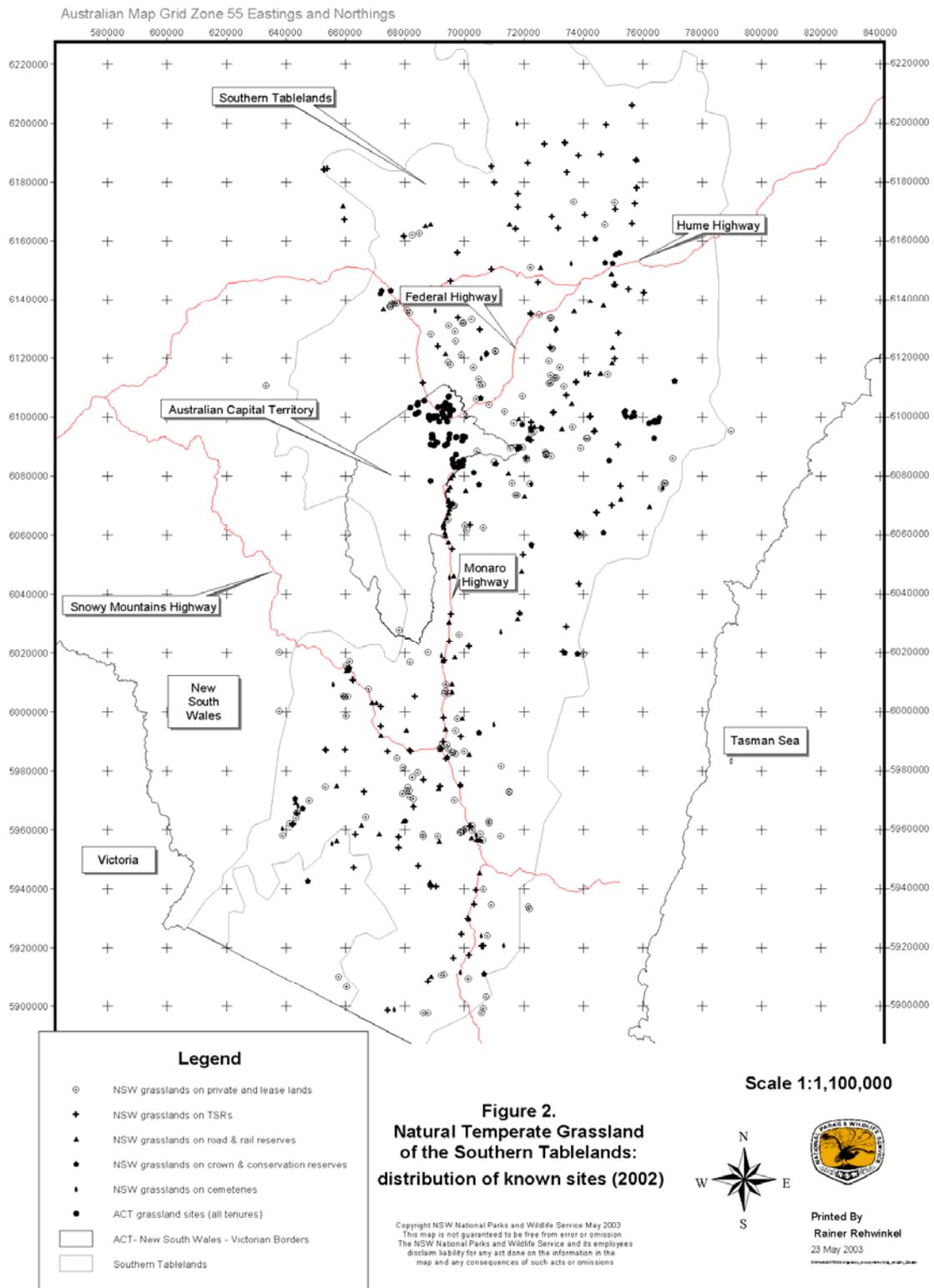
European land uses, particularly grazing, pasture improvement, cropping, the introduction of exotic species (including pasture species), changes to the pattern of burning and urban development and infrastructure, have greatly reduced the extent and integrity of Natural Temperate Grassland in the region. Of the NTG–ST ecological community that existed in the Southern Tablelands at the time of European settlement, there is probably less than three percent remaining that retains a level of ecological integrity.

Disconnected areas of NTG–ST of varying conservation significance are all that remain of the pre-European distribution of the community in NSW (Benson 1994, Rowell 1994, Rehwinkel 1996a, 1996b, 1996c) and the ACT (Sharp 1997, ACT Government 2004) (Figure 1). Many remaining sites are small (less than 10 ha). Some of the largest sites (over 100 ha) are on private land and on Australian Government occupied land, including areas managed by the Department of Defence. Some travelling stock reserves (TSRs) are also relatively large (25–60 ha).

The Southern Tablelands have not been uniformly surveyed for the presence of Natural Temperate Grassland. Ecological surveys were initially focused on the ACT (which has been comprehensively surveyed) and to a lesser extent the Monaro sub-region. More recently, the North-western and Eastern sub-regions have been the subject of survey effort. Private land in NSW is inadequately surveyed across all sub-regions and information regarding the location and boundaries of sites across all land tenures is incomplete.

A map showing the known distribution of sites assessed as meeting the definition of the NTG–ST community (Figure 2) indicates a bias towards the ACT and central parts of the





Southern Tablelands. As well as the greater survey effort there, this is due also to many of the sites being on public rather than private land.

In the NSW portion of the Southern Tablelands, over 400 sites on both public and private land (covering more than 7 000 ha) have been identified as containing NTG–ST in fair to good condition. A similar amount, as yet unsurveyed, is likely to exist on private land.

Lowland native grassland sites have been comprehensively surveyed in the ACT, most recently in 2003–4 as part of the preparation of the *ACT Lowland Native Grassland Conservation Strategy* (ACT Government 2005). The number of sites containing native grassland (which may or may not be assessed as Natural Temperate Grassland) is 47, totalling 2172 ha. Of these 47 sites, 42 (totalling 1534 ha) contain 991 ha of Natural Temperate Grassland. The latter is about 5% of the estimated original area of 20 000 ha. These sites also contain areas of native pasture (385 ha) and exotic grassy vegetation (157 ha). Vegetation on the other five sites is assessed as not being Natural Temperate Grassland because it lacks the native species diversity that is a characteristic of the ecological community in the ACT.

2.3 Threatened and Uncommon Plants and Animals Associated with Natural Temperate Grassland of the Southern Tablelands

Natural Temperate Grassland of the Southern Tablelands supports a number of species listed as endangered, vulnerable or threatened internationally, nationally and in the ACT, NSW and Victoria (Table 1). Some of these species are declared threatened in one jurisdiction, but not in others.

Many other plant and animal species occurring in grasslands are rare or uncommon, occurring either in low densities within sites, or in very few sites in the region. The abundance and distribution of many of these is poorly known. While some of these species may not necessarily be confined to the NTG–ST community, it is possible that they will become further threatened in that community should the existing threatening processes continue to operate. Unpublished data from recent studies are revealing more species with very low population densities in NTG–ST (R. Rehwinkel pers. comm., S. Sharp pers. comm.). The data on these species will need to be assessed in order to ensure their inclusion within any strategy to protect the full variety of species in NTG-ST.

2.4 Grassy Communities Adjacent to Natural Temperate Grassland of the Southern Tablelands

Natural Temperate Grassland of the Southern Tablelands intergrades with grassy woodland communities (containing 10–30% projective foliage cover of trees) on the lower hill slopes, forming a vegetation mosaic. The woodland communities include Yellow Box (*Eucalyptus melliodora*)–Red Gum (*E. blakelyi*) Grassy Woodland (declared endangered under the NCA Act (ACT)), and White Box Yellow Box Blakely’s Red Gum Woodland (declared an endangered ecological community under the TSC Act (NSW)). In large parts of the eastern and southern range of NTG–ST, the community exists within a mosaic of woodlands dominated by Snow Gum *E. pauciflora*, Manna Gum *E. viminalis* and other cold-climate woodland tree species (Fallding, 2002).

2.5 Other Native Grassland Communities

The following native grassland communities bear some resemblance to the structure and species composition of NTG–ST but are not the subject of this recovery plan. These grasslands may be included under definitions of other threatened communities or under legislation covering clearance of native vegetation. They may provide habitat for threatened plants and animals, the conservation of which is more appropriately dealt with in recovery plans for those species.

HIGHLY MODIFIED NATIVE GRASSLAND

Further loss of native floristic diversity and weed invasion has resulted in large areas of the Southern Tablelands containing highly modified native grassland (sometimes referred to as native pasture). These grasslands are at the other end of the continuum from high quality Natural Temperate Grassland sites that retain most of their ecological integrity. It is estimated that about five percent of the pre-European extent of Natural Temperate Grassland in the Southern Tablelands now exists as native grassland that may have a low to high cover of native grasses, low to high cover of exotic species, but very low to no forb diversity. Previously, these grasslands may have been intensively grazed, and may have undergone some level of deliberate pasture modification (sowing of introduced species including crops, legumes or perennial pasture species, and application of fertiliser). Such grasslands may also have a high content of introduced perennial species, in particular, persistent species such as *Phalaris aquatica*, or invasive species such as St John’s Wort *Hypericum perforatum*, African Lovegrass *Eragrostis curvula*, Serrated Tussock *Nassella trichotoma* and Chilean Needlegrass *Nassella neesiana*. There may also be a low diversity of native forbs, which are generally those that are the most disturbance tolerant species. However, because of their high exotic content, it is unlikely that such grasslands have much capacity for either natural or assisted rehabilitation, as they are unlikely to have the soil seed-store that would allow them to rehabilitate naturally.

Notwithstanding their depleted condition, highly modified native grassland sites may have a role in landscape function (e.g. erosion and groundwater management, salinity control and resistance to weed invasion), provide important habitat for threatened animal species, have value as ecological buffers and corridors, or they may represent all that remains of a particular floristic association of the former ecological community in a region. With appropriate management these sites may have some capacity for restoration and make a contribution to the conservation of the natural resources in a region.

SECONDARY OR DERIVED GRASSLANDS

Secondary grasslands are derived from grassy woodlands or forests that have been extensively cleared of trees since European settlement, through intentional removal, dieback or prevention of natural regeneration (Benson 1996). Species composition in these sites is often very similar to natural grasslands, but they may also contain shrub and forb species more characteristic of the community from which they are derived. Species diversity in these sites ranges from very high to low, similar to that of natural grasslands. Some secondary grasslands, therefore, have important ecological values in their own right (which may include habitat for threatened species) and may warrant consideration for protection, management and rehabilitation. Secondary grasslands in which Yellow Box and Blakely's Red Gum were dominant prior to clearance are included in the Yellow Box/Red Gum grassy woodland endangered ecological community. Similarly, grasslands in NSW derived from the clearing of White Box Yellow Box Blakely's Red Gum Woodland are regarded as part of that endangered community.

2.6 Condition of Lowland Native Grassland in the ACT

The remaining areas of lowland native grassland can be considered on a continuum from those that appear largely intact (similar to their estimated pre-1750 state though there are likely to be changes in component species) to those in a substantially modified state with only a few elements representing their original composition and structure. In the ACT, categories of remaining lowland native grassland have been established that reflect varying degrees of modification (ACT Government 2005). This categorisation can be used to classify sites by their condition and identify: (a) sites that are recoverable and perform significant functional roles (and therefore constitute the endangered ecological community); and (b) those that contain too few characteristics to be recoverable. However, the latter may have other values such as buffering to less disturbed remnants, corridors between remnants or habitat for threatened grassland species.

A similar framework is being developed for the NSW distribution of NTG-ST.

3 Reasons why the Ecological Community is considered to be Endangered

Natural Temperate Grassland of the Southern Tablelands is considered endangered within the meaning of the EPBC Act due to the severe decline in its extent, the fragmented distribution and isolation of many remaining sites, and modification of the community composition, structure and ecological processes (Environment Australia 2000a, ACT Government 2005).

3.1 Changes to Natural Temperate Grassland since European Settlement and Ongoing Threats

Some form of degrading disturbance threatens all grassland remnants, even those in permanent reserves. As noted previously, Natural Temperate Grassland has been reduced to small and disconnected fragments across its former range throughout south-eastern Australia. An estimated 99.5% has been destroyed or grossly altered since European settlement (Kirkpatrick *et al.* 1995). In most areas the grassland has been replaced completely by plant introductions associated with the European pastoral and agricultural economy or by urban and infrastructure development. In other areas, it has been partly transformed both intentionally and inadvertently (e.g. through weed invasion) and survives with varying levels of modification. There are small remnants that give an indication of the presumed character of Natural Temperate Grassland prior to European settlement, commonly in cemeteries, churchyards, on roadsides or in travelling stock reserves. A shared feature of these places is that they have not been subject to continual grazing and have not been subject to intensive pasture improvement or cropping (Benson 1994). Characteristically, they have a rich forb diversity and grass species intolerant of continuous grazing pressure are present.

Following European settlement, a number of factors have been responsible for the loss of Natural Temperate Grassland and modification of the remnants in the Southern Tablelands. These factors generally remain as ongoing threats. The changes and threats may be categorised as follows:

- **Pastoral and agricultural development:** The first modifications to the Natural Temperate Grasslands in the Southern Tablelands occurred when, from 1830, the area was carved up into grazing runs. Small-scale pasture improvement began in the 1860s and clovers were first sown in the 1920s. Intensive pasture modification involving the use of Subterranean Clover *Trifolium subterraneum* and application of superphosphate was undertaken after the Second World War (Benson and Wyse Jackson 1994). This accelerated the loss of native grassland.

Where native grassland has not been completely replaced by sown crops or the application of extensive improvement practices, the ecological effects of grazing depend upon its intensity and timing, and length of time that the area has been grazed. Most of the impacts of stock grazing have been inferred by comparing the vegetation at sites

protected from grazing (or known to have been only lightly grazed), with more intensively grazed sites. Grazing can affect grassland species and the ecological community through the removal of biomass, trampling, increased soil nutrient status, increased weediness (through creation of bare ground, dispersal of seeds, introduction of weeds through fodder), destruction and modification of faunal habitat, soil erosion, and loss of soil moisture (Sharp 1994). Plant species sensitive to grazing become less common as the ecological community is simplified (Moore 1967).

Changes in species composition and loss of floristic diversity are two of the significant changes that occur in heavily grazed grasslands. On the Monaro, for example, speargrasses have probably replaced more palatable species such as Kangaroo Grass as they were grazed out. Speargrasses now dominate many native pastures on the Monaro (Eddy *et al.* 1998). Perennial grasses such as Red Grass, wallaby grasses and speargrasses become more prominent as grazing intensity increases. Decades of pasture improvement have contributed to substantial changes in the floristic composition of Natural Temperate Grassland.

Much of the biodiversity of native grasslands is made up of species other than grasses. As well as being trampled, lilies, orchids and forbs are less likely to survive under heavy grazing due to their palatability and failure to set seed (especially upright forbs from which grazing removes the reproductive parts). Palatable forbs can be lost, even at low grazing intensities, with little obvious effect on the dominant grasses (Lunt 1991).

It should be noted that there has been a significant improvement in knowledge of and recognition of native grasslands in the last 15 years, and interest on the part of landholders in conserving remnant native grassland on their properties. This is reflected, for example, in the establishment of Conservation Management Networks, four of which are established in grassy ecosystems of south-eastern Australia (Thiele *et al.* 2003).

Lunt (2005) has reviewed the literature relating to the effects of stock grazing on biodiversity values in grassy ecosystems in south-east Australia and identified principles for grazing management in conservation areas.

- **Urban and Infrastructure Development:** This is particularly relevant to the ACT where the most extensive areas of Natural Temperate Grassland have been destroyed during the development of urban Canberra. Some fragments of the former grasslands remain, with the larger remnants located in areas set aside for special purposes such as radio beacons, the airport and military uses. Other smaller areas remain on urban blocks, on land originally set aside for future government uses and on current and former rural leases. Some contain very high quality remnants of Natural Temperate Grassland and/or populations of threatened species. In recent years, the conservation values of the remaining native grassland areas in the ACT, Queanbeyan and Bungendore have been recognised in land-use planning, resulting in significant planning changes and establishment of grassland reserves.

Threats to remaining grassland areas from urban and infrastructure development are of two types: direct loss of sites, and deleterious impacts on the natural integrity of the grassland from adjacent urban areas. Urban edge threats can be lessened at the planning stage (e.g. by allowing adequate buffers and not permitting housing on the outer edge of perimeter roads) and by effective management of remnants involving the local community.

- **Weed Invasion:** Weeds are a major threat to all grassland remnants. Grassland vegetation appears particularly prone to weed invasion, probably due to its location on fertile soils (Kirkpatrick *et al.* 1995). Many weeds e.g. hairgrasses *Aira* spp. and Quaking Grass *Briza minor* are indicative of levels of past disturbance and now function as part of the grassland vegetation without apparently threatening the integrity of the surviving native plants (Kirkpatrick *et al.* 1995; Eddy *et al.* 1998). However, they may be replacing or out-competing annual or spring flowering native species and could be critical in terms of native species richness and diversity (Sharp 1995). Weeds are favoured by soil disturbance, changes to drainage and nutrient levels (sites that become wetter are often subject to increases in nutrients from upslope fertiliser application) and in some instances, fire.

Categories of plants that have become established as weeds in Natural Temperate Grassland include: annual grasses (e.g. Rat's Tail Fescue and Squirrel Tail Fescue *Vulpia* spp., barley grasses *Hordeum* spp.); annual and biennial forbs (e.g. Viper's Bugloss *Echium vulgare*, Great Mullein or Aaron's Rod *Verbascum thapsus*); perennial grasses (Sweet Vernal Grass *Anthoxanthum odoratum*, Yorkshire Fog *Holcus lanatus*, Chilean Needlegrass *Nassella neesiana*, Serrated Tussock *N. trichotoma*, Phalaris or Canary Grass *Phalaris aquatica*, Bulbous Bluegrass *Poa bulbosa*); perennial forbs (e.g. St John's Wort *Hypericum perforatum*); and shrubs or woody weeds (e.g. Hawthorn *Crataegus monogyna*, African Boxthorn *Lycium ferocissimum*, Sweetbriar *Rosa rubiginosa*) (Rowell 1994; Sharp 1995; Rehwinkel 1996a,b,c; Eddy *et al.* 1998; Sharp and Rehwinkel 1998; Eddy 2002).

The following perennial and highly invasive weed species are of particular concern in the Southern Tablelands:

- African Lovegrass (*Eragrostis curvula*). This is an aggressive, tenacious, drought and frost tolerant species capable of dominating the ground flora on lighter low-nutrient soils (Muyt 2001).
- Serrated Tussock (*Nassella trichotoma*). A Weed of National Significance, Serrated Tussock is widespread in the Southern Tablelands, but may have occupied only 20% of its potential range. It has broad site tolerance and is highly invasive. Mature plants develop a drooping, smothering form eventually excluding other ground flora and are capable of producing 100 000 seeds annually with some remaining viable for 10–15 years (Parsons and Cuthbertson 1992; Muyt 2001).
- Chilean Needlegrass (*Nassella neesiana*). A Weed of National Significance, Chilean Needlegrass is one of the most threatening invasive plants of grassy

ecosystems in south-eastern Australia and has spread rapidly since 1990. Its adaptability to a wide range of conditions, large persistent seed bank, ease of seed dispersal, and tolerance of various treatments make control extremely difficult. Plants tolerate periodic inundation, extended dry periods, fire and heavy grazing and are adapted to low or high fertility soils, moderate shade or sunny locations (Muyt 2001). The species was surveyed in the ACT in 2000 and 2002 and found to be present in or adjacent to 85% of Natural Temperate Grassland sites.

- St Johns Wort (*Hypericum perforatum*). This species is a major weed of grasslands, grassy woodlands and forests in south-eastern Australia. It forms extensive infestations excluding most other ground flora and impeding overstorey regeneration. Perennial crowns develop from shallow rhizomes and produce new aerial growth each year. It also reproduces from seed (Muyt 2001).

- **Changed and Inappropriate Fire Regimes:** While it is known that fire regimes have changed, it is not exactly clear what they changed from and what the results have been. It is generally accepted that Natural Temperate Grassland was adapted to a fire regime that included Aboriginal burning (probably consisting of a mosaic of patchy, low intensity fires in spring and autumn) and occasional high intensity fires in summer (most probably caused by lightning strike). With European settlement, the dominant disturbance agent changed from burning under low grazing pressure by native species to grazing by stock with little burning. At local scales, however, areas such as roadsides and railway easements were burnt frequently. Increasingly, this burning has been phased out in favour of other means of defoliation (Lunt and Morgan 2002).

The timing of fire in relation to the life cycles of plants and the intensity and frequency of fires, all have a strong influence on the long-term results of a fire regime. The primary threats posed to native grasslands by fire are that the grassland is burnt too frequently, at too high temperatures or at the wrong time in the life cycles of the plants, and that the whole of a grassland remnant is burnt leaving no refuges for native animals and fire sensitive plant species. In the absence of other defoliation methods, fire can also be too infrequent allowing native grassland to become overgrown with a consequent loss in biodiversity. This is due, in particular, to the decline of inter-tussock perennial forbs that appear to need open conditions for seed production and germination (Eddy 2002; Lunt and Morgan 2002).

The effects of fire regimes on fauna in native grassland have been poorly studied. However, frequent burning is widely perceived as having negative impacts on many animals, particularly small species that are relatively immobile and live in small grassland fragments. The challenge for managers of small grassland remnants that contain a diverse flora and threatened fauna is to maintain an open vegetation structure to maintain plant diversity while also maintaining viable animal populations (Lunt and Morgan 2002). In these circumstances, defoliation by mowing or intermittent, light grazing may be more appropriate.

In their review of fire regimes in temperate lowland grasslands, Lunt and Morgan (2002) highlight the complexity of the subject and note that burning regimes should be tailored

to individual grassland remnants. They suggest that experience with *Themeda* grasslands points to the need to regularly burn productive grassland remnants to prevent further declines in biodiversity. While few fire studies have been conducted in grasslands dominated by wallaby and spear grasses, these have less biomass and shorter lifespans than *Themeda triandra* or *Poa* spp., so litter accumulation and competitive exclusion do not present the same threat to plant diversity. A significant issue is that fire opens the ground surface to opportunistic post-fire colonisation by exotic annual weed species that have a large soil seed bank and to exotic perennial grasses e.g. Chilean Needlegrass. Incorporating fire into the management of native grasslands remnants is difficult where fire spreading from off-site is a danger. These areas are also vulnerable to unplanned fires (e.g. bushfires, arson) from surrounding areas. There are a number of reasons, therefore, why other forms of defoliation are now used instead of burning in grassland remnants.

OTHER FORMS OF DISTURBANCE

- **Grazing by feral animals:** Loss or severe modification of Natural Temperate Grassland has also resulted from grazing by feral animals (particularly rabbits), soil disturbance, changes to soil fertility, altered drainage, traffic and trampling, and stockpiling and dumping of materials (Eddy 2002). Grazing by rabbits puts pressure on species that are less tolerant of regular or heavy grazing.
- **Physical disturbance:** Physical disturbance of the soil has occurred through activities such as cultivation, ripping rabbit burrows and laying pipes and cables. These activities remove or kill the existing vegetation, often releasing soil nutrients and creating a favourable environment for weed invasion. Soil moisture is a major determinant of plant community structure and composition. Alteration of drainage patterns by the construction of dams, roads and other earthworks, for example, has resulted in increased water flows on to grassland sites often bringing extra nutrients and allowing exotic species to out-compete the original vegetation. Traffic and trampling result in bare, compacted ground that is vulnerable to weed invasion, increased run-off and erosion, and cause the loss of cryptogams from naturally occurring bare patches. Vehicle traffic assists in weed seed dispersal. Grassland has been lost from road verges and public land areas following dumping, stockpiling and spreading of soil and gravel, which smothers the vegetation and creates bare areas vulnerable to weed invasion.
- **Use of fertilisers and other soil ameliorants:** Changes in soil fertility (e.g. by application or drift of superphosphate, gypsum or lime) can alter the competitive relationships between plants to the point where species composition in the community changes.
- **Mowing and slashing:** Mowing and slashing can be a threat to native grassland if they prevent flowering and seed production by being undertaken too frequently or at the wrong time. Mowing and slashing equipment can also transfer weed seeds and this is thought to be one of the means by which African Lovegrass and Chilean Needlegrass have been spread (Eddy 2002). A major concern with mowing is that cut material left on

site acts as mulch and inhibits intertussock forb growth. Mowing and slashing may also affect animal habitat.

- **Tree planting:** Natural grasslands are treeless or contain only scattered trees and this characteristic is important to their ecology. Tree planting in or near grasslands can have detrimental effects through shading, effects on soils, attracting birds that are vectors of weed seeds, and giving rise to the spread into the grassland of wildings (e.g. Monterey Pine *Pinus radiata*).
- **Herbicide use:** While herbicides are essential for the control of weed species, such application or spray drift has the potential to affect grassland native species (Eddy 2002).
- **Collection of grass seed:** There is increased interest in collection and propagation of native seed for use in revegetation work. Harvesting seed without considering recruitment requirements of the source community is a potential threat. Concern has also been raised about the genetic effects of the introduction of plants or seeds of the same species from another area (Eddy 2002). This is the subject of ongoing research.

In summary, the remaining Natural Temperate Grassland of the Southern Tablelands is threatened by a number of processes likely to lead to premature extinction. This is demonstrated by the severe decline in grassland area and the marked alteration in composition and structure of grasslands across the region. Threatening processes currently operating in NTG–ST can be divided into those resulting in total clearance, and those activities causing gradual reduction in the quality of the sites, as evidenced by loss of native species and increase in weediness.

3.2 Potential Threats

There is a medium-term likelihood of salinisation of soils becoming a threat to grasslands in the Southern Tablelands region. When remediation works are undertaken, it is important that the unique characteristics of NTG–ST are not compromised, especially by extensive tree planting in sites containing this community.

4 Existing Protection Measures

4.1 Australian Capital Territory

In the ACT about 990 ha of Natural Temperate Grassland are now left in a condition that meets the definition of this endangered ecological community. This represents about 5% of the estimated original area in the ACT. An additional 542 ha of highly modified and exotic grassy vegetation is closely associated with the sites containing the endangered ecological community. Another 639 ha of grasslands are known habitat for threatened species. These areas total 2172 ha (ACT Government 2005).

Approximately 47 percent of the 2172 ha referred to above are on sites where long-term protection from development is assured and conservation management is applied. Five sites totaling 489 ha (23 % of the remaining Natural Temperate Grassland and other grassland habitat) are protected within Public Land (Nature Reserve) areas. Another eleven sites totaling 531 ha (24% of the remaining Natural Temperate Grassland and other grassland habitat) are managed under MOUs with Australian Government or other agencies. The MOUs provide for conservation management to be undertaken within the framework of the primary land use. Another 16 sites (67 ha) are located in urban open space or on roadsides and are managed to retain their conservation values. Formal protection arrangements do not exist for these sites, however, liaison with managers of land containing small remnants of NTG–ST aims to achieve conservation-based management.

4.2 New South Wales

In the NSW part of the region, there are 9 major sites and 18 minor sites, totalling more than 350 ha in nature reserves or crown reserves dedicated to conservation. Other sites are being considered for reservation. In the short-term, this could add a further 100 ha of NTG–ST of high conservation significance to the reserved area.

A number of sites on various tenures are under negotiation for Joint Management Agreements (JMAs). JMAs under the TSC Act (NSW) are designed for the conservation management of sites on lands belonging to NSW State or local government authorities.

Other forms of protection available in NSW include statutory Voluntary Conservation Agreements, and non-statutory conservation management agreements. Voluntary Conservation Agreements (VCAs) are negotiated between the NSW DEC and private landholders, but can be used for public land sites.

Various management agreements are available, being offered by the CMAs. Agreements covering in excess of 1600 ha of NTG-ST have been established over various properties under such processes and former processes that were run by WWF Australia.

5 Previous and Future Recovery Actions

Significant recovery work in Natural Temperate Grassland has already been undertaken in the region, primarily by Environment ACT, the NSW Department of Environment and Conservation (formerly NSW National Parks and Wildlife Service), WWF Australia and the CMAs. Other government and non-government agencies, universities, individual landholders and community groups (in particular, Friends of Grasslands) have also made important contributions. Organisations are continuing this work in line with long-term goals and as part of their national and state or territory responsibilities. Considerable funding assistance has been received through several Australian Government programs administered by the Department of Environment and Heritage (previously Environment Australia Australian Nature Conservation Agency and Australian National Parks and Wildlife Service). The National Recovery Plan for NTG-ST builds upon these achievements to date.

5.1 Information Base

An adequate information base requires data on the location and ecological condition of remnant sites, what they contain and issues that need to be addressed.

Actions undertaken to date include:

- locating and mapping sites, and undertaking vegetation surveys in the ACT and NSW;
- identifying sites by floristic associations for NTG–ST in the Monaro sub-region and the ACT;
- undertaking biological surveys within grassy ecosystems, focusing on threatened flora and fauna;
- mapping the extent of pre-1750 and extant NTG–ST in most of the Southern Tablelands using remote-sensing technology;
- developing a preliminary regional database that includes information on the location and condition of all surveyed grassland sites in the Southern Tablelands; and
- incorporating all grassland dependant threatened species and the NTG-ST endangered ecological community into the PVP Decision support tools (NSW).

New actions required include:

- further surveys of the community throughout the region, particularly on private land in the North-western and Eastern sub-regions;
- further development of existing databases to allow for the investigation of species distribution and abundance across jurisdictions;
- analysis of the data to identify floristic associations to ensure regional and sub-regional identification of all structural and compositional variation;
- assessment of survey results to clarify which sites warrant protection or recovery actions;
- continuation of surveys of threatened grassland species across the region; and

- mapping/remapping parts of the Southern Tablelands region using remote sensing techniques.

5.2 Conserving Component Species

Conservation of NTG–ST remnants will protect a wide range of native plants and animals. NTG–ST contains several listed threatened flora and fauna species (Table 1) and many species that are regionally rare. Whilst measures to protect NTG–ST will also protect such species, some of these species occur in other ecological communities and highly modified sites. In these instances, while the threatened species has statutory protection under the listing of NTG–ST, part of its habitat may not. Special consideration may need to be given to the means of conserving some NTG–ST species throughout their range in both NTG–ST and other habitats.

Actions undertaken to date include:

- surveying ACT and NSW for threatened species in native grassland sites (not confined to NTG–ST sites as defined in this Recovery Plan);
- surveying groups of grassland species including reptiles, invertebrates and frogs;
- undertaking ecological studies of grassland species;
- preparing Recovery Plans (National, NSW) and Action Plans (ACT) for several threatened grassland species; and
- preparing management plans for NTG–ST sites that include actions to retain habitat for threatened species.

New actions required include:

- continuing surveys for plant and animal species characteristic of grassland;
- developing understanding of the ecology of species, through research and monitoring, to determine their conservation and management requirements; and
- integrating ecological information into management activities at sites where threatened species occur, or where known habitat exists.

5.3 Protection of Grasslands

The protection achieved to date has taken into account priorities based on conservation significance and how best the areas can be managed given that a variety of land uses will continue on, or adjacent to, many sites. Protection mechanisms have included the establishment of reserves, and other actions where reservation is not an option.

Actions undertaken to date include:

- establishment of five reserves (488 ha containing 206 ha of NTG) in the ACT (Mulanggari, Gungaderra and Crace Nature Reserves (Gungahlin), Dunlop Grassland Reserve and Mugga Mugga Special Purpose Reserve). A new reserve (106 ha) is proposed at Lawson (Belconnen). The ACT Government announced in July 2004 that 400 ha of Natural Temperate Grassland and other grassy habitat for threatened species (Grassland Earless Dragon) in the Jerrabomberra Valley would be protected in nature reserves;

- establishment and/or identification of seven major sites in NSW (Turallo Nature Reserve, Kuma Nature Reserve, an area within South East Forests National Park, Deua National Park, Queanbeyan Nature Reserves (with the addition of Letchworth, Old Cooma Common Grassland Reserve and Days Hill Reserve), and 21 minor sites, totalling in excess of 360 ha in nature reserves or crown reserves dedicated to conservation. A further 100 ha of NTG–ST of high conservation significance is proposed to be added to the reserved area.
- formal assessment and re-classification of 54 ha of Crown land on Adaminaby Golf Course for recreation and nature conservation and establishment of a community based Management Trust; and
- implementation of a range of conservation agreements (including MOUs and JMAs) (see Section 4).

New actions required include:

- identification of gaps (geographically and ecologically) in the reserve and off-reserve protection system;
- identification of key sites for conservation and protection; and
- creation of new reserves and implementation of new conservation agreements aimed at establishing a comprehensive, adequate and representative network of protected sites across the entire range of NTG–ST.

5.4 Applying ‘Best Practice’ Management

Whatever level of protection is provided for individual sites, the key factor for their long-term conservation is the implementation of management practices that will maintain and, ideally, enhance the existing conservation values. The application of ‘best practice’ management is critical for the preservation of these ecosystems and threatened species (Sharp 2000). The management approaches adopted may be site-dependent. Sites with different disturbance and land use histories, for instance, may require different management regimes.

Research and monitoring programs are the key source of information required to implement ‘best practice’ management and to keep this current. Both agricultural studies (e.g. on the use of native pastures for grazing) and ecological studies are relevant. Additionally, studies of the history of particular sites and the dynamics of species within those sites have provided important information for future management.

Actions undertaken to date include:

- long-term monitoring of vegetation and threatened species in sites containing NTG–ST in the ACT and NSW to measure the impacts of management. In the ACT, 18 sites have been monitored annually or bi-annually since 1993. In NSW two long-term monitoring sites have been established, and other sites are being monitored;
- investigating the impacts of burning on sites in the ACT which have not been burnt for a long time;
- preparing management guidelines to assist landholders in applying conservation management (Dorrough 1996, Eddy 2002, Langford *et al.* 2004);

- implementing best practice management for conservation outcomes on many sites in the ACT and NSW; and
- preparing a conservation management kit for grassland sites to assist landholders (Sharp *et al.*, 2005). The kit will include guidelines for assessing values of sites and for developing a management and monitoring program.

New actions required include

- use information from surveys and analysis of data to further develop management guidelines;
- develop and implement site specific management plans;
- monitor condition and species diversity of sites under varying management regimes and refine management guidelines based on the results of this monitoring and ongoing research programs;
- promote research and trials into the effects of management on biodiversity; and
- identify sites that should be targeted for an enhancement program and undertake suitable restoration activities.

5.5 Involving Landholders and the Community in the Conservation of Natural Temperate Grassland

Community groups and private landholders are becoming more actively involved in the conservation of NTG–ST and are seeking information on the subject. It is proposed to build upon the base of community support and involvement that has been established, in particular, through application of the Conservation Management Network model.

Actions undertaken to date include:

- providing advice to, and interacting with, private and public landholders and land managers;
- establishing a Friends of Grasslands (FOG) community group which now operates throughout the region;
- organising extension activities including site visits, field days, workshops, seminars, conferences and providing assistance and advice to community groups and land managers in preparing funding applications;
- liaising with officers in other regions and States in relation to grassy ecosystem conservation issues;
- preparing a field guide to grassland flora of the Southern Tablelands (Eddy *et al.* 1998). Over 5000 copies of this publication have been distributed and sold in the region and throughout Australia; and
- establishing the Monaro Grassland Conservation Management Network (CMN) and the Southern Tablelands Grassy Ecosystem CMN, which provide database support, newsletters, extension activities and assistance with funding and management planning.

New actions required include:

- extending the CMNs across the entire Southern Tablelands as a key means of communication and involvement in NTG–ST conservation;
- developing a communication strategy based on the CMNs but including the wider community; and
- facilitating access to financial and other incentives for NTG–ST conservation and links with other programs and activities, especially with the Catchment Management Authorities.

5.6 Applying Effective Planning for Natural Temperate Grassland Conservation in a Regional Context

Land uses and development activities that may impact on NTG–ST sites need to be considered as part of government policy and planning processes.

Actions undertaken to date include:

- providing information for policy, planning and management decisions made by catchment management boards;
- alerting Government agencies to the location and significance of NTG–ST sites to prevent uninformed clearing and/or modification;
- identifying significant NTG–ST for inclusion in the reserve system;
- developing a planning framework for conservation of natural ecosystems (including NTG–ST) for the Southern Tablelands through a cooperative program involving Australian Government, NSW, ACT and local government and non-government agencies and the community (Fallding 2002); and
- preparing the *ACT Lowland Native Grassland Conservation Strategy* (2005).

New actions required include:

- extending the planning framework for conservation of NTG–ST throughout the remaining sections of the Southern Tablelands beyond that covered by Fallding (2002);
- liaison with the CMAs to ensure that the new initiatives for property vegetation planning and incentive programs consider NTG–ST conservation;
- liaison with organisations and participation in regional planning processes to ensure that conservation of NTG–ST is incorporated appropriately into planning, management and development control in the region;
- preparation of a guide for decision-makers, based on conservation requirements and not requiring specialist knowledge, which will enable initial assessment of proposals potentially affecting NTG–ST; and
- review and evaluation of the legislative and regional environmental planning framework relevant to NTG–ST conservation.

6 Habitat Critical to Survival

The *Environment Protection and Biodiversity Conservation Act 1999* requires that habitat critical to the survival of the listed threatened ecological community is identified in the Recovery Plan.

Of the NTG–ST ecological community that existed in the Southern Tablelands at the time of European settlement, probably less than three percent retains a moderate to high level of ecological integrity. Other areas exist in lower condition states and may have the capacity to rehabilitate naturally under appropriate management. Such sites have varying conservation value related to their species composition and position in the landscape as potential buffers to higher quality sites

The NTG–ST remnants are highly fragmented. Given the small amount remaining, all sites that meet the definition of the community should be considered to be habitat critical to the survival of the NTG-ST ecological community. However, there will be a need to rank sites according to their conservation value as a basis for setting priorities in establishing formal and informal protection arrangements.

Actions related to Objectives 1–3 of this Recovery Plan (Tables 3 and 4) provide the basis for consistent assessment and classification of the conservation value of NTG–ST sites. This assessment will allow the Recovery Team to identify key sites for protection and conservation management. These sites maintain both the grassland community and component species, some of which are also threatened. The following criteria should be used to assign priorities for protection:

- moderate to high botanical significance rating based on native plant species diversity;
- high faunal habitat rating;
- presence of one or more listed threatened species;
- potential for natural rehabilitation and enhancement of habitat;
- size and shape which allows the site to be buffered from surrounding land uses;
- connectivity with other areas of native vegetation (including non-grassland communities), allowing for gene flow;
- regional representation and replication of floristic associations, species and habitat; and
- relatively low weediness – either density or presence of particular invasive species.

PART B: PLANNING

7 The Goal of the Recovery Plan

The goal of this Recovery Plan is to arrest the decline in extent and quality of Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory within ten years of adoption of the Plan.

7.1 Objectives and Actions for Recovery

The Recovery Team has developed objectives and actions (Table 2) after consideration of past recovery actions and the perceived requirements for achieving the principle goal of this plan. The project plan (Table 3) defines the performance criteria and actions required to achieve the objectives based on a five year time period. The estimated resources of implementing the actions identified in the project plan (Table 3) are presented in Table 4 and a summary of the costs in Table 5. The table does not apportion costs to the different organisations that have responsibility in achieving the outcomes.

7.2 Justification of Costs

(a) Grassland Project Officer: Fundamental to this Recovery Plan is the employment of a dedicated Grassland Project Officer in the Southern Tablelands. This is regarded as the most efficient and cost-effective way to advance the implementation of the diverse actions contained in the Recovery Plan. This approach has been successfully used in ACT and NSW to achieve the actions to date, as identified in Sections 4 and 5. The officer would work mainly with the NSW Department of Environment and Conservation and Environment ACT but maintain close ties with environmental organisations, land agencies and landholders. The officer would be based either at Environment ACT, Canberra, or NSW DEC, Queanbeyan, with the agencies providing day-to-day supervision. The Recovery Team would direct the officer's work program.

The costing for the proposed dedicated grassland officer (Professional Officer Grade 2) is based on a salary of \$56 467 p.a. (2003–4) rising to \$64 298 (2007–8) (based on ACT salary levels and future workplace agreement based salary rises), plus 25% on-costs and 25% for expenses (travel, computer etc). Based on the estimated scope and duration of the actions outlined, it is proposed to employ the Grasslands Project Officer initially for two years full-time, with the likelihood of an extension, possibly part-time, contingent on a review of progress and achievements.

(b) Specialist consultant advice: Costs are estimated at \$800 – 1000/day for short-term work.

(c) Fencing costs: These are calculated at \$6 000 per kilometre (labour, materials).

Table 2: Objectives of this Recovery Plan and related broad actions to achieve recovery of the ecological community
(detailed actions and performance criteria are outlined in Table 3)

AIM: Arrest the decline in extent and quality of Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT within 10 years of adoption of the Recovery Plan.	
OBJECTIVE	BROAD ACTION
1. Identify and evaluate the extent and quality of NTG–ST and component species	Survey NTG–ST sites and component species
2. Maintain an information database to support protection, management and monitoring activities	Develop and maintain an information and GIS database for all NTG–ST sites and dependent threatened species
3. Establish a comprehensive, adequate and representative system of NTG–ST areas protected either by reservation or conservation agreements (including MOUs)	Develop and implement a strategy to establish a comprehensive, adequate and representative system for NTG–ST areas protected either by reservation or conservation agreements. Monitor the results.
4. Ensure ‘best practice’ management is applied to sites containing NTG–ST	Continue to develop and promote ‘best practice’ management for NTG–ST. Monitor the results.
5. Ensure participation of the community in the conservation of NTG–ST	Develop and implement a strategy to involve landholders and the community in the protection and management of NTG–ST. Monitor the results.
6. Enhance the ability of government and non-government organisations at the national, regional and local levels (including consent authorities) to recognise and incorporate NTG–ST conservation issues into all planning processes	Develop a strategy to enhance: (a) the understanding by government and non-government organisations of NTG–ST conservation issues; (b) their commitment to considering NTG–ST conservation when participating in regional planning. Monitor the results.

7.3 Sources of Funding and/or other Support

Some of the actions identified in Table 3 would be undertaken by State/Territory environment agencies in conjunction with the Grasslands Project Officer, as part of routine activities (Table 4). Other actions may be undertaken as short-term projects by other agencies, landholders, universities or community groups.

It is important to ensure that the undertaking of actions detailed in this Plan (Table 3) is based on cost sharing amongst all stakeholders. Sources of funding and other resources (e.g. labour and equipment) are likely to include:

- Australian Government funding sources (e.g. Natural Heritage Trust grants);
- State and Territory governments and environment agencies;
- State land management agencies and local government;
- Landholders (including government agencies);
- Greening Australia;
- Industry (e.g. Meat and Livestock Corporation);
- Universities; and
- Volunteers, including community groups.

8 Guide for Decision-Makers

The following information provides an initial guide to decision-makers in assessing whether proposed development activities will have a significant impact on NTG–ST. It will assist in determining if such activities require environmental assessment and approval under the EPBC Act and the types of requirements to attach to any such approval. An action identified in the Recovery Plan is to develop a more detailed guide for decision-makers (Action 6.2, Table 3). The guide should also include the criteria developed for assessing critical habitat (Section 6).

Conservation management of NTG–ST sites aims to facilitate the reproduction and survival of plants and animals that comprise the NTG–ST community. The following site management actions or conditions, some of which are inter-related, are essential or highly desirable for the continued existence of NTG–ST. Changes in any one of these could have a significant adverse impact on the NTG–ST community:

- Maintenance of soil conditions (no physical disturbance (e.g. ploughing), chemical changes (e.g. from fertiliser or run-off), or compaction (e.g. from vehicles)).
- Maintenance of existing drainage conditions (or improvement if deleterious changes have been previously made). In particular, no changes should be made which make a site wetter.
- Control of plant introductions (weeds, introduced pasture species, inappropriate native species such as trees and shrubs, wildings from adjacent tree planting e.g. pines, olives).
- Removal of biomass through an appropriate defoliation regime (burning, slashing, herbicide, grazing).
- Maintenance of sunlight (no changes (e.g. building or tree planting) which result in prolonged shading).
- Maintenance of connectivity, where possible, between NTG–ST sites, or between NTG–ST and other natural grassland, woodland, forest, wetland or riparian areas. Avoidance of fragmentation e.g. roads, service lines and easements.

- Buffering NTG–ST from adjacent land uses that have the potential to impact on its integrity.

Site specific management plans which take account of the above in the context of specific site characteristics need to be developed. Management plans are a statutory requirement for NTG–ST areas that form part of the reserve system in the ACT and NSW.

Decision-makers should assess proposed development activities in or near NTG–ST sites in terms of the listed actions or conditions. On some matters (e.g. biomass removal) expert advice may be necessary. With regard to planning controls and proposed development activities, the Recovery Team does not consider acceptable the loss of high conservation value NTG–ST sites on the basis that low quality sites can be restored as a trade-off. With current knowledge, this is not generally considered to be feasible.

9 Community Participation and Landholder Incentives

Nature reserves, national parks and off-reserve conservation agreements (e.g. VCAs) can be used to protect a core set of sites, for which conservation is the primary objective. However, the Recovery Plan recognises that it is not possible, nor is it necessarily beneficial, to place all remaining NTG–ST sites into a formal protected area system.

Off-reserve conservation is critical to achieving the goal of arresting the decline in extent and quality of NTG–ST within ten years of adoption of the Recovery Plan. Extensive liaison with landholders will be required to address their concerns about the impacts that the presence of threatened species and communities may have on the use of their land, and the potential costs associated with habitat management and possible loss of production.

In order to ensure that the community, especially landholders, are fully involved in the process of conserving NTG–ST, it is proposed that networks of people with an interest in NTG–ST sites be established. Such a grouping is called a Conservation Management Network (CMN). The principal aims of a CMN are information dissemination, communication, and participation in decision making. It is anticipated that the formation of CMNs on the Southern Tablelands will significantly assist in overcoming barriers to the implementation of this Recovery Plan.

For a network to be successful, the cooperation and involvement of landholders is essential. CMNs facilitate the transfer of the knowledge and experience of all stakeholders, including landholders, management agencies and scientists. One of the most important goals of these networks will be to facilitate the integration of conservation and other land uses, and the development of practical management techniques for achieving conservation outcomes.

Incentive funding is required to ensure that landholders are not bearing the costs of activities that are a wider community responsibility. The network will be able to facilitate

access to incentives (financial and other) for landholders to conserve NTG–ST and assist in the achievement of more strategic and improved long-term outcomes. The network will provide the mechanism to link with other organisations, programs and activities (e.g. Greening Australia, Landcare, Catchment Management Authorities).

10 Communication

A communication strategy, based on the CMNs, will be developed to assist information sharing between all stakeholders and the community at large. As part of the communication strategy, CMN newsletters are in production. Other liaison and information activities would also be undertaken. Implementation of the Plan will involve close collaboration between the CMN Coordinators and the Plan’s Grassland Project Officer.

11 Monitoring, Reporting and Review

By keeping track of projects and actions that relate to the Recovery Plan, the Recovery Team will continuously monitor and review progress in implementing the Plan. The CMN databases will be the principle tool for monitoring increases in areal extent of conservation of NTG–ST and in the participation in the recovery process. Landholders, community members and others will be involved in implementing the plan through membership of the CMNs. Regular monitoring of the flora and fauna in sites across the region, which are subject to a range of land uses will provide information on whether actions undertaken are achieving the desired outcomes.

In addition, the Recovery Team will review the Recovery Plan against the performance criteria after two and five years to assess progress in the implementation of actions and their effectiveness. The community will be invited to assist in these reviews. Assessment of progress with the Recovery Plan will be reported to the relevant nature conservation agencies. At these times also, the Plan will be revised as required, to refine the objectives. The performance criteria shown in Table 3 will be used to measure the degree to which the objectives are being achieved.

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Personal Communications

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Appendix 1

Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT National Recovery Team

This Recovery Plan was prepared by Environment ACT based on the contributions of the current and former members of the National Recovery Team for Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT. Members of the Team represent government environment and land management agencies in the ACT and NSW, non-government organisations, the rural community and community groups.

The Team membership ensures participation by scientists, local and national community stakeholders, and government agencies with expertise and special interest in the areas of community ecology, flora and fauna of grassland communities, threatening processes and the management of sites for multiple purposes (including conservation and primary production). Members also have strong links with their community, and have undertaken to liaise with landholders and other stakeholders to facilitate the implementation of the Plan.

The current members are:

- Dr David Shorthouse, Manager, Wildlife Research and Monitoring, Environment ACT (chair);
- Mr Robert Adam/Ms Alison Treweek, NSW of Infrastructure, Planning and Natural Resources, Goulburn;
- Mr David Eddy, Monaro Grasslands Conservation Management Network facilitator;
- Ms Susan Mitchell, NSW Farmers Association, Cooma;
- Mr Rainer Rehwinkel, Senior Biodiversity Conservation Officer (Grassy Ecosystems), NSW Department of Environment and Conservation, South Branch;
- Mr Geoff Robertson, member of Friends of Grasslands;
- Mr Michael Saxon, Manager, Biodiversity Conservation Section, Department of Environment and Conservation, South Branch; and
- Ms Sarah Sharp, Senior Plant Ecologist, Wildlife Research and Monitoring, Environment ACT.

Table 3: Detailed actions required to achieve the objectives of the Recovery Plan and performance criteria related to those actions.

Objectives	Performance criteria	Actions
<p>1. Identify and evaluate the extent and quality of NTG–ST and component species</p>	<ul style="list-style-type: none"> • Areas of NTG–ST are identified, located, mapped and evaluated <ul style="list-style-type: none"> - Public land by 03/2006 - Private land by 02/2007 • Ratings of conservation value of sites are applied as they are surveyed, using standardised criteria (ongoing) • New information from surveys and analysis is communicated to relevant land managers 	<p>1. Survey NTG–ST sites and component species</p> <ol style="list-style-type: none"> 1.1 Use remote sensing and modelling to complete a predictive map of NTG–ST throughout its range 1.2 Using the existing inventory and map of known sites across the Southern Tablelands, determine where survey effort has been satisfactory and identify gaps to be surveyed for flora and fauna 1.3 Survey sites identified from the gap analysis (using methods compatible with national standards), enter data and communicate results to relevant land managers 1.4 Assess conservation value of all sites containing NTG–ST, based on flora, fauna and condition 1.5 Identify NTG–ST floristic associations through classification analysis of survey data 1.6 Continue threatened species surveys
<p>2. Maintain an information database to support protection, management and monitoring activities</p>	<ul style="list-style-type: none"> • A database is developed and maintained to support implementation of the Recovery Plan (12/2004) 	<p>2. Develop and maintain an information and GIS database for all NTG–ST sites and dependent threatened species</p> <ol style="list-style-type: none"> 2.1 Establish a database linked across jurisdictions, compatible with national standards 2.2 Maintain the database to support research, management and planning activities
<p>3. Establish a comprehensive, adequate and representative system of NTG–ST areas protected either by reservation or conservation agreements (including MOUs)</p>	<ul style="list-style-type: none"> • Protection mechanisms identified and evaluated (on-going) • Key sites identified and most appropriate forms of protection determined (12/2006) • A representative network of protected sites exists across the entire range of NTG–ST (as first stage to a fully comprehensive and adequate system) (12/2007) 	<p>3. Develop and implement a strategy to establish a comprehensive, adequate and representative system of NTG–ST areas protected either by reservation or conservation agreements</p> <ol style="list-style-type: none"> 3.1 Identify protection mechanisms that can be used for conservation of NTG–ST and assess their effectiveness in achieving a comprehensive, adequate and representative system (based on those already in place) 3.2 Using criteria in Section 6, identify key sites for conservation protection using a stratified approach aimed at including sites representing the entire geographic and ecological extent of the community 3.3 Determine the most appropriate form of protection for the identified sites and prepare proposals for those sites supported by documentation

Objectives	Performance criteria	Actions
		3.4 Identify key sites for acquisition. Negotiate reservation proposals with Australian Government, State and Territory agencies and other protection measures with landholders and managers (Note: All of the above to be undertaken with involvement of the CMNs*
4. Ensure ‘best practice’ management is applied to sites containing NTG–ST	<ul style="list-style-type: none"> • Management guidelines for landholders reviewed • Management plans for protected sites prepared (12/2005,ongoing) • Monitoring programs in place (03/2006) • Information needs identified (ongoing) • Noxious weeds are subjected to control programs on all protected sites (12/2005) • Control programs established for weeds, pests and other site disturbances across all identified sites (12/2007) • There is improvement in quality of both protected sites and sites where conservation is secondary (12/2007) • Sites for enhancement program identified and guidelines for restoration work prepared (12/2005 and ongoing) • Restoration activities are under way based on habitat enhancement and ensuring maintenance of genetic integrity of NTG–ST community (50% of sites chosen for enhancement by 12/2007) 	4. Continue to develop and promote ‘best practice’ management for NTG–ST <ul style="list-style-type: none"> 4.1 Maintain up to date best practice management guidelines for landholders managing NTG–ST and foster implementation 4.2 Develop and implement site management plans including species specific actions 4.3 Monitor condition and biodiversity of sites under varying management regimes 4.4 Identify information needs and priorities for research, in particular: <ul style="list-style-type: none"> 4.4.1 Develop an adaptive management approach to NTG–ST linking research and monitoring to management 4.4.2 Investigate the long-term impacts of grazing, burning and mowing on NTG–ST, component species and target weeds 4.4.3 Identify if there are regional differences in management impacts and develop and apply general principles and guidelines accordingly 4.4.4 Assess long and short-term costs/benefits of modifying practices to implement conservation management 4.5 Identify sites that should be targeted for an enhancement program to improve the existing values <ul style="list-style-type: none"> 4.5.1 Apply research results to aid restoration 4.5.2 Undertake restoration activities accordingly

Objectives	Performance criteria	Actions
<p>5. Ensure participation of the community in the conservation of NTG–ST</p>	<ul style="list-style-type: none"> • CMNs are established and operating across the ST region (12/2004)* • 70% of private landholders with NTG–ST participate in the conservation of Natural Temperate Grassland by 12/2007* • A communication strategy is in place and the essential components of the strategy (which may include a newsletter) have been commenced (12/2005)* • Aboriginal interest in management of NTG–ST sites has been identified and involvement facilitated if required (12/2006) 	<p>5. Develop and implement a strategy to involve landholders and the community in the protection and management of NTG–ST</p> <p>5.1 Facilitate information and skills exchange between landholders, land managers, government agencies, community groups and other stakeholders aimed at achieving best practice management</p> <p>5.1.1 Extend the operation of CMNs in the Southern Tablelands as a key means of communication and involvement in NTG–ST conservation*</p> <p>5.1.2 Develop a communication strategy based on the CMNs engaging the wider community, including Local Government Areas, especially at the Local Environmental Planning Stage*</p> <p>5.1.3 Facilitate access to financial and other incentives, and stewardship payments for land managers and landholders to conserve NTG–ST in conjunction with CMAs and NRM facilitators.</p> <p>5.1.4 Link with other organisations, programs and activities (e.g. Greening Australia, Landcare) to facilitate best practice management</p> <p>5.1.5 Identify Aboriginal interest in management of NTG–ST sites and facilitate involvement</p> <p>5.1.6 Encourage the establishment of rural industries and land uses that support NTG–ST conservation</p> <p>5.2 Maintain landholder and community representation on the Recovery Team and implementation process.</p>
<p>6. Enhance the ability of government and non-government organisations at the national, regional and local levels (including consent authorities) to recognise and incorporate NTG–ST conservation issues into all planning processes</p>	<ul style="list-style-type: none"> • All organisations involved in planning, management, development and development control of land/vegetation in the region are aware of the issue of NTG–ST conservation and have incorporated this matter into their functions (12/2005 and ongoing) • An assessment guide suitable for non-specialist decision-makers has been distributed to all organisations referred to above (12/2005) • Successful application of, and deficiencies in, legislative and 	<p>6. Develop a strategy to enhance: (a) the understanding by government and non-government organisations of NTG–ST conservation issues; (b) their commitment to considering NTG–ST conservation when participating in regional planning</p> <p>6.1 Liaise with organisations and participate in regional planning processes to ensure that conservation of NTG–ST is promoted and incorporated appropriately in planning, management and development control in the region</p> <p>6.2 Develop a guide for decision makers, based on conservation requirements and not requiring specialist knowledge, which enables initial assessment of proposals potentially affecting NTG–ST</p> <p>6.3 Review and evaluate the legislative and regional environmental planning framework, including Local Government Areas, relevant to</p>

Objectives	Performance criteria	Actions
	regional planning frameworks is documented and recommendations for change or further adoption have been made as appropriate (e.g. to government agencies administering legislation) (ongoing)	NTG–ST conservation
7. Review Recovery Plan implementation	<ul style="list-style-type: none"> Assessment of the outcomes of the recovery plan implementation achieved. 	7 Evaluate and report on progress with Recovery Plan actions

* These are actions where CMNs are the strongest vehicle for promotion and delivery, which will depend on on-going resources provided by government agencies to promote and maintain CMNs.

Table 4: Estimated resources for implementing actions identified in Table 3

Actions	Likely Expenses	Resource estimate	Responsibility (excl. funding)	Timeframe
1. Survey NTG–ST sites and component species				
1.1 Use remote sensing and modelling to complete a predictive map of NTG–ST throughout its range	Consultant statistician	<u>Yr 2</u> : 8 wks	NSW DEC EACT	Short
1.2 Using the existing inventory and map of known sites across the Southern Tablelands, determine where survey effort has been satisfactory and identify gaps to be surveyed for flora and fauna	Salary Grassland Project Officer (GPO)	<u>Yr 1</u> : 2 wks	NSW DEC	Short
1.3 Survey sites identified from the gap analysis (using methods compatible with national standards), enter data and communicate results to relevant land managers	Salary GPO & agency (Ag)	<u>Yr 1</u> : GPO 14 wks/ Ag 7 wks <u>Yr 2</u> : GPO 19 wks/ Ag 12 wks <u>Yr 3</u> : GPO 15 wks/ Ag 7wks <u>Yr 4</u> : GPO 6 wks/ Ag 2 wks <u>Total</u> : GPO 50 wks/ Ag 29 wks (79 wks)	NSW DEC EACT	Ongoing
1.4 Assess conservation value of all sites containing NTG–ST, based on flora, fauna and condition	Salary GPO & agency	<u>Yr 2</u> : GPO 1 wk/Ag 2 wks <u>Yr 3</u> : GPO 1 wk/Ag 2 wks <u>Total</u> : GPO 2 wks/ Ag 4 wks (6 wks)	NSW DEC EACT	Medium
1.5 Identify NTG–ST floristic associations through classification analysis of survey data	Consultant statistician	<u>Yr 2</u> : Ag 1 wk	NSW DEC	Short
1.6 Continue threatened species surveys	Salary agency Equipment, field costs	<u>Yrs 1-5</u> : Ag 22wks/yr <u>Total</u> : 110 wks	NSW DEC	Ongoing
2. Develop and maintain an information and GIS database for all NTG–ST sites and dependent threatened species				
2.1 Establish a database linked across jurisdictions, compatible with national standards	IT consultant	<u>Yr 2</u> : 6 wks	NSW DEC EACT	Short
2.2 Maintain the database to support research, management and planning activities	Salary agency	<u>Yrs 2-5</u> : 3wks/yr <u>Total</u> : 12 wks	NSW DEC EACT	Ongoing
3. Develop and implement a strategy to establish a comprehensive, adequate and representative system of NTG–ST areas protected either by reservation or conservation agreements				
3.1 Identify protection mechanisms that can be used for conservation of NTG–ST and assess their effectiveness in achieving a comprehensive, adequate and representative system (based on	Salary GPO Salary agency	<u>Yr 2</u> : GPO 1 wk/Ag 1 wk <u>Total</u> : 2 wks	CMNs, landholders, NSW DEC, EACT, other govt agencies	Short

Actions	Likely Expenses	Resource estimate	Responsibility (excl. funding)	Timeframe
those already in place)				
3.2 Using criteria in Section 6, identify key sites for conservation protection using a stratified approach aimed at including sites representing the entire geographic and ecological extent of the community	Salary GPO Salary agency	<u>Yr 1</u> : GPO 2 wks/ Ag 3 wks Total: 5 wks	CMAs, CMNs, landholders, NSW DEC, EACT, other govt agencies	Short
3.3 Determine the most appropriate form of protection for the identified sites and prepare proposals for those sites supported by documentation	Salary GPO Salary agency	<u>Yr 1</u> : GPO 2 wks/ Ag 3 wks Total: 5 wks	CMAs, CMNs, landholders, NSW DEC, EACT, other govt agencies	Short
3.4 Identify key sites for acquisition. Negotiate reservation proposals with Australian Government, State and Territory agencies and other protection measures with landholders and managers (Note: All of the above to be undertaken with involvement of the CMNs)	Salary GPO Salary agency Land acquisition	<u>Y3</u> : GPO 3 wks/Ag 4 wks <u>Y4</u> : GPO 3 wk/Ag 4 wks Total: GPO 6 wks/ Ag 8 wks (14 wks) Approximately 4 sites over 5 years	CMNs, landholders, NSW DEC, EACT, other govt agencies	Medium Medium-long
4. Continue to develop and promote 'best practice' management for NTG-ST				
4.1 Maintain up to date 'best practice' management guidelines for landholders managing NTG-ST and foster implementation	Salary GPO Salary agency	<u>Yr 2</u> : GPO 1wk <u>Yr 3</u> : GPO 1 wk <u>Yr 4</u> : GPO 1 wk <u>Yr 5</u> : GPO 1 wk/ Ag 1 wk Total: 5 wks	NSW DEC, EACT	Medium-long
4.2 Develop and implement site management plans including species specific actions	Salary GPO Fencing	<u>Yr 2</u> : GPO 6.5 wks/ Ag 2 wks <u>Yr 3</u> : GPO 6.5 wks/ Ag 2 wks <u>Yr 4</u> : GPO 8 wks/ Ag 2 wks <u>Yr 5</u> : GPO 2 wks/ Ag 2 wks Total: 31 wks <u>Yrs 1-5</u> : 40 km	NSW DEC, EACT, other agencies, CMNs, landholders	Medium-long
4.3 Monitor condition and biodiversity of sites under varying management regimes	Salary GPO Salary agency	<u>Yr 1</u> : GPO 2 wks/ Ag 4 wks <u>Yr 2</u> : GPO 2 wks/ Ag 4 wks <u>Yr 3</u> : GPO 2 wks/ Ag 4 wks <u>Yr 4</u> : GPO 2 wks Ag 4 wks <u>Yr 5</u> : GPO 6 wks/ Ag 4 wks Total: 34 wks	NSW DEC, EACT, CMNs, landholders	Ongoing
4.4 Identify information needs and priorities for research, in particular:	Salary GPO Salary agency	<u>Yr 1</u> : GPO 2 wks/ Ag 3 wks/ Cons. stat. 1 wk/ Res.org. 20	CMAs, NSW DEC, EACT, Research organisations	Short-medium

Actions	Likely Expenses	Resource estimate	Responsibility (excl. funding)	Timeframe
4.4.1 Develop an adaptive management approach to NTG–ST linking research and monitoring to management 4.4.2 Investigate the long-term impacts of grazing, burning and mowing on NTG–ST, component species and target weeds 4.4.3 Identify if there are regional differences in management impacts and develop and apply general principles and guidelines accordingly 4.4.4 Assess long and short-term costs/benefits of modifying practices to implement conservation management	Research organisation Consultant statistician Contractors Fencing for trials	wks/Contractor 0.5 wk <u>Yr 2:</u> GPO 1 wks/ Ag 3 wks/ Res.org. 12 wks <u>Yr 3:</u> GPO 1 wks/ Ag 3 wks/ Res.org. 12 wks <u>Yr 4:</u> GPO 1 wk/ Ag 3 wks/ Cons. stat. 1 wk/ Res. Org. 24 wks <u>Total:</u> GPO/Ag 34 wks; Cons. stat. 2 wks; Res. Org. 68 wks; Contractor 0.5 wk <u>Yr 1:</u> 2 km		
4.5 Identify sites that should be targeted for an enhancement program to improve the existing values 4.5.1 Apply research results to aid restoration 4.5.2 Undertake restoration activities accordingly.	Salary GPO Salary agency Herbicide, seed, fencing	<u>Yr 3:</u> GPO 2 wks/ Ag 6 wks <u>Yr 4:</u> GPO 2 wks /Ag 6 wks <u>Yr 5:</u> GPO 2 wks/ Ag 6 wks <u>Total:</u> 24 wks Herbicide, Seed, Fencing 1 km/yr	CMAs, NSW DEC, EACT, CMNs, landholders	Medium-long
5. Develop and implement a strategy to involve landholders and the community in the protection and management of NTG–ST				
5.1 Facilitate information and skills exchange between landholders, land managers, government agencies, community groups and other stakeholders aimed at achieving best practice management 5.1.1 Extend the operation of CMNs in the Southern Tablelands as a key means of communication and involvement in NTG–ST conservation 5.1.2 Develop a communication strategy based on the CMNs but including the wider community 5.1.3 Facilitate access to financial and other incentives, and stewardship payments for land managers and landholders to conserve NTG–ST 5.1.4 Link with other programs and activities (e.g. Greening Australia, Landcare), to facilitate best practice management 5.1.5 Identify any Aboriginal interest in management of NTG–ST sites and facilitate involvement 5.1.6 Encourage the establishment of rural industries that support NTG–ST conservation	Salary GPO Salary agency	<u>Yr 1:</u> GPO 16 wks/ Ag 8 wks <u>Yr 2:</u> GPO 12 wks/ Ag 6 wks <u>Yr 3:</u> GPO 12 wks/ Ag 6 wks <u>Yr 4:</u> GPO 16 wks/ Ag 6 wks <u>Yr 5:</u> GPO 10 wks/ Ag 6 wks <u>Total:</u> 98 wks	CMAs, NSW DEC, EACT, other agencies, CMNs, landholders	Ongoing

5.2 Maintain landholder and community representation on the Recovery Team and implementation process	Salary GPO Salary agency	<u>Yr 1:</u> GPO 1 wk Ag 2 wks <u>Yr 2:</u> GPO 1 wks/ Ag 2 wks <u>Yr 3:</u> GPO 1 wks/ Ag 2 wks <u>Yr 4:</u> GPO 1 wks/ Ag 2 wks <u>Yr 5:</u> GPO 1 wks/ Ag 2 wks <u>Total:</u> 15 wks	NSW DEC, EACT, other agencies, CMNs, landholders	Ongoing
6. Develop a strategy to enhance: (a) the understanding by government and non-government organisations of NTG–ST conservation issues; (b) their commitment to considering NTG–ST conservation when participating in regional planning.				
6.1 Liaise with organisations and participate in regional planning processes to ensure that conservation of NTG–ST is incorporated appropriately in planning, management and development control in the region	Salary GPO Salary agency	<u>Yr 1:</u> GPO 1 wk/ Ag: 1 wk <u>Yr 2:</u> GPO 2 wks/ Ag: 1 wk <u>Yr 3:</u> GPO 2 wks/ Ag: 1 wk <u>Yr 4:</u> GPO 2 wks/ Ag: 1 wk <u>Yr 5:</u> GPO 1 wk/ Ag: 1 wk <u>Total</u> 13 wks	CMAs, NSW DEC, EACT, other agencies	Ongoing
6.2 Develop a guide for decision makers, based on conservation requirements and not requiring specialist knowledge, which enables initial assessment of proposals potentially affecting NTG–ST	Salary GPO Salary agency	<u>Yr 2:</u> GPO 2 wks/ Ag: 3 wks <u>Yr 3:</u> GPO 1 wk <u>Total</u> 6 wks	NSW DEC, EACT, other agencies	Medium
6.3 Evaluate the legislative and regional environmental planning framework relevant to NTG–ST conservation	Salary GPO Salary agency	<u>Yr 2:</u> GPO 0.5 wk/ Ag: 0.5 wk <u>Yr 3:</u> GPO 0.5 wk/ Ag: 0.5 wk <u>Yr 4:</u> GPO 0.5 wk/ Ag: 0.5 wk <u>Total</u> 3 wks	NSW DEC, EACT, other agencies	Medium

7. Evaluate and report on 5 year NTG-ST Recovery Plan program.				
	Salary GPO Salary agency Consultant statistician	<u>Yr 5</u> : GPO 10 wks/ Ag: 6 wk <u>Total</u> 16 wks Cons. Stat: 1 wk	NSW DEC, EACT, other agencies, CMNs, landholders	Long
Operating costs				
	Travel Field equipment Vehicle lease and running		NSW DEC, EACT	Yrs 1-5

Table 5: Estimated costs of implementing actions identified in Table 3 and 4. Implementation is subject to funding.

Action No	Action Title	Priority	Estimated Cost/yr (\$)					Total Responsible cost Party/funding (\$) source	In kind (\$)	Cash (\$)	
			Year 1	Year 2	Year 3	Year 4	Year 5				
Action 1	1. Survey NTG-ST sites and component species	1	24000	87345	22596	8753	0	142694	DEC, EACT	300718	340
Action 2	2. Develop and maintain an information and GIS database for all NTG-ST sites and dependent threatened species	1	0	0	0	0	0	0	DEC, EACT	28080	
Action 3	3. Develop and implement a strategy to establish a comprehensive, adequate and representative system of NTG-ST areas protected either by reservation or conservation agreements	2	7500	0	4237	4377	0	16114	DEC, EACT	33957	
Action 4	4. Continue to develop and promote 'best practice' management for NTG-ST.	1	6000	21356	17653	25423	16575	87007	DEC, EACT	183378	
Action 5	5. Develop and implement a strategy to involve landholders and the community in the protection and management of NTG-ST.	1	25500	17775	18360	24799	16575	103010	DEC, EACT	107088	
Action 6	6. Develop a strategy to enhance (a) the understanding by government and non-government organisations of NTG-ST conservation issues, and (b) their commitment to considering NTG conservation when participating in regional planning.	1	1500	6153	4943	3647	1507	17750	DEC, EACT	26781	
Action 7	7. Evaluate and report on 5 year NTG-ST Recovery Plan program	1	0	0	0	0	15068	15068	DEC, EACT	24752	
Operating costs		1	10500	28160	93412	91234	80600	3039076			
Total			75000	160789	161201	158233	8234	130325		704754	754
Other costs	Land acquisition costs	2		250000	250000	250000	250000	1000000			