- Appendix 2 -
Compendium of Regional Templates on the Status of Temperate Grasslands Conservation and Protection

Photo by Chris Harris

Prepared for

The World Temperate Grasslands Conservation Initiative Workshop
Life in a Working Landscape: Towards a Conservation Strategy for the World's Temperate Grasslands

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IUCN WCPA World Commission on Protected Areas

Temperate Grasslands Conservation Initiative

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1. INTRODUCTION

The mission of the Grasslands Protected Areas Task Force of the World Commission on Protected Areas is:

> *To promote and facilitate the establishment of new or expanded grassland protected areas throughout the grasslands biome, with a priority on temperate grasslands, toward a goal of protecting 10% of the temperate biome by the year 2014, and to provide for the protection, restoration and wise use of grassland protected areas through the development of best management practices and guidelines.*

In 2005, the J.M. Kaplan Fund invited expressions of interest designed to enhance international communication and cooperation for the protection and conservation of the world's temperate grasslands. The Grasslands Protected Area Task Force submitted a proposal and in 2006 was awarded a grant - as a result the Temperate Grasslands Conservation Initiative (TGCI) was born.

To this end the TGCI scheduled a workshop on June 28-29, 2008 as part of the joint International Range Congress and International Grasslands Congress in Hohhot, China. The goals of this workshop were:

- To establish a global strategy and two regional-specific action plans for increased protection by 2014.
- To develop a mechanism for improving international communications and cooperation for the continued conservation, protection and management of the world's temperate grasslands.
- To establish a Steering Committee to help guide the Project Team and implement the global strategy and region-specific action plans.
- To confirm South America and East Asia as the two priority pilot regions for the project.
- To discuss the potential for and benefits of transboundary protected areas.

This compendium is Appendix Two of the report Life in a Working Landscape: Towards a Conservation Strategy for the World's Temperate Grasslands, a record of the Temperate Grasslands Conservation Initiative workshop in Hohhot China June 28-29, 2008.

Description of Temperate Grasslands

For the purposes of this workshop the following description of indigenous temperate grasslands was used in an effort to achieve a consistent approach:

Indigenous Temperate Grasslands: Grass and graminoid-dominated indigenous ecosystems, where seasonal climates and soils favour the dominance of perennial grasses and other graminoids; these ecosystems occur mainly in the middle latitudes and also in areas of tropical and temperate high mountains above the regional tree line where generally similar environments and temperate biogeographic affinities occur.

At Hohhot there was also a discussion about an ecosystem-transboundary approach to protecting temperate grasslands. It is important that our analysis not be country-by-country, and instead present the various world regions to ensure the approach to protecting temperate grasslands isn't limited by country boundaries.

Identified Temperate Grassland Regions

The TGCI felt it was important to provide initial inventory and status information on the priority temperate grassland regions to the workshop participants. A participant from each region was therefore contacted and requested to complete a description and background template document on their particular grassland region. The various descriptions of the grassland templates vary from the continental level, to country to the regional level, depending on the ecosystem configuration. The 17 templates have been brought together in this compendium. The templates have been grouped together by continent, as below[1]:

Africa
- Equatorial Africa (High Altitude)
- Southern Africa

Asia
- China
- Daurian Steppe
- Iran
- Kazakhstan
- Mongolia
- Russia: Amur River Basin
- Russian Steppes
- Ukraine*
- Uzbekistan

Australasia
- Southeastern Australia
- New Guinea*
- New Zealand

Europe
- Bulgaria/Romania

North America
- Canada, Mexico, United States

South America
- Northern Andes
- Central Andean Grasslands
- Río de la Plata Grasslands
- Patagonian Steppes

Upon reading this compendium a 'world perspective' on temperate grasslands emerges. This context will assist in developing both a global strategy and regional approaches in East Asia and South America.

This project and the progress to date would not be possible without the generous funding from the J.M. Kaplan Fund.

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If you are reading this compendium separate from the full Life in a Working Landscape: Towards a Conservation Strategy for the World's Temperate Grasslands Hohhot China workshop report and wish to receive a copy of the report please contact Bob Peart.

[1] Upon publication of this report the templates from the Ukraine and New Guinea had not yet been received.

2. TEMPERATE GRASSLAND REGION: EQUATORIAL AFRICA (HIGH ALTITUDE)

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2.1 Major Indigenous Temperate Grassland Types

Temperate grasslands in tropical Africa – a biogeographical perspective
Sub-Saharan Africa is estimated to comprise some 12-14 Mio. km² of grasslands (White et al. 2000). Approximately a third of these is situated in equatorial Africa and are mostly Savannas or other tropical grasslands. They differ widely from temperate grasslands; not only in terms of climate (warm-hot), but also in terms of their corresponding biogeographical affinities. Common grasses are represented by mainly tropical genera such as Andropogon, Hyparrhenia or Eragrostis (White 1983), while northern and temperate elements are restricted to high-mountain regions (Fig. 1). Vegetation above the alpine treeline is constituted by a mixture of shrub- and grasslands, which are predominantly built by northern-hemispheric grass genera such as Festuca, Koeleria, Poa, Deschampsia; at moist sites Carex spp. largely replace Cyperus spp. White (1978; 1983) sharply distinguished the tropical lowlands from the "afromontane-archipelago-like regional centre of endemism" referring to the montane forests and the "afroalpine-archipelago-like region of extreme floristic impoverishment" mainly situated above the treeline. The afromontane flora is rich in plant species (~4000) and is characterised by a high level of endemic, often woody taxa. Although less rich in species, the afroalpine flora shows many similarities with the afromontane flora, and differences are not always clear (Grimshaw 2001). Approximately 80% of the afroalpine species can be considered endemic and, even on a species-group level (genus and similar), endemics account for one third of the afroalpine flora; with another third being pantemperate (e.g. Senecio, Ranunculus) and 13% northern-hemispheric taxa (e.g. Arabidopsis thaliana; Hedberg 1986). Ethiopia's (sub-) alpine habitats are particularly rich in endemic, and often threatened taxa (see Table 2 in the appendix for some examples).

Abiotic background: Climate and soils
During the ice ages, much of Africa's high mountains were glaciated and vegetation belts were depressed by 400-800 m. Although gaps between high-altitude grassland sites were considerably diminished they probably never came into direct contact (Hedberg 1969; White 1981). The present climate of the afroalpine grasslands is cool due to the high elevation, but it is nonetheless widely different from mid-latitude regions. Temperatures show diurnal, rather than seasonal fluctuations ("winter every night, summer every day", Hedberg 1964). Annual mean temperatures are typically between 5 and 8°C near the treeline; under clear skies temperatures in afroalpine grasslands may range between +13.5 and -3°C in the same day (weather hut at 3750 m asl., +200 cm above ground, Wesche 2003; Wesche et al. 2000). Frosts may occur on occasion down to about 3000 m asl. (Wesche 2002). The precipitation regime is usually semi-humid, as most African mountains experience one or two pronounced dry seasons. Annual total precipitation is usually between 800 and 2000 mm, but droughts may occur on virtually all mountains. High levels of radiation and evaporation result in rapid desiccation of the vegetation, often causing severe fires.

Typical tropical soil types like ferralsols or nitosols are not found on upper montane or alpine sites (Hamilton & Perrott 1980; Schmitt 1991; Speck 1982), whereas luvisols are developed on morainic substrates, and andosols are widespread on volcanic ashes. Even histosols are common. Soils thus often have huge mineral-organic top horizons.

Classification schemes – major grassland types

Temperate grasslands in equatorial Africa are common above the treeline, i.e. in the afroalpine (or tropical-alpine) belt (Hauman 1955) between 3700/3800 to 4500 m asl. At 3000 – 3800 m, the ericaceous belt constitutes the treeline ecotone. The ericoid-leaved trees and shrubs burn easily, and the vegetation usually represents a mosaic of remnant forests, scrub and secondary grassland (Miehe & Miehe 1994a; Schmitt 1991; Wesche 2006). For the current survey we will therefore concentrate on altitudes ranging from 3000 m to 4500 m asl., above which vegetation cover becomes very sparse in equatorial Africa.

In the last two decades detailed surveys of high-altitude vegetation have been published which cover most of the larger eastern African mountains (Table 3, appendix). However, knowledge on mountains along the Albertine Rift (Rwanda, Sudan, especially Congo) is much more limited, and few of the Ethiopian mountains have been studied in great detail. Moreover, there is no updated synoptic classification of afromontane and afroalpine vegetation which includes grasslands. In his continental overview, White (1983) distinguished “afromontane & afroalpine shrublands”, “afromontane & afroalpine grasslands”, and “mixed afroalpine communities”. In spite of the detailed classification however units in the accompanying map were combined into only one class. In his much more detailed account, Knapp (1973) distinguishes afroalpine grasslands from upper montane/subalpine grasslands where temperate grasses intermingle with more tropical elements. Most of the respective stands are in fact replacement communities of various types of ericaceous vegetation.

Table 1: Major vegetation types of the high-altitudes in tropical Africa
(Hedberg 1964; Knapp 1973)

	Typical genera	Physiognomy
Subalpine communities		
Ericaceous scrub	*Erica*, *Stoebe*, *Hypericum*, *Cliffortia*	Shrubs between 0.5 and 5 m
Subalpine grassland	*Andropogon*, *Exotheca*, *Sporobulus*	Usually dense grassland, bunches small
Alpine communities		
Afroalpine scrub	*Alchemilla*, *Helichrysum*	Partly very dense shrubs 0.5-1.5 m
Dendrosenecio woodland	*Dendrosenecio*, *Lobelia*	Open woodland with Tree Groundsels (≤ 5 m)
Tussock grassland	*Poa*, *Avenae*, *Festuca*, *Koeleria*	Large tussocks (≤ 1 m) with open space between
Bogs	*Carex*, *Scirpus* sl.	Large tussocks (≤ 1 m)

The benchmark works of Hedberg (1951; 1964) provide a sufficiently simple classification that is largely followed here. Among the subalpine communities, we distinguish between ericaceous scrub and subalpine grasslands (Table 1). The afroalpine vegetation was classified into bogs, tussock grassland and *Dendrosenecio* woodland. The latter may have a field layer of grasses, but more commonly of *Alchemilla* shrubs. We deviated from Hedberg by uniting *Alchemilla* scrub and *Helichrysum* scrub as they were usually not separated in the available vegetation maps. All these community groups can be rapidly interchanged by fire or grazing (Hemp 2006a; Wesche 2002), with grasslands usually replacing woody vegetation under high fire frequency. Scrub communities are especially widespread in the mountains of southern and central Ethiopia and the general flora there also differs somewhat from sites in equatorial Africa. However, we refrained from establishing separate units as data on Ethiopian (sub-) alpine vegetation are far from comprehensive (see Table 3 in the appendix for a general overview).

2.2 Impact of Human Settlement

Human impact differed considerably between the mountains within Ethiopia and between those of Cameroon and East Africa. The highlands of Ethiopia have been settled for Millennia, and even altitudes well above 3000 m may be under agriculture. Ethiopia is one of the Vavilov centres mainly because it is the centre of origin and diversity for unique high-altitude crops including Enset (*Musa ensete*) and Tef (*Eragrostis tef*). Tef and indigenous strains of barley are cultivated well into the (former) ericaceous belt, and thus lie within the potential range of temperate grasslands. At even higher altitudes, afroalpine vegetation is used in partly transhumant animal husbandry. Permanent settlements are found up to 3700 m asl., even in the main national parks (Bale, Simen). Here, people still cultivate vegetables, but mainly rely on livestock rearing. Ethiopia has the largest livestock population of any country in Africa and the tenth largest in the world (*c*. 30 million cattle, 42 million sheep and goats, 7 million equines, >53 million chickens, Alemneh 2003). The majority of the population lives in the highlands where many temperate crops can be grown and animal parasites (e.g. Tse-Tse flies) are relatively rare. Intense land use led to an almost complete replacement of montane forests but grassland cover also declined (Gete & Hurni 2000; Hurni et al. 2005). Today, most of Ethiopia's high altitude natural vegetation is long gone, to the extent that the state of the potential natural vegetation is often unknown (Miehe & Miehe 1994b). Many of the former natural grassland sites may nonetheless still show some kind of grass cover, but communities are often heavily modified and can not be compared to original grasslands or grasslands elsewhere on tropical African mountains. Ericaceous forest was almost completely replaced by heterogeneous scrub communities and unique meadow-like heavily grazed *Erica* stands which are only 40 cm high. Tussock grasslands are comparatively rare in the southern Ethiopian mountains, where afroalpine *Helichrysum* scrubs are more common instead. Whether grazing, repeated fires or the impact of burrowing rodents (especially in the Bale Mts.) has favoured scrub over tussock grassland is not clear (Miehe & Miehe 1994b). Bogs are, however, still relatively intact in protected regions.

Compared to Ethiopia, human settlements at the treeline in equatorial Africa have been very limited. Farming is a more recent introduction there (Maxon 1994) and poses a major threat to the montane forest, but not to sites at the treeline ecotone and above. Permanent settlements have usually been restricted to well below 3000 m, an exception being the Elgony tribe who already raised cattle on treeline sites of Mt. Elgon when the first Europeans arrived (Cotton 1932; Scott 1998). The Elgonys were evicted from the park due to conservation efforts in the 1980s. In several sites of the Kenyan (Mau escarpment, Kinangop grasslands) and the Interlacustrine highlands (Virunga Mts. - Rwanda, Congo) human settlements have climbed up to altitudes of around 3000 m, but these are exceptions restricted to the lower boundary of high-altitude grasslands in tropical Africa. Farming is thus of practically no importance there, and even livestock grazing only locally reaches 3000 m in East Africa.

On Mt. Cameroon, where Bantu tribes had settled much earlier than in East Africa, farming and livestock grazing did not extend above the montane belt (Hall 1973; Richards 1963). Nonetheless, hunters have moved to Mt. Cameroon's high-altitudes and lit fires to promote open vegetation and growth of fresh foliage. This practice had already become well established by the 1930s (Maitland 1932) and has continued ever since. One of the main consequences has been a depression of the treeline by several hundred metres, heavy fragmentation of ericaceous vegetation, and a spreading of open vegetation, being mainly tussock grasslands. Much of the current grassland vegetation on Mt. Cameroon thus represents a fire-maintained, pseudo-climax community (Hall 1973; Richards 1963) that has persisted due to regular fires from frequent lava outbreaks and, more recently, human impact.

Fires are equally common on other African mountains (including Ethiopia, Table 5, appendix). Poachers and bee hunters move to the ericaceous and afroalpine belt and light fires, thereby increasing fire frequency (Hemp 2006a; Wesche 2002). Here, the treeline has also lowered by 300 - 800 m, and broad-leaved upper montane forest has been replaced by ericaceous vegetation and subalpine grasslands (Hemp 2005, 2006a). Most ericaceous species can survive occasional fires, but they usually resprout slowly and from dormant buds near the surface (Hemp & Beck 2001; Miehe & Miehe 1994a; Wesche et al. 2000). As a consequence, much of the ericaceous vegetation is currently scrub rather than forest. In contrast, tussock grasses such as the widespread *Festuca pilgeri* resprout within days of fire (Beck et al. 1986; Wesche 2006) and can be considered fire-resistant (Hedberg 1964). Afroalpine *Alchemilla* and *Helichrysum* scrub also needs only 5-10 years to recover from fire (Beck et al. 1986), but the grass *Deschampsia flexuosa* was observed to cover a former *Alchemilla* stand within one year after burning (Wesche 2002). Thus, grasslands appear to be favoured by the current widely human controlled high fire frequency (Bader 1976; Hedberg 1964; Knapp 1973). In drier regions (Mt. Kilimanjaro, Bale Mts.), *Helichrysum* scrub, rather than grasslands, may be the principal replacement community under high fire frequency; as this often has –in contrast to the tussock grasslands– limited biomass not offering sufficient fuel for regular fires (Hemp 2005). The *Helichrysum* communities seem to expand at the expense of tree heathers and other ericaceous formations (Masresha et al. 2006; Miehe & Miehe 1994b).

2.3 Current Status

Spatially explicit assessments of current grassland status suffer from two constraints: The high fire frequency results in pronounced temporal dynamics where a given community can change its distribution by >200% in 25 years (Hemp 2005). This makes it necessary to assess all stages of the potential successional system. Moreover, precise spatial information is widely lacking as vegetation maps have only been produced for some of the sites. We have thus supplemented the available data with estimates based on the potential habitat defined by the area at a given altitude taken from a digital elevation model (SRTM data, Jarvis et al. 2006). These were combined with published information on the relative importance of vegetation types and personal field experience. Table 4 in the appendix summarizes the results.

2.3.1 Natural state

The maximum potential extent of (sub-) alpine vegetation can be estimated with respect to the 3000 m asl. contour line. According to Table 4 (appendix), major potential grassland regions >3000 m cover *c*. 19000 km² in tropical Africa, afroalpine regions in the stricter sense (>3500 m asl.) total 5000 km². Of these, 75 and 65% respectively are found in Ethiopia. The following countries of importance are Kenya (12/15%), Uganda (5/10%) and Tanzania (4/8%). The relatively larger importance of East Africa for the higher altitudinal belt relates to the more pronounced uplift in the equatorial part of the Rift Valley.

Detailed estimates for different grassland types are hard to give for Ethiopia outside of the national parks (Table 4), but the Bale Mts. NP and the Simen Mts. region host some 800 km² of ericaceous scrub, ~200 km² of subalpine grassland, ~550 km² of alpine *Helichrysum* scrub, 550 km² of tussock grassland and 100 km² of alpine bog. Our estimates for equatorial Africa give a total of 1200 km² ericaceous scrub, 300 km² subalpine grasslands, 650 km² afroalpine scrub and *Dendrosenecio* woodland; tussock grasslands cover some 400 km² and *Carex* bogs some 200 km². This is slightly more than half of the potential habitat above 3000 m asl. in East Africa (the rest is largely forest and some open sites such as rocks). Mount Cameroon is included in this figure because it has some importance for subalpine grassland (~50 km²) and ericaceous scrub (~22 km²). Due to its successional character and a lack of precise data for Ethiopia, the total remaining extent of near natural grasslands cannot be estimated with any certainty. Based on available data, about 50% of the total former potential (sub-) alpine vegetation seem to be relatively intact (though by no means always pristine), with figures for Ethiopia (35%), Sudan (30%) and Cameroon (80%) being much lower than for the other tropical African Mountains (>90%).

2.3.2 Formal Protection

According to available information (Tables 4 & 5), about 45% of the regions above 3000 m are subject to some form of legal protection. Figures for Ethiopia are considerably lower with a total protected area of only 30%, while other sites in East Africa benefit from between 90 and 100% protection. In Congo, only 50% of the habitats >3000 m asl. are protected, mainly as a consequence of the poor protection in the Itombwe mountains, which do however hardly reach into truly afroalpine elevations. Thus, protection of sites in Congo >3500 m asl. is better. This is also true in terms of the total area >3500 m asl., as the relatively well-managed national parks of East Africa account for a disproportionally large share of this altitudinal belt (35%). Even in Ethiopia, *c.* 1400 km² (i.e. a more than a third) of the total area >3500 m asl. are protected by the two relatively effective and functional national parks in the Simen and Bale Mts. (Table 4). Although most of the above figures are based on somewhat rough calculations, much of tropical Africa's true afroalpine grasslands have apparently been designated as reserves, and even a fair share of the more heavily used subalpine regions have, at least on paper, some conservation status. Thus, the situation in tropical Africa is better than in some other temperate grassland regions such as North America or Middle Asia (Henwood 1998, 2003).

A major drawback, however, is the fact that few of these PAs are truly free from human impact. Fires occur at virtually all sites (see Table 5), but burning may be at least partly beneficial for grassland vegetation. Poaching does pose a serious threat to mammal and bird biodiversity however, and it is effectively excluded only in a limited number of parks in Kenya, Tanzania, Uganda and Rwanda. Park administrations have limited facilities in parts of Ethiopia and in several forest reserves throughout tropical Africa including Mt. Cameroon. General lack of security adds to these problems in Congo and Sudan. Given that even small sites often host endemic taxa (e.g. >100 plant species are confined to a single mountain or mountain group; Hedberg 1992), conservation of single sites, and not only of a sufficient overall share, is important. Thus, in certain circumstances and localities, conservation and protection measures are more imperative than implied by our summary figures.

2.4 Opportunities for Improving the Level of Protection and Conservation in the Region

Only a few improvements are needed in the national parks of Kenya and Tanzania (Table 5). In Kenya, protection status of the Cherangani Mts. and for parts of the Mau escarpment is insufficient, and unrest and insecurity have repeatedly been an issue in the Elgon region. Park management in Uganda has improved tremendously over the last two decades, and prospects for Rwenzori (east side) and Mt. Elgon are good, though both regions have suffered (and may suffer again) from insecurity and/or rebel activity. Protection in Mgahinga Gorilla NP seems to be adequate, while conservation activities on Mt. Moroto and Mt. Kadam are very limited. Here, lack of funds and security issues continue to hamper any efforts. While we are aware that political instability usually hinders traditional conservation efforts, the Kenya Wildlife Service has demonstrated that a determined park administration can tremendously improve the general security situation.

Conservation in Rwanda has continued even through one of Africa's darkest periods, and at least the high-elevation sites of the Rwandan Virungas can now be considered relatively well protected. The chief problems in the East African region are concentrated in eastern Congo, where the political situation is far from stable, rendering even surveying activities difficult at the moment. There are certainly problems even in the two great NPs Virunga and Kahuzi-Biéga, though the consequences for the high-altitude grasslands may be not as severe as in the montane forest. Here, law enforcement and even designation of new reserves (Itombwe Mts.) remains a major challenge. The political situation in southern Sudan is better but is still far from stable, and despite being urgently needed, gazetting of a national park in the Imatong Mts. as well as the establishment of conservation measures in the area have not moved beyond the stage of initial planning.

The level of protection for Mt. Cameroon has remained low, but the conservation project at Limbe is currently striving to improve not only coverage of protected area but also effectiveness and conservation management within the existing forest reserves. The problem is again certainly more pronounced for the montane forest than the grasslands.

The greatest challenges (spatially) are possibly found it Ethiopia, where the long-lasting and intense human activity has put grassland sites under pronounced pressure. Even the prominent NPs are relatively poorly managed compared to e.g. Kenyan and Tanzanian national parks, and many of the other sites hardly have any formal protection. Forest cover is still lost at a high rate (Gessesse & Kleman 2007) and although grasslands are less heavily affected, there are also severe threats of agricultural encroachment (e.g. Bezuayehu & Sterk 2008). Ethiopia is rich in endemic species, and a surprisingly high number seem to tolerate moderately intense land use (e.g. the "grazing weed" *Kniphofia foliosa)*. Thus, much of the biodiversity is not (as yet) extinct, but improved and enforced management is needed in virtually all high-altitude grasslands of Ethiopia.

2.5 Constraints Against Improving the Level of Protection and Conservation in the Region

The perhaps most difficult constraint in Africa is political instability, which is the principal problem in Congo but also in parts of Uganda and Sudan, locally in Kenya (conflicts in the Elgon region in 2007/2008) and to some extent in Ethiopia (mainly in the Oromiya region Southeast and south-west). Lack of funds, general poverty and an inappropriate policy approach which completely separates local communities from the resources they depend on for their livelihoods all add to political problems. Ethiopia is one of the poorest countries in the world, yet is the single most important country in terms of temperate grasslands in tropical Africa. Conservation is notoriously underfinanced, and there is limited hope for improvement unless international funding is forthcoming. Future prospects are hard to predict with respect to the current political situation. Many of the required measures such as strengthening of the overall administration and security level are beyond usual conservation efforts.

The local effects of global climatic change represent another aspect that can only be mitigated, but not controlled by local conservation activities. Temperatures in tropical Africa are rising, as they are elsewhere, and there is evidence that precipitation is decreasing, at least locally (Hemp 2005; Mote & Kaser 2007). Trends are debated, but the IPCC predicts generally stable or even increasing precipitation for the region (IPCC 2007). It seems however likely that fire frequency will remain high, even under global change, which will benefit grasslands in most sites (but not in all - for a contrasting example see Hemp 2005). At present, we can see no immediate danger of uprising vegetation belts "squeezing" out high-altitude grasslands on mountains; although small ranges such as the Cherangani Mts. and the Mau escarpment may face problems in the future. Ongoing changes in land use are likely to have more immediate impacts on high-altitude grasslands than possible effects of climatic change (see summaries provided by CDE & MRI 2008).

2.6 Suggested Next Steps and Action Plan

Conservation in Africa faces so many problems that temperate grasslands are unlikely to be in the general focus. Still, several steps are both realistic and straightforward. Ethiopia has to continue improving its conservation efforts. The government is challenged here, particularly in terms of enforcing protection in some of the more poorly administered reserves. Conserving the Ethiopian highlands is also of utmost importance in terms of watershed management (Hurni et al. 2005); as e.g. 8 major rivers originate in the Bale Mts. alone with 12 million people in Ethiopia and neighbouring Somalia depending on this water supply.

The importance of non-governmental projects such as the Ethiopian Wolf Conservation Project (EWCP) can not be overstated. A similar local role may be envisioned by the Mount Cameroon Project hosted at Limbe Botanical and Zoological Gardens. Their success depends on the continued commitment of private and public stakeholders and international donors.

Legal protection of the Cherangani Mts. (and to a lesser extent of the Mau Escarpment) in Kenya needs to be improved. The area has a high potential for ecotourism and the ongoing –mainly private– activities need support by a general promotion of tourism in western Kenya, a repeatedly mentioned long-term goal of involved institution including the Kenya Wildlife Service. Special problems are posed by mountain ranges located at interstate boundaries. Plans for a transboundary management system have been implemented on Mt. Elgon (Muhweezi et al. 2007), and cooperation seems to work reasonably well in the Rwandan and Ugandan Virungas.

The greatest challenge is posed by eastern Congo. Political unrest on the Congolese part of the Rwenzori has affected security in the region to the extent that the Ugandan Park also had to be closed for several years. The latter has been reopened now, but the situation in the Congolese Parks is still unclear. As the security situation hopefully improves, national, and more importantly international support for the reserves needs to be bolstered, although institutions such as the GTZ are active in the region. There is also a need to designate further PA's, but in the first place detailed surveys, some of which have already commenced, are needed to assess the current state of affairs. Moreover, most of the existing management plans must be reviewed and improved. Similar steps are needed in southern Sudan, where the political situation has improved somewhat, but where constraints still demonstrate the particular challenges conservation efforts in Africa face today.

2.7 Appendices

Map 1: Regional map illustrating the location of important mountain regions with sub-alpine grasslands in tropical Africa

(site selection in Ethiopia follows largely the proposal of EWCP - http://www.ethiopianwolf.org/wolves/ EWdistirbution_ clip_image002.gif; altitudinal data were taken from SRTM tiles)

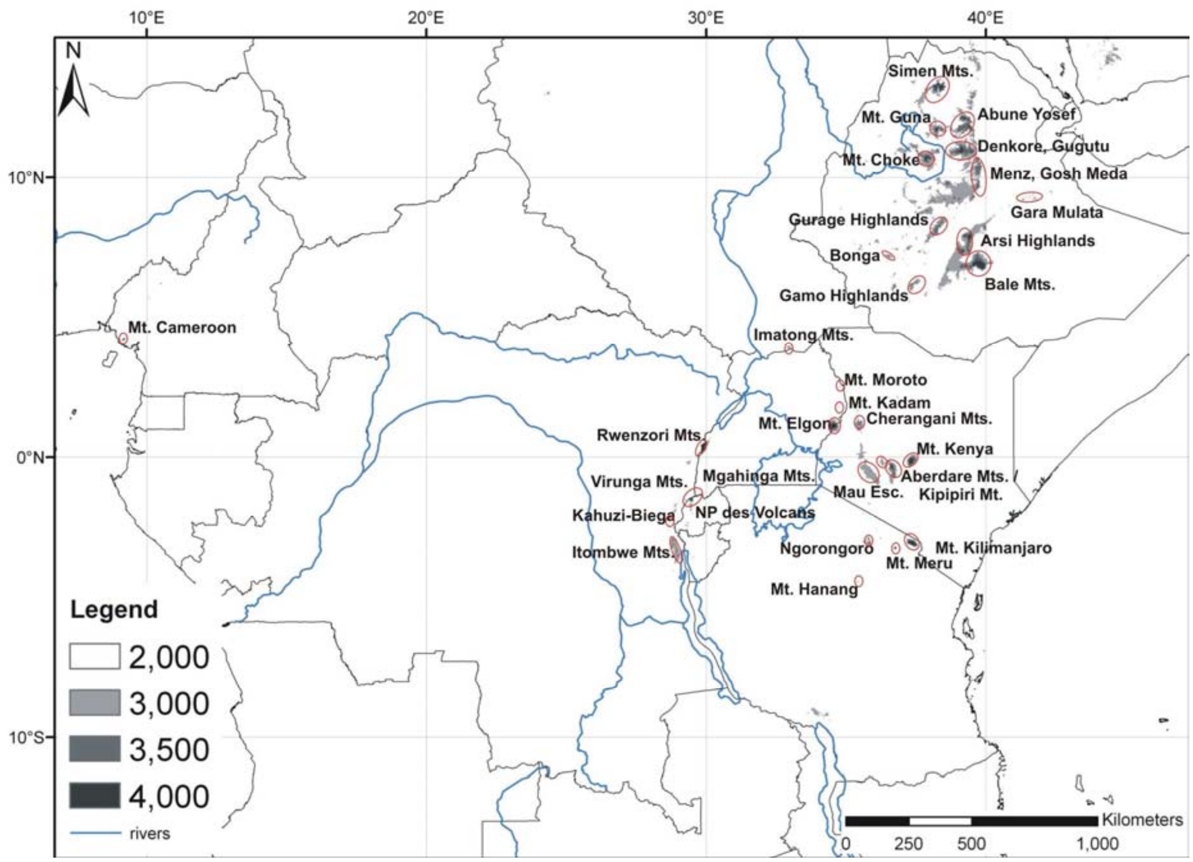

Table 2: Examples of important high-altitude endemics occurring in the Ethiopian highlands
(all data according to www.iucnredlist.org)

Taxon	Distribution	Red List Status
Vascular Plants		
Lobelia sect. *rhynchopetalum* (Giant lobelias)	21 vicariant endemics on mountains of East Africa and Ethiopia (Knox 1998)	- [1]
Echinops spp.	Several endemic species on mountains of East Africa and Ethiopia (Mesfin 2004)	- [1]
Kniphofia foliosa (Ethiopian ret hot poker)	Several endemic species on mountains of eastern Africa	- [1]
Mammals		
Canis simensis (Ethiopian wolf)	Ethiopian mountains (mainly Bale)	EN
Tragelaphus buxtoni (Mountain Nyala)	Ethiopian mountains (mainly Bale)	EN
Capra walie (Walia Ibex)	Northern Ethiopian mountains	CR
Tachyoryctes macrocephalus (Giant mole rat)	Bale Mts. Ethiopia	VU
*Arvicanthis blicki (*Blick's grass rat)	Bale Mts. Ethiopia	NT
Crocidura lucina (Morrland shrew)	2 mountain sites in southern Ethiopia	VU
Theropithecus gelada (Gelada)	Ethiopia	Lr/nt
Cercopithecus aethiops djamdjamensis (Bale monkey)	Bale Mts. Ethiopia	DD
Birds		
Rougetius rougetii (Rouget rail)	Mountains of Ethiopia and Eritrea	NT
Cyanochen cyanoptera (Blue-winged goose)	Ethiopia	NT
Zavattariornis stresemanni (Ethiopian bush-crow)	Southern Ethiopia	VU
Hirundo megaensis (White-tailed swallow)	Ethiopia	VU
Tauraco ruspolii (Prince Ruspoli's turaco)	South Ethiopia near Yabello	VU
Serinus ankoberensis (Ankober serin)	Ethiopia	VU
Sarothrura ayresi (White-winged flufftail)	Ethiopia and South Africa	EN

[1]levels of assessment in vascular plants are generally poor

Table 3: Mountain ranges with extensive afromontane/afroalpine vegetation in tropical Africa (according to Table 1 - altitudinal ranges are given in m asl.)

Region	Abbreviation	Main high-altitude open vegetation types (detailed spatial estimates in km² if available)	Source
Ethiopia			
Simen Mts.	Simen	Short-grass *Danthonia-Festuca-Poa* steppe, long-grass *Danthonia-Festuca-Alchemilla* steppe, *Carex* bogs	Nievergelt et al. 1998
Mt. Choke	Choke	*Erica* scrub, *Alchemilla* & *Helichrysum* scrub, *Festuca* grassland, *Carex-Festuca* bog	Hurni et al. 2005, own observation
Mt. Guna	Guna	*Pennisetum* grassland, some tussocks, shrubland very rare (*Erica*)	Own observation, Melku 2004
Abune Yosef	Yosef	Hardly any woody vegetation left, some grassland	Own observation
Denkore, Gugutu	Denkore	Ericaceous scrub, tussock grassland	Abate et al. 2006
Central Shewa Highlands	Shewa	Ericaceous, *Festuca* grassland, afroalpine scrub, some bogs	Own observation, Fishpool & Evans 2001
Arsi Highlands / Mt. Kaka	Arsi	Highly degraded, fragments of vegetation similar to Bale Mts.	Own observation
Gurage Highlands	Gurage	Tussock and subalpine grassland, *Carex* bogs	Unpublished report, Fishpool & Evans 2001
Bonga	Bonga	Ericaceous vegetation, afroalpine vegetation small, *Carex* bogs relatively extensive	Own observation
Bale Mts.	Bale	*Erica* scrub, *Alchemilla* scrub, *Helichrysum* scrub, *Festuca* grassland, *Carex-Festuca* bog	Menassie & Masresha 1996; Miehe & Miehe 1994b
Gamo Highlands	Gamo	Very limited afroalpine, mostly subalpine grasslands	Own observation, Scott 1952
Gara Mulata	Mulata	*Erica* scrub and some limited tussock grassland, *Carex* bogs	Demel 1996, Uhlig & Uhlig 1990b
Kenya			
Mt. Kenya	Kenya	Ericaceous scrub, *Dendrosenecio-Alchemilla* woodland, *Festuca-Alchemilla* tussock grassland, *Dendrosenecio-Carex* moorland/bog	Rehder et al. 1988
Aberdare Mts.	Aberdare	subalpine scrub (*Erica*, *Stoebe*, *Cliffortia*) subalpine grasslands (*Exotheca*, *Cyperus kerstenii*), alpine grassland (*Alchemilla-Festuca*), alpine scrub *(Alchemilla)*	Schmitt 1991
Kipipiri (W Aberdares)	Kipipiri	According to satellite image hardly any open or (sub) alpine vegetation	Schmitt 1991
Mau Escarpment	Mau	Unspecified “montane grassland”, with respect to altitude unlikely to host “temperate”(sub-) alpine vegetation	Ndang'ang'a et al. 2003
Cherangani Mts.	Cherang.	Small (sub-)alpine zone >3300: mainly ericaceous belt, some *Dendrosenecio* woodland, moorland small (*Festuca*), small bogs (*Carex*),	Mabberley 1975
Mt. Elgon (E-side)	ElgonE	Subalpine *Exotheca* & *Andropogon* grassland, *Erica-Stoebe* scrub, *Alchemilla scrub, Dendrosenecio-Alchemilla* woodland, *Festuca-Koeleria grassland*, *Carex* bogs	Wesche 2002
Tanzania			
Mt. Kilimanjaro	Kilimanj.	*Erica* bushlands, *Helichrysum* scrub, (sub-) alpine *Festuca* grassland, *Carex* bogs	Hemp 2005, 2006b
Mt. Meru	Meru	ericaceous scrub 3000-3700, “steppe like” tussock grassland with *Pentaschistis*, no bogs, very limited *Alchemilla* srub, some *Helichrysum* scrub	Hedberg 1951, 1964
Mt. Hanang	Hanang	Ericaceous scrub mainly between 2900 – 3200, 3000 – 3400 *Helichrysum* moorland with *Andropogon*, *Pentaschistis*, *Koeleria*, *Anthoxanthum*	Greenway 1955
Ngorongoro	Ngoro.	Ericaceous scrub with *Artemisia afra* and *Erica arborea*, subalpine grassland with *Pennisetum* and *Eleusine* (not temperate)	Herlocker & Dirschl 1972

Region	Abbreviation	Main high-altitude open vegetation types (detailed spatial estimates in km² if available)	Source
Uganda			
Mt. Elgon (W-side)	Elgon-W	Subalpine *Exotheca* & *Andropogon* grassland, *Erica-Stoebe* scrub, *Alchemilla scrub, Dendrosenecio-Alchemilla* woodland, *Festuca-Koeleria grassland*, *Carex* bogs	van Heist 1994; Wesche 2002
Mt. Moroto	Moroto	no high altitude grassland	Thomas 1943
Mt. Kadam	Kadam	>3200 subalpine "moorland" with *Exotheca abyssinica* & *Eragrostis lasiantha* and shrubby moorland with *Eragrostis volkensii* & *Erica*, no proper afroalpine grassland	Thomas 1943
Rwenzori Mts.	RwenzE	*Erica* scrub, *Helichrysum* scrub, *Dendrosenecio* woodland, *Alchemilla* scrub, *Festuca-Poa* tussock grassland, *Carex* bog	Osmaston 1965; Schmitt 1985, 1998
Mgahinga / Virunga	Mgahinga	3300 – 3500: ericaceous vegetation, 3500 – 4100: *Dendrosenecio* woodland, *Helichrysum* scrub common, *Alchemilla* scrub very common, *Festuca* tussock grassland rare, few bogs	Hedberg 1964; Karlowski 1995
Rwanda			
Virunga Volcanoes	Volcano	3300 – 3500: ericaceous vegetation, 3500 – 4100: *Dendrosenecio* woodland, *Helichrysum* shrub common, *Alchemilla* scrub very common, *Festuca* tussock grassland rare, few bogs; vegetation sparse above 4300	Fischer & Hinkel 1992; Hedberg 1964
Dem. Rep. Congo			
Virunga	Virunga	3300 – 3500: ericaceous vegetation, 3500 – 4100: *Dendrosenecio* woodland, *Helichrysum* shrub common, *Alchemilla* scrub very common, *Festuca* tussock grassland rare, few bogs; vegetation sparse above 4300	Hedberg 1964
Rwenzori Mts.	RwenzW	*Erica* scrub, *Helichrysum* scrub, *Dendrosenecio* woodland, *Alchemilla* scrub, *Festuca-Poa* tussock grassland, *Carex* bog	Osmaston 1965
Kahuzi-Biega Mts.	Kahuzi	*Erica scrub*, *Dendrosenecio* woodland (with grasses), *Deschampsia* mats on summit	Fischer 1996
Itombwe Mts.	Itombwe	No temperate grasslands, only montane grassland ("high prairie") and bamboo forest	Doumenge 1998; Ilambu et al. 1999
Cameroon			
Mt. Cameroon	Cameroon	>2500 montane *Andropogon* / *Sporobolus* grassland, above 3000 partly *Festuca* / *Bulbostylis* grassland, some ericaceous thicket, >3250 only *Deschampsia-Festuca* (sub-)alpine grassland	Hall 1973; Maitland 1932; Richards 1963
Mt. Oku	Oku	Only some *Hypericum-Adenocarpus* scrub (max 3010 m asl).	
Sudan			
Imatong Mts.	Imatong	> 2900 ericaceous scrub, some subalpine *Exotheca* & *Festuca* grassland (small), no afroalpine grassland	Jackson 1956

Table 4: List of legally protected grassland areas in the region by country, mountain region (cf. Table 3), grassland type and size

Names of Protected Areas follow IUCN listings wherever possible, those not given in the IUCN layer are underlined. The IUCN layer was also used to estimate fraction of a given (sub-) alpine region (>3000 m asl.) covered by the PA. SRTM data were used to estimate potential extent of (sub-) alpine vegetation (i.e. area above 3000 m asl) and extent of afroalpine zone (3500 – 4500 m asl). Whenever possible, these data were compared against spatial extent of main vegetation types derived from published vegetation maps; figures in italics refer to own estimates based on information in Table 3, own field observations and information from the Digital Elevation Model. Several publications gave only a total amount of (sub-)afroalpine vegetation for the given region; these figures are additionally listed as "unspecified" to allow comparison with our estimates on the level of vegetation types.

Region	Name PA	Potential spatial Extent (km²)				Vegetation types – subalpine		Alpine							estimated according to
		>3000	>3500	>4000	>4500	ericaceous	subalpine grassland	*Alchemilla / Helichrysum*	*Dendro -- senecio*	tussock	bogs	unspe -cified	% protected (>3000 m)	% near natural	
Ethiopia															
Simen	Simen Mts. NP	1374	552	115	0.1	246.6	164.4	55.2	0.0	469.2	27.6		24	40	Nievergelt et al. 1998
Choke	Mt. Choke NFP[2]	993	246	4	0	95	20	60	0.0	20	10		~30	*20*	Own observation
Guna	No protection	569	82	10	0	1	25	10		2			0	5	Own observation
Yosef	Abune Yosef[3]	2215	307	0	0	200	40	120		40			0	20	Own observation
Denkore	Denkore NFP[3], Gugutu[1]	2203	410	17	0	360	40	35		8			20[1]	20	Abate et al. 2006
Shewa	Wof Washa NFP, Ankober NFP, Menz NFP, Gosh Meda NFP[2]	1275	24	0	0	105	35	20		95			~30	20	Own observation, Fishpool & Evans 2001
Arsi	Arsi Highlands / Mt. Kaka GR	1867	423	24	0	95	2	165		95	15		~40	20	Own observation
Gurage	Butajir NFP	727	7	0	0	?	5	5		35	6		1	5-10	Own observation
Bonga	Bonga NFP	64	0	0	0		4	12			23		90	60	Own observation
Bale	Bale Mts. NP, HR, WR, FR	2856	1198	216	0	535		470		85	43	1250	75	80	Miehe & Miehe 1994b
Gamo	Gamo Highlands	181	0.3	0	0	20	160						3[4]	20	Anonymous 2006
Mulata	NFP does not reach highlands	12	0	0	0	1	1			2	1		0	40	Uhlig & Uhlig 1990a
Kenya															
Kenya	Mt. Kenya NP & FR	743	368	122	11	40			40	35	20		100	98	Beck et al. 1990

Region	**Name PA**	**Potential spatial Extent (km²)**				**Vegetation types – subalpine**		**Alpine**							**estimated according to**
		>3000	>3500	>4000	>4500	ericaceous	subalpine grassland	*Alchemilla / Helichrysum*	*Dendro -- senecio*	tussock	bogs	unspe -cified	% protected (>3000 m)	% near natural	
Aberdare	Aberdares NP & FR	608	122	0	0	120	20	15	40	40	60		94	95	Schmitt 1991
Kipipire	Kipipiri FR	18	0	0	0		0.5						89	95	Schmitt 1991
Mau	Grasslands unprotected	57	0	0	0		57					140	0	30	Ndang'ang'a et al. 2003
Cherang.	Kiptaberr FR	260	0.3	0	0	110		15	5	5	5		44	50	
	Kipkunurr FR	0	0	0	0										
ElgonE	Mt. Elgon NP	670	253	41	0		50	40	40	120	20	270	98	98	Neville 2001
	Chepkitale NR	0	0	0	0										
Tanzania															
Kilimanj	Mount Kilimanjaro NP	624	385	191	61	257		218		34	10		99	98	Hemp 2001, 2005
	Mt. Kilimanjaro FR	0	0	0	0										
Meru	Arusha NP(GR, FR)	48	19	4	0	30	5	2	5	5		<30	100	98	Hedberg 1951, 1964
Hanang	Hanang FR	72	0	0	0								100	98	Greenway 1955
Ngoro.	Ngorongoro CA	100	2	0	0	190	5				3		100	95	Herlocker & Dirschl 1972
Uganda															
ElgonW	Mt. Elgon NP	348	154	26	0	53		50		48	10		100	95	van Heist 1994
Moroto	Mt. Moroto FR	0.2	0	0	0		0.2					0	100	20	Thomas 1943
Kadam	Mt. Kadam FR	0	0.1	0	0		0.1						100	20	Thomas 1943,
RwenzE	Rwenzori Mts. NP	589	322	123	11	110		50	60	40	70		100	99	van Heist 1999
Mgahinga	Mgahinga Gorilla NP	9	2	0.1	0	7		1	1	0.5	0.5	<30	100	99	Hedberg 1964; Karlowski 1995
Rwanda															
Volcano	Parc Nacional des Volcans	80	26	2	0	25		15	5	2			100	95	Fischer & Hinkel 1992; Hedberg 1964

Region	Name PA	Potential spatial Extent (km²)				Vegetation types – subalpine		Alpine							estimated according to
		>3000	>3500	>4000	>4500	ericaceous	subalpine grassland	*Alchemilla / Helichrysum*	*Dendro -- senecio*	tussock	bogs	unspe -cified	% protected (>3000 m)	% near natural	
Dem. Rep. Congo															
Virunga	Virunga NP	49	13	2		8		*7*	2	2	1		100	95	Hedberg 1964
RwenzW	Virunga NP	162	83	35	5	40		8	15	7	*20*		100	95	Hedberg 1964
Kahuzi	Parc Nacional Kahuzi-Biéga	3	0	0	0	4			2	2		8	100	95	Fischer 1996
Itombwe	No PA	224	0	0	0	150	75					550	0	90	Doumenge 1998; Ilambu et al. 1999
Cameroon															
Cameroon	Mokoko River FR, Bomboko Fr, Southern Bakundo FR	46	10	0.1	0	22	54			27		103	70	80	LBZG 2002
Sudan															
Imatong	Imatong Mts. FR	2	0	0	0	1	1						100	30	Jackson 1956

Abbreviations: “NP” National Park, “HR” Hunting Reserve, “WR” Wildlife Reserve, “FR” (National) Forest Reserve, “NA” Nature Reserve, “CA” Conservation Area, “GR” Game Reserve / Controlled Hunting Area, “NFP” National Forest Priority Area

[1] PA not listed by IUCN, but there is an NFP, and the area is well protected due to inaccessibility and a church being present

[2] PA-listings by IUCN for Ethiopia are incomplete

[3] PA proposed

[4] The entire high-altitude belt above 3000 m is considered sacred implying some level of conservation

Table 5: List of major threats to grassland vegetation by area
(according to published sources and own field experience)

General level of protection was subjectively estimated on an ordinal scale ranging from ‘0’; ‘1’ only “paper park”; ‘2’ moderately effective; to ‘3’ complete protection. Two numbers are given were PA quality differs in a region. Fire is indicated as a threat but may have both positive and negative effects on grasslands.

Region	Threats	Conserva-tion	Source
Ethiopia			
Simen	Heavy grazing, hunting, settlements inside park	0+1	Fishpool & Evans 2001; Nievergelt et al. 1998
Choke	Heavy grazing, expansion of agriculture, *fire*	2	Gete & Hurni 2000, own observations
Guna	Extreme overgrazing, agriculture, erosion	0	Hurni et al. 2005, own observations
Yosef	Heavy grazing, agriculture	1[6]	Own observations
Denkore	Heavy grazing, agriculture, fires, hunting	1	Fishpool & Evans 2001
Shewa	Traditional rotational grazing, system partly broken down, locally hardly any natural vegetation left	1+2	Fishpool & Evans 2001
Arsi	Heavy grazing, agriculture, *fire*	0	Own observations
Gurage	Heavy threatened with conversion to agriculture	0+1	Own observations
Bonga	Heavy grazing, tree plantation	1	Own observations
Bale	Grazing, *fire*, encroachment - agriculture	2	FZS 2007; Miehe & Miehe 1994b; Wesche et al. 2000
Gamo	Grazing, some agricultural encroachment	1	Own observations, Anonymous 2006
Mulata	Heavy grazing, agriculture	0	Own observations
Kenya			
Kenya	*Fire*, very locally high impact by tourist activities	3	Bennun & Njoroge 1999; Kokwaro & Beck 1987; Paulsch & Scholze 1999
Aberdare	*Fire*, very locally high impact by tourists	3	Bennun & Njoroge 1999
Kipipiri	*Fire*	3	Bennun & Njoroge 1999
Mau	Grazing, encroachment of agriculture	0	Bennun & Njoroge 1999; Ndang'ang'a et al. 2003
Cherang.	Encroachment, degazettement, grazing, *fire*	2 (1?)	Bennun & Njoroge 1999
ElgonE	*Fire*, poaching, some security	3 (2?)[1]	Bennun & Njoroge 1999; Neville 2001
Tanzania			
Kilimanj.	*Fire*, encroachment from lower slopes, locally heavy impact by tourism	3	Hemp 2005, 2006b
Meru	*Fire*	3	
Hanang	?	2?	
Ngoro.	Spreading agriculture in montane belt, *fire*	3	Fishpool & Evans 2001
Uganda			
ElgonW	Poaching, *fire*, grazing very limited	2	Wesche 2002
Moroto	Poaching, heavy overgrazing, *fire*	1	Fishpool & Evans 2001; Thomas 1943
Kadam	Overgrazing, *fire*, poaching	1	Mugisha 2002
RwenzE	Poaching, encroachment, poor tourism management, general insecurity	3[2]	Fishpool & Evans 2001; McCall 1998
Mgahinga	Poaching, some grazing and encroachment from lower slopes upwards	3	Fishpool & Evans 2001; Karlowski 1995
Dem. Rep. Congo			
Virunga / RwenzW	Rapid population growth, encroachment, general insecurity - partly inaccessible to administration	1?	Fishpool & Evans 2001
Kahuzi	Poaching, *fire*, general lack of security and administrative power	2 (1?)[3]	Fischer 1996; Fishpool & Evans 2001
Itombwe	No legal protection, massive agricultural encroachment, pastoral incursions	0 (1?)[4]	Doumenge 1998; Ilambu et al. 1999
Rwanda			
Volcano	Poaching, some encroachment, feral dogs	3	Fishpool & Evans 2001
Cameroon			
Cameroon	“effectively unprotected”, severe *fires*, encroachment	1 (2)[5]	Fishpool & Evans 2001; LBZG 2002
Oku	Grazing, *fire* (a Bird Life International Project is active)	0 (2)	Fishpool & Evans 2001
Sudan			
Imatong	*Fires*, agriculture is rising upwards	1	Fishpool & Evans 2001

[1]2007/2008 unrest in the region; [2] potentially instable due to recurrent rebel activity in the area in the last two decades; [s]ituation still not stabilised after war in the last decade but conservation projects operate in the area (gtz); [4]IUCN lists a PA in the region but recent sources indicate total lack of legal protection; [5]ongoing efforts for improvement by Mt. Cameroon Project (Limbe); [6]Biosphere reserve proposed

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3. TEMPERATE GRASSLAND REGION: SOUTHERN AFRICA

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Continent: Africa
Region: southern Africa (in the narrowest sense)
Countries: South Africa, Lesotho and Swaziland
Extent: c. 360,589 km^2; synonymous with the Grassland Biome of southern Africa (mostly grasslands of the central Highveld, Drakensberg Mtns and the sub-Escarpment)
Total contribution to biomes of southern Africa: c. 28 % (i.e. the second-largest biome after the 33% contributed by the Savanna Biome)
Latitude: 25° S to 33º S; longitude: 24° E to 31º E
Elevation: 300 m to 3482 m (Thabana Ntlenyana - the highest mountain in southern Africa)
Centres of plant endemism (CE): Three: Drakensberg Alpine CE; Wolkberg CE; Midlands CE (proposed). Three other centres are shared with the Savanna Biome: Barberton CE; Sekhukhune CE; and Soutpansberg CE
Major grassland units: four bioregions (composite spatial terrestrial units based on similar biotic and physical features and processes at the regional scale)
Minor vegetation types: 72 vegetation types (resulting from the correlation of floristics and environmental factors)
Formal conservation: very low (c. 2%)
Transformation: high (c. 34%)
Red Lists: The Grassland Biome has 640 Red Listed species, excluding species categorized as 'not threatened'. Some 136 are threatened with extinction; six already extinct. Only nine species of grass occupy the list (Hilton-Taylor 1996).

3.1 Major Indigenous Temperate Grassland Types

A. Background and approach

In southern Africa, global cooling during the late Tertiary was accompanied by continental uplift that began in the Early Miocene and culminated in significant uplift of up to 900 m in some parts of the subcontinent during the Pliocene. This uplift moved a core area into a cool, high-altitude climate, more suitable for grasslands than savannas. Uplift towards the west was less pronounced, resulting in the sloping east-west gradient. The effect of this gradient, enhanced by the east-west moisture gradient across the subcontinent, is believed to have determined the limits of grassland on our subcontinent (Mucina & Rutherford 2006).

The temperate grassland region of southern Africa (southern Africa in this context is defined as the region encompassing the countries South Africa, Lesotho and Swaziland) is congruent with the region's Grassland Biome[2] (therefore used interchangeably), one of nine biomes identified in our region (see Mucina & Rutherford 2006). The biomes are further subdivided into bioregions (lower-ranking sub-units

[2] According to the latest National Vegetation Map (see Mucina & Rutherford 2006). However, this was not always so (compare with Rutherford & Westfall 1986, Low & Rebelo 1996). The humid sub-tropical grasslands, the edaphic grasslands of Maputaland and Pondoland, and the Ngongoni grasslands (all previously of the Grassland Biome) have now been shifted to either the Savanna Biome or the Indian Ocean Coastal Belt Biome.

of a biome), which in turn are subdivided into vegetation units (the lowest ranking, most basic units of vegetation mapping), defined as ‘a complex of plant communities ecologically and historically, both in spatial and temporal terms, occupying habitat complexes at the landscape scale’ (Mucina & Rutherford 2006). Each vegetation unit shares similar vegetation structure and floristic composition, coupled with similar climate and disturbance. According to the most updated National Vegetation Map / Atlas of southern Africa (Mucina & Rutherford 2006), the temperate grasslands[3] (~ Grassland Biome) are represented by 72 vegetation units, and four bioregions.

B. General overview of the temperate grasslands

The Grassland Biome of southern Africa (Appendix 1A), covering an area of c. 360,589 km^2, occupies the high central plateau of South Africa (‘highveld’), the inland areas of the eastern seaboard, the mountainous areas of Lesotho, and the high-lying ground of KwaZulu-Natal, Eastern Cape, and Mpumalanga (provinces of South Africa) (Low & Rebelo 1996). The topography ranges from flat or undulating, to rugged mountain escarpment. Elevation ranges from 300 m to 3482 m a.s.l. (Thabana Ntlenyana - the highest mountain in southern Africa). Winters are generally cold and dry, with frequent frosts and snow falls in the higher reaches. Rainfall varies spatially from 400 mm to 2,500 mm per annum, corresponding to the MAR in other parts of the world where similar vegetation is found. Rainfall is strongly seasonal (summer) and the growing season lasts approximately half the year (Mucina & Rutherford 2006).

The temperate grasslands of our region are structurally fairly conservative; they comprise relatively simple, short-growing, single-layered herbaceous communities of tussock (or bunch / tufted) graminoids (predominantly perennial grasses of the Family Poaceae), as well as a forb component of mostly long-lived perennials that mostly reproduce vegetatively. Many such forbs have significant below-ground biomass; either as corms, rhizomes, tubers or bulbs. Biomass is mostly attributed to the grass component (Family Poaceae), whist the diversity is attributed mostly to the forb component. Woody plants are rare (usually low to medium-sized shrubs) or absent. Most woody plants are confined to specific habitats serving as fire refugia (rocky hilltops, drainage lines etc.). Grassy ‘fynbos’ (heathland-like vegetation) occurs at the higher elevations and in higher rainfall areas, often on steep, highly leached slopes protected from fire. C_4 grasses dominate most of the Biome, except at the higher elevations (e.g. Maloti-Drakensberg Mtns), where C_3 grasses predominate (Low & Rebelo 1996). Canopy cover of the grasslands is moisture-dependent and decreases with low MAR. Cover is also influenced by intensity and type of grazing, as well as by fire (seasonality, intensity) and by minimum temperature (implications for frosts). The temperate grasslands of southern Africa are subdivided into moist (dependent on fire for maintaining structure) and dry types (not dependent on fire for maintaining structure) (Mucina & Rutherford 2006).

C. Major vegetation units (~ Bioregions; refer to Appendix 1B)

i) Drakensberg Grasslands

(42,177 km^2 or 11.7% of the Grassland Biome; represented by 10 of the 72 minor vegetation types)

The moist temperate grasslands of this bioregion are loosely congruent with the Drakensberg Alpine Centre (DAC) (Van Wyk & Smith 2001, Carbutt & Edwards 2004, Carbutt & Edwards 2006). This centre of endemism (CE) is also southern Africa’s only true alpine region (Linder 1990) and is recognized as one of southern Africa’s eight ‘hotspots’ of plant diversity (Myers 1988, Carbutt 2005). This is the highest-lying bioregion in southern Africa with the fewest number of vegetation types (10), extending from the highlands of the Eastern Free State in the north, through the rugged Maloti Mnts of Lesotho, the KwaZulu-Natal and Eastern Cape Drakensberg, and southwards to the Stormberg and Amathole Mtns of the Eastern Cape. The high rainfall (> 600 mm MAR) renders the grasslands as ‘sourveld’ (a vegetation type dominated by grasses with a low nutritional value, particularly during

[3] Defined according to similar vegetation structure, macroclimate (mainly the amount of summer rainfall, minimum winter temperatures and frost), and disturbance (frequent fire and grazing).

winter when the grasses withdraw nutrients to their below-ground storage organs, and have a high fibre content), tending to occur on infertile, acidic, leached soils. Sour grasses have a low nitrogen-to-carbon ratio, making them indigestible to livestock (Low & Rebelo 1996, Mucina & Rutherford 2006). The Lesotho plateau and high Drakensberg support extensive grasslands, dwarf shrublands, heathlands (in fire refugia, generally on rocky outcrops or steep, highly leached slopes), and peat-forming bogs in poorly drained depressions. Life forms here are predominantly xeromorphic, reflecting the severity of this climate. Rainfall is generally very high (up to 2000 mm per annum); intense summer thunderstorms and orographic mists predominate in summer, while cold fronts bring drizzle in winter. Winter snow and frosts are common at the higher elevations, and winter temperatures are generally cool to very cold (Mucina & Rutherford 2006).

ii) Mesic Highveld Grasslands
(125,044 km^2 or 34.7% of the Grassland Biome; represented by 29 of the 72 minor vegetation types)

The moist temperate grasslands of this bioregion occur in the eastern Highveld, extending in the north-easterly direction to the northern escarpment of the Mpumalanga Drakensberg and western Swaziland. This bioregion is the largest of the four bioregions with the most diverse suite of vegetation types (29/72), attributed to geology and other substrate properties, elevation, topography and rainfall (Mucina & Rutherford 2006). The grasslands are dominated by 'sour' andropogonoid grasses (as above) due to the high MAR. Embedded within this grassland matrix are shrublands on rocky outcrops, where soils tend to be more nutrient-rich and protected from fire and herbivory. A unique feature of this bioregion is the summit grasslands (extrazonal sourveld vegetation occurring on the summits of the northern mountain ranges embedded within the Savanna Biome north of 25°S; see Mucina & Rutherford 2006).

iii) Sub-escarpment Grasslands
(75,615 km^2 or 21% of the Grassland Biome; represented by 18 of the 72 minor vegetation types)

These moist grasslands occupy the rolling foothills of the Drakensberg Range, from the KwaZulu-Natal Uplands and Midlands to the Eastern Cape. A strong rainfall gradient of decreasing rainfall from north-east (c. 961 mm MAR) to south-west (c. 423 mm MAR) is prevalent across this region. The sub-escarpment grasslands, with strong floristic links to the grasslands of the Drakensberg, are believed to result from the cold streams of winter air that descend from the high escarpment of the Drakensberg, thereby creating severe climatic (Drakensberg-like) conditions that support frost-tolerant grasslands rather than savannas. Regular mists are also a feature of these grasslands, due to the orographic influence of the rising landscape (Mucina & Rutherford 2006). A putative centre of plant endemism has been proposed for the KwaZulu-Natal Midlands (C. R. Scott-Shaw, unpublished data).

iv) Dry Highveld Grasslands
(117,753 km^2 or 32.6% of the Grassland Biome; represented by 15 of the 72 minor vegetation types)

The dry temperate grasslands of this bioregion are restricted to the extensive central plateau (western 'highveld') of South Africa, where the MAR is below 600 mm. Topography ranges from gently undulating to hilly, with occasional small mountains ('koppies') and incised river valleys. The major driver of vegetation pattern is annual rainfall, with an east to west gradient of decreasing moisture characterizing this Bioregion (Mucina & Rutherford 2006). The grasslands are 'sweetveld' (a vegetation type dominated by grasses that retain their nutritional value during winter, often occurring on richer, more alkaline soils and have a lower fibre content) and dominated by chloridoid types. These are mostly plains grasslands distinguished primarily on substrate characteristics (nutrient-rich soils that are water-limited), but also include topographically complex, steep mountain grasslands of the Karoo Escarpment. Shrublands occur on rocky slopes and outcrops, where soils are shallow and often have a high surface rockiness (Mucina & Rutherford 2006).

3.2 Impact of Human Settlement

The Grassland Biome contains the economic heartland of South Africa and is home to most South Africans. South Africa's largest urban centre, the conurbation of Johannesburg and Pretoria, is located within the grasslands as are production landscapes that make a significant contribution to the country's economy through agriculture, forestry, mining and industry. However, these activities also constitute the main threat to grasslands biodiversity.

The main economic sectors operating in the Grassland Biome include plantation forestry, rangeland and cultivated agriculture, and mining, particularly coal (see Table 1).

Table 1: Major land uses in the grassland biome (Reyers *et al*. 2005)

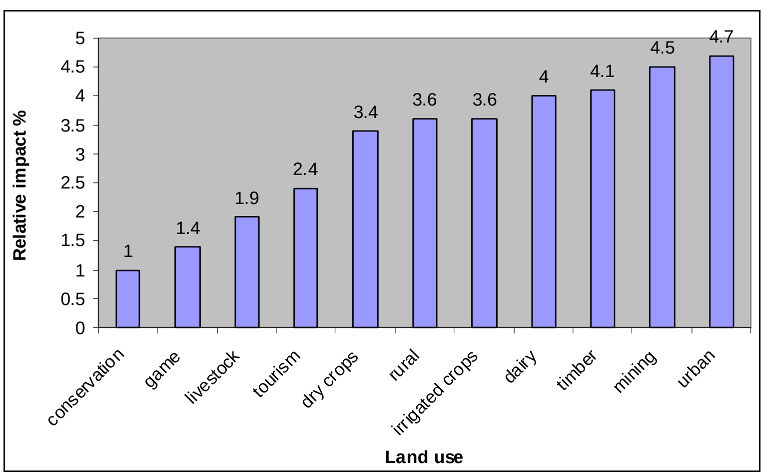
Land Use in the Grasslands	km^2 (% of Grassland Biome)
Cultivated areas	75,833 (22.1%)
Forest plantations	9,932 (3%)
Mines and quarries	933 (0.3%)
Degraded lands	22,041 (6.4%)
Urban and industrial areas	5,843 (1.7%)

An indication of the economic contribution of activities in the Grassland Biome is provided in the following figures: the Gauteng economy, which is located fully within the Biome generates 33.9% of South African's GDP; the value of grassland ecosystem services such as water production, carbon storage, nutrient cycling is estimated at R9.7 billion per annum; the total output value of plantation forestry is R5.4 billion/year; from 1993 to 2002, the market value of the total biome farm output increased from R11.2 billion to R58.4 billion, or R31 billion value in real terms (i.e. the market value discounted by inflation).

Economic activities such as these put the biome under a huge amount of development pressure (Kirkman 2006, O'Connor & Kuyler 2005). This biome is one of the most threatened in southern Africa, because out of the 72 vegetation types in the biome, one is listed as critically endangered, 14 are endangered and 24 are classed as vulnerable (Reyers *et al*. 2005). Economic activities have also impacted on aquatic ecosystems, with 83% of the 42 river ecosystems in the biome ranked as threatened, and 48% ranked as critically endangered (Reyers *et al*. 2005). As natural habitat is lost or degraded in an ecosystem, its functioning is increasingly compromised, leading eventually to the collapse of the ecosystem and its associated ecosystem services, and to losses of species associated with that ecosystem.

A study by O'Connor & Kuyler (2005) assessed the impact of different land uses on the biodiversity of the Grassland Biome (see Figure 1).

Figure 1: Findings of the relative impact of land uses on grasslands (O'Connor & Kuyler 2005)



Land cover data indicates that almost 30% of the grasslands biome of South Africa has been permanently transformed, primarily as a result of the land uses mentioned above (Fairbanks *et al*. 2000). Furthermore, ground surveys of land cover in areas of the Eastern Cape with dense rural populations indicate that up to 80% of the natural grasslands may be old fields. This suggests that at least in some of the worst affected areas of South Africa, as little as 15% of the natural grassland is still in its natural state. Of additional concern is that those areas of grassland that are untransformed are highly fragmented and some areas of grassland may be composed of fragments as small as a few hectares in extent. This is particularly the case in Gauteng whereby the dominant vegetation types are ecosystems are classified as threatened (Mucina & Rutherford 2006).

3.3 Current Conservation Status

A meager 2% of the region's temperate grasslands are conserved within PAs (see Table 2). This level of protection is less than half of the global average of 4.6 % (see Chape *et al*. 2003). This also falls short of the IUCN target of 10% formal protection by 2013, and at a local (national) scale, way short of the 12% target[4] by 2028 (or an additional ± 42,500 km^2) set by South Africa's National Protected Area Expansion Strategy (NPAES) (SANBI & DEAT 2008).

Table 2: The conservation status of temperate grasslands in southern Africa

Broad Vegetation Unit (~ Bioregion)	Total Area (km^2)	Area in PAs (km^2)	Protected (%)	Transformed (km^2)	Transformed (%)
Drakensberg Grasslands	42,177	2,477.48	5.87	8,222	22.30
Dry Highveld Grasslands (*)	117,753	1,785.57	1.52	32,717	31.51
Mesic Highveld Grasslands (*)	125,044	1,996.70	1.60	51,689	42.91
Sub-escarpment Grasslands (*)	75,615	1,080.19	1.43	27,547	39.60
Total for Grassland Biome	**360,589**	**7,339.94**	**2.04**	**120,175**	**33.33**

An assessment of conservation priorities in the Grassland Biome identified that 36.7% of the biome is important for biodiversity conservation (Reyers *et al*. 2005). The nature of biodiversity in the Grassland Biome is that there are high levels of fragmentation and much of this land is located within the production landscapes mentioned above. The difference between the national PA expansion target (12%) and the grasslands biodiversity target (36.7%) arises due to the criteria used to select land suitable for protected area expansion. This difference highlights the importance of a conservation strategy for grasslands that includes the expansion of land under formal protection, as well as conservation stewardship and biodiversity mainstreaming.

All broad temperate grassland types are below target, although the Drakensberg Grasslands are the most protected (see Table 2) as a result of the Maloti-Drakensberg Transfrontier Project [comprising the Ukhahlamba-Drakensberg Park[5] (UDP) in South Africa and Sehlabathebe National Park in Lesotho].

[4] This is the largest addition of land to formal protection across all of South Africa's biomes in order to meet the target. However, this target only includes large intact and un-fragmented areas suitable for the creation or expansion of large (> 5,000 ha) PAs.

[5] The UDP occupies some 243,000 hectares (in 12 PAs and four Wilderness Areas). It was enlisted as a World Heritage Site for both its outstanding cultural and biodiversity assets. The Grassland Biome harbours a further two World Heritage Sites, namely the Cradle of Humankind and the Vredefort Dome.

Furthermore, some 70% of the minor vegetation types within the bioregions have no or very little (< 2 %) legal protection! As a result, a number of the minor vegetation types in the biome are listed as critically endangered, endangered or vulnerable (see Reyers *et al*. 2005). At a coarser level, priority should be given to Dry- and Mesic Highveld Grasslands, and Sub-escarpment grasslands. Ironically, the bioregions with the most PAs (e.g. Mesic Highveld Grasslands; Sub-escarpment Grasslands) conserve some of the smallest areas per bioregion, highlighting the futility of small reserves in fulfilling conservation targets (see Appendix 2). Values (area) relating to the PAs available for grassland conservation are also generally overestimates due to the prevalence of forests within these areas, reducing the overall area for grassland conservation.

3.4 Opportunities for Improving the Level of Protection and Conservation in the Region

Current biodiversity conservation initiatives in the Grassland Biome

The National Protected Area Expansion Strategy (2008 – 2012) has identified the Grasslands biome as the biome that requires the largest additional land to reach its conservation target[6]. However, given the difference between the protected area expansion target and the biodiversity target, it is apparent that formal protection alone, nor agencies working in isolation, will succeed in conserving the biodiversity of the Grasslands Biome. Conservation strategies need to incorporate a variety of approaches to biodiversity management, including stewardship and biodiversity mainstreaming. Furthermore, given the high turnover of biodiversity across the biome, these initiatives need to be implemented across the extent of the biome.

The National Grasslands Biodiversity Programme (NGBP)
The NGBP, otherwise known as the Grasslands Programme, is a 20 year initiative which aims to contribute 'to securing the biodiversity and associated ecosystem services of the grasslands biome for the benefit of current and future generations'. Hosted by the South African National Biodiversity Institute (SANBI), the Programme is a strategic partnership between the three spheres of government, the private sector, civil society and the academic sector. In its first five years, the Programme is focusing on a strategy to mainstream conservation objectives into major production sectors operating on the biome. This strategy includes interventions to integrate biodiversity compatible land uses into agriculture; to ensure a direct contribution by the forestry sector to biodiversity conservation; to mainstream biodiversity into Gauteng's economy and to secure biodiversity management in the coal mining sector. The Grasslands Programme recognizes that promoting off-reserve conservation on privately or communally owned land has to form a major component of a grasslands conservation strategy. Given the conservation targets above, the Grasslands Programme has set to achieve 4% conservation target by 2012 and 22.3% target over 20 year period.

Grassland National Park
The Grassland Biome is South Africa's only biome that is not represented by a national park. Within the context of the National Protected Area Expansion Strategy and the biodiversity priority areas of the Grassland Biome, there are opportunities for the creation of a national park which can serve as a core for eco-tourism driven economic development in the grasslands containing iconic landscapes (such as the Drakensberg), cultural and heritage sites (such as Vredefort dome) and species (such as SA's national bird, the Blue Crane). The identification and establishment of the park will be initiated by Department of Environment and Tourism (DEAT) in partnership with the South African National Parks and the Grasslands Programme.

[6] About 10,624 km^2 (3%) is required over 5 year period and about 42424 km^2 (12%) is required to meet the 20 year conservation target (SANBI & DEAT 2008).

Ekangala Grasslands Project

The Ekangala Grasslands Trust is aimed at establishing mechanisms for conserving and maintaining a million hectares of high altitude moist grasslands extending across Mpumalanga, Free State and KwaZulu-Natal. The Ekangala Grassland Trust acts as a platform for facilitating co-operation between stakeholders to jointly implement priority projects (DEAT 2005). The NGBP is partnering with the Ekangala Grassland Trust around the implementation of demonstration project to secure the priority grassland areas within the Ekangala project area.

Threatened species initiatives

The most significant conservation work being undertaken outside major conservation areas in the grasslands of southern Africa is often focused on highly threatened species such as blue swallow, various crane species, black and white rhinos. The basis for these conservation efforts is the awareness that managing habitats are the key to managing the threats to these species since habitat loss is the primary reason for their decline. The World Wide Fund for Nature (WWF) plays a critical role in supporting these initiatives.

Protected Area proclamations and expansions

The Maloti-Drakensberg Transfrontier Project (MDTP) aims to conserve temperate grasslands and associated biodiversity in the Maloti-Drakensberg region. The Maloti Mountains of Lesotho in particular are poorly protected, as this region is characterized by communal land tenure (see Appendix 1C & 1D). Studies have shown that species richness in such communally grazed areas is significantly lower when compared to conservation areas nearby (Everson & Morris 2006). Currently, only 0.21% of Lesotho's total area of c. 30,355 km^2 is under protection (Letšela *et al*. 2003, Everson & Morris 2006). The establishment of the Tsehlanyane National Park (53.33 km^2) and the Bokong Nature Reserve (19.72 km^2) will double the area in Lesotho under protection. Linking the two areas through a biosphere reserve as proposed by the Lesotho Highlands Development Authority (LHDA), will extend the area under conservation even further (Letšela *et al*. 2003). This initiative provides an opportunity to use Community Conservation Areas which recognizes opportunity to use the potential compatability of communal resource use and management conservation.

3.5 Constraints Against Improving the Level of Protection and Conservation in the Region

1. High population levels and high utilization by the agricultural industry (both for cropping and as rangelands), mining, and forestry. Refer to point 3.2 above for more information.

2. PAs within the Grassland Biome are relatively few, generally small and highly fragmented (see Appendices 1C, 1D & 2). Opportunities for expansion into biologically meaningful, contiguous, mega-reserves (to sustain ecological processes) appear few, particularly given point (1) above. High gamma-diversity across our grasslands means that PAs also need to be located across the full extent of the biome, and not clustered into certain areas to ensure conservation representative of grasslands biodiversity.

3. Detailed information relating to informal conservation areas is sorely lacking. No national registry or spatial database exists of these areas. These areas may be contributing meaningfully toward conservation goals and targets, but to what extent is currently unknown. No national standard for the certification and management of these areas has been set, so one cannot assume that all are well managed and therefore adequately safeguarding biodiversity.

4. Strategies to meet the conservation targets of the Grassland Biome need to recognize the complexities of implementing conservation actions across this landscape. The biome covers a vast area which straddles national boundaries, as well as several provincial and numerous local government boundaries. Much of the important biodiversity of the biome is on land that is privately or communally owned or under production. Currently transfrontier conservation initiatives are hindered by politics and lack of funding.

3.6 Suggested Next Steps and Action Plan

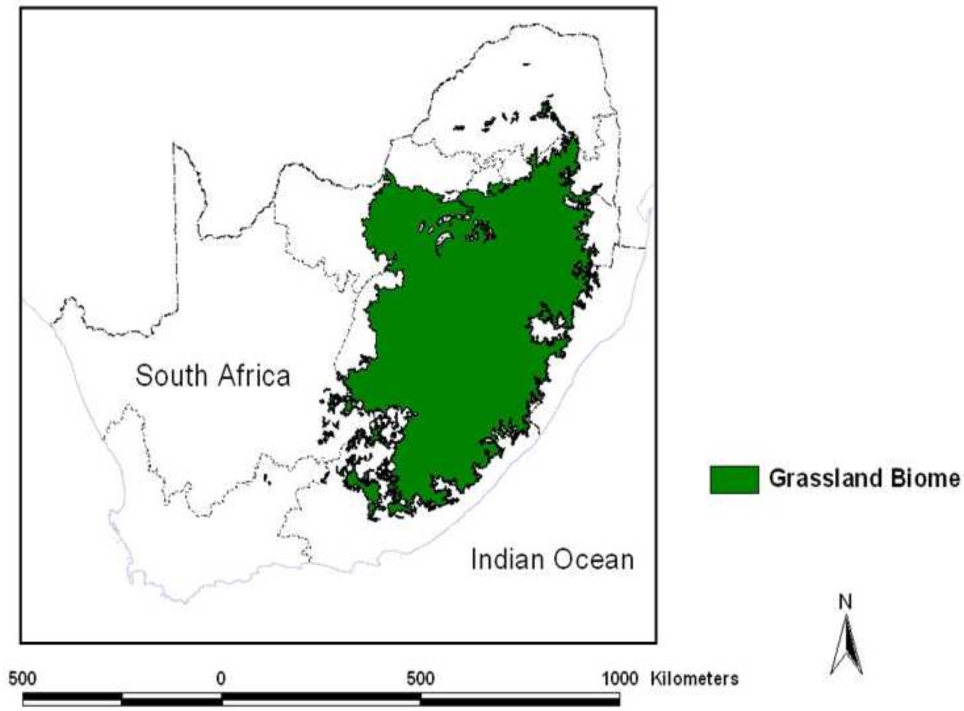
- Plug the gaps: This assessment made used of a strict definition of southern Africa as explained above. However, if a broader, more conventional delineation of southern Africa is required, this assessment should be expanded to include the eastern highlands of Zimbabwe (Chimanimani-Nyanga Centre of plant endemism[7], part of the Afromontane Region; Van Wyk & Smith 2001). Threats here include agriculture, commercial afforestation, lack of fire, and alien invasive plants (Van Wyk & Smith 2001). The conservation status of the temperate grasslands of this region is unknown. The assessment should also include the temperate grasslands of south-central Africa, in particular Mt. Mulanje (64,000 ha; Sapitwa Peak at c. 3001 m) and the Nyika Plateau (180,000 ha; Nganda Hill at 2607 m) of southern and northern Malawi respectively.

- Further develop and continue the implementation of the strategies and programmes outlined in 3.4 above. Of critical importance is to strengthen the integration of biodiversity management into production sectors, private and communal land uses currently operating (or dependent) in the Grassland Biome. Meeting the biodiversity targets for the Grassland Biome requires a concerted conservation strategy that all balance conservation and development outcomes.

[7] Mt. Binga - 2440 m, Chimanimani National Park (17,110 ha); Mt. Inyangani - 2593 m, Nyanga National Park (47,100 ha).

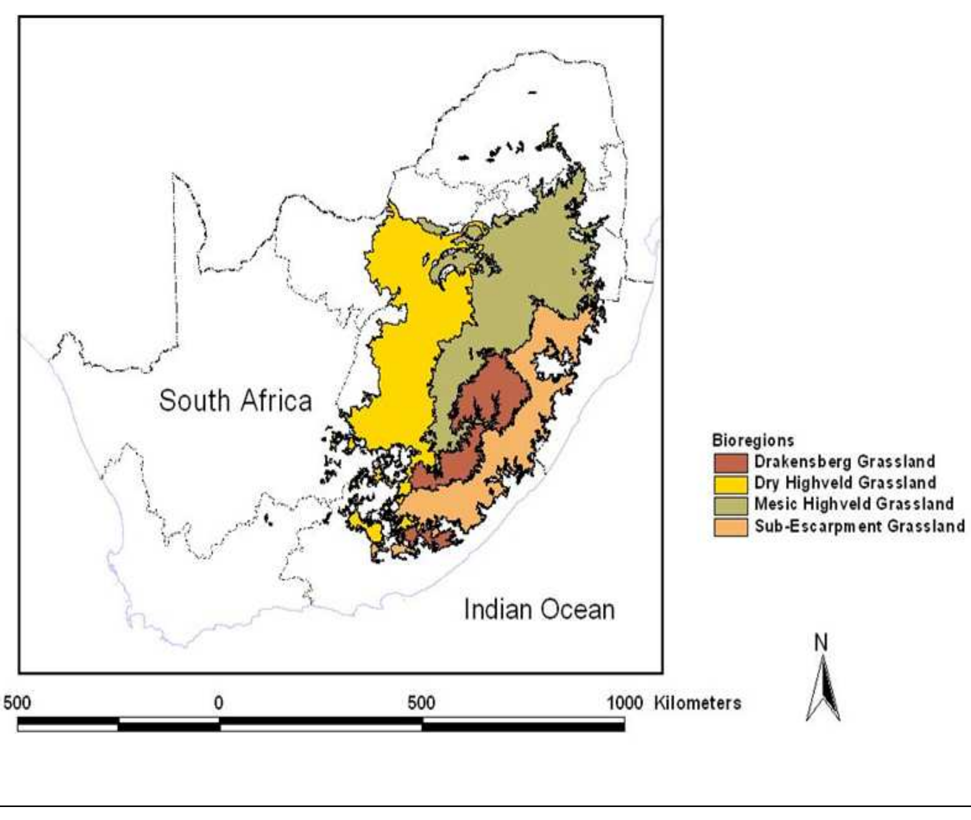
3.7 Appendices

Map A: The distribution of temperate grasslands in southern Africa

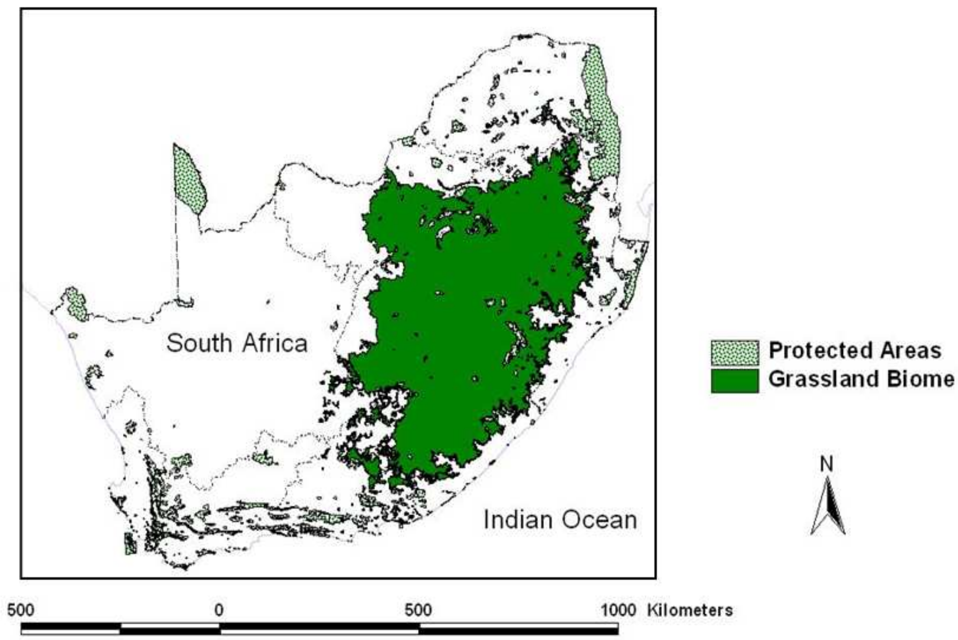


Map B: The broad vegetation units of southern Africa's temperate grasslands

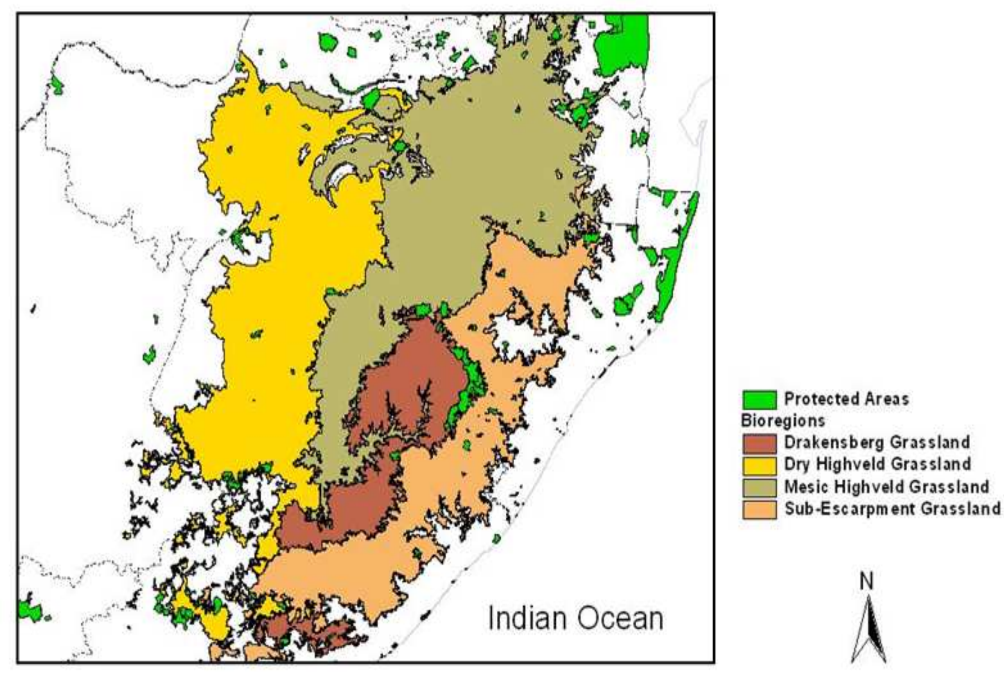
.



Map C: The protected areas of southern Africa (according to the latest National Protected Area Expansion Strategy) and their location relative to the temperate grasslands of southern Africa



Map D: A close-up of the grassland biome showing its constituent broad units of vegetation and their location relative to the PAs of southern Africa



Appendix 2 - Table 3: Bioregional classification of the legal protection of temperate grasslands in southern Africa

'Total PA' refers to the total extent of the PA, regardless of Bioregion; 'PA in Bioregion' refers to the fact that some PAs straddle more than one bioregion; the extent of the PA within the bioregion is therefore included and used in the calculations (See Table 2).

	1. Drakensberg Grasslands		
No.	**Protected Area**	**Total PA (ha)**	**PA in Bioregion (ha)**
1	Cathedral Peak State Forest	25350.996	23518.318
2	Cobham State Forest	46664.786	42160.961
3	Garden Castle State Forest	35197.490	33536.626
4	Giants Castle Game Reserve	42352.338	39182.616
5	Golden Gate Highlands National Park	32701.559	11845.666
6	Highmoor State Forest	15094.060	14649.009
7	Kamberg Nature Reserve	6612.751	5777.112
8	Lotheni Nature Reserve	4866.049	4797.023
9	Malekgonyane (Ongeluksnek) Wildlife Reserve	13861.767	11975.520
10	Mkhomazi State Forest	28938.405	26903.336
11	Monks Cowl State Forest	17838.693	13963.737
12	Poccolan/Robinson's Bush	70.675	65.573
13	Royal Natal National Park	6338.882	6146.332
14	Rugged Glen Nature Reserve	419.698	249.642
15	Sehlabathebe National Park	6928.141	6928.141
16	Sterkfontein Dam Nature Reserve	18489.936	5784.381
17	Vergelegen Nature Reserve	1541.824	263.569
	Total	**301726.226**	**247747.56**

	2. Dry Highveld Grasslands		
No.	**Protected Area**	**Total PA (ha)**	**PA in Bioregion (ha)**
1	Abe Bailey Provincial Nature Reserve	5093.992	5093.992
2	Barberspan Bird Sanctuary	3165.467	3165.467
3	Bloemhof Dam Nature Reserve	16656.300	7820.748
4	Boskop Dam Nature Reserve	3084.883	3002.651
5	Botsalano Game Reserve	5688.594	5577.910
6	Caledon Nature Reserve	5053.315	5053.315
7	Cradle of Humankind World Heritage Site	51414.274	25473.596
8	Doringkloof	9814.034	9814.034
9	Faan Meintjies Nature Reserve	893.924	49.505
10	Groenkloof National Park	581.836	131.363
11	Hendrik Verwoeddam Nature Reserve	46823.883	46116.439
12	Kalkfontein Dam Nature Reserve	5246.261	3720.554
13	Krugersdorp Municipal Nature Reserve	1351.976	583.078
14	Lichtenburg Game Breeding Centre	5155.294	5155.294
15	Mafikeng Game Reserve	4625.444	4625.444
16	Molemane Nature Reserve	6452.348	6452.348
17	Oviston Nature Reserve	34393.489	4784.585
18	Rolfontein Nature Reserve	13353.468	13353.468
19	Rondebult Bird Sanctuary	99.511	99.511

20	Rustfontein Nature Reserve	2488.255	2488.255
21	Sandveld Nature Reserve	25057.206	15.643
22	Schoonspruit Nature Reserve	4324.482	4324.482
23	Soetdoring Nature Reserve	7925.039	7925.039
24	Voortrekker Monument Private Nature Reserve	273.230	5.403
25	Willem Pretorius Nature Reserve	12738.214	11608.625
26	Wolwespruit Nature Reserve	1756.843	1756.843
27	Wurasdam Nature Reserve	359.093	359.093
	Total	**273870.655**	**178556.685**

	3. Mesic Highveld Grasslands		
No.	**Protected Area**	**Total PA (ha)**	**PA in Bioregion (ha)**
1	Balele/Enlanzeni Valley Game Park	3073.714	855.616
2	Barberton Nature Reserve	350.505	350.505
3	Bill Stewart Municipal Nature Reserve	65.736	65.736
4	Blougat Municipal Nature Reserve	152.946	61.785
5	Blouswaelvlakte	427.012	289.429
6	Boschkop Municipal Nature Reserve	4.062	4.062
7	Boskop Dam Nature Reserve	3084.883	82.232
8	Bronkhorstspruit Municipal Nature Reserve	882.546	882.502
9	Buffelskloof Private Nature Reserve	1458.110	1280.375
10	Coetzeestroom	1579.408	1254.584
11	Cradle of Humankind World Heritage Site	51414.274	5650.238
12	Cythna Letty Nature Reserve	6.845	6.845
13	Dr Hamilton Nature Reserve	17.493	17.493
14	Emlwane Game Park	2579.469	1150.961
15	Ezemvelo Private Nature Reserve	7566.458	3561.745
16	Flora Nature Reserve	63.750	9.407
17	Glen Austin Bird Sanctuary	20.193	20.193
18	Golden Gate Highlands National Park	32701.559	20855.893
19	Gustav Klingbiel Nature Reserve	2220.832	2220.832
20	Hartebeesvlakte	1969.946	1969.946
21	Klipriviersberg Municipal Nature Reserve	632.906	26.266
22	Kloofendal Municipal Nature Reserve	120.106	2.124
23	Korsman Bird Sanctuary	45.324	45.324
24	Krugersdorp Municipal Nature Reserve	1351.976	768.898
25	Kwaggavoetpad Nature Reserve	7239.940	4767.187
26	Lone Hill Municipal Nature Reserve	10.503	10.503
27	Makobulaan Nature Reserve	1083.130	847.401
28	Malalotja Nature Reserve	16922.764	12663.789
29	Marievale Bird Sanctuary Provincial Nature Reserve	1011.964	1011.964
30	Melville Koppies Municipal Nature Reserve	48.090	3.613
31	Mlilwane Game Sanctuary	4195.446	1864.259
32	Morgenzon	4055.370	4055.370
33	Motlatse Canyon National Park	53777.976	23308.476
34	Mount Anderson Catchment Nature Reserve	13486.085	13486.085
35	Mountainlands Nature Reserve	16704.483	8870.079
36	Mt Anderson Properties	1285.241	1285.241
37	Nelsberg	541.807	541.807
38	Nelshoogte Nature Reserve	279.842	279.842
39	Nkomazi Wilderness	17654.757	4224.081

40	No Name 3	1216.613	1153.353
41	Nooitgedacht Dam Nature Reserve	2986.892	2986.892
42	Ohrigstad Dam Nature Reserve	2508.827	2508.827
43	Overvaal Nature Reserve	401.183	373.362
44	Paardeplaats Nature Reserve	2425.819	2425.819
45	Phongola Bush Nature Reserve	883.223	883.223
46	Pumula Private Nature Reserve	46.696	46.696
47	Queensriver	1652.403	1652.403
48	Rhenosterpoort Private Nature Reserve	779.991	277.845
49	Rietfontein Ridge Municipal Nature Reserve	26.472	26.472
50	Rietvlei Dam Municipal Nature Reserve	4480.268	4480.268
51	Ruimsig Municipal Nature Reserve	13.238	13.238
52	Songimvelo Nature Reserve	49127.530	32260.372
53	Starvation Creek Nature Reserve	521.315	218.030
54	Sterkfontein Dam Nature Reserve	18489.936	11282.683
55	Sterkspruit Nature Reserve	2338.821	2338.821
56	Suikerbosrand Provincial Nature Reserve	19761.495	6206.424
57	Thorncroft Nature Reserve	16.599	16.599
58	Tinie Louw Nature Reserve	9.192	9.192
59	Tullach-Mohr Private Nature Reserve	771.960	619.299
60	Tweefontein	516.278	516.278
61	Vaaldam Nature Reserve	538.673	76.511
62	Verloren Valei Nature Reserve	5991.130	5991.130
63	Vertroosting Nature Reserve	32.075	32.075
64	Vryheid Mountain Nature Reserve	744.641	676.421
65	Vulture Conservation Area	1961.578	556.424
66	Wakkerstroom Wetland Nature Reserve	633.345	633.345
67	Walter Sisulu National Botanical Garden	286.354	8.588
68	Willem Pretorius Nature Reserve	12738.214	1129.589
69	Witbad Nature Reserve	1079.499	717.650
70	Witbank Nature Reserve	889.142	889.142
71	Wonderkloof Nature Reserve	829.353	10.595
	Total	**384786.206**	**199670.254**

	4. Sub-escarpment Grasslands		
No.	**Protected Area**	**Total PA (ha)**	**PA in Bioregion (ha)**
1	Balele/Enlanzeni Valley Game Park	3073.714	2218.097
2	Blinkwater Nature Reserve	685.721	685.721
3	Cathedral Peak State Forest	25350.996	1832.678
4	Chelmsford Nature Reserve	5984.118	5984.118
5	Cobham State Forest	46664.786	4503.825
6	Coleford Nature Reserve	1282.338	1282.338
7	Commando Drift Nature Reserve	5826.141	2717.193
8	Doreen Clark Nature Reserve	8.403	8.403
9	Emlwane Game Park	2579.469	1428.508
10	Fort Nottingham Nature Reserve	130.130	130.130
11	Garden Castle State Forest	35197.490	1660.864
12	Giants Castle Game Reserve	42352.338	3169.723
13	Highmoor State Forest	15105.946	456.937
14	Himeville Nature Reserve	42.517	42.517
15	iGxalingenwa Nature Reserve	1517.406	1517.406

16	Impendle Nature Reserve	8753.940	8753.940
17	Indhloveni Nature Reserve	29.777	29.777
18	Ingelabantwana Nature Reserve	341.716	341.716
19	Isandlwana	781.462	201.686
20	Ithala Game Reserve	29393.384	19497.110
21	Kamberg Nature Reserve	6612.751	835.639
22	Karkloof Nature Reserve	2083.087	2083.087
23	Kwa Yili Nature Reserve	695.907	695.907
24	Lotheni Nature Reserve	4866.049	69.026
25	Malekgonyane (Ongeluksnek) Wildlife Reserve	13861.767	1886.248
26	Marutswa Nature Reserve	267.655	267.655
27	Marwaqa Nature Reserve	357.185	357.185
28	Mbona Mountain Estate	732.028	732.028
29	Midmar Nature Reserve	2840.793	2840.793
30	Minerva Nature Reserve	1018.442	1018.442
31	Mkhomazi State Forest	28938.405	2035.068
32	Monks Cowl State Forest	17885.751	3922.015
33	Moor Park Nature Reserve	288.651	288.651
34	Mount Currie Nature Reserve	1769.762	1769.762
35	Ncandu Nature Reserve	1858.328	1858.328
36	Nduli Luchaba Nature Reserve	8720.890	2057.105
37	Ntinini Training Centre	747.864	692.448
38	Ntsikeni Wildlife Reserve	9289.531	9289.531
39	Poccolan/Robinson's Bush	1300.927	1288.725
40	Qudeni Forest Reserve	2358.410	2358.410
41	Queen Elizabeth Park Nature Reserve	92.959	22.579
42	Royal Natal National Park	6314.130	192.550
43	Rugged Glen Nature Reserve	419.698	170.056
44	Soada Forest Nature Reserve	496.345	51.703
45	Spioenkop Nature Reserve	5438.857	5438.857
46	Sterkfontein Dam Nature Reserve	18489.936	1422.872
47	The Swamp Nature Reserve	231.892	231.892
48	Tsolwana Nature Reserve	7906.187	2185.759
49	Tugela Drift Nature Reserve	34.553	25.258
50	Umgeni Vlei Nature Reserve	956.911	956.911
51	Umvoti Vlei Nature Reserve	460.936	460.936
52	Utrecht Town Park	1300.116	1300.116
53	Vergelegen Nature Reserve	1541.824	1278.255
54	Vryheid Mountain Nature Reserve	744.641	68.220
55	Wagendrift Nature Reserve	733.849	733.849
56	Xotsheyake Nature Reserve	98.277	98.277
57	Zinti Valley	575.534	572.275
	Total	**377432.620**	**108019.105**

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4. TEMPERATE GRASSLAND REGION: CHINA

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4.1 Major Indigenous Temperate Grassland Types

With a total area of 320 million ha, grassland accounts for about 41.41% of China's land area. Among these grasslands, around 61% or 196 million ha falls into temperate grassland according to the proposed criterion, which can be categorized into following six types:

Temperate meadows are distributed naturally in the transitional zones from temperate forest to the temperate steppe areas in most of China's Northeastern and Northwestern provinces. With mean precipitation between 350-550 mm, they are believed to be one of the best grassland types in temperate China in terms of its primary productivity (mean above ground biomass is 1450kg per ha (dry matter). Around 350-400 vascular plant species were found in this type and the mean vegetation coverage and the height is about 70-90% and 35-50 cm respectively. Besides the dominant tuft *graminoids* such as *Leymus chinensis, Stipa baicalensis, and Cleistogene polyphylla*, forbs (mostly *composita* species) cover 30-40% of the land. Based on the land topographies and the soil substrates, this type can be further classified into three sub-types: temperate plain and hilly meadow, temperate mountain meadow, and temperate sandy meadow.

Temperate steppes ranges between N32-45, E104-115, where is typically the temperate semi arid zone in China. In the arid Northwestern China, they also distribute in the higher altitude in mountain areas. With mean vegetation coverage around 30-50%, and community height around 14-25 cm, the above ground biomass of this type mostly between 1200 to 1600 kg ha-1. Because of the high variation in climate, soil substrates and landforms, the species composition, land coverage, and biomass are highly diversified from place to place. *Stipa* spp., *Leymus chirensisi, Artimisia* spp., *Aropyron cristatum, Cleistogenes squarrossa, Allium polyrrhizum, Thymus serpyllum* etc. are commonly dominant species in the plant communities.

Temperate deserts are found in the center and West of Inner Mogolia, North of Ningxia, center of Gansu, South of Tibet and Xijiang, where the annual rainfall ranges from 150-250mm. Despite its horizontal zonal distribution, it is also situated in the Northwestern Mountains above the temperate mountain steppes. Land coverage, community height and above ground biomass of this type are 10-40(50%), 10-30cm, and 300-1000kg ha-1. The plant communities are dominated by dwarf tuft *graminoids* like *Stipa klemenzii, S. breviflora, S. caucasica, S. glreosa, S. gobica* and xero subshrubs such as *Artemisia, Ajania, Hippolytia, Seriphidium, Psammochloa, Glycyrrhiza* species.

High meadows are naturally located in the West and Southwest mountain areas (including the mountains on Tibetan Plateau) of China above the timber lines(3800 to 4500m), but can also be found at lower altitudes in the mountains of Northern, Northeastern, and Eastern China. With mean temperature from 2— -4□, and annual rainfall from 300-800mm, the mean above ground biomass is about 2500 kg ha-1, containing over 800 species in total. Dominant species include tuft *graminoids* and rhizome sedges such as *carex* and *kobresia* species. *Aster, potentilla, Taraxacum, andorosace, polygonum, Arenaria* etc. are the common associated genus.

High steppes are mainly referred to the steppes in the high altitude areas with dryer and cooler climate than that of high meadows. They are mostly distributed in the middle and Eastern Tibetan Plateau, but can also be found in the high mountains of Northwestern China above the high steppes. With annual temperature 0 to-4 and annual rainfall 100-300mm, the plant life forms are primarily deciduous shrubs, dwarf subshrubs, tuft and rhizome grasses, containing many cushion and rossete species. Growth season for this type is often less than four months. The community height varies from 5-15(40cm), vegetation coverage from 10-50%, and mean above biomass from 100-700kg ha-1. Dominant species including *Orinus, Stipa, Carex, Potentilla,* and *Artemisia* species.

High deserts are found mainly in the high mountains of Tibetan, Xijiang and Gansu. Compared with high steppes, they distribute mostly on the sunny or sub-sunny slopes, where the habitat is relatively dryer (100-200mm), and the community height, coverage and above ground biomass is lower. Besides the graminoid species (Stipa spp.), they contains many xero forbs and shrubs like *Seriphidium, Ceratoides, Salsola, Reaumuria, Sympegma, Caragana, and Ammopiptanthus* species.

4.2 Impact of Human Settlement

About 110 million people live on the temperate meadow areas in China, including 45 million herders and farmers. The major impacts of human settlement are:

- Changes of land uses because of urbanization, agriculture expansion, mining and infrastructure development. About 8 million ha of indigenous temperate meadows were turned to farmland.
- Degradation owning to overgrazing: increasing of soil erosion and reduction of primary productivity and land coverage.
- Loss of biodiversity: forest clearance, wildlife extinction, wetland shrinking.

Some 54 million people live on temperate steppes and temperate deserts; about half of them are purely herders. Around 0.5 million indigenous temperate steppes were used as farmland, and over one million were turned to be the "artificial grassland". Besides the human impacts mentioned above, desertification and land salinization caused by over grazing and climate changes is the major concern for these two types.

The temperate deserts and high steppes and high deserts in Western Inner-Mongolia, Northern Gansu and Qinghai as well as in Xinjiang are dwelled by some 20 million people and over 55 million livestock. In past four decades, these areas were suffered from desertification, frequent droughts because of over grazing, and have been believed to be the major source of sand storms that strike Beijing almost every year.

There are some 12 million people living on the high meadow, high steppe and high desert areas in and around Tibetan Plateau, together with around 75 million livestock. Rangeland degradation (include woody invasion) caused by overgrazing, over-collection (for fuel and commercial collection of medicinal plants), as well as wild life extinction owning to illegal, hunting and infrastructure development, which are also believed to be the major human threats to the natural grassland in this area.

4.3 Current Status

4.3.1 Natural State

Most of the indigenous grasslands are subjected to human uses, i.e., for grazing or for agricultural or industrial uses. Some of the lands have not been used because of their geographically remoteness and inaccessibility. Exact figures for the area of the grasslands and the percentage of the area "in a natural state" are not available. Many of indigenous grasslands are changed or degraded because of grazing. The following table summarizes the total area, percentage of degraded area, the percentage of "unavailable area", and the percentage of farmland area. The estimation was made on the basis of the authors' experiences and recalculated with data from many government reports.

Table 1: Grasslands overview

Grassland Type	Total area[1](ha)	Degraded area[2] (%)	Unavailable area[3] (%)	Farmland (%)	Other uses (%)	Estimated natural grassland[4] (%)
Temperate meadow	14,519,331	48	12	5.6	5.0	*64*
Temperate steppe	51,769,989	65	12	3.7	/	*47*
Temperate desert	23,428,418	52	11	1.7	/	*59*
High meadow	70,586,243	55	13	/	/	*58*
High steppe	41,623,171	55	17	/	/	*62*
High desert	17,693,769	46	21			*75*
Total	**195,592,503**	**62.7**	**15.7**			***53***

Note:
1: recalculated with data from Liao et al. 1996
2: recalculated from various government reports in 1990-2007, here degraded area refers to degraded grazed area. Percent of grazed area=1-unavailable area%
3: recalculated with data from Liao et al. 1996. Unavailable area refers to the grassland inaccessible to be grazed.
4: percent grassland in natural state=((1- degraded area%)+unavailable area%)×100%

According to our estimation, about 53% or 103,664,026 ha of the indigenous temperate grassland is still kept in a state of nature in China, while about 47% has been visibly changed by human uses. On the other hand, according to a SEPA (state environment protection administration) report, over 95% of the grassland in China is subjected to certain degree of degradation. Temperate steppe, high meadow and high steppe are the most threatened types.

4.3.2 Formal Protection

Up to end of 2006, there are 2,349 natural reserves in China. Total area of the natural reserves is 149.95 million ha, occupying around 15% of the Country's land area. Among the natural reserves, 87 natural reserves at various levels are established on temperate grassland, which, surprisingly covers about 80, 946,142 ha or 42% of the grassland. Some of the reserves such as Xinluhai in Sichuan and Mt. Arkin in Xinjiang shown in Appendix contain not only the grassland ecosystems, but also vast area of forests. However, we can still reasonably assume that no less than 35% of the temperate grassland area is formally protected in China, in principle. One of the reasons is that China has established many new reserves since the beginning of 21th Century, some of them are extremely huge, e.g., Qiangtang Natural Reserve in Tibet covers a land area of almost 300 thousand square kilometers, and the area of Sanjiangyuan (water head areas of Yangtze, Yellow and Lancang Rivers) Natural Reserve in Qinghai is around 150 thousand square kilometers. These two reserves alone, with temperate grassland as their main vegetation type, account for over 23% of the temperate grassland in China. In addition, besides these two giants, there are nine other nature reserves with respective area over ten thousand square kilometers (see Appendix).

Ironically, estimated with also many government reports, over 62% of China's temperate grassland is suffering from land degradation, which means that many of the officially protected areas are not effectively protected, in practice.

A number of the reserves even haven't done any scientific research or vegetation inventory, thus, precise estimation of the protected areas for each grassland types is not available.

4.4 Opportunities for Improving the Level of Protection and Conservation in the Region

There are enormous opportunities to strengthen the protection and conservation in China, especially in recent decade, which can be summarized as follows:

1. Increasing public awareness for environment protection. As China enjoys rapid economic development, people are more aware of environment issues such as land degradation and biodiversity loss. Because the temperate grasslands mainly distribute in Western China and Tibetan Plateau, where are also the waterhead areas of China's major rivers or the major source of the duststorm that frequently strikes the industrialized areas in Northern and Eastern China, protecting the natural ecosystems and rehabilitating the degraded lands have being drawing great concerns only not of the governments and scientists, but of people from many other sectors in the society.

2. Favorable government policies for grassland protection and sustainable development. In the national strategy of "Great Western Development", promoting natural conservation was taken as one of the priorities to achieve sustainable development. Establishment of nature reserve and other forms of protected areas is highly encouraged. Because overgrazing is considered as the most important driver of grassland degradation, realizing "balance between the grassland and the livestock" becomes the major government policy recently for grassland protection and sustainable development in the Western pasturing area.

3. Improved legal framework for natural protection. Since 1980s, China has developed a series of laws and administrative regulations for nature conservation and grassland management, e.g., Law of grassland management (1985, revised in 2002), Law of wildlife protection(1988), Law of environment protection (1989), Byelaw of nature reserve (1994) and land management in nature reserve (1995), Implementation statute of teressetial wildlife protection (1992), Statute of wild medicinal resources (1987), statute of wild endanger plant protection (1996). Among these, Law of grassland management is in its legislative process for the second revision, and byelaw of nature reserve will be uplifting to a national law.

4. Preferable government fund and programme supports to grassland conservation and development. Besides the Wildlife Protect and Nature Reserve Programme(2001), which has been implemented across the country with aims to establish or strengthen nature reserves to protect 16% of the land area that covers at least the country's 90% species and ecosystems in ten years, Natural Grassland Protection Programme and Pastureland Protection Programme (Tui Mu Huan Cao Gong Cheng) were designed specially for grassland areas in Western China. These two programmes, starting in 2003 and with total investment over tens of billion RMB, aim to restore most of the degraded rangeland with integrative approach.

4.5 Constraints Against Improving the Level of Protection and Conservation in the Region

1. Knowledge and technology gaps. In many of the protected areas, there has not been scientific research or vegetation inventory. In protection improvement, lack of necessary baseline information is common to most of the reserves. Although research were carried out in some of the reserves and for some grassland types, they are either not sufficient or without cross-scale checking. In general, the knowledge of ecosystem dynamics, drivers and effects for the temperate grasslands is very much in need. Moreover, scientifically and culturally based technologies or approach suitable to the Western grassland areas for rangeland monitoring, assessment and management are specially needed to be developed.

2. Conflict between conservation and development. In the grassland areas, land degradation and poverty are usually concurrent. Up to now, majority of local people still solely rely on grassland for their livelihood and development. Lack of alternative livelihood is the major constrain to nature protection. When conservation is strengthened, livelihood of local people is often affected. Approach of rangeland co-management and a better institutional arrangement for benefit sharing should be developed and promoted.

3. Insufficient coordination and participation in grassland management. Many government agencies are responsible for grassland management. And the protected areas can be managed by different government sectors even they are all grassland. The problem caused by the land tenure issues and conflicts among different laws, statutes and policies are adding more complication to grassland conservation. Furthermore, top-down decision making in project/policy designing and implementation makes many governmental projects, including the major programmes mentioned above, less effective both ecologically and economically in some areas.

4. Low capacities at local level. Many protected areas are both understaffed and poorly equipped. The management staffs usually don't have the basic knowledge and technique for monitoring and working with local communities. About one third of the protected area management agencies don't have any infrastructure, some of them even don't have full time staffs.

5. Shortage of fund or unstable fund support. Although huge amount of money has been invested to nature reserve establishment and to grassland conservation, according to a government report however, the annual investment for nature reserve is only 250 RMB or 35 USD per square kilometers, comparing with 2,000 USD in developed countries and around 250 USD in the other developing countries in average. As protected areas for grassland in Western China are usually much larger than other type, the mean investment is even less. To mitigate this problem, the governments encourage a diversity of financing channels for protected area development, e.g., getting loan from bank and donation from NGOs, company and individuals. In 2004, for instance, about 32% of the fund for nature reserve establishment in Tibet was from non-governmental sources. The multi-financing is good but usually not stable.

4.6 Suggested Next Steps and Action Plan

As there has already been high percent of area being zoned as protected area for temperate grassland in China, it is suggested that strengthening and improving the existing framework be the focused purpose of next step.

To fulfill the purpose, the following actions are proposed:

1. An ecological assessment for the current status of temperate grassland to identify the most critical types at country level.
2. A review on related decision-making process at various levels to identify the problems and the potentials for collaborative management and adaptive management for the protected areas.
3. A joint study on impacts of the major current policies and programmes and/or climate changes to evaluate the environmental and/or socio-economic effects on the grassland, and to make policy or technique suggestions to decision makers.
4. A joint research on technologies for grassland monitoring that are suitable to the temperate grassland areas in Western China.
5. A demonstration of sustainable conservation and development for important or chosen critical temperate grassland.

4.7 Appendices

Map 1: Temperate grasslands and their distributions in China

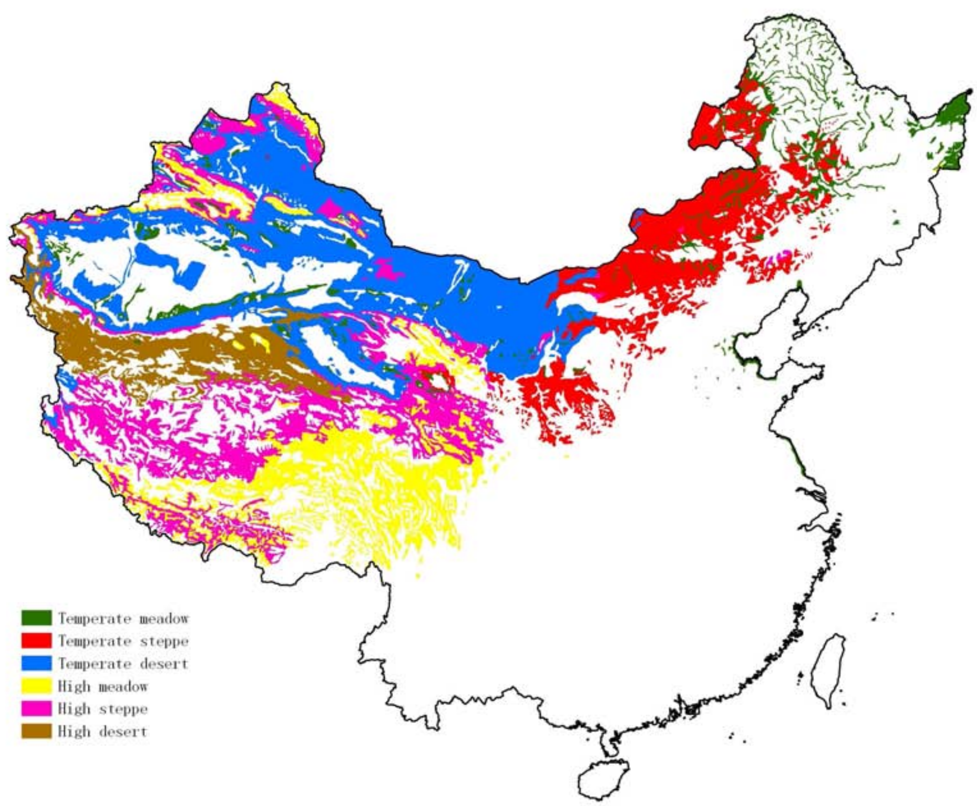

Table 2: Legally Protected Areas in China

Province	Name of natural reserve	area(hm^2)	Grassland type
Inner Mongolia	Tumuji	94830	Temperate steppe
Inner Mongolia	Xilingol	1078600	Temperate meadow
Inner Mongolia	Western Erduos	555849	Temperate meadow
Inner Mongolia	Wulate	68000	Temperate desert
Inner Mongolia	Ejina	26253	Temperate desert
Sichuan	Zoige	166571	High meadow and peatland
Sichuan	Chaqingsongduo	143683	High meadow
Tibet	Mt.Everest	3381000	High steppe, high meadow, high desert
Tibet	Qiangtang	29800000	High steppe, high meadow and high desert
Gansu	West lake Dunhuang	660000	Temperate desert
Gansu	Anxi	800000	Temperate desert
Gansu	Liangu	389883	Temperate desert
Qinghai	Kekexili	4500000	High meadow, high steppe
Qinghai	Longbao	10000	High meadow and peatland
Qinghai	Sanjiangyuan	15230000	High meadow and peatland
Ningxia	Shapotou	13722	Temperate steppe and temperate desert
Ningxia	Baijitan	81800	Temperate desert
xinjiang	Mt.Arkin	4500000	High steppe and high desert
xinjiang	Luobupo	7800000	Temperate desert
xinjiang	Ganjiahu	54667	Temperate desert
Inner Mongolia	Bayinhangai	49650	Temperate desert and temperate steppe
Inner Mongolia	Alukerqin	136794	Temperate steppe and wetland
Inner Mongolia	Weinahe	125564	Temperate steppe and temperate meadow
Inner Mongolia	Baerhu	528388	Temperate steppe
Inner Mongolia	Gurigesitai	544600	Temperate meadow and temperate steppe
Inner Mongolia	Caimushan	42477	Temperate meadow
Inner Mongolia	maogaitu	83246	Temperate steppe and high steppe
Inner Mongolia	Etuoke	144762	Temperate desert
Inner Mongolia	Bayineeger	36000	Temperate desert
Inner Mongolia	Kubuqi	15000	Temperate desert
Inner Mongolia	Wushen	19148	Temperate desert
Inner Mongolia	Hatengtaohai	60490	Temperate desert
Inner Mongolia	East Alasan	1071549	Temperate desert
Inner Mongolia	Tengri	1006454	Temperate desert
Inner Mongolia	Tamusu	25000	Temperate steppe
Inner Mongolia	Yabulai	152700	Temperate steppe
Jilin	Yaojinzi	23800	Temperate steppe and temperate meadow
Heilongjiang	Yueya lake	5130	temperate meadow
Sichuan	Kaqiu Lake	19200	High meadow and wetland
Sichuan	Gexigou	7975	High meadow and wetland
Sichuan	Xinlu Lake	16875	High meadow and wetland
Sichuan	Luoxu	155350	High meadow
Sichuan	Changshagongma	669800	High meadow
Ningxia	Mt.Yunwu	4000	Temperate steppe
Xinjiang	Qitai	38600	Temperate steppe and desert
Xinjiang	Mt Kunlun	3200000	High meadow and high steppe
Xinjiang	Tashkurgan	1500000	High meadow and high steppe
Xinjiang	Xinyuan	65300	High meadow

Province	Name of natural reserve	area(hm^2)	Grassland type
Xinjiang	Tacheng	1500	Temperate steppes
Xinjiang	Jintasi	56700	High meadow
Xinjiang	Burgen	5000	Temperate meadow
Inner Mongolia	Wulanbutong	31550	Temperate meadow
Inner Mongolia	Denglonghe	14100	Temperate meadow and wetland
Inner Mongolia	Kerqin	7020	Temperate desert
Inner Mongolia	Huitengxile	16000	Temperate meadow
Sichuan	Nanmodan	10486	High meadow and wetland
Sichuan	Mt.Yanboyeze	442519	High meadow
Sichuan	Dangling	47219	High meadow
Sichuan	Duopugou	22102	High meadow
Inner Mongolia	Gonger	101900	Temperate meadow
Inner Mongolia	Chenbarhu	510200	Temperate meadow
Inner Mongolia	Herhonde	48296	Temperate meadow
Inner Mongolia	Huahusuo	34000	Temperate meadow
Inner Mongolia	Mt.Qinglong	7200	Temperate and high meadow
Inner Mongolia	Harijiaobao	1107	Temperate meadow
Inner Mongolia	Summer campus	9000	Temperate meadow
Inner Mongolia	Holingol	700	Temperate meadow
Inner Mongolia	Gericaolu	10000	Temperate meadow
Inner Mongolia	Hairihan	1833	Temperate meadow
Inner Mongolia	Wangyeshan	6667	Temperate meadow
Inner Mongolia	Aguidong	2500	Temperate meadow
Inner Mongolia	Abaxia	45000	Temperate meadow
Inner Mongolia	Wuherqin-aobao	139300	Temperate meadow
Inner Mongolia	Aguimiao	107	Temperate desert
Inner Mongolia	Eqisuosuolin	66667	Temperate desert
Liaoning	Namuslai	7103	Temperate desert and wetland
Heilongjiang	Qinsecaoyuan	12564	Temperate meadow
Heilongjiang	Daheishan	21000	Temperate meadow
Heilongjiang	Yixin	136	Temperate meadow
Heilongjiang	Lixin	333	Temperate meadow
Heilongjiang	Laohugang	667	Temperate meadow
Heilongjiang	Sifangshan	12000	Temperate meadow
Heilongjiang	Songzhan	14666	Temperate meadow
Heilongjiang	Hepingqinglong	6500	Temperate meadow
Sichuan	Riganqiao	122400	High meadow and peatland
Shaanxi	Dalishayuan	6540	Temperate desert
Gansu	Wuweishadi	850	Temperate desert

5. TEMPERATE GRASSLAND REGION: DAURIAN STEPPE

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5.1 Major Indigenous Temperate Grassland Types

5.1.1 Daurian steppes

Daurian steppe belongs to Central Asian Sub-region of Eurasian Steppe Region (Lavrenko, 1970). Most of the Daurian steppe area is found in north and North-East China and East Mongolia, Russian part is confined to Zabaikalsky Krai and Buryat Republic. In Russia other grasslands of Central Asian Steppe Sub-region lie in Tuva Republic, Khakasia Republic, Irkutsk Province, Krasnoyarsk Krai. In terms of WWF Terrestrial Ecoregions of the World Dauria Steppe covers Nenjiang River Grassland, Daurian forest Steppe, Mongol-Manchurian Steppe, Selenge-Orkhon forest-steppe ecoregions (Olson, Dinerstein, 1998).

These grassland areas are united by geographic location, annual and multi-year rythms of ecological factors, structure and composition of communities. Annual precipitation varies from 144 to 330 millimeters west of Great Hinggan, exceeding 400 mm in Nenjiang Grasslands and barely reaching 57 mm at the fringes of Gobi. Average altitude is 1000-1500 meters, with – 25° C mean January temperature in Russian part, deep freezing of soils and formation of permafrost pockets. This favors cryophytic character of Daurian steppes. Broad distribution of stony soils causes important role of long-root herbs not only in meadow steppe, but also in true steppe communities. Spring is cold and dry, while most of rainfall coincides with highest annual temperatures during second half of the summer. This leads to absence of spring-time ephemeroid plants, highly intensive cycling of nutrients in short summer period and as a result formation of primarily poor shallow soils. In arid mountains stony steppes often intermingle with stony tundras, since forest belt is often absent, thus forming cryo-xerophitic tundra-steppe landscapes.

Central Asian Steppe Subregion has flora notably different from steppes west of it, with such endemic genera as Cymbaria, Saposhnikovia, Filifolium, Panzeria, Schisonepeta, Stellera, Lespedeza, etc. Feather grasses (*Stipa sp*) dominating Daurian steppes belong to *Capillatae* section, different from those of western steppes. Communities dominated by *Filifolium sibiricum*, *Leymus chinensis*, *Stipa baicalensis* are not found in other grassland areas. Higher abundance of bird taxa, including multitude of rare and endangered species is also a typical feature of Dauria. They find luxuriant habitats near rivers and numerous small lakes.

Climate, geology and geomorphology indicate that this region has a great spatial diversity of ecosystems. However, most striking characteristic of Daurian landscape is thorough adaptation well-pronounced multi-year climate cycle. Fluctuating climate adds considerably to temporal diversity, changing the species/communities distribution and composition over time in a cyclical manner. The region is outstanding for the connectivity that remains among habitats, of essential importance for migrating species of wildlife. Cycle manifests itself in regular changes in appearance and species composition of plant communities, gradually moving borders of communities and ecosystems, alternating breeding areas of millions of birds and changing migration patterns in hoofed animals, all of which depends on regular precipitation changes. Depending on the phase in the climate cycle the same plot in steppe may change from “meadow-steppe” to “true –steppe” and back. Its one of evidence why traditional sub-division of steppe into “meadow-steppe”, “true-steppe” and “dry steppe” does not work really well for Dauria, although is still used by botanists.

Gramineous grassland communities are intermingled other vegetation types (wetlands, solonchaks, forest groves, bush, etc.) and should be described and preserved only in broader landscape context.
These cyclical changes are even more evident in steppe lakes, generally following a long 30-year cycle, and less pronounced in large stream valleys that are sustained by influx of water from mountains even in some dry years. Droughts have influence on water flow, mosaics of wetland vegetation, and chemical composition of water. Since the sources of Erguna and its tributaries are in Great Hinggan Mountains, while Dalai and Buir Lakes are fed both from the Great Hinggan and Henty Mountains of Mongolia, water abundant and water-deficient years do not coincide in different sub-basins of the Daurian ecoregion. Therefore waterbirds and other wildlife in different years may move to different habitat clusters, which at that moment have more favorable conditions. Most rare species populations use territory of at least two adjacent countries. Probably, this complex cyclical drought is the most pronounced ecological process influencing local ecosystem dynamics in Dauria. Therefore for the DIPA area, coordinated protection measures should cover the Argun River valley in steppe and forest-steppe zones, major lake systems (Dalai, Buir, Torey) and extend to the forest-steppe zone in the Onon valley in Russia. Such coverage may guarantee that in any given stage in the drought cycle, sufficient suitable habitat is under appropriate protection.

5.1.2 Major indigenous vegetation types

Meadow-steppes

Form a fringe along foothills of Henti, Great Hinggan and other mountain ranges, often forming so-called "exposition forest-steppe", where grasslands and shrubs occupy southern slopes, while Larix forests, etc. cover northern slopes. *Stipa baicalensis* steppes are found in eastern parts along Argun river and tributaries, while steppes dominated by rhizome graminoid *Leymus chinensis* are more abundant in lake depressions, southern valleys of Zabaikalie. Also characteristic formation is *Filifolium sibiricum* steppe. This species form both meadow and true steppe communities.

True steppes

Occupy vast areas in all three countries -
*Filifolium (*thatch-needle grass*)* steppes are dominated by *Filifolium sibiricum* and occupy mountain slopes mostly in forest-steppe landscapes.

Petrophytic steppes have many co-dominant species e.g. *Artemisia commutata, Potentilla acervata, P.tanacetifolia*, *Filifolium sibiricum*, *Lespedeza juncea* and found in upper parts of mountain forest-steppe.

Small tussock steppes dominated by *Festuca litvinovii, F.valesiaca, Poa botryoides, P.attenuata* are widely distributed both in forest-steppe and steppe landscapes.
Large-tussok steppe dominated by *Stipa krylovii* occupies plains in the south of Zabaikalie and North-east Mongolia.

Bush-steppe communities with *Ulmus macrocarpa, Spiraea aquilegifolia, S.media, S.pubescens, Armeniaca sibirica* and clear to them *Artemisia gmelinii* communities are derivatives of broad-leaf forests of past geological periods and peculiar to contemporary forest-steppe landscapes. Grass layer them is formed by both xerophytic and mesophitic species, which have prevalence in years with different humidity. Such dual composition is typical for several types of plant communities in Dauria.

Dry steppes (desertified steppes)

Form continuous belt only in Central-southern Mongolia. In Russian Dauria found only in the driest parts of landscape: bare hill tops, southern slopes, etc. Formed par excellence by gramineous species of dry steppe *Stipa krylovii, Agropyron cristatum, Cleistogenes squarrosa, Koeleria macrantha, Artemisia frigida* as well as species of desert-steppe: *Stipa klementzii, S.glareosa, Cleistogenes songorica, etc.*

Steppe wetlands
Floodplain wetlands in river valleys and brackish wetland complexes in thousands of lake depressions are equally important part of Dauria steppe landscape.

Grass (*Calamagrostis sp.*) and sedge (*Carex sp.)* meadows prevail in floodplains, halophytic *Ahnatherum splendens* steppes, meadows with *Puccinellia sp.*, *Hordeum sp.* and *Iris lactea* at lake edges. Also along the shores of the lakes and in floodplains are reed (*Phragmites australis*) groves, willow and several species of wild fruit trees (Crataegus sp, *Padus avium, etc*). *Carex-Phragmites* and halophytic *Carex-* marshes are found in low, wet depressions. Solonchacks are covered by *Suaeda sp.* and other halophytic species.

Due high variation in precipitation during 30-year climate cycle borders between steppe communities and mesic communities of floodplains/lake depressions constantly move recreating greater habitat diversity.

Forest-steppe tree groves
Equally important parts of landscape are forest groves that create Daurian "exposition forest-steppe". Besides larch, birch and aspen have prominence in forest steppe, while Scotch pine may form island forests on sandy dunes along river valleys. In Nengjiang Grasslands sparse Elm trees form savanna-like landscapes.

5.1.3 Daurian fauna

Faunal diversity
High diversity of fauna is probably due to several factors: diversity of regional landscapes and historic dispersion corridors, overlap of several zoogeographic zones (Daurian- Mongolian, East Siberian, Manchurian, etc), and high cyclical variations of climate conditions triggering wide migrations in many species populations.

5.1.4 Daurian wildlife

Grasslands are rich in small mammals such as scilly shrew (*Crocidura sauveolens*), harvest mouse (*Micromys minutus*), long-tailed souslik (*Citellus undulatus*), Maximovich's vole (*Microtus maximowiczii*), Daurian pika (*Ochotona daurica*), Tolai hare (*Lepus tolai*), a number of hamster species (*Phodopus* spp.), Daurian zokor (*Myospalax aspalax*), Manchurian zokor (*Mysospalax epsilanus*). Rodents play exceptional role in forming soil, plant communities and erosion patterns in Daurian landscapes.

Predators include wolf (*Canis lupus*), fox (*Vulpes vulpes*), polecat (*Vormela pereguzna*), Eurasian badger (*Meles meles*), and Pallas' cat (*Otocolobus manul*). Some high-profile mammals such as musk deer, Siberian moose, raccoon dog, Eurasian otter, lynx, registered in Mongolia's Red Data Book are found on forest-steppe borders and adapt here to much more open landscapes than in forest zone.

Breeding bird species diversity is high (altogether well over 300 species), especially in such groups as bird of prey, cranes, waders, geese and ducks, etc. At least 20 bird species are listed in IUCN RDB. Region lies on major flyways, steppe wetlands and especially lakes are globally important stop-over sites for millions of birds. Following tables provides examples of bird species depending on Daurian ecoregion.

Table 1: Importance of Daurian ecoregion for conservation of some rare bird species
(After Goroshko et al. 2006)

Species	Number in the region	
	Individuals number	**% of world population**
Swan Goose (*Cygnopsis cygnoides)*	41000	75
Great Bustard (*Otis tarda. dybowski*)	1050	66
Demoiselle Crane *(Anthropoides virgo)*	73000	37
White-naped Crane *(Grus vipio)*	1400	29
Relict Gull *(Larus relictus)*	2430	20
Red-crowned Crane *(Grus japonensis)*	275	13
Hooded Crane *(Grus monacha)*	1200	13
Asiatic Dowitcher *(Limnodromus semipalmatus)*	300	2

Table 2: Importance of Dauria ecoregion for conservation of some migrant bird species
(After Goroshko,et al. 2006)

Species	Number of birds (individuals)	% of birds migrating along East Asia-Australian flyway
Grey Plover (*Pluvialis squatarola)*	6500	40
Lesser Golden Plover (*Pluvialis fulva*)	48000	50
Wood Sandpiper (*Tringa glareola*)	12000	20
Rufous-necked Stint (*Calidris ruficollis*)	150000	32
Broad-billed Sandpiper (*Limicola falcinellus*)	4500	16

Other rare bird species that breed here are Oriental White Stork (*Ciconia boyciana*, IUCN Endangered), Black-headed Ibis (*Threskiornis aethiopicus melanocephalus*), Mandarin Duck (*Aix galericulata*), and Eurasian Spoonbill (*Platalea leucorodia*), Black Stork *(Ciconia nigra)*, Whooper Swan *(Cygnus cygnus)*, Baikal Teal *(Anas formosa*, Baer's Pochard (*Athya baery*), Golden Eagle *(Acquila chisaetus*), White-tailed Sea-Eagle *(Haliaeetus albicilla),etc.*.

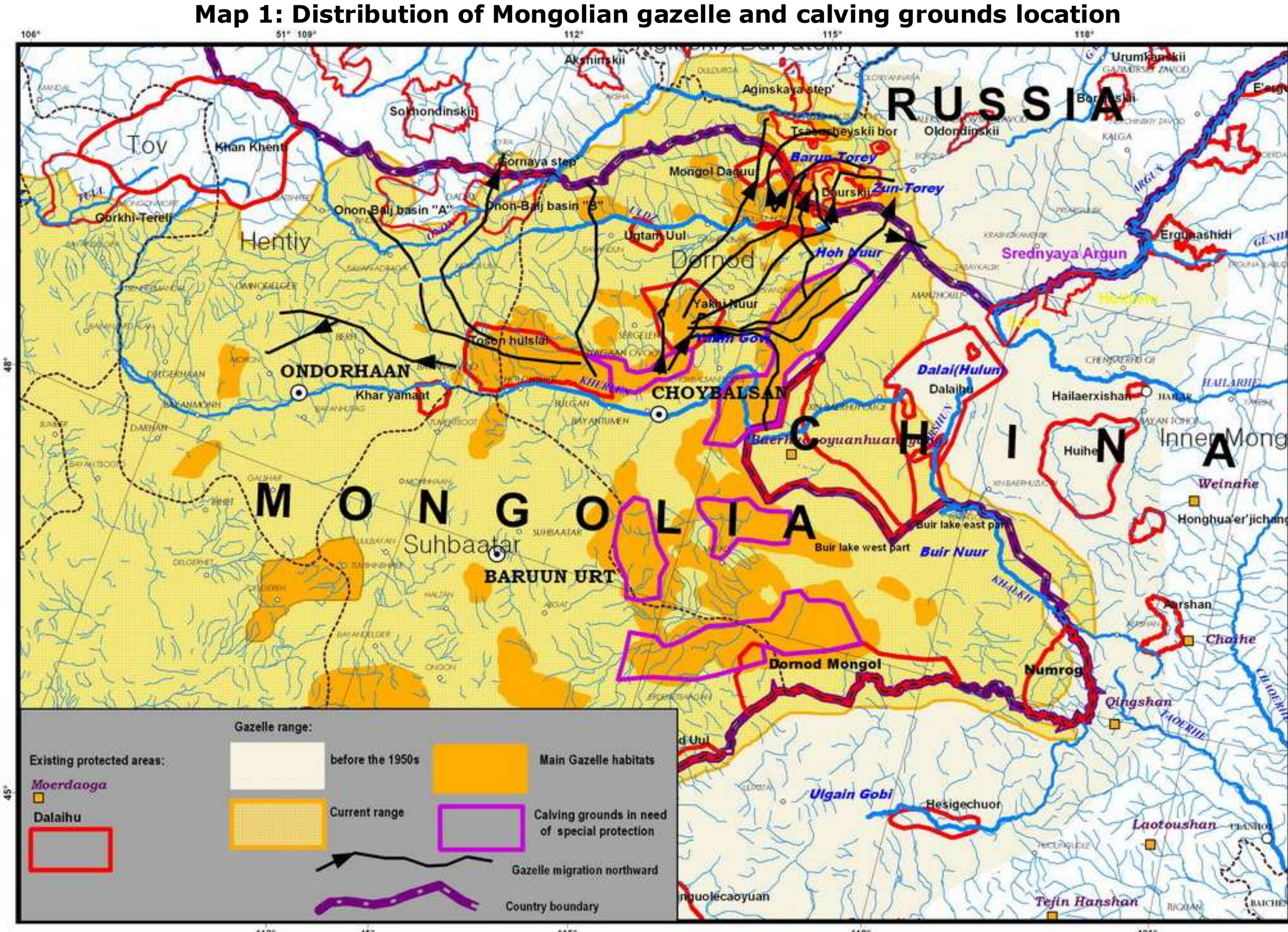
Dauria hosts at least six of the world's 15 crane species. The three species that breed here include red-crowned crane (*Grus japonensis*, IUCN Endangered), white-naped crane (*G. vipio*, IUCN Vulnerable), and Demoiselle crane (*Anthropoides virgo*). Three species stage here prior to migrating to their breeding habitat, the common crane (*G. grus*) Siberian crane (*G. leucogeranus*, IUCN Critically Endangered), and hooded crane (*G. monacha*, IUCN Vulnerable). Depending on the particular phase of the local climatic cycle, birds regularly move between different breeding areas and this poses very peculiar requirements to protected areas planning in the region.

Mongolian gazelle (Procapra gutturosa)
This is the last part of Eurasia sustaining migration of multi-thousand herds of ungulates. The Mongolian Gazelle is the main representative of the eastern Mongolian dry feather-grass steppe, although present distribution across many grassland types is dictated mainly by competition with domestic livestock. Around 1 million Mongolian Gazelles inhabit the eastern Mongolian steppe. The bulk of the population is located in Mongolia while a small resident herd has been reestablished in Russia after complete local extinction Migration and distribution are thought to relate to drought cycles and other climatic phenomena. Gazelles no longer migrate to China because a fence was constructed along the Mongolian border leaving few openings for gazelles to cross. On the China side, suitable range for gazelle is fragmented by fences and herders' camps. The population in China is severely fragmented in small groups and probably reaches several hundred individuals, roaming mostly along the border with Mongolia. One group of 10-13 gazelles is regularly observed near Hulungou Station of Dalai Lake Biosphere Reserve.

There are only 4-5 principal major herds of gazelle in Eastern Mongolia; on these herds, the well being of the species depends. They roam widely and intermix in winter, but in summer calving season each herd concentrates in a particular calving ground. Gazelles are especially vulnerable to overgrazing, infrastructure development and other activities in the vicinity of calving grounds. Presently herds south of Kherlen River have lost most of their winter range due in part to construction of China/Mongolia boundary fence. In addition, grass resources of their summer range are exhausted by overgrazing by livestock and grass-fires. And migration paths are blocked by mineral extraction activities and road construction. Poor placement of new yurts and wells in the calving grounds is also a major factor adding to the continuing population decrease in the past few years.

During autumn and spring migration and in winter gazelles are usually widely distributed and often penetrate into the Chita region of Russia. During the last 10 years distribution of Mongolian gazelles shifted northwards to the southern border of the forest steppe across the Kherlen River (Kiriluk and Tseveenmyadag 1999). In the early 2000s, mostly due to drought, some gazelles from a maternity group in the north Kherlen population began to move to the northeast where a new large calving ground was formed near the China-Russia border. In April 2008 more than 5000 animals were trying to cross barb-wire fence dividing Mongolia from Russia near the place where three counties meet. See Map 1 for distribution of Mongolian Gazelle and location of calving grounds (data from V.Kiriliuk.2007).

Map 1: Distribution of Mongolian gazelle and calving grounds location



5.2 Impact of Human Settlement

All Daurian grasslands are affected by some human activities. Five leading impacts are fires, overgrazing, conversion to arable land, mining and infrastructure and overexploitation of water resources.

Fires are most common impact factor in Russia, which related to traditional pasture management practices. Spring burning often goes out of control and leads to catastrophic consequences, especially in drought years, and fires of 2008 is a good example. Fires exterminate dry grass that serves as thermo isolator, helps retention of moisture, and slows wind velocity near surface. This leads to desiccation, erosion and change in temperature regime. Recurrent fires change species composition in plant communities favoring species with buds below soil surface. They also exterminate some breeding birds and other animals. Fires severely affect both steppe and wetland components of regional landscapes and facilitate extermination of forest component from forest-steppe.

Grazing impacts depend on intensity. Moderate grazing is important factor in nutrient cycling, seed dissemination, etc. Overgrazing by livestock, especially sheep, leads to soil degradation and change in plant composition with higher share of xerophitic unedible plants (Artemisia frigida, Cleistogenes squrrosa, Thermopsis lanceolata etc.). It is most severe in China portion of Dauria. In Mongolia shift from nomadic grazing to stationary and semi-stationary grazing system leads to high pressure in areas with settlements and water-sources. During drought livestock concentration near steppe wetlands severely limits living space for other fauna and virtually destroys riparian communities. Water-well building in dry areas one of leading threats to remaining gazelle populations. In Russia due to decline in livestock numbers pressure was removed from many areas recently and huge grassland areas recovered during last two decades.

Conversion to arable lands exterminates grassland ecosystems and recovery of steppe plant communities on abandoned fields takes 30-50 years. This has been important factor in Russia, which slowed down due to drought and economic turmoil. Most lands converted in socialist times are now abandoned and under some stage of natural succession. Forest-steppe areas in foothills have much greater conversion rate in all countries. In China expansion of arable land mainly in forest-steppe zone is supported by irrigation projects.

Mining has complex profound impacts on Dauria landscapes, as well as transportation infrastructure and settlements associated with mining industry. Steppes around Haranor mines are degrading under aerosol pollution. Mining is a growing industry in grasslands of all three countries.

Water consumption and associated infrastructure development is highly threatening factor in this water-deficient region, especially in China. Water tables are lowering fast in china section and many ambitious water-diversion projects are proposed like transfer from Argun-Erguna River to Dalai Lake. One of underlying reasons is that many settlements and industries are placed in areas where there is not enough water to support them during dry phase of climate cycle.

5.3 Current Status

5.3.1 Natural State

At the Regional Level

This estimate is based on expert judgments and Chita (Zabaikalie) region statistics and relates only to Russian part. Total area of steppe and forest-steppe landscapes in Zabaikalsky Krai is roughly 10 million hectares. Out of those 7,5 million are not used by industry, urban areas and transportation. Arable lands cover 0,5 million ha, abandoned fields 0,7 million ha, pastures 4,5 million ha. The remaining 1,8 million ha should be considered unused and therefore more or less natural. Lands of state reserve along national border (approx. 0,1 million ha) and lands covered by existing strict protected areas (7 846 ha) should be added to this figure.

Total estimate comes to 1,9 million ha of unused grasslands and 5 million ha of moderately used and recovering grasslands (pastures and abandoned fields). However, except for some southern slopes in forest-steppe (none of which is protected) all other regional grasslands are not intact and were used by humans at some point in history.

For each grassland type

According to traditional classification (by V.B.Sochava) there are 40-45 landscape types in forest-steppe and steppe zones of Dauria. Among them: in forest-steppe landscapes climax vegetation is about 62-67% types; in steppe landscapes – 68-70%. Sub-climax vegetation types are about 8-10% in forest-steppe and near 5% in steppe. Serial vegetation types are 22-25% in forest-steppe and about 25% in steppe. Most of serial landscapes are concentrated in floodplains (and they are serial by their ever changing nature), and less – in abandoned arable lands.

Table 3: Landscape types of Dauria (in Russia)

Category	Steppe (number of types)	Forest-steppe (number of types)
Climax	68-70%	62-67%
Sub-climax	5%	8-10%
Serial	25%	22-25%

5.3.2 Formal Protection

Protected Areas in Russian portion of Dauria (Zabaikalsky Krai)

Due to lack of time we can present such estimate only for Zabaikalsky Krai of Russia. The rest of available data on Daurai is available only in GIS format, where acreage of protected areas could be easily calculated, but consistent groundtruthing presents difficulties. Therefore we attach a list of more than 120 PAs known to us in Russia, Mongolia and China (see attachment), but cannot quickly make a credible estimate on what portion of grassland communities is protected.

Table 4. Protected areas in natural zones of Zabaikalsky Krai
(after T.Strizhova, O.Kiriliuk 2007)

Protected areas by zone	Protected areas as % of zone area in Zabaikalski region	% of total Protected areas coverage in the Zabaikalski region
Forest steppe:	**5,5**	**13**
Wildlife refuges	4,23	15
Nature monuments	0,04	5,7
Nature Reserves	1,23	89,6
Steppe:	**5,64**	**19**
Zapovednik (Strict nature reserves, including their buffer zones)	3,22	45,9
Wildlife refuges	2,39	12,7
Nature monuments	0,03	35,5

Landscape types representation
From all protected areas only 7896 hectares in Daursky Zapovednik (Strict nature reserves –core zone) is fully excluded from any economic activity. Therefore only 7-10 types of steppe landscapes are under strict protection (2- climax, 2-subclimax and the rest- serial types)

Forest-steppe landscape types are protected only in wildlife refuges and other lower level PAs. Many key landscape types are not represented in any PAs: Montane Daurian steppes, floodplains, South-siberian and Amur-Sakhalin forest-steppes, etc. All categories of protected areas in Russian Dauria include about 25 landscape types in two zones or 55% of total landscape diversity.

Plant community representation
Out of 23-24 actual steppe and forest-steppe types of plant communities, 18 types are found in some protected areas. However, except for core zones of zapovedniks and national park these communities could be subject to overgrazing and other impacts.

In fully strictly protected core zone only the following communities of steppe zone are present:
- Steppes dominated with tussok grasses *Stipa krylovii, S. baicalensis, Agropyron cristatum, Leymus chinensis, Cleistogenes squarrosa, Koeleria cristata*
- Steppes dominated with *Filifolium sibiricum* in complex with steppe shrubberies and stepped meadows
- *Caragana-Leymus-Stipa* steppes combined with *Festuca* and *Cleistogenes* steppes
- Meadows and hydropytic communities, including reeds

The following communities with high biodiversity value typical of forest-steppe zone **are not represented** in any protected areas:
- Forest-steppe landscapes with elements of Far East (Amur-Sakchalin) flora and vegetation, including groves of dahurian birch (Betula dahurica), reach herbatious meadow steppes and shrubberies of manshurian species
- West-Transbaikalian moutain forest-steppes (birch groves, Filifolium steppes, steppe meadows and steppe shrubberies)
- South-siberian small-tussok steppes with steppe shrubs
- Central-asian meadow and hydrophytic communities (Phragmites australis, Caslamagrostis sp., Carex sp., Equisetum sp.) in Argun River floodplain and floodplain vegetation in Onon River floodplain (meadows, Salix sp. communities, Populus suaveolens forests)

5.4 Opportunities for Improving the Level of Protection and Conservation in the Region

5.4.1 Major factors influencing Dauria ecosystem conservation and development of ecological network

1. Active dynamic change of Dauria ecosystems is dictated by regular climate cycle and trends in climate change.
2. Region is the key habitat for many globally endangered species, especially birds.
3. Many local ecosystems are interconnected even over large distances by migration patterns of wildlife, hydrological phenomena and other processes. In the Daurian ecoregion, protection of single wetland-steppe clusters makes relatively little sense, since most of the charismatic fauna migrates among different areas in the course of climate cycles. In humid periods, the steppe with large lakes and multiple small shallow pools becomes optimal habitat for most wildlife. In dry periods forest-steppe and some floodplains of rivers with permanent flow provide smaller and sub-optimal but relatively stable habitat, while most of the steppe becomes highly inhospitable to wildlife (Goroshko, Kiriliuk 2006).
4. Coordinated protection is needed for steppes, forest-steppes and wetland areas. Many species use all three during different phases of life-cycle and climate cycle. Borders between those zones and ecosystem types are subject to change due to climatic fluctuations.

5. Forest –steppe ecosystems have the lowest level of protection, not present in national-level protected areas in Russia, but have more stable conditions and host highest landscape and species diversity (contact zone for Siberian, Mongolian, Manchurian flora and fauna)
6. Economy of the region is increasingly dependent on natural resource extraction, especially mining
7. "Water shortages" increase throughout the region due to natural climate cycles and climate change, and shortsighted development of industries with high water intake and high water pollution, well beyond carrying capacity of regional ecosystems during dry phase of climate cycle. This triggers serious ecosystem degradation and huge engineering schemes to redistribute regional waters. Competition for water resources between three countries is accelerating and poses severe threats to the region as a whole, international coordination in resource use is not well developed.
8. Local human communities, mostly engaged in agriculture, are highly dependent on conditions in local steppe and wetland ecosystems.
9. Since 1994 three countries established trilateral nature reserve (Dauria International Protected Area –DIPA) as means to coordinate biodiversity conservation efforts and it has been effectively covering key portions of Dauria by conservation research, monitoring and education efforts. DIPA could serve as a good basis for further development of transboundary ecological network and species conservation programs.

5.4.2 Conservation strategy

Transboundary ecological network based on provincial, national and international protected areas should be developed by coordinated effort of Mongolia, Russia and China.

International Level
Objectives: Securing areas important for large-scale ecological processes: breeding and migration of key species (e.g. gazelle, cranes), ecosystem resilience during hydrological and climatic cycles, etc. Developing protected areas on both sides of the border when it crosses important natural area (e.g. Middle Argun river valley). Ensuring that increase in resource use (first of all water) is coordinated, and does not severely affect key ecosystem process and areas of high biodiversity value.

Mechanisms: Three countries developed comprehensive set of treaties and international institutions to address biodiversity issues, but most of those mechanisms are yet to be utilized to their full potential. Bilateral agreements and relevant working groups exist at national level, Argun River Basin is subject to comprehensive Sino-Russian inter-provincial agreement, trilateral reserve is governed by trilateral interagency agreement. Expansion of DIPA and development of new inter-governmental agreement, trilateral World Heritage Site, Ramsar Site and Bioshpere reserve is a crucial component of any future cooperation. Planning of transboundary ecological network and species recovery programs is possible under existing agreements if handled properly. However to secure well-being of natural areas key resource extraction policies (e.g. water resources management, etc) should also become a subject to trilateral coordination in transboundary region. (see action plan for details on specific areas)

National Level (Russia example, since national situations differ)
Objectives: Forming large high-profile PAs that encompass full gradient of local ecosystem conditions from plateau steppe to floodplain wetlands. Expanding PA coverage to ecosystem types not represented on national-level PAs, forest-steppe ecosystems being priority. Upgrading management of existing national protected areas and enlarging their area (Daursky, Sokhondinsky Biosphere reserves). Changing status of several Pas from provincial to national (e.g. Aginskaya steppe). Including key habitats of endangered species into PA network.

Means: According to Government Decree from 23.03.2008 all provinces are to develop "spatial planning schemes" within a year. At the same time "National PA Scheme until 2020" is developed by Ministry of Natural Resources and Environment. To come into effect any expansion and upgrade should be incorporated into those documents.

Provincial Level (Zabaikalsky Krai example)
Objectives: Ensure delineation and gazetting of new local protected areas in conjunction with new large-scale development plans focused on resource-extraction (e.g. forestry concessions, new mining areas, etc). Secure areas sustaining local environmental conditions and supporting traditional lifestyles of rural communities and development of low-impact tourism. Link ecological network planning/development with compatible means to support local rural populations, which rely on agriculture and are deprived from means of existence during droughts. Focus efforts of habitats of species listed in Provincial Red Data Book, unique natural phenomena and objects, areas with high recreational and healing values, etc.

Means: Cooperation with key businesses, burdening them with responsibility to support ecological network development in areas where they plan to expand extractive activities. Instituting calm zones that protect certain habitats during critical periods of natural cycles. Developing spatial planning schemes. Improving management of provincial protected areas presently fragmented between several agencies. Educating regional decision-makers regarding role of ecological network in sustainable development of Zabaikalie.

5.5 Constraints Against Improving the Level of Protection and Conservation in the Region

Dynamic nature of Daurian ecosystems presents key conceptual and management constraint to development of stationary protected areas network
In the course of a climate cycle with a 25-40 year span, ecosystems of the Daurian ecoregion are subject to drastic changes. Vivid example is Dalai Lake that can cover 2300 sq. kilometers and reach a depth of 7 meters, but in 1904 and then again in 1940s was naturally reduced to a small chain of shallow 1m deep pools. Thousands of smaller steppe lakes dry completely in water-deficient periods, while flow of Argun/Erguna river at the Sino-Russian border fluctuates from 1.5 cubic kilometers per year to more than 6 cubic km per year. Many smaller streams dry completely or flow only during rainy periods.

Unlike many other regions here responsible conservationist is from the start deprived of an illusion that a single protected area could be big enough to sustain key processes and succession stages over long period of time. Key species migrate over thousand kilometers and plant communities reoccur at different locations.

Competition for resources in dry periods is concentrated in "biodiversity hotspots"
Livestock is concentrated in small river valleys, competing with wildlife and exterminating plant communities; water consumption constitutes significant share of available water resource, etc. Nomadic traditions are ceasing and new agricultural practices so far are unsustainable. While Russia is temporarily blessed with decline in agriculture, China and Mongolia undergo serious crises livestock breeding sustainability.

Distribution of Mongolian Gazelle is presently dictated by rangelands and migratory corridors not yet occupied by herders, rather than by any preference to particular landscapes or plant communities.

Linear growth of regional economy vs cyclic nature of ecosystem process
From planning perspective, increasing amount of infrastructure in the areas with such obvious climatic fluctuations (and pronounced aridization trend added to it) will inevitably lead to huge environmental and economic risks and losses. Presence of major trade corridor through which resources are pumped from Russia to China provokes further growth in population, transport infrastructure and local industries. Both China and Russia could revise development plans and relocate investment and some import-export flows to the areas better suited for massive development. Areas where water is abundant, ecosystems more resilient and fluctuations in biological productivity of landscape less pronounced.

In this respect water resources management policies are of key concern, since relatively inexpensive engineering efforts may lead to catastrophic change in water regime all over Dauria (plans to transfer waters of Hailaer-Argun to Dalai, Kherlen River to Gobi, Khakh River to Xilingol, etc.)

Very low environmental consciousness
In all three countries national parts of Dauria are viewed as places to expand resource extraction. Local communities have ever increasing share of newcomers, especially in China. Traditional lifestyles somehow adapted to regional ecosystems are rapidly replaced with absolutely unsustainable practices. New society does not see connection between climate fluctuation and affordable/appropriate lifestyles, and tries to overcome this "difficulty" by engineering and increased competition for dwindling resources.

Land privatization already occurred de-facto in all countries
Reserving land for PAs is increasingly difficult and costly task.

5.6 Suggested Next Steps and Action Plan

Objective	Action	Stages/Outcomes
	INTERNATIONAL ACTIVITIES	
1. Secure natural water regime through trilateral coordination.	Harmonizing bilateral and trilateral water use in region with high climate variations. Establish and enhance trans-boundary PA network and support PA developmental priority Middle-Argun valley. -Lay technical foundation for harmonizing trilateral water management policies; Formulation of water management guidelines for the region; Assessment of proposed water transfers; -Design of additional protected areas	2008-Develop report on Argun river ecological water requirements and possible impacts of water transfer, dykes, increase in water use. 2009-10 develop draft action plan and enlist allies in national agencies 2010- 11- introduce strategy elements into negotiation processes and domestic planning.
2. Spatial planning/climate adaptation in Dauria	Address such issues as equitable and sustainable use of water resources, management of transboundary wetlands and steppes, conservation of migratory flag species (cranes, geese, bustard, gazelle, etc.), adaptation of reserve network and management to climate change, etc. It should develop DIPA's capability to predict and confront problems related to biodiversity conservation on the basis of advanced remote sensing techniques combined with focused fieldwork. Development of "adaptation for climate change" blueprint for the Dauria region and a set of local interventions aimed to develop model solutions to common problems: fluctuating availability of water, recurrent wild-fires, overgrazing, placement of infrastructure and new mining.	2008 general proposal to trilateral Committee. Getting approval 2009-2010 –supporting individual reserve expansion 2010-2011 –support establishment of trilateral transboundary world heritage Site (var.MAB reserve/var.Ramsar Wetland) development of common management plan.
3. DIPA expansion	Dauria International Protected Area expansion and upgrade: Coordinated expansion of nature reserves comprising DIPA in several high-priority areas and trilateral WHS establishment: a) Erguna/Argun wetlands section has critical value for protection of wetlands and waterbirds of Dauria; b) Gazelle Steppe section is most important for the restoration of Mongolian Gazelle populations and steppe fauna; and c) Buir Nur Lake section is an internationally listed Ramsar wetland, critically important for protection of waterbirds of Dauria. Adjacent steppe has high biodiversity value. d) Establishment of trilateral UNESCO-MAB biosphere reserve, or the first trilateral World Natural Heritage site, or/and a trilateral Ramsar wetland. Develop and implement Transboundary Management Plan e) Upgrading trilateral 1994 interagency agreement to intergovernmental treaty.	

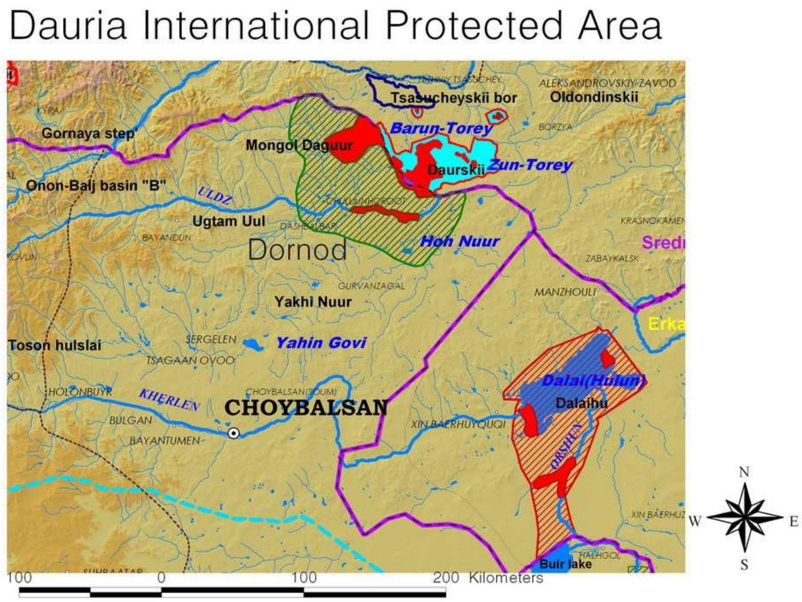
Objective	Action	Stages/Outcomes
3.1 Argun River Midflow and adjacent steppe in Russia.	Support to planning and establishment of the Erguna/Argun cluster of Daursky and corresponding cluster of Dalaihu Biosphere reserves. a) Priargunsky (Argun Midflow) cluster of Daursky Zapovednik in border zone (Russia). b) Daursky Biosphere reserve experimental transition zone and regular transition zone linking steppe habitats between Argun River and Torey Lakes. c) Upgrade protection and expand Erka Nature Reserve, Huliyetu Nature Reserve and Erguna Wetlands Nature Reserve, thus forming uninterrupted protection band in wetlands and steppe of Argun river valley on china river bank. Append this cluster to Dalai Lake Biosphere Reserve.	2009- Gazetting completed at provincial level 2010-11 Obtaining national approval. 2009 –on –support to on-site fire-control and community relations. 2010-2011 establishment of transition zone connecting Daursky and Argun midflow
3.2 Gazelle conservation PAs	Trilateral effort building on success of Mongolian gazelle recovery in Russia: a) Expand and solidify steppe clusters around Daursky Bisphere reserve.(Russia) b) Protect South Hohnuur calving grounds of Mongolian Gazelle and append this valuable area to Mongol Daguur Biosphere Reserve. (Mongolia) c) Reorganize Toson-Hulstai Nature reserve, which borders need adjustment and its protection regime needs a significant upgrade. One of the possibilities is to change its status to Strictly Protected Area, probably by appending it to Mongol-Daguur Biosphere Reserve(Mongolia) d) Establish one or several clusters of PA to protect calving grounds south of Kherlen river.(Mongolia) e) Establish gazelle recovery station in Hulungou core area of Dalai Lake Bioshpere Reserve (China)	2008 Communication of success-story in Russia and wider needs for conservation. Proposing plan. 2009. International Workshop on Gazelle PAs in Mongolia. 2010 Assisting preparation for PA gazetting 2011 Gazetting PAs in Russia and Mongolia 2009-2011 Developing recovery station for Gazelle in Dalaihu, China.
3.3 Swan goose conservation	Swan-goose conservation strategy supported by field projects. Supporting planning and lobbying of Buir Lake protection as part of Mongol Daguur BR and DIPA. Establishment of Buir Lake PA cluster with two core zones and buffer area. PA should include nearby Tashgain Tavan Nur area rich in biodiversity.	
4. Developing "Source of Amur PA"	Transboundary PA is planned on Mongolian-Russian border in forest-steppe and mountain forest zones. It will include 4 existing protected areas and expand to new areas such as: a) Onon River Valley (Russia) b) Buffer zone of Sokhondinsky Biosphere Reserve with meadow steppe ecosystems (Russia) c) Solidified territory of Onon-Baldj NP with buffer zone (Mongolia)	
5. Professional training for PA managers	Hold regular training workshops and field practice for staff of Dauria PAs. Could be best organized on DIPA basis.	
6. Conservation of Forest steppe areas along Lower Argun river.	Design several PAs on Russian side that would complement existing and planned PAs along Argun/Erguna on China side.	

Objective	Action	Stages/Outcomes
	NATIONAL LEVEL (Russia)	
Development of PA component of spatial planning scheme for Zabaikalsky Krai	Critical precondition for PA development according to new Russian regulations. Requires GIS mapping, field surveys, analysis of land-use plans.	2008 –draft 2009- confirmation with authorities
Upgrading PA status to national level	Aginskaya Steppe Provincial Wildlife Refuge.	
Establishment of new national-level PAs in forest steppe	a) Urulunguy River Valley b) Nerchinsky Forest-Steppe c) *Urov and Gazimur rivers headwaters* d) Watershed areas between Uriyumkan and Shilka rivers	
	NATIONAL LEVEL (some examples from other countries)	
Grassland conservation in national nature reserves in China	Most grasslands are protected in "experimental zones" of NR, which does not give reserve managers any real rights to prevent deterioration, except for participation in EIA. Therefore huge grassland areas in Huihe NNR and Dalai Lake NNR would benefit from adjustment of existing zoning schemes, bringing them into core or buffer areas.	
Moergol River Valley in Hulunbeier, China	20 000 ha wetland of highest value for breeding and migrating birds (4 cranes, 3 geese, bustard, etc). 25 km from Hailaer –capital of the area. Weak wildlife conservation management, extensive egg collection, bird poisoning, overgrazing. Need to establish protection station, nature reserve and community co-management projects.	
Gazelle migration corridor planning in Mongolia	Spatial planning. Coordinate drilling of new water wells, location of new stationary herding camps and mining leases with necessity to preserve sufficient space for gazelle migration.	

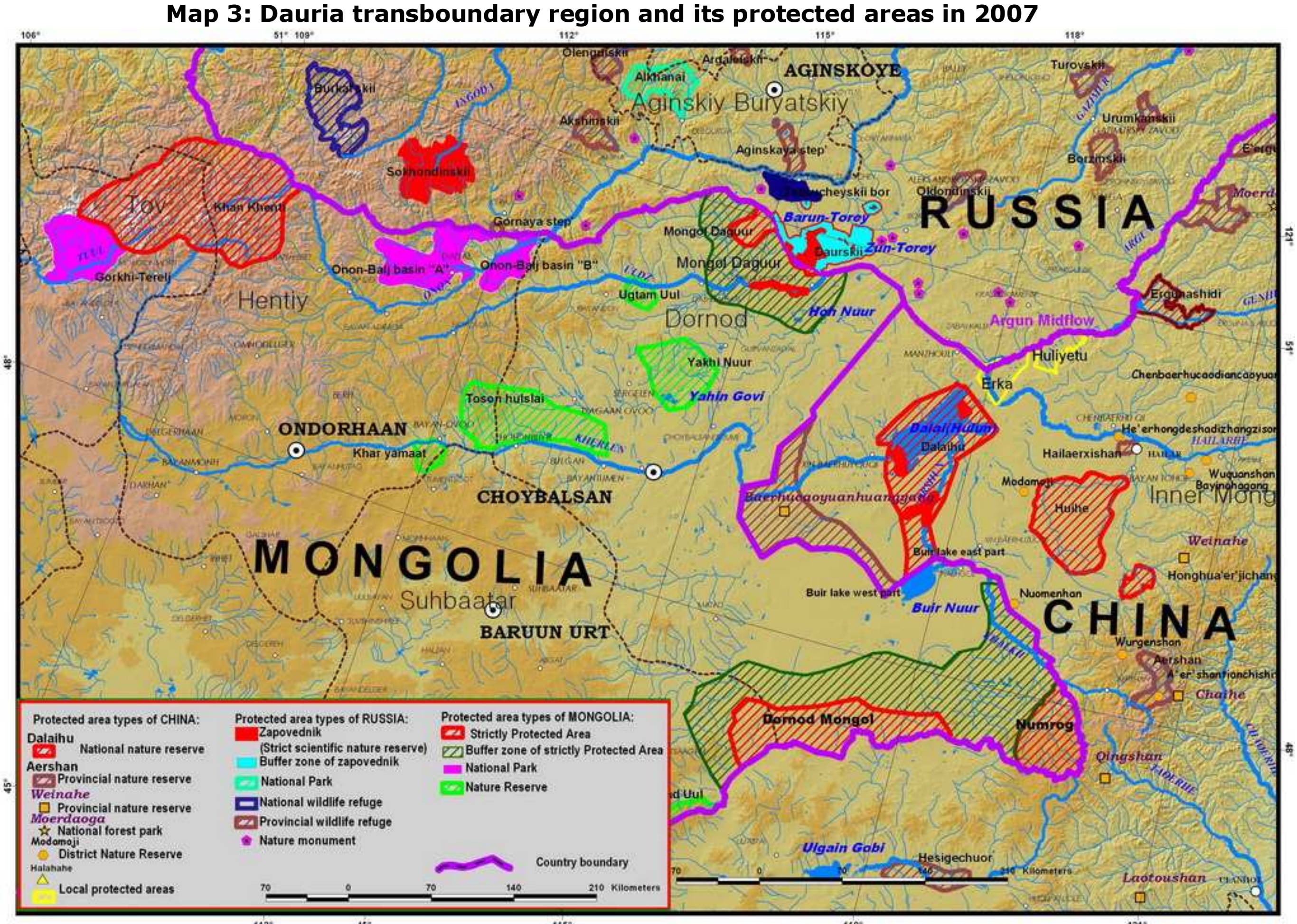
5.6 Appendices

(Note: In providing these maps, the authors make no judgments regarding exact locations of international borders and configuration of national territories.)

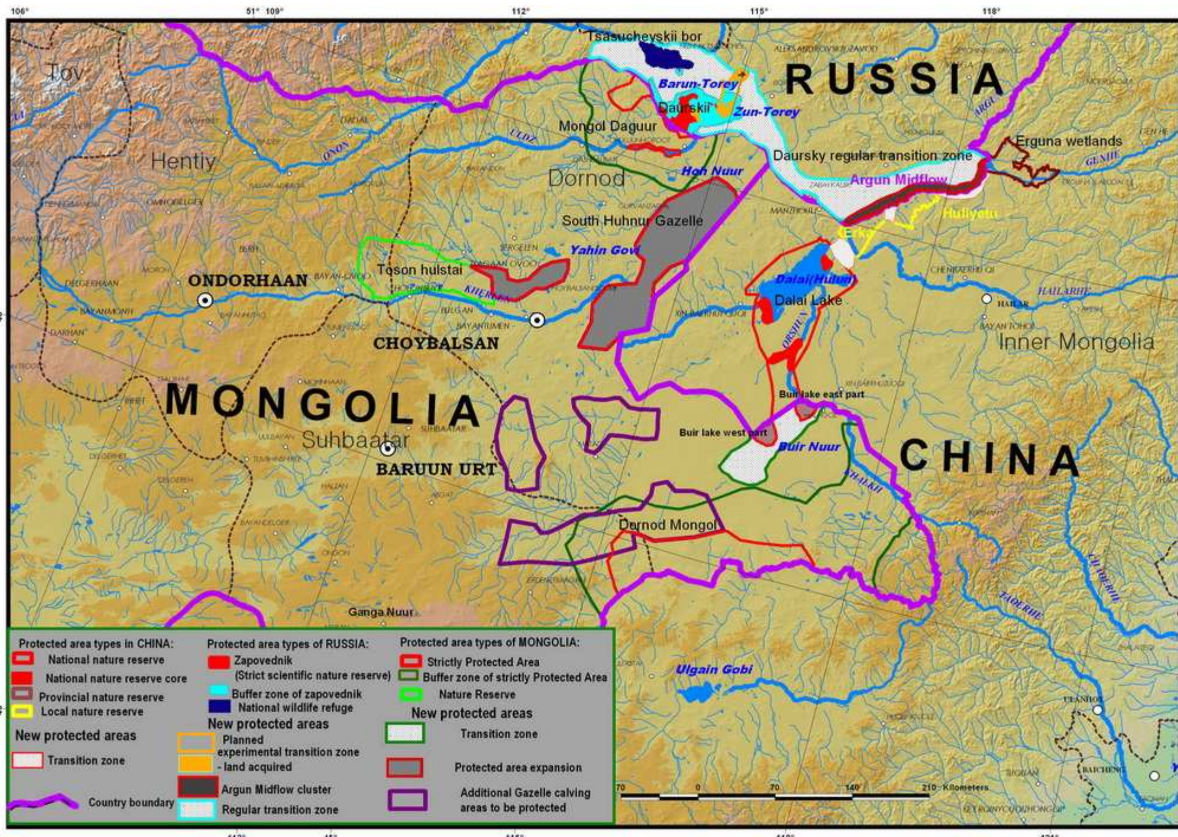
Map 2: Nature reserves comprising DIPA in 2007



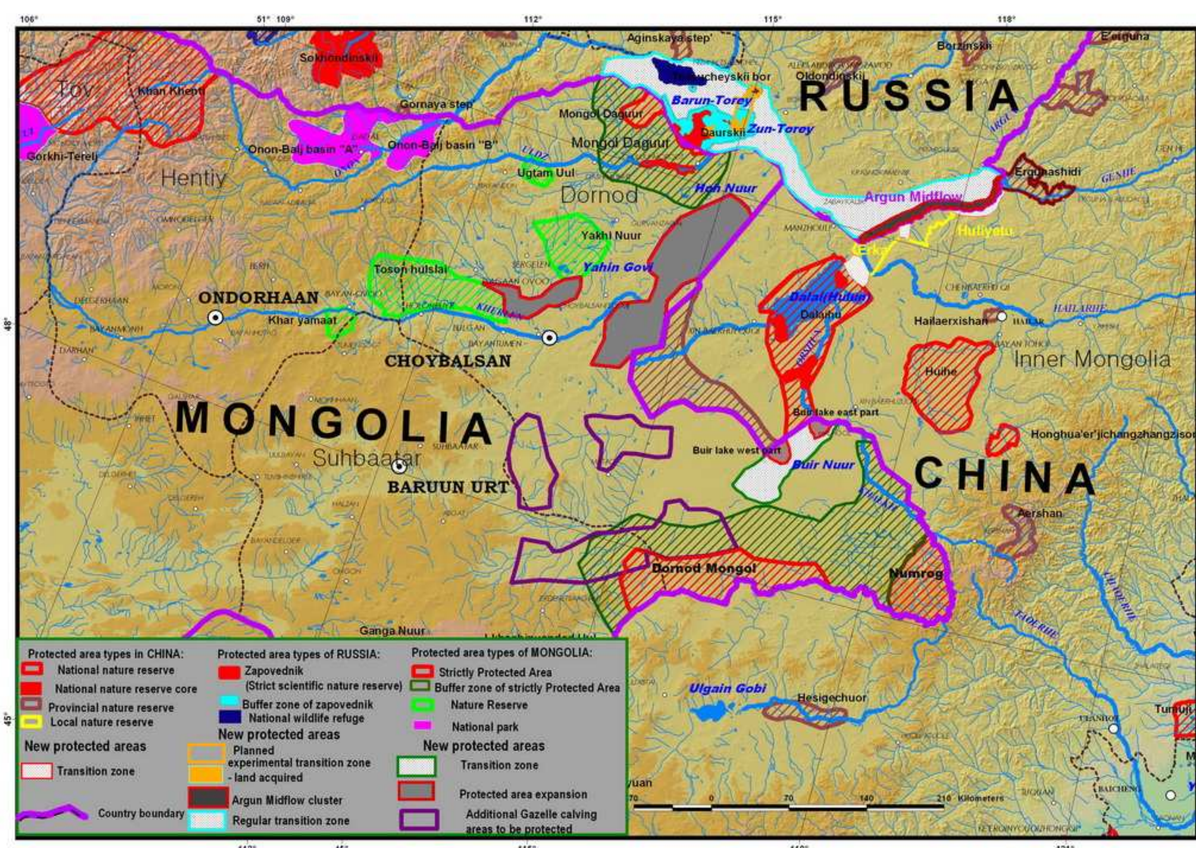
Map 3: Dauria transboundary region and its protected areas in 2007



Map 4: Proposed expansion of national parts of DIPA



Map 5: New configuration of protected areas in Dauria after proposed DIPA expansion



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6. TEMPERATE GRASSLAND REGION: IRAN

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6.1 Major Indigenous Temperate Grassland Types

Iran is a mountainous country. The Alborz stretches along NW to NE in the south shore of Caspian Sea and Zagros lies along NW to SE of country (Map 1). Both of them are rather continues mountain chains. There are many mountain peaks in Iran with an elevation higher than 4,000 m. The high mountain areas (subalpine and alpine zone) exhibit a strong continental climate. High mountain steppes of Iran are kind of temperate grasslands. These sites are characterized by high level of endemic and narrow distributed plant species (Noroozi et al. 2007). Iran is situated within the dry belt of Asia: Zonobiom III (hot deserts) in the south, Zonobiom VII (rIII) in the north (Breckle 2002). Only the Hyrcanian forests located in the South Caspian Sea characterized a humid climate with a rich vegetation of lowland and montane deciduous forests (Akhani 1998). Under natural conditions potential timberline in Iran should be— according to climate— always above 3,000 m; if below, it is certainly because of longlasting (hundreds of years) anthropogenic influence, deforestation, grazing etc.

6.1.1 Subalpine shrubby grasslands

In most places there is a transition between oak forest of north slopes of Central Alborz and true alpine vegetation consisted of *Juniperus communis* subsp. *nana* in lower limit, mixed sometimes with shrubs like *Acer hyrcanum*, *Carpinus orientalis*, *Crataegus* spp. and *Lonicera* spp. In upper limit this transition zone ends to *Juniperus sabina* (Akhani 1998, 2005). In some parts of southern slopes of Alborz and Kopet Dagh and Khorassan Mountains the timberline is composed of *Juniperus excelsa*. However, in most parts of Alborz there is no tree or shrubby vegetation apparently due to long-term land use and degradation of original vegetation. In some places there are still scattered remnants of *Amygdalus* spp., *Rosa* spp. *Cotoneaster* spp. and *Crataegus* spp. shrubs. One of the most important threats of these habitats has been collecting shrubs and trees for fuel or other purposes especially in the last century.

6.1.2 Large herbs and the umbelliferous plants

Large parts of Alborz, Zagros and Kopet Dagh subalpine areas are covered by the umbelliferous plants (2,500–3,500 m a.s.l.). The physiognomy of these communities is governed by the large herbs and the umbelliferous species (ca. 1 to 2 m). These vegetation types which may be composed of different tall umbelliferous genera like *Prangos*, *Ferula* and *Leutea* are very conspicuous in the subalpine zone of Iran mountains (Zohary 1973, Klein 1988, Noroozi & Akhani 2006, Noroozi et al. 2007). Vegetation cover is ca. 65% and between 1 to 2m high. These habitats are one of the most heavily grazed zones. Grazing under these conditions can be categorized as overgrazing and it starts from mid spring to autumn, leading to the degradation of the pastures and increasing soil erosion. Also some herbs are collected in great masses from the slopes to feed and medicine purposes.

6.1.3 Tragacanthic heathlands

Windswept areas of the subalpine–alpine zone of Alborz and Zagros (3,300–3,600 m) are occupied by dense tragacanthic and thorn-cushion formations. (Zohary 1973, Ku¨rschner 1986, Klein 1987, Noroozi & Akhani in press). The important species of these communities are from grasses and tragacanthic species of *Astragalus*, *Acantholimon, Onobrychis*, *Cousinia* and some other genera. These areas are free of snow for a longer period than the surrounding vegetation. Vegetation cover is ca. 45–60%. Grazing is heavy in these habitats but thorn-cushion species protect other species from grazing and trampling.

6.1.4 Alpine desert grasslands

The alpine xerophytic areas which are located at hill tops, ridges, and windswept areas are covered by grasses such as *Bromus tomentosus*, *Poa araratica*, *Alopecurus textilis*, and cushion forming species such as *Asperula glomerata*, *Arenaria insignis*, *Ziziphora clinopodioides*, *Acantholimon demavendicum*, *Astragalus macrosemius*, *Trachydium depressum*, *Erigeron heterotrica* and *Jurinella frigida*. Vegetation cover is ca. 50% and the average height is ca. 50-60 cm. These vegetations are summer pastures. Altitudinal range of these grasslands is ca. 3500 to 4000 m.

6.1.5 Alpine meadow grasslands

The physiognomy of alpine meadow grasslands is characterized by incompact cushion forms of *Astragalus* and short (10cm) and high (50cm) grasses. This formation is distributed in altitudinal range of ca. 3400 to 4000 m. The snow cover remains until late June. In Central Alborz *Piptatherum laterale*, *Catabrosella parviflora*, *Bromus tomentosus* and *Allium tuchalence* are dominant grasses. Plant cover is ca. 60–80% with 50-60 cm high. These habitats represent sufficient food potential for livestock. They are used as summer pastures. Overgrazing favors the growth of thorny and cushion forms like *Cousinia crispa* and *Astragalus iodotropis* in Central Alborz.

6.1.6 Snowbed short-tussock grasslands

This formation occurs on depressed places where snow cover remains to mid summer and growth period is very short. This formation is scattered and fragment in alpine areas. They are usually covered by small tussock of *Catabrosella parviflora* with 10 to 15 cm tall. The life forms of most of the species here are rosettes. The species richness is poor and vegetation cover is between 50 and 100%. Snow cover and melted water in these vegetations remain until mid summer and grazing effect is lower than previous habitats. Global warming is threatening this fragment and scattered vegetations.

6.1.7 Subnival scree steppes

Scree habitats govern steep high alpine and subnival areas. Some species occur on mobile screes with very low cover. The species richness of these habitats is very low. These species also can be found in the nival zone (above 4,000 m). In stabilized screes size of stones is larger, steepness is lower and soil is more developed than mobile screes. *Elymus longaristatus*, *Bromus tomentosus* and *Poa araratica* are common grasses in these habitats in Central Alborz. Because of difficult terrain and steep slopes, most areas of these habitats are not accessible to livestock. Global warming could be the most important factor that threatens endemic species of these habitats.

6.1.8 Narrow distributed and endangered plant species in these habitats

The high percentage of endemism and rare species in the alpine zone and the fragile ecosystems are good arguments for particular attention to stop future loss of biodiversity in high mountain regions. Based on the evaluation of published data from 682 known alpine species, ca. 160 species have been known only based on one record and 110 species based on 2–3 records. From 394 endemic species, 87 species have been known only based on type location (Noroozi et al. 2007). Many of these plants are potentially endangered and vulnerable species.

6.2 Impact of Human Settlement

The alpine zones in Iran have been less affected by humans in comparison to the lowland ecosystems. The harsh conditions and physical barrier limit human settlements and intensive agricultural activities. However, in recent years strong grazing impact is increasingly threatening the fragile subalpine and alpine ecosystems in Iran, even in legally protected areas. The overgrazing leads to the destruction of the vegetation, loss of biological diversity and erosion of soil. The dominance of thorn-cushion formations is obviously one of the consequences of long-term overgrazing and land use in Iranian plateau. The severe overgrazing in most parts of high altitudes in recent years resulted in a spread of poisonous and spiny species such as Euphorbia sp. in Sahand Mts., Colchicum tryginum in Talesh Mts., Gundelia tournefortii in Bozgush and Central Alborz and Cousinia crispa in Central Alborz. An important threat to the alpine ecosystems of Iran in recent years is road construction in many mountain areas. Littering and man made fires are two damages in many high mountains in Iran. According to climatic data from meteorological stations around Central Alborz we can see increasing temperature in this area during the recent decades that is threatening endemic alpine and subnival species.

6.3 Current Status

A series of protected areas, most of which embrace high mountain steppes and grasslands, have been established periodically over time since 1967 until now and formally protected and managed by the Department of Environment of Iran. There are 172 protected areas in Iran with 12103897ha that 23 protected areas cover high mountain grasslands with 1416903 ha (ca. 12% of whole protected areas of country). Ca 36% of them is concentrated to Central Alborz (Map 1, Table 1 and 2). Iranian protected areas have been classified into four groups of national parks, national natural monuments, wildlife refuges and protected areas which are conformed to the IUCN classes and are known as the four areas.

6.4 Opportunities for Improving the Level of Protection and Conservation in the Region

According to our researches there are several areas which are really important for more protection and conservation because they embrace different types of indigenous grasslands and recognized as hotspot of biodiversity in terms of species richness and high rate of endemism. For example below mountain ranges are suggested for establishment new protected areas:

1- Sabalan Mountains in NW of country, highest point 4844m (map 1. 24)
2- Sahand Mountains in NW of country, highest point 3707m (map 1. 25)
3- Lalezar Mountains in SE of country, highest point 4465m (map 1. 26)
4- Shahvar Mountains in Eastern Alborz, highest point 3945m (map 1. 27)
5- Zard Kuh Mountains in Central Zagros, highest point 4221m (map 1. 28)

6.5 Constraints Against Improving the Level of Protection and Conservation in the Region

Insufficient knowledge about ecology, biodiversity and size of indigenous grasslands, inappropriate grazing management even in legally protected areas, economical interests, impact of development activities, lack of knowledge and awareness among rural people about the importance of grasslands, and also insufficient fund for protection are the main constraints against improving the level of protection and conservation in the region.

6.6 Suggested Next Steps and Action Plan

Some suggestions for protection of these vulnerable habitats could be strongly concerned:

1. The high steppes and grasslands of Iran is weakly known and needs more studies and researches botanically, ecologically and biogeographically.

2. The size of the livestock and grazing intensity should be controlled in all parts of these habitats.

3. In spite of concentration many endemic and narrow distributed plant species, there are no data specific to report threatened plant species of these habitats. It is strongly necessary to assess the threatened status of Iranian alpine plants according to IUCN categories and criteria.

4. We strongly recommend the establishment of long-term climate and vegetation monitoring programmes in several representative sites in Alborz and Zagros integrated with the GLORIA network (http://www.gloria.ac.at). One target region for GLORIA was chosen and field work for setting up of stations has been started in 2007 on Central Alborz. We are eager to expand it to other mountain ranges.

5. Expanding protected areas in regions that embrace indigenous grasslands with high rate of endemism. Therefore, the protection and management of rangelands in these zones—as in all other vegetation types in Iran—needs to be considered.

6.5 Appendices

Table 1: Size and number of protected areas in Iran which embrace mainly high altitude of Iran in comparison to whole protected areas of country

Kind of Protected Areas	Whole Country		Embrace High Altitudes	
	Number	Hectares	Number	Hectares
National Parks	19	1756533	1	27798
Protected Areas	98	6451756	17	1277374
Wildlife Refuges	35	3874701	1	96952
National Natural Monuments	20	20907	4	14779
Total	**172**	**12103897**	**23**	**1416903**

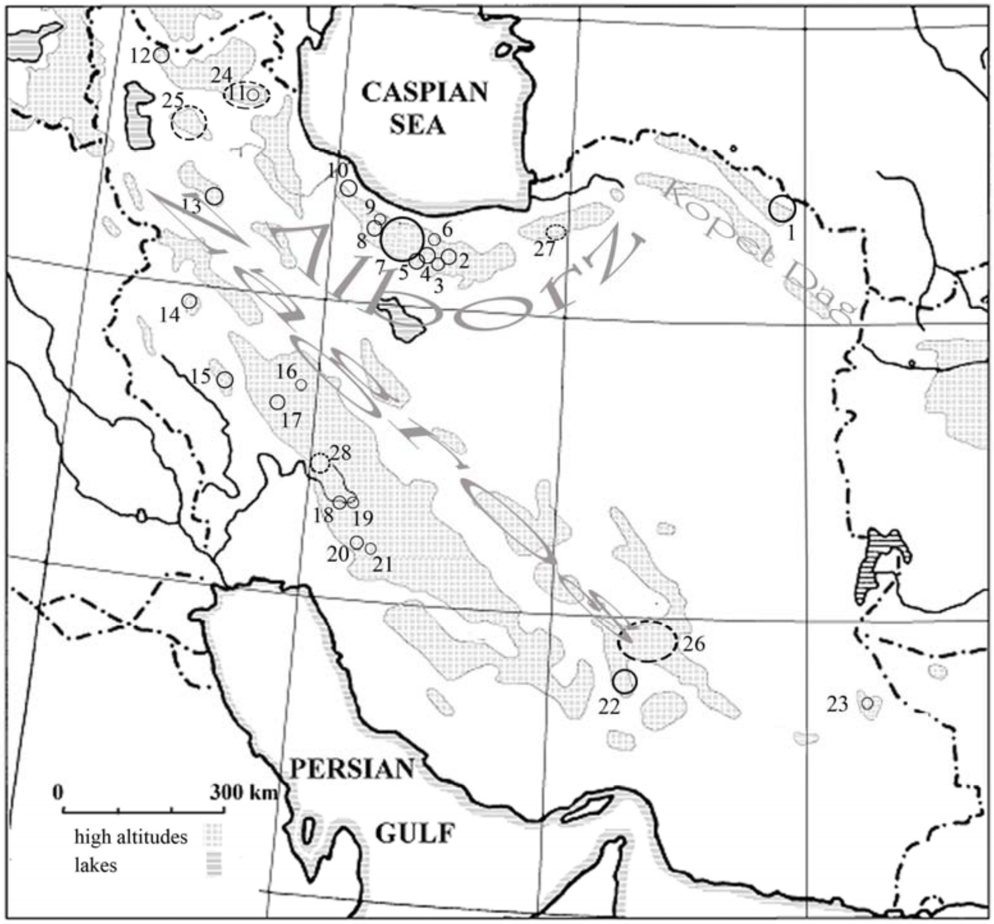
Table 2: Selection of protected areas of Iran that embrace mainly high mountainous areas

Protected Areas	Hectares	Province	Mountain Chain	Altitudinal Range (m)	Year of Establishment
Aras Sistan PA	112714	Khorasan	Kupet Dag	900-3330	1999
Haraz PA	15481	Mazandaran	Alborz	500-3520	2001
Varjin PA	26907	Tehran	Alborz	1700-3900	1982
Central Alborz PA	398853	Tehran-Mazandaran	Alborz	-10-4300	1967
Vaz PA	9646	Mazandaran	Alborz	800-3420	2001
Chahar Bagh PA	19482	Mazandaran	Alborz	770-3460	2001
Sarvelat Javaherdasht PA	21254	Mazandaran	Alborz	0-3550	1999
Anguran PA	91280	Zanjan	Zagros	1240-3320	1970
Bistoon PA	39000	Kermanshah	Zagros	1300-3380	1967
Sefid Kuh PA	68776	Lorestan	Zagros	1120-3870	1990
Alvand PA	8618	Markazi	Zagros	2040-3080	2002
Oshtoran Kuh PA	98407	Lorestan	Zagros	1300-4080	1970
Kuhe Helen PA	40231	Chaharmahal Bakhtiari	Zagros	1100-3200	1997
Sabz Kuh PA	54291	Chaharmahal Bakhtiari	Zagros	1300-3860	1980
Dena PA	93660	Kohkiluye boyerahmad	Zagros	1360-4413	1990
Denaye Sharghi PA	28792	Kohkiluye boyerahmad	Zagros	1820-4220	1999
Khabr PA	149982	Kerman	Zagros	1040-3860	1971
Lar NP	27798	Tehran	Alborz	2500-4200	1976
Kiamaki WR	96952	Azarbayjane Sharghi	Alborz	540-3414	1973
Damavand Peak NNM	2978	Tehran	Alborz	3500-5670	2002
Alam Kuh NNM	4077	Mazandaran	Alborz	3950-4850	2002
Sabalan Peak NNM	7500	Ardabil	Alborz	3540-4844	2002
Taftan Peak NNM	224	Sistan	Makran	3700-4110	2002

NP= National Park; PA= Protected Area; WR= Wildlife Refuge; NNM= National Natural Monument

Map 1: The map illustrates high altitudes of Iran and protected areas and proposal protected areas (PPA) in these altitudes

1. Aras Sistan PA
2. Haraz PA
3. Damavand NNM
4. Lar NP
5. Varjin PA
6. Vaz PA
7. Central Alborz
8. Chaharbag PA
9. Alam Kuh NNM
10. Sarvelat Javaherdasht PA
11. Sabalan NNM
12. Kiamaki WR
13. Anguran PA
14. Bistoon PA
15. Sefid Kuh PA
16. Alvand PA
17. Oshtoran Kuh PA
18. Helen PA
19. Sabz Kuh PA
20. Dena PA
21. Denaye Sharghi PA
22. Khabr PA
23. Taftan NNM
24. Sabalan PPA
25. Sahand PPA
26. Lalezar PPA
27. Shahvar PPA
28. Zard Kuh PPA



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7. TEMPERATE GRASSLAND REGION: KAZAKHSTAN

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7.1 Major Indigenous Temperate Grasslands Types

Kazakhstan's steppe area is a part of the extensive Eurasian steppe zone which stretches from the Black Sea region to Mongolia. Within Eurasia, Kazakhstan plays a special role in the steppe conservation as it possesses most of the remaining natural steppe. There are different communities of steppe type vegetation which cover large areas of plains, plateau, slopes of hills and mountains. Steppes are also found in all mountain areas of Kazakhstan from Altai in the East of the country to Karatau in the South. Kazakhstan's steppe habitat may be broken into four main sub-types, which become progressively dryer towards the south, eventually transforming into semi-desert and then desert. The forest steppe in northern Kazakhstan is characterized by forbs-feather grass steppes with islands or larger areas of trees. Mainly aspen-birch groves are typical for this zone. Further south, the trees disappear in the zone of the meadow steppe. The natural habitat here consists of a forbs and feather grass steppe, sometimes in combination with fescue, or bunch grass instead of feather grass. The most important aspect of this zone is the very fertile chernozem soil, which provides large areas suitable for agriculture. In contrast, agricultural use of dry steppe further south is sharply restricted by less rain and less fertile kastanozem soils. The natural vegetation of different types of feather grass steppe in northern parts and fescue-feather grass steppe in the south, partly in complex with sagebrush communities and halophytic vegetation in depressions, is consequently still widely spread or regenerates on abandoned agricultural lands. Finally, the most southern, desertified steppe is characterized by mainly sagebrush-short feather grass steppe, sometimes combined with fescue or replaced by areas of orach communities.

Overall, sagebrush communities increase to the South, grasses are higher and combined with more forbs northwards. In all zones, shrubs or even trees occur along rivers or on sandy territory. As noted, the frequency of trees increases from South to North. In some classifications, the northern parts of steppe are also called long-grass steppe (common steppe, partly forest steppe), the southern short-grass steppe (dry steppe, desertified steppe).

Among steppe plant communities should be mentioned shrub steppes (*Caragana* and *Spiraea*) with an unique structure, which are only found in Kazakhstan, bunch-grass steppes with *Peucedanum morisonii*, dry steppes with xerophytes, desert shrub-bunch-grass steppes and original stony steppes characterized by rare and endemic petrophylic species. Among relict steppes, which are the result of more damp and cold periods, there are meadow steppes with a set of mountain-steppe (sub alpine) species situated on tops of low mountain groups in Central Kazakhstan. The vegetation of Kazakhstan's steppes differs both from western steppes of Black Sea region (or Pontian steppes) and from eastern steppes (Mongolian) (Rachkovskaya, Ogar & Marynich 1999). In some classifications, traditional in Europe, it is described as Pontian steppe.

During the 1950s and 1960s, Kazakhstan lost an area of natural steppe comparable to half the size of Spain due to ploughing. Conversion of steppe took place mainly in the less dry, northern areas, on so-called 'meadow steppe.' Other northern steppe areas – namely dry and forest steppe – were less affected.

Today, Kazakhstan holds an estimated 60-80% of the world's remaining natural Pontian grasslands (or 100% of unique Kazakhstan's steppe). Regions of natural steppe are mainly located in Central Kazakhstan – which was less affected by the agricultural conversions of earlier years.

7.2 Impact of Human Settlement

The Soviet Union's Virgin Lands Campaign was aimed at opening up vast tracts of previously unfarmed lands in the area which is nowadays northern Kazakhstan. Beginning in 1954, the campaign turned large areas of pristine steppe in Kazakhstan into intensive agricultural land. Up until 1961, about 255,000 km^2 of natural steppe was ploughed, increasing the total area of arable land to more than 300,000 km^2. Following the collapse of the Soviet Union, the grain fields lay fallow since dry-land farming remained unprofitable without large subsidies. The current ecological conditions – particularly the lack of grazing ungulates – do not allow for the natural restoration of wild steppe habitat (Dieterich 2000).

It is likely that grain production is going to be expanded and abandoned areas to be ploughed again due to the raising prices on the world market. In 2007, a total of 222.6 million ha. across Kazakhstan were classified for agricultural use. However, about 85% of this was grazing land. Today, Kazakhstan's agricultural policy calls for both expansion and intensification of agricultural production. For example, from 2005-2007, the area of wheat production increased by 246,900 ha., representing a moderate two per cent increase (Ministry of Agriculture of the Republic of Kazakhstan 2007).

Drier steppe zones are mainly used for livestock production (mainly cattle, sheep, horses and camels). Livestock numbers have decreased since the end of the Soviet Union and are relatively low nowadays. Overgrazing in specific areas of the steppe, e.g., near settlements, causes substantial damage to the natural steppe vegetation (Ward 2006). In the northern regions of the steppe zone (moderate dry and dry steppe), cattle numbers have exceeded the pasture loads of the limited grassland areas, and year-round grazing has caused the rapid degradation of vegetation cover resulting in soil compaction, which alters the soil's physical and chemical characteristics, and also contributes to the loss of some species.

First of all the nowadays endangered characteristic feathergrass (*Stipa spp*.), wild tulips and other typical flowering plants, followed by other steppe grasses like *Festuca spp*., disappear. This leads to an incrimination of *Poa bulbosa*, which can be considered as a typical grass species of overgrazed areas. Finally these are being encroached by *Artemisia austriaca*, which is not found in natural steppe (NBSAP Kazakhstan 1999, Walter & Breckle 1994).

The drastic decline of wild ungulates, especially the Saiga Antelope (*Saiga tatarica tatarica*), together with changes in livestock numbers and distributions, may have contributed to substantial ecological changes across Kazakhstan's steppe zone. The lack of cyclic grazing leads to changes in the vegetation, invasion of weeds and the development of an inhomogeneous vegetation cover.

7.3 Current Status

Table 1: Kazakhstan's Main Ecosystem Types

Main ecosystem type	Total size (ha)	Estimated remaining area of natural habitat
Forest steppe	7,683,000	1,000,000
Meadow steppe	18,157,000	3,000,000
Dry steppe	49,041,000	41,000,000
Desertified steppe	38,419,000	32,000,000
Steppe semi-desert	47,242,000	46,000,000
Desert	55,704,000	52,000,000
Mountains	40,520,000	35,000,000
Others (rivers, lakes, forests, solonchaks)	15,734,000	12,000,000
Totals	**272,500,000**	**181,000,000**

Source: Calculations based on GIS data of GEF-UNEP-WWF- «ECONET Central Asia»; estimation of natural area based on expert knowledge

Table 2: Protected Area System Coverage, by ecozone

Main ecosystem type	Estimated remaining area of natural habitat	# protected areas *	# ha protected	Protected area, as % of remaining area of natural habitat **
Forest steppe	1,000,000	8	620,068	62.0
Others (rivers, lakes, forests, solonchaks)	12,000,000	34	2,336,645	19.5
Desert	52,000,000	12	9,837,990	18.9
Mountains	35,000,000	30	6,553,771	18.7
Meadow steppe	3,000,000	15	446,448	14.9
Steppe semi-desert	46,000,000	6	976,042	2.1
Dry steppe	41,000,000	16	481,689	1.2
Desertified steppe	32,000,000	13	165,781	0.5

* PAs often consist of different ecosystems and thereby might be counted more than once here.
** The assumption was made, that PAs consist of 100% natural habitat.
Source: The area of PAs is based on calculations with GIS data of GEF-UNEP-WWF- «ECONET Central Asia»

Table 3: Protected Areas Within the Steppe Ecological Zone, by PA and ecosystem type

PA Type	# PAs*	Total area [ha]	Est. target habitat coverage [ha]			
			Meadow steppe	Dry steppe	Desertified steppe	Steppe semi-desert
State Nature Reserves	3	118,973	0	109,548	7,756	0
State National Nature Parks	3	192,068	172,594	18,587	887	0
State Nature Rezervats	3	885,028	3,211	143,630	66,899	671,288
State Natural Sanctuaries (Zakazniks)	22	872,835	270,643	209,924	90,239	302,029
State Reserved Zones	1	1,057	0	0	0	1,057
Totals	**32**	**2,069,961**	**446,448**	**481,689**	**165,781**	**976,042**

* PAs often consist of different ecosystems and thereby might be counted more than once here.
Source: Calculations based on GIS data of GEF-UNEP-WWF- «ECONET Central Asia»

7.4 Opportunities for Improving the Level of Protection and Conservation in the Region

Several large scale projects are planned or being implemented:

1. The Altyn Dala Conservation Initiative (ADCI) is a large scale project to conserve the northern steppe, semi desert and desert ecosystems and their critically endangered flagship species like the Saiga Antelope (*Saiga tatarica tatarica*) or the Sociable Lapwing (*Vanellus gregarius*). ADCI is implemented by the Kazakh government, the Association for the Conservation of Biodiversity of Kazakhstan (ACBK), the Frankfurt Zoological Society (FZS), the Royal Society for the Protection of Birds (RSPB) – BirdLife in the UK and the WWF International. The German Center for International Migration and Development (CIM) is supporting the project through the integration of two long term experts working for the Association for Conservation of Biodiversity in Kazakhstan since beginning of 2007. The 2006 initiated ADCI focuses on an area of about 55 Million hectare (the size of France) which is the range of the Betpakdala population of the migratory Saiga Antelope. The main objectives of the Altyn Dala Conservation Initiative are:

- to address the main threats to the future viability of the Betpakdala Saiga Antelope population and its habitats, such as poaching as well as habitat conversion and fragmentation
- to establish a network of protected areas of up to 6 Mio ha of various categories and corridors to conserve the migration routes and habitats of Saiga Antelope and other key species like the Asian Wild Ass, Goitered Gazelle, Great Bustard and Sociable Lapwing.
- to identify and put in place key enabling conditions such as the genuine involvement of local communities and other relevant stakeholders as well as ensuring tangible contributions to peoples livelihoods and rural development.
- to gather baseline understanding of the Kazakh steppe and semi-desert ecosystems and their species in order to inform the planning and implementation of this conservation measures.
- to raise awareness and understanding for steppe and Saiga conservation nationally and internationally

2. A full-size UNDP / GEF Project on Steppe Conservation and Management is currently being developed. This project aims to extend the protected area system in Kazakhstan within the steppe eco-region through a strategically planned and broadly negotiated expansion programme, to increase conservation effectiveness through enhanced systemic, institutional and individual capacities and to create knowledge, tools and incentives for key stakeholders that enable and encourage them to take actions in support of defined, landscape-level conservation objectives.
3. A project on sustainable pasture management is implemented by CACILM and the GTZ – UNCCD (UN Convention to Combat Desertification) Implementation in Central Asia (GTZ-CCD Project)
4. A project on sustainable management of wildlife in steppe areas is being planned by the GTZ-CCD Project
5. Planned Protected Areas are:

Table 4: Current Status of PA Expansion Programme for the Steppe Ecozone

Protected area	Establishment or expansion?	Area being Added (ha)	Main ecosystem types	Partners	Status and timing
Karkaralinsk State National Nature Park	Expansion	65,248 ha: Bakty area (12,042 ha); Beldeutas (15,477 ha); Konyrtemirshi (37,729 ha)	Low mountain meadow steppe, dry steppe, forest	No	Draft ENO (nature scietific background report) prepared and submitted to CFH, Draft decree on establishment of the State National Nature Park to be submitted to the Government – end 2008
Buiratau State National Nature Park	Establishment	142,934 ha (of which 45500 ha already existing as 3 small PAs of lower category)	Dry steppe	No	ENO submitted to CFH, Draft decree on establishment of the State National Nature Park to be submitted to the Government – end 2009

Protected area	Establishment or expansion?	Area being Added (ha)	Main ecosystem types	Partners	Status and timing
Korgalzhyn State Nature Reserve	Expansion	284,208 ha	Moderately dry, dry and desertified steppe, aquatorial areas, wetlands	UNDP/GEF	Draft decree on expansion to be submitted to the Government – end 2008
State Nature Rezervat "Altyn Dala"	Establishment	489,774 ha	Desertified steppe, dry steppe, lakes	Altyn Dala Conservation Initiative (ADCI), ACBK	ENO approved by CFH, submitted to Ministry of Environmental Protection for EIA

7.5 Constraints Against Improving the Level of Protection and Conservation in the Region

The main constraints to effective steppe conservation in Kazakhstan are: (i) Systemic, institutional and individual capacity for steppe conservation and management: Protected areas are managed in isolation from the surrounding landscapes and there is no or insufficient cooperation between conservation agencies, development sectors and land-use planning authorities at national and regional (oblast) levels; (ii) Knowledge and management barriers: Steppe ecology and interactions between habitats and species are not yet fully understood; (iii) governmental development strategy aims to expand wheat production in arable lands (especially chernozems).

7.6 Suggested Next Steps and Action Plan

1. Establishment and expansion of a network of steppe protected areas (including temporary protected areas) and ensuring their interconnection through ecological corridors and adapted land use types.

2. Improvement of the wildlife management and protected area policy.

7.7 Appendices

Map 1: Protected Area System in Kazakhstan

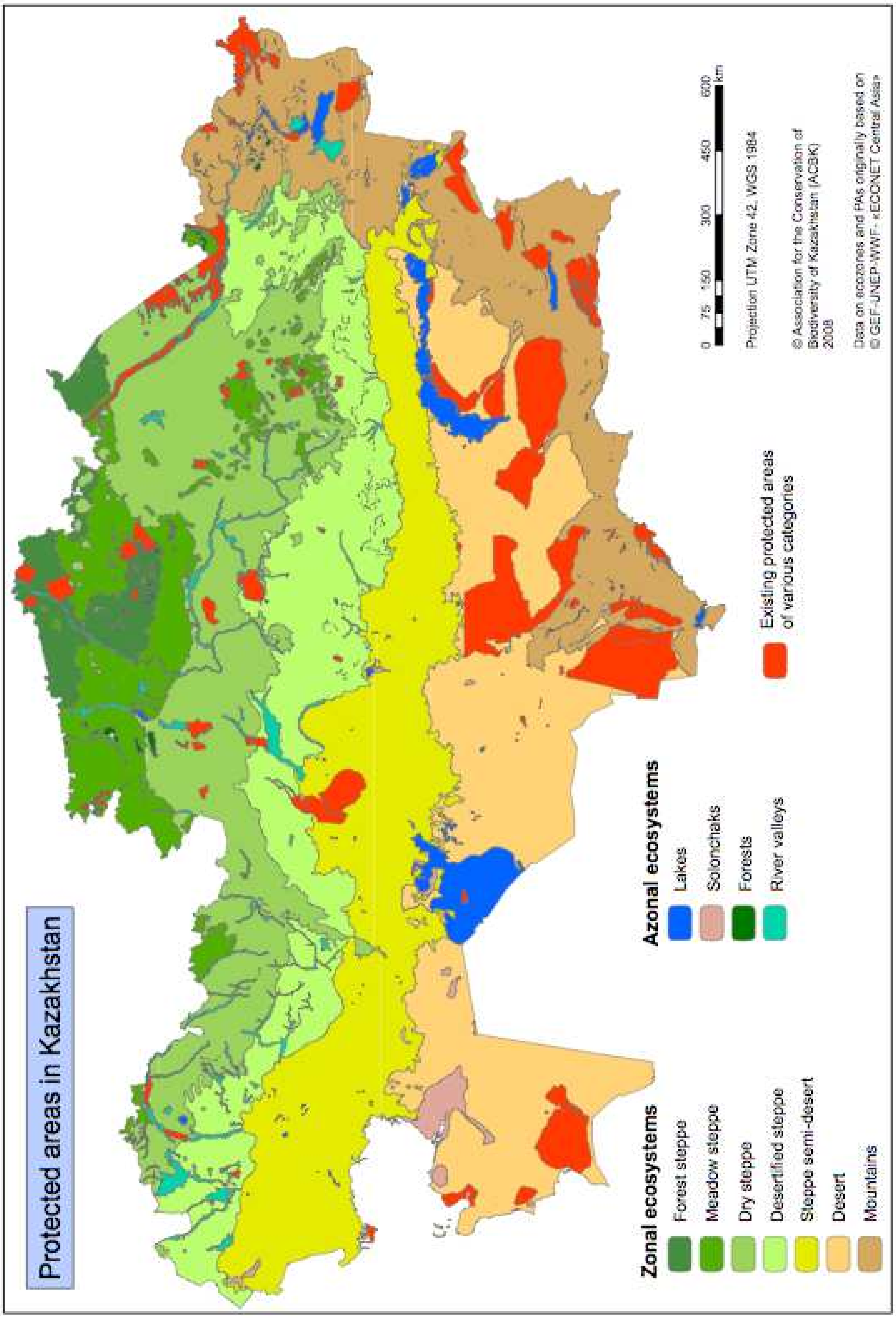

Table 5: List of Steppe Protected Areas in Kazakhstan

Protected area	Size (ha)
Korgalzhynskiy State Nature Reserve	258963
Naurzumskiy State Nature Reserve	191381
Alakolskiy State Nature Reserve	19713
State National Nature Park "Burabai"	83511
Baianaulskiy State National Nature Park	141024
Karkaralinskiy State National Nature Park	90323
Irgiz-Turgaiskiy State Nature Rezervat	763550
State Nature Rezervat "Cemey Ormany"	662167
State Nature Rezervat "Ertys Ormany"	277961
State Natural Sanctuary "Poima Reki Irtysh"	377133
Atbasarskiy State Natural Sanctuary	75100
Bektauatinskiy State Natural Sanctuary	500
Belodymovskiy State Natural Sanctuary	3000
Belagashskiy State Natural Sanctuary	1500
Budarinskiy State Natural Sanctuary	80000
Bulandinskiy State Natural Sanctuary	93500
Vostochniy State Natural Sanctuary	100000
Ereymentauskiy State Natural Sanctuary	35000
Zhaltyrkulskiy State Natural Sanctuary	19000
Karaagashskiy State Natural Sanctuary	6800
Kirsanovskiy State Natural Sanctuary	61000
Kogashikskiy State Natural Sanctuary	15000
Kuvskiy State Natural Sanctuary	33500
Kysylaraiskiy State Natural Sanctuary	18200
Mikhailovskiy State Natural Sanctuary	76800
Novinskiy State Natural Sanctuary	45000
Sarykopinskiy State Natural Sanctuary	51200
Smirnovskiy State Natural Sanctuary	240000
Tounsorskiy State Natural Sanctuary	35000
Turgaiskiy State Natural Sanctuary	348000
Ulytauskiy State Natural Sanctuary	19300

Note: These PAs all include parts of steppe but not all of them are completely located in the steppe zone

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8. TEMPERATE GRASSLAND REGION: MONGOLIA

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8.1 Major Indigenous Temperate Grassland Types

Mongolia possesses a wide range of grasslands. The territories with the steppes vegetation extend from the western up to the eastern frontiers of the country (from 90^0 up to 120^0E longitude), while in the south they reach 44^0 20'N latitude. Flora of Mongolian steppes is represented by 5 large geographic groups, which are divided into more fractional geoelements:

1. South-Eastern Siberia-North Mongolian
2. Proper Mongolian
3. Central Asian
4. West Palaearctic-West Mongolian
5. East Asian (Manchurian, Daguur-Mongolian, Daguur-East Mongolian) (Karamysheva, Khramtsov, 1995).

The **South-Eastern Siberia-North Mongolian steppe** consisting of the *cryoxerophytic forb-bunch-grass and cushion-bunch-grass* are found on the higher mountains such as Mongol Altai, Gobi Altai, Khangai and east Khentii.

The **Proper Mongolian steppes** composed of *Caragana microphylla (Pall), Cleistogenes squarrosa (Trin) and Cymbaria dahurica L.* occupy of the central part of Mongolia.

The **Central Asian steppes** consist of *Anabasis brevifolia C.A.Mey, Stipa gobica Rochev, Cleistogenes songorica Ohwi and Allium mongolicum Regel*. This steppe vegetation occupies the basin of Hyargas, Khar us, Boontsagaan, Orog and Taats lake and the desert steppe region.

The **West Palaearctic-West Mongolian steppes** consisting of *Veronica pinnata L, Allium galanthum Kar, Stipa pennata and Spiraea hyericifolia* occupy the basin of Uvs lake, Hovd, Zavkhan, Bulgan River Watershed and Khan-khokhii Mts.

The **East Asian steppes** composed of *Iris dichotoma Pall, Paeonia lactiflora Pall, Filifolium sibiricum (L), Clematis hexapetala Pall, Spiraea aquilegifolia Pall, and Bupleurum scorzonerifolium Willd* occupy the eastern and northern part of the country.

8.2 Impact of Human Settlement

The grassland degradation is now considered one of the most pressing problems for Mongolia. Causes of degradation vary, overgrazing in areas close to markets and water points due to the failure to manage and maintain deep water wells; mining operation, especially gold mining, coupled with the lack of land rehabilitation and infrastructure development (road construction).

8.3 Current status

8.3.1 Natural state

At the regional level, according to our calculation, the grassland area occupies 70.2% of the country's total land.

7.7% of the grassland area is covered by South Eastern Siberia-North Mongolian steppe, 6.6% is covered by Proper Mongolian steppe, 15.4% is covered by Central Asian steppe, 10.2% is covered by West Palaearctic-West Mongolian steppe, 30.3% is covered by East Asian steppe (see Figure 1).

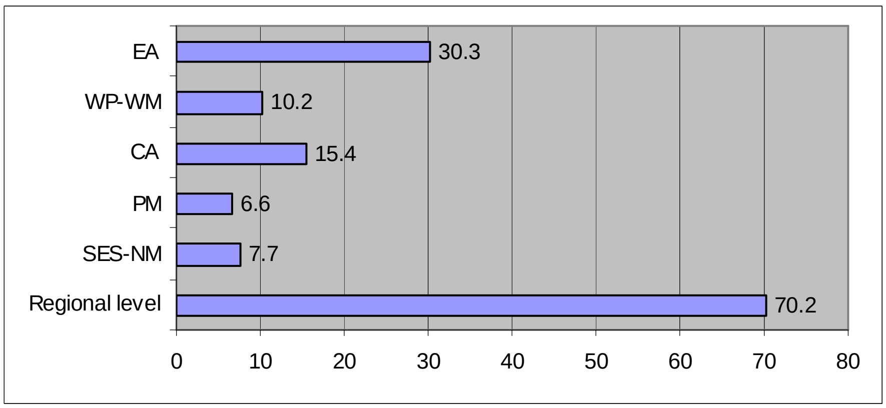

Figure 1: Proportion of major grassland types

8.3.2 Formal Protection

At the regional level, at present 10.3% of the country's total grassland area is taken under state protection.
South Eastern Siberia-North Mongolian steppe has 18.6% of PA cover, Proper Mongolian steppe has 1.5% of PA cover, Central Asian steppe has 19.3% of PA cover, West Palaearctic-West Mongolian steppe has 7.8% of PA cover while East Asian steppe has 6.4% of PA cover (see Figure 2).

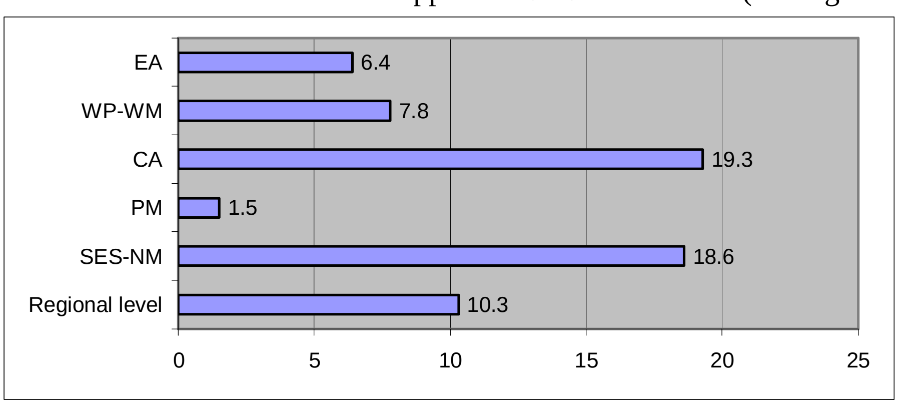

Figure 2: Proportion of Protected Area coverage by major grassland types

8.4 Opportunities for Improving the Level of Protection and Conservation

- Much of the grasslands in Mongolia remain in a natural state. Table 1 lists the important grassland areas with potential to improve the level of protection in the region and proposed grassland protected areas.

Table 1: List of the important grassland areas in Mongolia

Name of grassland areas	% remaining areas	% PA cover	Proposed grassland PA
Sangilen Mts steppe	100	0.0	Shavariin gol, Jugnai nuur
Uilgan forest steppe	99	1.0	Uilgan river watershed
Eg-Selenge forest steppe	96.7	3.3	Zed-Hantai-Buteel, Burengiin nuruu
North West Hentii forest steppe	100	0.0	Honin nuga
Nuuruudiin hondii desert steppe	100	0.0	Boon Tsagaan nuur, Orog nuur
Southern Hangai Mts steppe	100	0.0	Galuutiin havtsal, Oshgogiin nuruu
Bulnai Mts steppe	100	0.0	Bulnain nuruu
Orhon-Hanui steppe	99.8	0.2	Tunel, Dulaan haan uul, Olon goliin belchir
Tuul-Tarna steppe	96.2	3.8	Ogii nuur
Ulz watershed	95.9	4.1	Ugtam uul Natural Reserve extension
Dundad khalkh plain upland	100	0.0	Nyalgiin tal, Sum hoh burd
Ondorhaan-Baruun urt steppe	100	0.0	Sansar uul
Menen steppe	100	0.0	Menengiin tal, Buir nuur, Jaran togoon tal
Mandal ovoo-Huld desert steppe	96.2	2.8	Delger hangai uul

- Mongolia has a strong conservation policy. Conservation policy of Mongolia is outlined in documents, including the National Program on Protected Areas and the Millennium Development Goals (2000-2015) to increase coverage of protected areas up to 30 percent of its land.

- Mongolia has a population of only 2.5 million people. The country has a low population density of 1.5 persons per km^2.

- Much of the land is owned by the State.

- Mongolians have unique traditions for grasslands conservation.

8.5 Constraints Against Improving the Level of Protection and Conservation in the Region

- **The important and proposed grassland areas have been included in the areas under licenses for exploration minerals and mining**
  Mining is primary economic activity in Mongolia. As of 2007 more than 30% of GDP and about 80% of the country's total exports have been contributed by the mining industry. Currently, the areas under lease for exploration minerals and mining occupy almost 30% of the country's total land.

- **Compensation for land taken under state special protection**
  According to the Law on Mineral Resources of Mongolia the state administrative organization which made decision taken land under state special protection shall provide compensation to license possessor.

- **Lack of financial capacity for protection and conservation**
  The financial capacity of the special protected areas of the country is very low. Special protected areas taken under state protection get US$4 per square km (Special Protected Areas of Mongolia, 2007).

- **Lack of human and technical resources for grassland conservation**
  The state protected areas, which comprised 3.6% in 1990, were increased to 13.1% in 2000 and further to 13.3% in 2006. This rapid increase of the protected areas in the region requires more trained people to work for them.

- **Lack of incentives to protect and conserve grassland**
  Restricted use rights upon local people and business entities.

- **Grassland areas have been abandoned**
  Due to the open access pastureland use system, the grassland areas of the region have been abandoned.

8.6 Suggested Next Steps and Action Plan

- Establish a study team to prepare a proposal for establishing new grassland protected areas in the region
- Prepare a proposal for establishing new grassland protected areas
- Consultation with local herders, local and central government, mining companies, and NGOs
- Workshops for decision makers
- Submit a final proposal to the Ministry of Nature and Environment
- Support to train young grassland experts in developed countries to get qualifications and academic degrees
- Experience sharing study tours to grassland areas of other temperate grassland region
- Support herder cooperation for sustainable grassland management
- Support well rehabilitation and new well construction in the region
- Promote trans-frontier initiative
- Support conservation the grasslands through culture

8.7 Appendices

Map 1: Location of the Grassland Areas

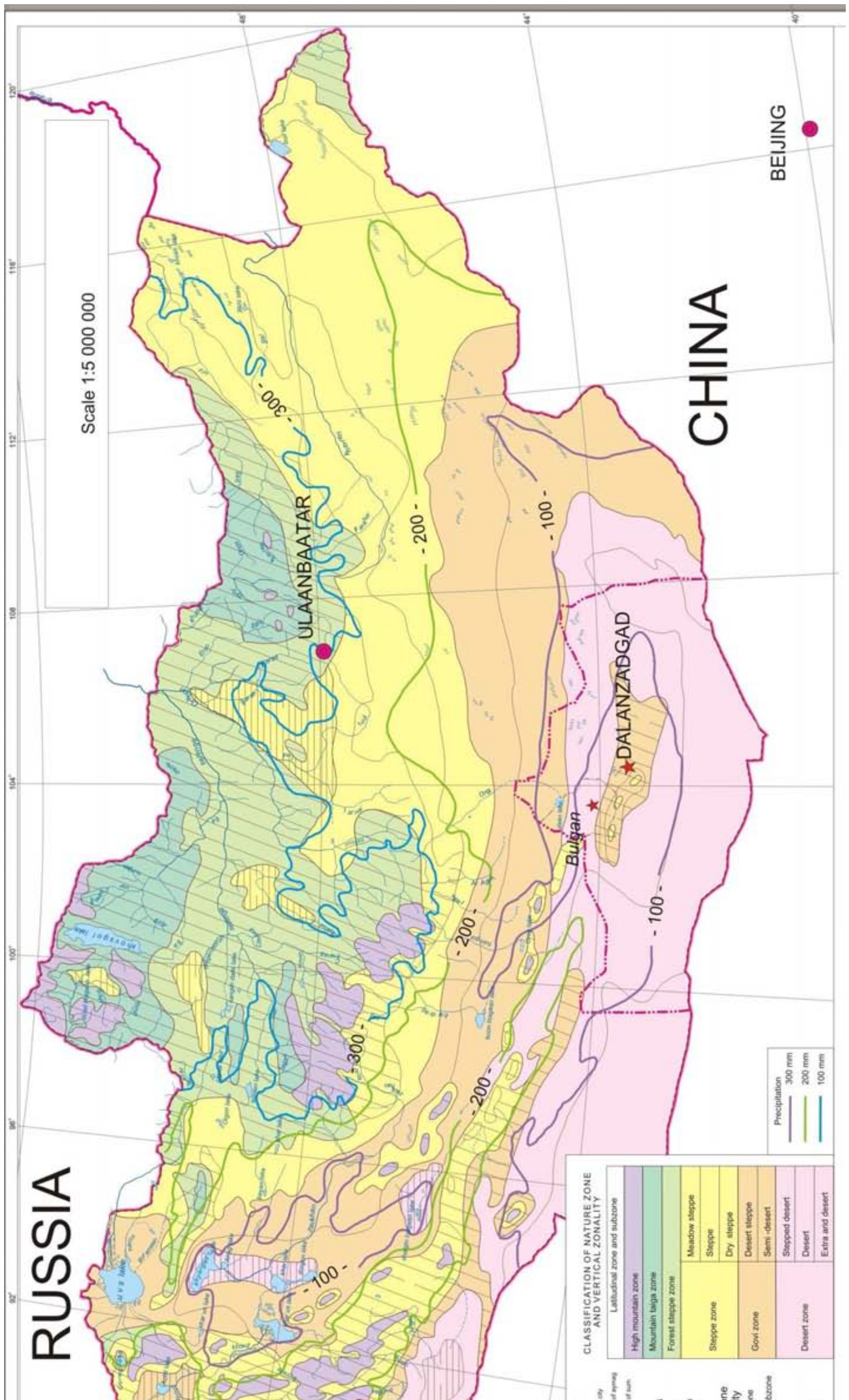

Table 2: List of Grassland Protected Areas in Mongolia

	Major Grassland Types	Name of PA	Area ha
1	**South-Eastern Siberia-North Mongolian**	Hoh Serh SPA	65,920
		Otgontenger SPA	95,510
		Siilhem NP part A	68,300
		Altai tavan bogd NP	636,161
		Monkhhairhan NP	300,446
		Myangan ugalzat NP	63,212
		Noyonhangai NP	59,088
		Hangai nuruu NP	888,455
		Burhan buudai NR	52,110
		Huisiin naiman nuur NM	11,500
		Total	**2,240,702**
2	**Proper Mongolian**	Hogno-Tarna NP	83,612
		Hustain nuruu NP	50,620
		Bathaan NR	21,850
		Total	**156,082**
3	**Central Asian**	Hasagt hairhan SPA	27,448
		Gobi gurvan saihan NP	2,694,737
		Har us lake NP	850,272
		Hyargas lake NP	332,800
		Sharga-Manhan NR	390,071
		Ih Nart NR	43,740
		Zagiin us NR	273,606
		Ih gazriin chuluu NR	34,094
		Total	**4,646,768**
4	**West Palaearctic-West Mongolia**	Uvs nuuriin ai sav SPA	712,545
		Siilhem NP part B	74,400
		Han Hohii NP	220,500
		Tsambagarav NP	110,960
		Bulgan gol NR	7,657
		Tesiin gol orchim NR	102,897
		Devel NR	10,300
		Total	**1,239,259**
5	**East Asian**	Bogdhan SPA	41,651
		Mongol Daguur SPA	103,016
		Dornod Mongol SPA	570,374
		Nomrog SPA	311,205
		Gorhi-Terelj NP	293,168
		Onon-Balj NP	415,752
		Har yamaat NR	50,594
		Lkhachinvandad uul NR	58,800
		Bulgan uul NM	1,840
		Uran-Togoo-Tulga uul NM	5,800
		Shiliin bogd NM	17,935
		Horgiin hondii NM	6,041
		Total	**3,044,369**
		Grand total	**11,327,180**

SPA-specific protected area, NP-national park, NR-natural reserve, NM-natural monument

9. TEMPERATE GRASSLAND REGION: RUSSIA - AMUR RIVER BASIN

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9.1 Major Indigenous Temperate Grassland Types

Actual steppe in the east extends to the border of the areas with monsoon climate. Further east outside of Steppe Region other grassland communities develop in much more humid conditions and are confined to large river (Amur, Zeya, Bureya, Ussury, Suiphun-Razdolnaya) and lake valleys (Lake Khanka) and alluvial plains: Lower Amur Valley, Amur Meadow Steppe, and Suiphun-Khanka forest meadows ecoregions . Each of those ecoregions contains extensive graminoid communities, but in common classifications they are usually treated only as fringes of wetlands. Total area with high proportion of grassland and forest-steppe ecosystems is roughly between 100 000 and 200 000 square kilometers, out of which more than 10 000 sq. km is occupied by floodplains and the rest belongs to adjacent alluvial plains and river terraces.

Amur river system is a major historic dispersion corridor for fauna and flora, with mind-boggling mix of Daurian, Manchurian, Siberian and Okhotsk-Beringian species. Therefore remnant steppe, steppe-meadow and forest-steppe areas along river valleys are evidence of evolutionary dispersal of steppe and grassland flora in north-East Asia. Upper Amur valley Amursky Province of Russia and Heilongjiang Province of China hosts small, but very species rich patches of steppe vegetation on slopes with high proportion of species from regional red lists (V.Starchenko, Amur Botanical Garden. 2005, 2007). Below City of Blagoveshensk on Russian side Zeya-bureya Plain hosts vast variety of meadow types from dry steppe meadows and forest-meadows to floodplain meadows, collectively known as “Amur prairie”. Typical dominants of these meadows are *Calamagrostis purpurascens, C.epigeios* with wide array of forbs including lilies, orchids, ragworts, cinquefoils, etc. Upper terraces between Zeya and Bureya feature savanna-like of groves *Quercus mongolica, Betula davhurica* surrounded by true steppe grass species including fescue and feather-grass, *Filifolium sibiricum, Sophora flavescens, Picris davurica, Clematis hexapetala, Leymus chinensis.* (Taran 2005).

Downstream from Hinggan gorge (Evreiskaya Autonomous Province, Khabarovsky Province in Russia and Heilongjiang Province of China *Calamagrostis langsdorfii* is a dominant species in Amur floodplain shaping a belt of gramineous communities 1600 kilometers long all the way to the Pacific coast. (Akhtyamov M. 2000) This floodplain ecosystem is very dynamic, due to unique accumulation process that constantly raises the river bed (instead on cutting deeper down), which leads to stable dynamic prevalence of grasslands over shrubbery and trees (Makhinov A.N. 2006). Surrounding alluvial planes also feature many graminous communities and forest-meadow formations.

Khanka lowlands in Primorsky Province of Russia and Heilongjiang Province of China along with transboundary stretch of Ussury River also host notable grasslands. Lower parts are covered with reed beds and Zizania, reed and sedge meadows. Upper parts affected by agriculture still have remnant relic steppe communities with *Cleistogenes chinensis, Stipa baicalensis,* onions, wormwood, asters, irises, etc. Some well-drained areas dominated by *Arudinella anomala* have resemblance with North-American prairie. Forest fringes with *Quercus mongolica, Betula davhurica* also have unusual forest-steppe communities with Manchurian and Siberian apricots forming canopy and steppe grasses and forbs in groundcover. (Taran 2005).

These areas are globally important habitats of Red-Crowned Crane, White-Naped Crane, Oriental White Stork and a number of other globally endangered species. Great Bustard (*Otis tarda)* was common in the Khanka lowland and Amur prairie less than 100 years ago, but not seen in last decades. Roe deer is the most common ungulate species, famous for massive seasonal migrations in the area.

9.2 Impact of Human Settlement

Except for Lower Amur downstream from Khabarovsk City the whole area is severely affected by agriculture. For well understandable reasons mesic grasslands were first choice for placing croplands ever since agriculture started here.

Khanka Lowlands, Sanjiang plain in China, Zeya-Bureya Plain in Russia are areas with highest rates of agricultural conversion. Conversion to rice-paddies is the most radical ecosystem alteration common in Khanka Lowlands and Sanjiang plain.

Human-induced fires are a major factor in all abovementioned ecosystems. Anywhere from 30 to 80% of grass-cover in Russian part is affected by fires annually, significantly influencing species composition and productivity. In China fires are more under control, but at least 80% of grasslands converted into croplands.

Hydro-power plants on Zeya, Bureya and to less extent Songhua influence flood regime and sedimentation patterns in floodplains, leading to major changes in ecosystems. Plans to build HPP on Amur main stem is the main threat to floodplain ecosystems.

Settlements and transportation infrastructure are confined to upper slopes of river values, therefore also first affecting communities in question.

9.3 Current Status

9.3.1 Natural State

Current status estimates depend on how you treat fire impacts. Only 5-10 % of grasslands are affected by fires less than once in 5 years, which is probably as “natural” as you can get.

Lower Amur valley downstream from Khabarovsk City is affected by other factors much less than other grasslands described. However, here is the opposite problem of growing area of secondary grasslands in place of forests exterminated by fires and logging.

Khanka Lowlands, Sanjiang plain in China, Zeya-Bureya Plain have highest rates of agricultural conversion and thus only from 5 to 20 % of grasslands+wetlands in near-natural state.

In each of areas steppe meadows and forest meadows are more affected by human impacts than floodplain wetlands.

9.3.2 Formal Protection

Total Area – my estimate is 5 %, mostly protected wetlands.
Amur floodplain meadows – approx 2%
Khanka Lowland meadows and wetlands – 10-20% (not accounting for experimental zones of reserves in China)
Zeya-Bureya plain meadows and wetlands – 10-15 %
Upper Amur Valley -- cannot estimate.
Ussury River floodplain meadows and valley slopes – 50% in China and 1% in Russia.

9.4 Opportunities for Improving the Level of Protection and Conservation in the Region

Policy -- Supporting new Russia-China biodiversity and transboundary PAs working group that is tasked to develop joint conservation strategy for transboundary ecosystems.

PA assessment --- Promote establishment of green Belt of Amur-Heilong – transboundary network of protected areas. The existing network of protected areas must be thoroughly assessed to provide uniform data for Ecological network design. Uniform GAP analysis made possible by use of standard methodology and basin-wide databases. Lobbying national governments for establishment of higher number of national-level PAs along the border and probably enacting special legislation supporting this process

Border issues --Assessment of border area in terms of potential biodiversity value, present degree of human impacts and actual and potential threats. Major communication effort on national and bilateral levels to enlist conservation as and important issue of national security (environmental security), which could be solved by concerted bilateral efforts. Development of proposals for additional protected areas in the border zone based on assessment exercise and preliminary negotiation with responsible authorities. Communication effort directed both to the commanding staff of border guards and lay-units to achieve understanding that conservation is already part of their agenda and performance in this field could be greatly improved with the help of conservation NGOs.

Fire control--Exploit China's success in fire control and measure its actual influence on ecosystems and species; Develop regular communication between nature reserve managers engaged in fire-control and help them to access advanced world-wide programs (WWF_TNC alliance, etc) to provide opportunities to upgrade their thinking and technology. Conduct actual assessment of fire frequency and impacts on ecosystems in selected transboundary river valleys.

Model projects -- Reviving Ussury\Wusuli Project of 1996 to promote coordinated transboundary land-use planning and establishment of Ussury\Wusuli River Basin commission by provincial governments. (In 1998 MOU was signed between three provinces)

Flagship species -- Activities to protect Oriental Stork: Develop species-range –wide monitoring system and maps of stork density/dynamics. Stork –best model species for Sino-Russian habitat conservation plan. Establish new nature reserves, nest protection and construction program, conduct regular counts, support reintroduction programs in parts of stork's former range, etc)

9.5 Constraints Against Improving the Level of Protection and Conservation in the Region

- All ecosystems, except for Lower Amur Valley divided by national border, conservation efforts poorly coordinated and low on national agenda for bilateral cooperation.
- Ecology of local grasslands poorly studied, including natural and human-induced dynamics.
- Fire not controlled in Russia due to weak enforcement, lack of responsibility and long-standing tradition of grass-burning
- Agricultural reclamation speeding up in China and migrant Chinese farmers leasing land on Russian bank.
- Military border protection policies have poorly defined ecosystem conservation component. Many areas are inaccessible for surveys and conservation work, but accessible for economic exploitation.

9.6 Suggested Next Steps and Action Plan

Table 1: Next Steps

Activity	Description
1. KHANKA-WUSSULI ECOREGION PROTECTED AREAS CORRIDOR	Covers full 200 km stretch of the border from Lake Khanka to Raohe/Bikin on Middle Ussuri River. Prime Stork habitat. Due to strong China wetland conservation policies Khanka ecoregion is plastered with 6-7 large protected areas in China. So far it has little symmetric response from Russia which makes river floodplain/valley ecosystems unprotected in a longer term. In Amur Basin this is the best ecoregion to try to use conservation/ecological network policies in one country (China) to improve cooperation and initiate complementary policies in another country. Issues range from floodplain wetland and river valley ecosystem conservation (reportedly one of two most species rich places in whole basin) to protection of key habitat for oriental stork, tiger conservation, transboundary reserve enhancement.
2. Comprehensive forest/wetland habitat conservation planning.	Develop comprehensive conservation program addressing forest and wetland-grassland landscape conservation in Ussury/Wusuli watershed, where the same network of protected areas is managed as wetland corridor and as migration corridor for large mammals (tiger, prey). Dongfanghong nature reserve seem to be most promising model site to launch this approach. This will combine goals of wetland conservation in Suifen-Khanka ecoregion and forest conservation in top-priority Ussury Forests ecoregion, making one local model project address key issues in two Global 200 ecoregions.
3. Species/wetland habitat protection Inventory of important habitats	Identify and plan protection measures in habitats of key species: rare bird breeding areas, fish spawning areas and turtle breeding beaches. Oriental stork inventory. Assessment and conservation mapping of wetlands in transboundary river valleys of Ussury and Songacha as a basis for PA planning. Identify, map and secure key forest-steppe areas as corridors between Khanka lake, river valleys and surrounding mountains
Oriental stork	Oriental white stork-Protection of key nesting areas along Ussury and tributaries, fire control, artificial nesting

Activity	Description
4. PA adjustment and expansion	Develop the Econet as the system of protected areas connected by the buffer zones and ecological corridors: --improve the environmental regime in buffer zone of Khankaiskii nature reserve on army testing range and implement other measures to solidify reserve territory and protection regime; --improve the protection regime of Xinkaihu nature reserve on China side, expand core zone to Songacha and no-fishing core zone across the lake; --support establishment and management of reserves along important wetland corridors on Wussuli/Ussuri and Songacha.
5. Trans-boundary Management Plan for International Reserve	Improve the collaboration within Russian-China Khankaiskii/Xinkaihu transboundary nature reserve and extend it to other wetland reserves of Siufen-Khanka forest meadow ecoregion: --elaborate the Trans-boundary Management Plan (for Ramsar wetlands) and conduct the International Conference to adopt these TMP
6. Analysis of reviving agriculture and env impacts.	Khanka Lakes Lowland. The area is relatively small, even if the whole lake watershed is considered. International management of transboundary waterbody and resolving conflict between agriculture and conservation.
7. Capacity building for transboundary conservation	Conduct joint training for nature reserve staff of wetland nature reserves of the ecoregion: Russia-China Khankaiskii/Xinkaihu, Zhenbaodao, Dongfanghong, etc. Elaborate and implement the program of artificial nesting of Oriental Stork in all PAs ; Support the fire-fighting brigades, joint planning and mutual training in fire-control; --Involve the boundary guards to control poaching/illegal fishing along the border

9.7 Appendices

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10. TEMPERATE GRASSLAND REGION: RUSSIAN STEPPES

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10.1 Major Indigenous Temperate Grasslands Types

Along with steppes Russia has many other grassland ecosystem types occupying vast areas. These are different kinds of dry meadows (both serial and edaphic), floodplain and coastal meadows, alpine meadows and alpine lawns, high-mountainous grasslands dominated with *Cobresia* spp., salt and freshwater marshes, halophytic grasslands in inland and coastal salt habitats, etc. This template describes only steppes proper (and one additional template is filled for Amur river basin floodplain meadows).

Accurate inventory of total steppe area in Russia has not been done yet; neither has it existed for total area of all temperate grasslands here. Approximate estimation of total grasslands area based on land-use data would yield 670,000 sq.km (with mountainous grasslands are underestimated and without polar tundra). By this method the steppes area is estimated at 500,000 sq.km (Figure 1). Steppe grasslands are presented at 36 administrative provinces of Russia lying south from N55°. From these 15 provinces are situated in the core of Eurasian Steppe Region and formerly were almost entirely covered with steppe grasslands, while recently each of them keeps from 10 to 30+% grasslands area only (Figure 2). In several southern provinces (Kalmykia, Astrakhan, and flat part of Daghestan) the natural semiarid grasslands take up to 50-70% of whole territory, but there is a complex of steppes, semideserts, and sagebrush deserts. Share of each ecosystem type is unsteady here, their ratio dramatically changes during last decade.

Huge Eurasian steppe biome is divided along latitudinal/altitudinal and longitudinal gradients, which leads to many subdivision schemes recognized by different authors (Kucheruk 1959; Lavrenko et al. 1991; Mordkovich 1982; Chibilyov 1998; Nikolaev 1999; Korolyuk 2002). Here we only describe common basic gradients and characteristics used for such zoning.

Latitudinal and Altitudinal Zoning

According to zoning by E.M.Lavrenko (1970, 1991) most accepted in post-Soviet countries, the steppe zone in the Eurasian plains is split into 4 latitudinal bands. All those have analogous zones describing altitudinal changes in the mountains in the south of Russia. In general from north to south (as well as down-up along altitudinal gradients) there is decreasing species richness, total biomass, share of aboveground biomass (from 1/8 to 1/30 within the whole gradient), productivity (by 100 times), vegetation coverage density, etc. Number and diversity of small burrowing mammals as well as other burrowers increase from north to south.

1) **Meadow steppes** are the least dry and the most mesophytic steppe grasslands, typically form grassland component of forest-steppe landscapes and intermingle with tree and bush groves even on plain watersheds. Grass canopy is dense and colorful, dominated with many species of loose-bunch grasses and forbs. The vegetation species richness (up to 80 species per are), evenness, coverage (about 100%), total biomass (15-30 t/ha), and productivity (18-25 t/ha) are high. The relatively high share of biomass is above-ground. Many blossom waves alternate non-stop one after another from April to October. Characteristic species are: *Phleum phleoides, Poa stepposa*, *Helictotrichon schellianum*, *Calamagrostis epigeios, S. pennata, Carex humilis*, etc. The most thick Chernozem soils are formed under meadow steppes.

2) **Genuine forbs-bunchgrass steppes**. Dominated by xero-mesophytic graminoids (*Stipa zalesskii, S. tirsa, S. pulcherrhima, Helictotrichon desertorum* are characteristic), and have significant share of xero-mesophytic and even mesophytic forbs. Blossom waves are not so numerous; vegetation development is interrupted with short summer pause while not every year. Typical Chernozem soils are formed under these grasslands.

3) **Genuine (dry) bunchgrass steppes** are even more droughty grassland type. Dominated by xerophytic and meso-xerophytic graminoids (e.g. *Stipa lessingiana, S. krylovii, Festuca valesiaca, Koeleria cristata, Agropyron pectinatum*), with xerophytic semi-shrubs (*Artemisia* spp., some other Asteraceae, Chenopodiaceae, etc.). Vegetation is not dense; the main biomass is placed belowground. The characteristic soils (in Russian classification) are Southern Chernozem, Dark Kastanozem, and Kastanozem.

Many authors combine the types (2) and (3) into a more large genuine steppes unit.

4) **Desertified and desert steppes** are the driest types. Vegetation is rather sparse; no more than 20% of the ground is covered with plants while belowground root systems are densely packed. Typical dominants are *Stipa sareptana, S. glareosa, S. caucasica, S. gobica, Cleistogenes squarrosa.* The characteristic soils are Light Kastanozem, and Kastanozem. Desertified steppes form a steppe component of semi-desert landscapes, where they are intermingled with desert dwarf shrubs communities, salt habitats, and xerophytic shrubs communities.

5) **Special mountainous steppes**. Mountains have many additional steppe formations not found on plains. Especially noteworthy are cold cryophytic steppes in Altay, Dauria, Siberian Beringia (including tundra-steppes communities), where temperate grasslands directly contact and intermingle with alpine tundras. Another type is "subtropical steppe" with *Andropogon ischaemum,* some species of *Elytrygia* etc., presented in Caucasus Mountains and also found in mountains of Central Asia.

Longitudinal Zoning

There are two major sub-regions of the Steppe Region of Eurasia: Pontic-Kazakh Steppe Subregion and East Siberia - Inner Asian (Daurian-Mongolian) Steppe Subregion (Lavrenko et al. 1991; Korolyuk 2002) dividing roughly at Altay Mountains and Enissey river. More detailed, the Steppe zone in Russia could be divided into 5 longitudinal sectors (and 7 ones are recognized for the whole continent). The Subregions differ in many characters. Flora of each Steppe Subregion is notably different from another one. Distribution of many plant genera is restricted to only one steppe subregion: *Cymbaria, Saposhnikovia, Filifolium, Panzeria, Schisonepeta, Stellera, Lespedeza*, etc. may be recorded in Eastern steppes only while *Trinia, Seseli, Crambe, Salvia, Verbascum, Tulipa, Ornithogalum*, etc. are inhabited only Western ones. Feather-grasses (*Stipa spp.* from *Stipa* and *Barbata* sections) specifying the habit of Western steppes are not represented in Inner Asia while all species of *Stipa* dominating Eastern steppes belong to the needle-grasses, *Capillatae (=Leiostipa)* section, and *Smirnovia* section. Many plant and invertebrate species are endemic for only one subregion. Pontic-Kazakh Steppe Subregion is rich with spring ephemeroids while late-summer annuals are characteristic for Daurian-Mongolian steppes due to very different precipitation regime. Communities dominated with *Filifolium sibiricum, Leymus chinensis, Stipa baicalensis* are not found in Western half of the Steppe Region, and communities dominated with *Stipa lessingiana, S. zalesskii, S. ucrainica, Artemisia austriaca* and *Artemisia spp.* from *Seriphidium* section are not found in Eastern one. Desert steppes type is represented only in Eastern Steppe Subregion.

Edaphic variants
Depending on specific substrate steppes form many types of edaphic variants. The sand (psammophytic) steppes, stony (petrophytic) steppes, different variants of salt steppes, and calcareous steppes are recognized generally. Near all the variants present in every latitudinal band and each Subregion (only sand steppes are restricted to the Western Subregion).

Shrub steppes
Shrub species are common component of steppe vegetation in all latitudinal bands and longitudinal sectors. Many shrubs are characteristic for steppe biome as species of *Caragana* (*C. frutex* and many other), *Chamaecythisus*, *Calophaca*, *Spiraea* (especially *S. crenata*, *S. hypericifolia*, *S. trilobata*), *Amygdalus, Prunus, Cerasus, Armeniaca*; *Ulmus*, etc. Sometimes shrubs has especially important role and define certain steppe community types – they are recognized as special shrub steppes.

Steppe landscape complexes with other ecosystems
In most cases steppes are linked with other ecosystem types forming typical landscape of grassland zone. Two most obvious examples are forest-steppe and semi-desert. Both landscapes are regular mosaic of steppe communities with other types.

Throughout vast plains of Western Siberia, Dauria, and to a smaller extent the Russian Plain and Middle Siberia the steppes are combined with salty and freshwater wetlands, salt grasslands, halophytic succulents communities, and are dotted with birch and aspen groves.

Many communities of these landscape complexes are found only or primarily in steppe zone landscapes (characteristic ravine forests and shrubs, steppe wetlands, “rocky steppe” petrophytic dwarf shrubs, etc.). For conservation purposes and any landscape planning these “additional ecosystems” should be treated together with “steppe ecosystem” as holistic landscape complex.

Succession series
Dynamic steppe ecosystem is always experiencing extensive and strong disturbances. Therefore all steppe types listed above have their serial and degraded variants. Some kinds of disturbances are common and characteristic for steppes. These are mainly grazing and fire intimately interacting. Another characteristic disturbance is digging activity of burrow-inhabited mammals. Some serial communities have a wide distribution and compose an important part of the steppe biodiversity (e.g. steppes dominated by *Stipa capillata* and *Andropogon ischaemum* in Caucasus foothills).

10.2 Impact of Human Settlement

Greatest threat/impact is conversion of steppe into cropland and to far less extent mining, urban growth and transportation infrastructure development. Other most common while not so dangerous impacts include overgrazing, hay cutting, burning.

Historically all steppes of Russia have been extensively used by nomadic herders for sheep, horse, camel, and cattle breeding. European crop-based agricultural development started in north-west corner of most productive European meadow-steppes in the 17^{th} century. It was expanding east and south to reach desertified steppes near Caspian Sea by end of the 19^{th} century and arid steppes of Tyva only by 1940-1950s.

Meadow steppes and more mesic part of genuine steppes (types (1) and (2) listed above) were massively turned into arable land for production of crops and fodders as early as before the end of 19^{th} century. Forest-steppe zone also has highest population density in Russia and is most affected by infrastructure, industry and urban sprawl. Both types are affected by afforestation that has public support and strong backing of agricultural and forest sciences and agencies. Meadow steppes, at least in European part, are more often plowed to cultivate fodder-crops, rather than used as pastures.

Genuine dry bunchgrass steppes (type 3) were massively reclaimed into croplands in the 1950s. But their use as croplands is not sustainable due to climate fluctuations, lower soil fertility, lack of moisture, widespread salinity, etc. Therefore many of these croplands were abandoned after 1991, and recently are a scene of old-field succession. This type of steppes is widely used as seasonal pastures. In some southern mountains still sustain nomadic grazing (South-East Altay, Tyva).

Desertified and desert steppes could become croplands only through costly irrigation. They are mostly used as rangelands for seasonal grazing.

High-mountainous cryophytic steppes are used as seasonal and nomadic rangelands only. It had never been plowed at all.

Stony slopes, sand steppes, and the salt habitats cannot be converted into croplands and often remain the only untouched pieces of steppe grassland in meadow steppe and genuine steppe. At the same time they are most vulnerable to overgrazing. Water infrastructure affects steppe wetlands and surrounding areas subject to irrigation and reclamation. Therefore it is most threatening in dryer areas, where water is more scarce and irrigation/water diversion has more dramatic effect on ecosystems. Shrub steppe communities are most vulnerable to fire in all zones. The same threat is even more severe for any forest-steppe and steppe landscapes with tree and shrubbery groves.

Intensity of fires in most places is increasing with decrease in grazing pressure. Therefore effects of presently observed decrease in livestock numbers are very controversial for such landscape types. Serial steppe communities on abandoned lands are result of the old-field succession. Fires and grazing affect them as well, but these disturbances actually may suppress ruderal vegetation, and favour to increase succession rate.

In general agriculture activities selectively exterminate certain steppe communities, while only moderately alter other community and ecosystem types.

10.3 Current Status

No accurate estimation based on field survey exists. Therefore table below is based on land-use official statistics. The following assumptions are made:

(a) natural state – anything not yet converted into cropland or urban/infrastructure, disregarding present mode of grassland exploitation.

(b) formally protected at federal(national) and local(provincial) level – calculated as share of what is let, not as share of historic ecosystem cover before settlement.

Table 1: Steppe Grassland Types – Natural State and Protected

Steppe grassland types	a. Percent of indigenous steppe grassland in a natural state	b. Percent of indigenous steppe grassland formally protected
at the national level in total	<15%	Federally protected <1%, totally protected ≤ 5% (no sufficient data)
Meadow steppes – typical – rocky (petrophytic) (+ "rocky steppe" dwarf shrubs) – sand (psammophytic)	 <1% 10-20% 10-20%	 <3% (federally + locally) <10% (federally + locally) <10% (federally + locally)
Genuine forbs-bunchgrass steppes – typical – rocky (petrophytic) (+ "rocky steppe" dwarf shrubs) – sand (psammophytic)	 <10% 20-30% 20-30%	 <3% (federally + locally) <10% (federally + locally) <10% (federally + locally)
Genuine (dry) bunchgrass steppes	<15%	<3% (federally + locally)
Desertified and desert steppes	Near 80%	<5% (federally + locally)
Cryophytic steppes (mountainous and sub-arctic)	> 90%	<1% (federally + locally)
Steppes of subtropical mountains	no sufficient data	<5%? (no sufficient data)

Longitudinal sectoral differences are more difficult to assess. As we suppose Pontic steppes are the least preserved botanical province. Approximately 10% of all steppe ecosystems remaining natural, the bulk of them – desertified steppes of Rostov, and Kalmykia provinces, and provinces of North Caucasus.

The least preserved are "typical" zonal communities on plain watersheds. Such is the case in all latitudinal bands and longitudinal sectors, especially in Meadow steppes and Genuine forbs-bunchgrass steppes. Stony slopes, sandy, and saline areas have substantially greater proportion of preserved natural ecosystems.

Natural steppe grasslands in vast mountains of South Siberia are best preserved – near 80%, but not more than 20% are preserved in depressions of these mountains. Next best preserved formations are desertified steppes of South Siberia and Cis-Volga region (Astrakhan and Volgograd provinces) – near 50%.

Only 0,11% of the Steppe Region is formally covered with protected areas (Figure 3a), which is the lowest figure of PA coverage among all biomes of Russia (Nikolsky & Rumyantsev, 2001). But inside even those few protected areas different non-steppe ecosystems occupy most of their acreage. Only 10% of Zapovedniks (federal strict scientific nature reserves, Russia has 101 ones) include some significant area of steppe. At least smallest steppe areas are found in 25% of zapovedniks and 16% of national parks. Only 1% of total acreage of national (federal) protected areas system is covered by grasslands of all types (Martynov, Tyshkov 1999).

10.4 Opportunities and Constraints for Improving the Level of Protection and Conservation in the Region

The main part of Russia's steppes is situated on agricultural land, which is either private property or municipal property, many of there lands leased. Therefore steppes are strongly depending on agricultural land-use practices, first of all on grazing and burning practices. Russian legislation and legal practices so far lack clear workable mechanisms for nationalization of private property to establish protected areas. Neither there is proven legal mechanisms to protect steppe on private lands without PA establishment.

In the last two years several new (or renewed) threats to steppe have been rapid-growing. First, this is turning lands to non-pastoral use, presumably for mining, oil and gas production. Another new threat is re-ploughing old-fields and even ploughing virgin steppe remnants induced by recent Global Food Crisis and Global Biofuel Boom.

At the same time Russia has huge acreage of still unprotected good-conditioned steppe landscapes, and there are several different means to preserve such ecosystems:

a) Establishment of protected areas without changing land-ownership.
b) Developing system of conservation easements and restrictions based on agreement between authorities (or responsible NGOs) and land-owner.
c) Expansion and change of conservation management regime of existing steppe PAs (since present regime does not help to conserve grassland).

During last year "National PAs development Scheme until 2020" is being developed by WWF Russia on demand of Russian Ministry of Natural Resources and Environment. More than 120 locations suggested for establishment of new national PAs contain steppe ecosystems (list attached, and see Figure 3b).

10.5 Suggested Next Steps and Action Plan

The key problem is to make Russian society and authorities recognize value of steppe and its protection, which is a basic precondition for a multitude of specific policy, management, economic and other measures.

Today preservation of steppes could be addressed as preservation of biodiversity on agricultural lands and the following concrete steps are very desirable:

1. Inventory of major remaining natural and semi-natural steppe ecosystems, their land-use regime and legal status.

2. Delineation of the most important biodiversity areas that should be hotspots for conservation: IBAs, IPAs, HNVF (High Nature Value Farming) areas, etc.

3. Policy formation to recognize multiple values of agricultural land, including ecosystem services and necessity to support provision of such services provide to public via governmental programs. In particular it should lead to:
   - adding conservation to management activities allowed on agricultural lands (Russian legislation prescribes very narrow rules for these lands use and so far conservation formally is not allowed)
   - rethinking priority of arable land over other land-use practices
   - development of legal and management means to use easements and other legal tools on privately held land
   - develop tax-easement for supporting biodiversity hotspots on private agricultural land;
   - special national policy on biosphere reserves that could be most adequately used for steppe preservation

4. Increase representation of steppe ecosystems at all levels of protected areas network, which requires new methodology and new sources of funding.

5. Expand Russia's participation in international programs on agricultural biodiversity conservation within the framework of CBD themes (on Agricultural Biodiversity, on Biodiversity of dry and sub-humid lands), European programs on biodiversity of agricultural lands, PEEN, Emerald network, Important Bird Areas, Important Plant Areas, Prime Butterfly Areas and so on. Expand Russia's participation in FAO, yet unsigned conventions (Bonn), etc.

10.6 Appendices

Table 2: Rough summary of impact factor significance
Scale from "5" – major impact to "0" – absence of impact

Steppe and related ecosystems type	IMPACT FACTOR (THREATS / DISTURBANCES)						
	Ploughing / Conversion to cropland	Mining	Infrastructure and urban development	Over-grazing	Forest and shelterbelt plantation	Fire	Water infrastructure
(1) Meadow-steppes – typical	5	2	3	1	5	2	1
Forest-steppe – tree groves	4	1	3	2	0	5	0
(2) Genuine forbs-bunchgrass steppes – typical	5	3	2	3	4	2	1
– stone steppe (petrophytic)	1	4	2	2	3	1	0
– sand steppe (psammophytic)	1	3	1	4	4	2	1
(3) Genuine (dry) bunchgrass steppes	3	1	1	2	1	2	1
Halophytic steppe types	1	1	1	4	1	2	2
(4) Desertified and desert steppes	1	1	1	3	1	1	2
Different shrub steppes	1-5	1-4	1-3	1-3	1-5	5	0-1
Old field succession serials	5	1-2	1	0	4	0	0-1
Steppe-wetland complexes	2	4	3	3	1	4	4

Figure 1: Main types of steppe grassland ecosystems of Russia

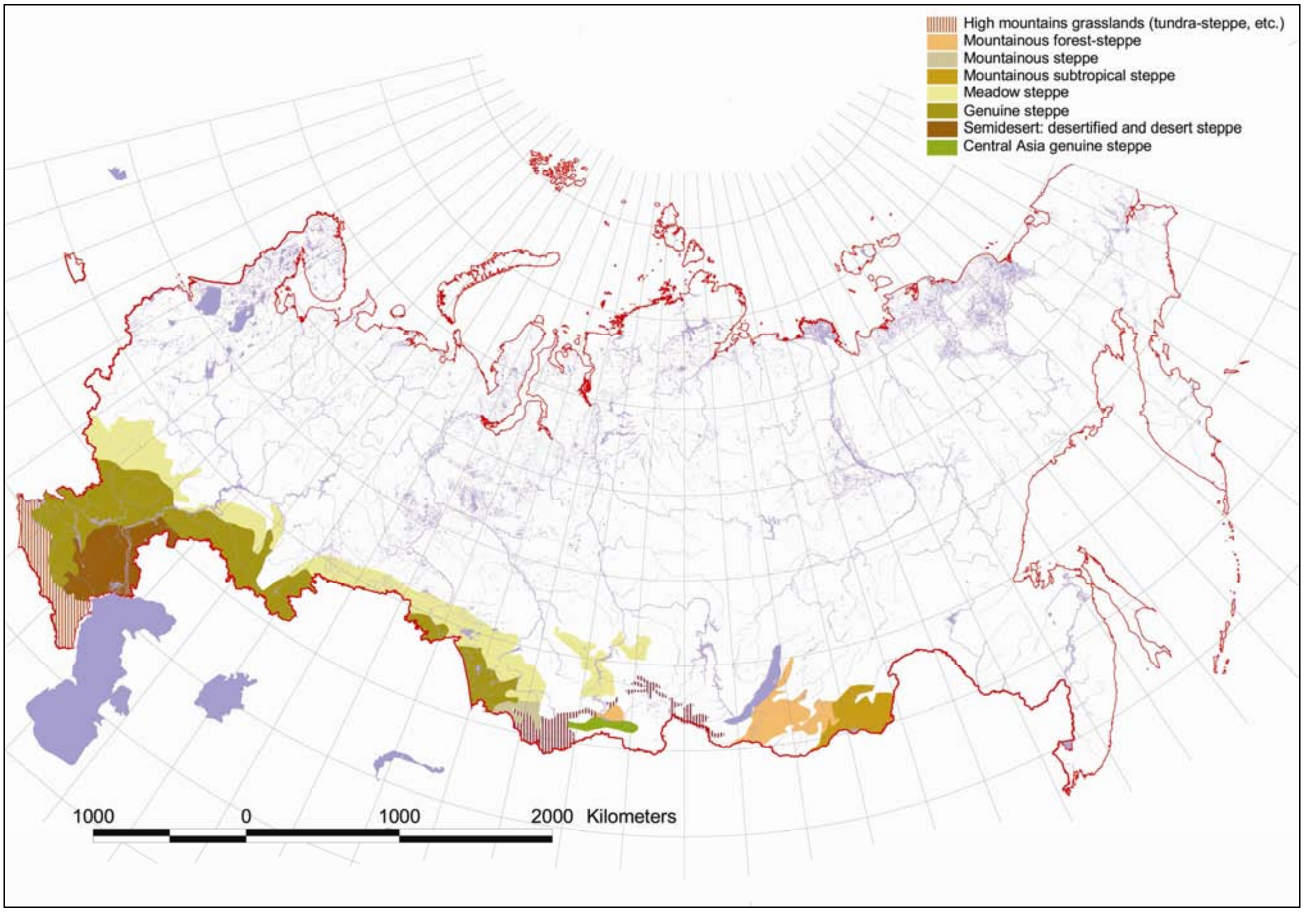
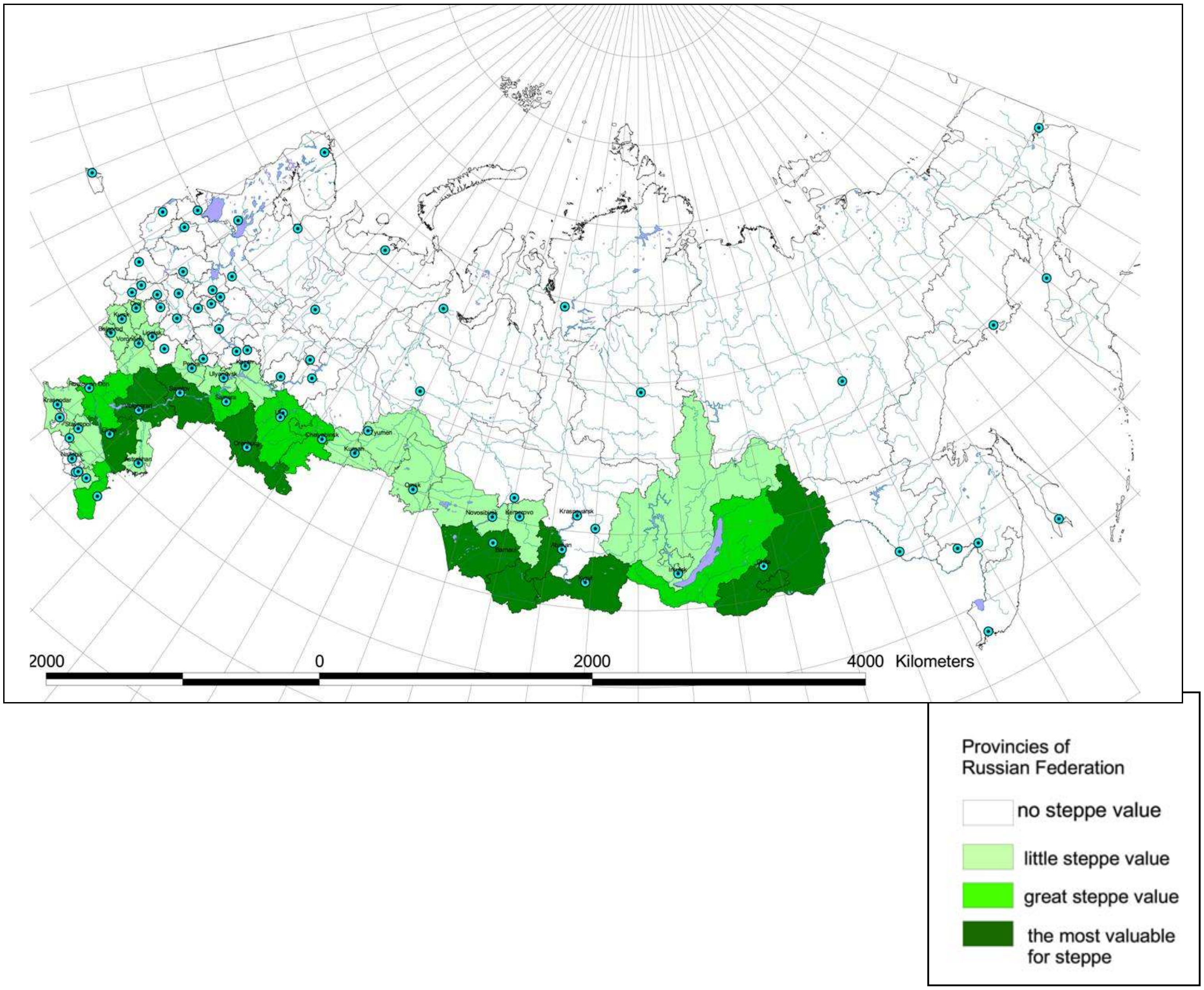


Figure 2: Steppe Value of Federal Provinces of Russia
(based on number, extent, and quality of large steppe tracts)



Note: The lack of the accurate data is the problem of top-priority in steppe conservation in Russia. We are collecting available information on the greatest and the best conditioned steppe tracts – but only several of them are known recently. Only several provinces have the good inventory data (either our data or published ones).

Therefore we have no possibility to map important grassland areas for Russia as a whole. The map only we can provide to date is the steppe value of Russian provinces (Figure 2). We divide all the provinces by (1) number of large steppe tracts (>10 sq.km), and (2) total area of steppe grasslands (that is estimated by the method described above).

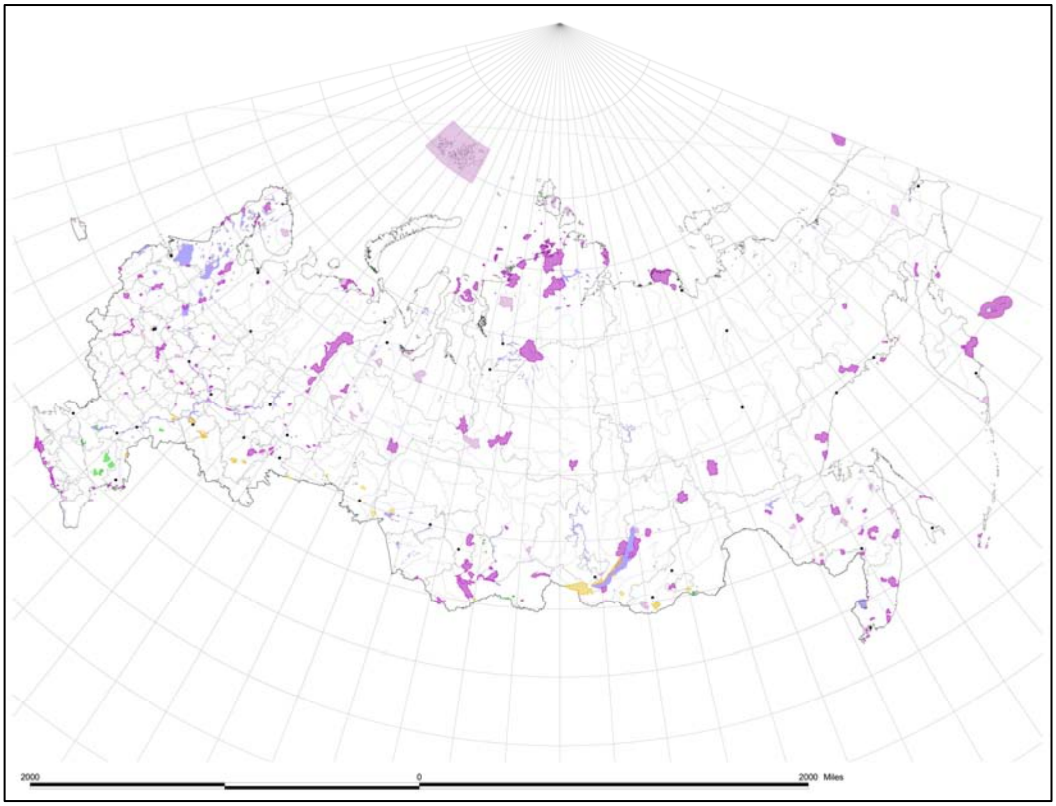
There are three level of PAs in Russia: national (federal), provincial, and local ones. The accurate data are available for federally protected areas only. Making a complete list of steppe protected provincial PAs is a high priority task for us.

Table 3: Steppes in national level (Federal) protected areas

Federal PAs	Land area, ha	Province
Zapovedniks (Federal state strict nature reserve, IUCN Ia category)		
A. Protecting steppe grasslands at more than 25% of the reserve' area		
Belogorye	2,131	Belgorod
Daurskiy (Biosphere Reserve, Dauria Transboundary Reserve)	45,790	Chita (Zabaikalskii Krai)
Orenburgskiy	21,653	Orenburg
Privolzhskaya Lesostep'	8,373	Penza
Rostovskiy (Biosphere Reserve)	9,532	Rostov/Don
Ubsunurskaya Kotlovina (Biosphere Reserve, UvsNuur Transboundary Reserve)	323,198	Tyva Republic
Khakasskiy	267,565	Khakassia Republic
Centralno-Chernozemny (Tsentral'nochernozem Biosphere Reserve)	5,287	Kursk
Chernye Zemli (Biosphere Reserve)	121,482	Kalmyk Republic
Galichya Gora	231	Lipetsk
B. Protecting only small pieces of steppe grasslands (at <10% of the reserve area)		
Azas	333,884	Tyva Republic
Altaiskiy	871,212	Altai Republic
Astrakhanskiy (Astrakhanskiy Biosphere Reserve)	56,619	Astrakhan
Baikalo-Lenskiy	660,000	Irkutsk
Bashkirskiy	49,609	Bashkortostan Republic
Bogdinsko-Baskunchakskiy	18,525	Astrakhan
Voroninskiy	10,320	Tambov
Zhigulevskiy	23,157	Samara
Katunskiy (Biosphere Reserve)	151,678	Altai Republic
Prioksko-Terrasnyi (Biosphere Reserve)	4,945	Moscow Province
Prisurskiy	9,148	Chuvash Republic
Sayano-Shushenskiy (Biosphere Reserve)	390,368	Krasnoyarsk
Sokhondinskiy (Biosphere Reserve)	210,985	Chita (Zabaikalskii Krai)
Shulgan-Tash	22,531	Bashkortostan Republic
Jerginskiy	238,088	Buryat Republic
Tighirekskiy	41,415	Altaiskiy Krai
Totally steppe Zapovedniks (A group)	***764,031***	
Total area of Zapovedniks including small steppe plots (B group)	***3,092,484***	

National Parks (IUCN II category)		
Steppe grasslands <10% of the park area only		
Samarskaya Luka	134,000	Samara
Khvalynskiy	25,514	Saratov
Bashkiria	82,300	Bashkortostan Republic
Pribaikalskiy	418,000	Irkutsk
Zabaikalskiy	267,177	Buryat Republic
Tunkinskiy	1,183,662	Buryat Republic
Alkhanai	138,234	Chita (Zabaikalskii Krai)
Total area of NPs with small steppe plots	***2,248,887***	
Federal Wildlife Refuges (Zakazniks, IUCN IV and VI categories)		
A. Protecting steppe grasslands at more than 25% of the Refuge area		
Tsimlyanskiy	44,998	Rostov/Don
Kharbinskiy	163,900	Kalmyk Republic
Sarpinskiy	195,925	Kalmyk Republic
Mekletinskiy	102,500	Kalmyk Republic
Saratovskiy	44,302	Saratov
B. Steppe grasslands <10% of the Refuge area		
Tsasucheiskiy Bor	57,867	Chita (Zabaikalskii Krai)
Stepnoy	75,000	Omsk
Starokulatkinskiy	20,166	Ulyanovsk
Kurganskiy	31,846	Kurgan
Kirzinskiy	119,808	Novosibirsk
Kamennaya Step’	5,232	Voronezh
Beloozerovskiy	17,850	Tyumen
Bairovskiy	64,831	Omsk
Altacheyskiy	60,000	Buryat Republic
Kabanskiy	12,100	Buryat Republic
Totally steppe Wilflife Refuges (A group)	***551,625***	
Total area of Wilflife Refuges including small steppe plots (B group)	***464,700***	

Figure 3a: Steppes in national level (Federal) protected areas



Protected area types

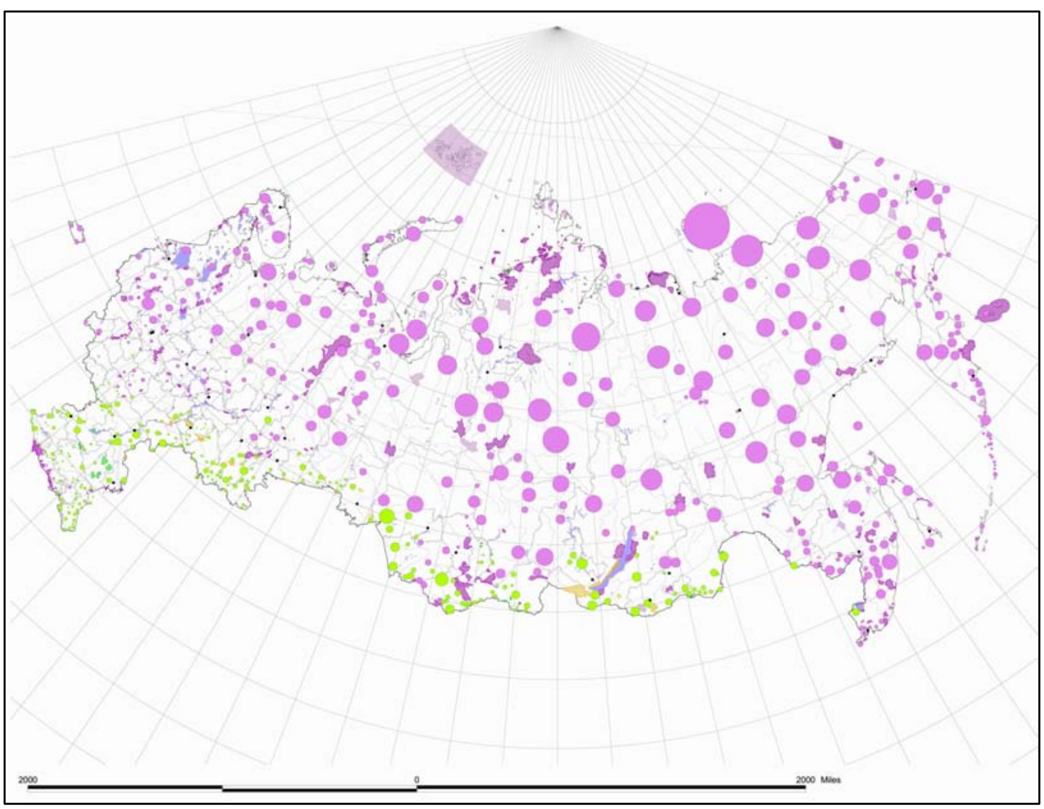
Federal nature reserves (zapovednik):
- no steppe
- small pieces of steppe
- steppe > 25 %

National parks:
- no steppe
- small pieces of steppe

Federal wildlife refuges:
- no steppe
- small pieces of steppe
- steppe > 25 %

Recently proposed
(sized proportionally to acreage)
- no steppe
- including steppe plots

Figure 3b: Recently proposed (WWF Russia) national level (Federal) protected areas



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11. UKRAINE

Template information was not received at time of report production.

12. UZBEKISTAN

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12.1 Major Indigenous Temperate Grassland Types

Waste areas of grasslands mostly characterize the territory of Uzbekistan. It is used as a grazing area for small ruminant domestic animals, while some territories converted into croplands to grow rainfed wheat and barley. Only 10% of the total territory is suitable for irrigated farming, which becomes very costly due to salinization and erosion.

Grasslands provide local population with food and are principal domain where they make their living via different activities. Continuous economic changes, population growth and overgrazing necessitate the development of economically sustainable and ecologically friendly technologies for the utilization of natural resources.

Grasslands of Uzbekistan are divided as follows: plains (arid) comprise 83.4 percent , foothills 12.8 percent , mountains 2.4 percent and alpine pastures 1.3 percent. The total grassland area is represented by four types: ephemeral-ephemeroidal, shrub-grass, subshrub-ephemeral and salty grass vegetation according to Amelin (1943) and Morozova (1946).

Ephemeral-ephemeroidal grasslands (about 1,500,000 ha). There are vegetation communities found among all types of arid grazing lands which consist of annual and perennial grasses covering loess foothills and plains in the the Central Asian republics. In Uzbekistan they are close to adyr of Surkhandarya, Kashkadarya, Samarkand and Jizak regions. *Carex pachystylis* and *Poa bulbosa*, forming a solid sward, are the basis of the vegetation cover of this type. In addition, in the herbage of ephemeral pastures *Anisanta tectorum*, *Bromus* spp, *Eremopyrum orientale, Trigonella noeana* grow. Among large plants *Alhagi pseudoalhagi, Cousinia resinosa,* and *Ferula asafoetida* are found.
In favorable years the height of the ephemeral herbage reaches 50-60 cm, and in normal years 20-30 cm; in lean years vegetation may not be higher than 8-20 cm. The fodder capacity of ephemeral-ephemeroidal grazing varies greatly by year and season of the year and on average is 400-700 kg of dry matter. The total number of ephemeras, long vegetating annual grasses, in years with different weather, can vary from some species up to 40-65 and more. However, the extent of development and specific weight of a particular fodder in the community differ depending on the weather conditions and spring period.

Shrub-grass grasslands grasslands (about 9,000,000 ha), the most widespread type, which occupies a vast area is typical of sandy deserts. It occupies the greater part of the Kizilkum desert (most of the grazing lands of Bukhara, Navoi regions and the Republic of Karakalpakstan); here and there it prevails in Kashkadarya, Jizak and Samarkand regions. Shrub-grass lands of sandy desert areas are exceptionally valuable grazing. Variety of life forms (here there are all life forms of desert plants), different seasons and quite long growing period or absence of summer interruption in plant growth, the seasonal character of forage etc. allow them to be used for sheep grazing practically the whole year round.
The many-tiered formation of vegetative cover is common: trees and bushes make up the upper layer exceeding 2 metres; sub shrubs and some perennial long vegetating grasses make up the middle layer (0.5-1.5 m high), and the lower layer often is formed of ephemeroids - *Carex physodes, Poa bulbosa* and

a multitude of ephemerals. By the duration of vegetation the vegetative cover of this type is formed of ephemeras (annual and perennial) of spring-summer, summer-autumn, long vegetating kind and one evergreen kind. *Haloxylon persicum, Haloxylon aphyllum, Salsola paletzkiana, Salsola richteri*, kinds of *Calligonum*, *Astragalus* (3 kinds), *Carex physodes*, *Poa bulbosa, Anisanta tectorum, Eremopyrum orientalis*, etc are the most valuable fodder plants of sandy deserts (Melnikova, 1973).

Schematically, the feed for sheep in shrub-grass grazing is as follows: spring - period of rapid growth and eating of ephemerals and ephemeroids; animals are provided with exceptionally vitamin-rich, green fodder. By summer due to cessation of growth of the grass layer, dry fodder from ephemerals, kinds of calligonums, and dry annual salty grass vegetation are the main components of feed for the sheep.
In autumn the available feed is slightly better owing to their eating shrub-subshrub fodder, dry *Carex physodes*, and small grasses. Shrub-subshrub pastures accumulate a stock of phytomass in summer; ephemeras and ephemeroids in spring; and annual halophytes by the autumn. Ridges, hill tops and slopes are often low yielding while plains yield more; fixed areas of sands are not only easy to use, but are the highest yielding. Average yield of shrub-grass grazing varies by year from 200 to 700 kg/ha of dry mass.

Subshrub-grass type of grasslands (total area 6,700,000 ha) prevails on sierozems, brown-brown soils, condensed sands in practically all the regions of the republic where the Karakul sheep are kept. The herbage of this type is usually two-tier: sub shrubs (kinds of *Artemisia, Salsola orientalis, Halotamnus subophyllus, Salsola gemmascens, Astragalus willosissima*) are in the upper tier. In compacted sands in this area *Iris, Aristida, Ferula asafoetida*, etc. may grow. The lower tier is formed of ephemeras and ephemeroids, *Carex pachystylis, Poa bulbosa,* seldom *Carex physodes* and other ephemeras of crucifers, legumes and other genera. This economically important type is represented by a large number of options. But *Artemisia*-ephemeral and wormwood-halophyte-ephemeral options are the commonest. The forage capacity of these lands ranges from 300 to 600 kg of dry matter, per ha mostly from *Artemisia diffusa* and *Artemisia turanica (*65-70 percent). The share of other kinds is about 30-35 percent : various grasses accumulate the most fodder in spring and sub shrubs in summer and autumn.

Salty grass vegetation (halophyte) grasslands with a total area of about 1,500,000 ha is localised, with small patches on almost all types of soil salinized to different extents. The vegetation cover is sparse and consists, in general, of: *Climacoptera lanata* (Pall.), *Gamanthus gamacarpus* (Mog.), *Salsola sclerantha*, etc. have a great importance (Akjigitova, 1982). The yield of salty grass vegetation grazing varies, within the limits of 50-600 kg/ha of dry mass. They are good grazing lands before and during mating (autumn) periods. The nutritive value of the main kinds of vegetation varies with the seasons of representative kinds of grass: in spring 23 fodder units; shrub-subshrub kinds 25-28; in summer 47-52; in autumn 36-38 and in winter 30-33 fodder units.

From the grazing point of view salty grass vegetation pastures are found on two types of land: annual salty grass vegetation and perennial salty grass vegetation. Of the annual halophyte, morphologically divided into rich and dry kinds, *Climacoptera lanata* and *Gamanthus gamocarpus*, etc. have great importance and prevail in Kizilkum. The above kinds alone or in a mixture with one another often grow in blind saline hollows, depressions, dried up lake beds, *takirs* (local), old river-beds, etc. Of the annual halophyte kinds *Agriophyllum latifolium, Galimoknemis* spp. , *Salsola paulsenii*, and of shrub kinds - *Haloxylon persicum, Salsola richteri* mixed with annual halophyte groups prevail in the sandy part of deserts in the form of islets or larger areas. A distinguishing peculiarity of Kizilkum halophyte grazing is that more often subshrub are kinds of *Salsola orientalis, Salsola gemmescens, Halothamnus subaphyllus* and shrub kinds of *Haloxylon aphyllum, Haloxylon persicum, Salsola richteri, Salsola paletzkiana.*
The distinguishing biological peculiarity of salty grass vegetation, representing the main fodder in this type of land, is a quite long growing period of 200-236 days with only a few exceptions. The content of digestible protein per 1 kg of halophyte fodder ranges within the limits of 20-50 g. Fruit and leaves containing 7-13 percent of protein and a little cellulose (10-16 percent) are deemed to be the most nutritive part of the fodder.

Most feed of *Climacoptera lanata* and other halophytes (70-80 percent) becomes available in autumn; the best season for their use is autumn and early winter. Alternation of sheep grazing on annual halophyte with other types of vegetation improves the effective use of the fodder. For camels halophyte lands can be used at all seasons as they eat halophyte practically the whole year round. The main reason for eating rich halophyte by other animals during the growing period is their high content (37.7-55 percent) of mineral salts.

In terms of seasons of use the pastures of the republic are distributed unequally: over 50 percent of them are good for all-the-year-round use, about 20 percent for spring-summer use; the rest can only be grazed only during a short season.

At the beginning of 1993 a farm had in average 209,300 ha of grazing land. However, depending on the region, the rangeland area also is distributed unequally. Thus, the number of farms having agricultural land area of up to 50,000 ha was 18; 50,100-10,000 ha - 23; 100,100-200,000 ha - 14; 200-500,000 ha - 18; over 500,000 ha - 12. Currently establishing organizational and economic structures of astrakhan sheep production have considerably changed such distribution of grazing land to farms, which now tend to break up into smaller farms.

The average weighted yield of rangelands of the republic is 121 kg/ha of fodder units. In years of average weather, provision of the stock with grass fodder is 80 percent, in lean years - 55-60 percent , in extremely dry, unfavourable years falls to 30-40 percent . In years unfavourable for the development of vegetation the farms have to buy concentrated fodder and emergency stocks of coarse fodder, or by first using their own laid-in stock in order to properly maintain the livestock population.

The low yield of natural grazing, the low and uneven pastoral water supply which causes a continuous shortage of water, the need for ecologically balanced land useare some of the key topics presently being discussed. Of course, effective use of natural pasture is the basis for maintaining and supporting the natural potential of arid grazing, the botanical variety of the herbage, as well as raising their productivity. As has been proven by science, in Karakul sheep production the main and determining element of effective use of arid zone pasture is seasonal and annual change of grazing areas with removal of annual growth of fodder mass not exceeding 65-70 percent. In this way the duration of using an area in time is achieved with an optimal load of sheep. Following a seasonal use pattern promotes the self-restoration and self-regulation of the vegetative cover.

12.2 Impact of Human Settlement

Population growth and associated expansion and intensification of agricultural activity in many areas of the Central Asia have caused increased rates of land degradation. The region faces a serious challenge with regard to its natural resource base. Croplands, grasslands and mountains are getting degraded. The reduced availability of agricultural inputs, and feed and fodder is resulting in a decline in livestock numbers. Water scarcity and misuse is compounding the threat to food security, human health, and ecosystems.

These grasslands are rich in medicinal and industrial plants, and represent a “hot spot” for the conservation of unique flora and fauna. However, the vegetation of these lands is under pressure due to an increasing need for food and feed. Overgrazing and uprooting of shrubs for fuel wood are particularly threatening the precious biodiversity found in these lands, and the livelihoods of the people who live there.

Table 1: Grasslands resources of Uzbekistan

Regions	Total grazing land, thousand ha	Without Water Supply	
		Thousand ha	%
Republic of Karakalpakstan	3461.1	430.9	12.4
Bukhara	2416.0	439.7	18.2
Jizak	582.9	205.5	35.2
Kashkadarya	1011.9	122.5	12.1
Navoi	9245.8	110.3	12.0
Samarkand	633.2	124.9	19.73
Surkhandarya	407.9	64.6	15.84
Total	**17,758.8**	**2,498.4**	**14.0**

12.3 Suggested next steps and action plan

Taking into account that limited financial resources are available, we choose the following activities from a wide-ranging problem:

1. Researching land use change and drylands degradation with Remote Sensing and GIS, focusing on Karnap Chul and Bakhmal areas and potential for up-scaling to larger areas;

2. Calculation of NDVI and other vegetation indexes and comparison with ground measured data on biomass, chlorophyll content so as to make a better calibration limited by and caused by dusts, clouds and others;

3. Researching revegitation of degraded rangelands with manure coated seeds; Feed blocks, containing seeds of different fodder plants, can feed small ruminant animals. Domestic animals will disseminate this seeds and they will germinate.

4. Researching vegetable and ornamental plants farming in dryland conditions with efficient use of scarce water resources of artesian wells;

5. Income generating activities (small-scale carpets, ecological tourism etc).

Measures and activities
Environmental data collection
Socio-economic data collection
Income generating
Regional planning workshops
Publications

Expected outputs

The results of this work will help scientists understand trends in local biodiversity degradation and will give ideas for their improved management, and will help identify particularly dynamic, resourceful, and resilient components used by villagers.

On the basis of this research it will be possible to create an "Electronic Atlas of Grasslands of Uzbekistan" for further use.

12.4 Appendices

Map 1: Regional map

Table 2: The dynamics of livestock in Uzbekistan (1990-2005)
(FAOSTAT, 2006)

Species	Years							
	1990	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
cattle (,000)	4580	5848	5268	5344	5478	5879	6243	5400
(Including cows ,000)	1856	2336.9	2305.2	2364	2293.2	2556.7	2704	2.800
Sheep and goats (,000)	9230	10,049	8886	8930	9234	9929	10580	10500
Horses (,000)	120	144.8	155.0	150.0	145.0	145.0	145.0	145.0
Pigs (,000)	716	350.4	80.0	89.0	75.4	89.9	86.7	90.0
Poultry (,000)	26,473	18,500	14,787	14,800	15,725	18,053	19,184	18.350

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Since the drafting of this profile a major book on Uzbekistan's rangelands has been published (Gintzburger *et al*., 2003)

FAO link for further information on Uzbekistan

13. TEMPERATE GRASSLAND REGION: SOUTHEASTERN AUSTRALIA

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13.1 Major Indigenous Temperate Grassland Types

Natural temperate grasslands in Australia occur in the southern, temperate per-humid sections of the continent. The dominant grass species are tussock-forming, and occur from sea level to alpine regions. The grasslands *sensu strictu* have a relatively small area, but they form a floristic continuum with temperate grassy woodlands, which are widespread in southern and eastern Australia. Together they occur in a wide arc from Adelaide in South Australia to Armidale in New South Wales (Moore 1970), and are found in 11 of the 85 bioregions (Environment Australia 2000). They are one of the highest conservation priorities in the country.

Australia's temperate tussock grasslands consist of a mix of perennial C3 genera (*Poa*, *Austrodanthonia*, *Austrostipa*) and a widespread C4 grass *Themeda triandra*. There are numerous species of dicotyledonous herbs (forbs), and few woody species. The major grassland types are:

- Lowland *Themeda triandra* tussock grassland
- Lowland *Poa* tussock grassland
- Lowland *Austrodanthonia-Austrostipa* tussock grassland
- Lowland *Lomandra* tussock grassland
- Upland (alpine and subalpine) *Poa* tussock grassland

Australia also has extensive tropical and subtropical grasslands and grassy woodlands. However these ecological communities have not been the subject of this report. Much of these grasslands are part of Australia's extensive rangelands and are poorly represented in the protected area system.

13.2 Impact of Human Settlement

The current distribution of grasslands and grassy woodlands is highly fragmented, and the ground layer composition of both grasslands and grassy woodlands has been highly modified due to 200 years of European land use – mainly grazing of domestic livestock on native and exotic pastures, and clearing for cropping. Broad-scale conversion of the natural grasslands for crop production continues to pose the largest single threat to this community. More recently, changes in technology such as pivot irrigators and access to water have allowed irrigated cropping to occur in dryland agricultural regions, and this has led to an acceleration of clearance and conversion. Energy development is an emerging threat, in particular wind power and biofuels.

Future threats to biodiversity conservation in temperate grasslands include:

1. Intensification of grazing and agricultural land uses, resulting in the replacement of diverse native ecosystems by species-poor exotic-based systems.
2. Nutrient additions, both intentional and unintentional (which also reduce native plant diversity and promote exotics).
3. Global warming (impacts on interactions amongst native and exotic species under different disturbance and grazing regimes are unknown).
4. Competition from exotic species, including ongoing commercial development of new cultivars of existing pasture species (e.g. for increased drought tolerance), plus newly introduced species such as woody fodder species.
5. Losses of diversity in small populations in fragmented landscapes.
6. Urban and infrastructure development (particularly peri-urban expansion in the Australian Capital Territory, Victoria, and more recently Tasmania).
7. Development for recreation and tourism. Subalpine grasslands are natural areas for the establishment of tourism facilities including winter snow sports.
8. Tree planting including the establishment of commercial plantations, carbon planting and biofuels.
9. Inappropriate fire regimes, particularly lack of burning.
10. Shrub and tree invasion.

13.3 Current Status

13.3.1 Natural State

The current analysis undertaken for this assessment report finds the current extent of lowland temperate grasslands to be 87,850 hectares, with 192,000 hectares of upland grasslands (Table 1 & Map 1).

Regional analyses have been difficult to compile at a national level as there is no consistent grassland classification approach between the States. Carter et al. (2002) undertook a detailed analysis of Australia's temperate lowland grasslands at the bioregional level, compiling information provided by each of the States. They estimated a pre-1750 distribution of c. 6 million hectares, with <100,000 hectares remaining (<2%).

More recently the National Vegetation Information System (NVIS) has compiled data from each of the States and Territories on the current extent and estimated pre-1750 distribution of Australia's native vegetation, and classified it into 67 major vegetation subgroups (DEWHA, 2008; NLWRA, 2001). NVIS reports an original pre-1750 extent of c. 5.5 million hectares of temperate grassland in Australia of three major types (temperate tussock grassland, other tussock grassland and wet tussock grassland) (Map 2). However, the NVIS current extent of 3.4 million hectares (62% of pre-1750 extent) is problematic and reflects inconsistent classification of data at the State level. This over-estimation arises for four reasons. (1) Many highly degraded lowland grasslands (now exotic-dominated) have been retained in the estimate. (2) The estimate includes many derived or secondary grasslands that result from the removal of the tree layer in woodlands or forests from eucalypt dieback, tree harvesting and/or failure to regenerate because of heavy stock grazing and/or burning. These are not considered natural indigenous grasslands for the purposes of conservation reporting. (3) Semi-arid and arid grasslands may also be reported in these figures for some bioregions, and the figures also include wet grasslands that are inundated for more than a month and are more commonly classified as wetlands. (4) Source maps in some regions had a resolution coarser than the NVIS target scale of 1:100,000 (DEWR, 2007). Additionally, in some regions (e.g. NSW Riverina) it is difficult to know which areas were dominated by native grasslands before European settlement, and which areas have been derived (owing to rapid destruction of dominant shrubs) since settlement, and this issue makes reporting difficult in many regions. The National Reserve System Program relies on NVIS data for reporting on native vegetation reservation levels in the protected area system.

13.3.2 Formal Protection

Temperate grasslands and grassy woodlands are one of Australia's most under-represented biomes in the national conservation estate, with one notable exception – alpine and subalpine grasslands which, not withstanding their small areal extent, are well-represented in Australia's reserve system (Williams *et al*. 2006). It is estimated that <2% of the lowland temperate grasslands remain in most Australian regions (Kirkpatrick et al. 1997; Carter et al. 2002), with much of this area in private ownership.

Approximately 140,000 hectares of temperate grasslands are protected in the Protected Area system (21,000 hectares of lowland temperate grassland (25% in Protected Areas) and >120,000 hectares of upland grasslands (>90% in Protected Areas). These figures represent both formal reserves managed by State conservation agencies, and informal perpetual reserves on private land.

13.4 Opportunities for Improving the Level of Protection and Conservation

Temperate lowland grasslands and woodlands represent one of the major challenges to biodiversity conservation in Australia, and have triggered the development of many innovative policies and practices aimed at promoting biodiversity conservation in privately-owned, production grazing landscapes. There has been an increasing emphasis on best practice management, including the development of grazing management guidelines for the sustainable use of native indigenous grasslands as pasture (for example, McIntyre et al. 2002, Mokany et al. 2006). These new approaches have great potential to greatly enhance the conservation of these threatened ecosystems.

Recent conservation efforts on private land have largely focused on facilitating landholder stewardship, with financial incentives paid to secure conservation agreements that enshrine sustainable natural resource management. Most approaches to grassland conservation are voluntary and often focus on whole-of-property planning, enabling landowners to negotiate management of natural resources in the context of their whole property. Approaches to conservation management agreements on commercial agricultural businesses have attempted to remove disincentives for engagement. Fixed-term rather than perpetual agreements have increased uptake of this policy instrument, as has a shift from strict conservation objectives to allowing more broadly for the sustainable management of natural resources, including biodiversity. Increasing use of outcomes-based approaches to monitor the impact of stock grazing on commercial grazing properties that are to be protected under conservation management agreements has shifted the emphasis away from prescriptive approaches that are a disincentive to many landholders.

Market-based approaches are increasingly seen as an incentive for private landowners to engage in conservation activities, including stewardship payments for the provision of ecosystem services. There are many successful examples in operation (e.g. Levitt, 2005). Recently in Australia new programs have offered a conservation auction or tender-style of approach to securing conservation management, whereby the landowner puts in a sealed competitive bid or tender (Stoneham et al., 2003). One such program has successfully conserved significant areas of lowland temperate grassland (Buchan, 2006).

Work is underway with the wool and cattle industries on environmental accreditation to provide market rewards for good management practices. Consumers worldwide are increasingly asking questions about the environmental credentials of the products they purchase and also want verification of producer claims. Environmental accreditation and eco-labelling of sustainable land management practices, biodiversity protection, animal welfare, wildlife-friendly management practices and organic certifications are some of the emerging schemes, but "willingness to pay" is a key factor that will determine the future success of these approaches.

In a new initiative in Tasmania, farming families have initiated an approach to protect some of the best remaining examples of lowland grassland in the state. These farmers wish to formalize a long-term partnership with government to protect their grasslands rather than enter into permanent conservation covenants. They have identified that conservation should provide them with an annual income stream and are establishing a trust fund to manage conservation investment funds that they hope to attract from both the government and the philanthropic sector. They have developed an innovative legal instrument that provides an evergreen or alliance contract. This initiative advocates a performance-based approach to conservation management agreements, leaving landholders (rather than governments) to settle how to get the agreed results.

13.5 Constraints Against Improving the Level of Protection and Conservation in the Region

Few opportunities exist on public land to improve the level of protection and conservation in most regions, therefore efforts must focus on privately-owned land. Lowland native grasslands are found on arable fertile soils so the opportunity costs of agricultural land uses other than extensive grazing are attractive to landowners, leading to clearance and conversion. It is difficult for conservation incentives programs to provide attractive incentives to compete with these lost opportunity costs. Regulation of the clearance and conversion of grasslands has proven very difficult to implement.

13.6 Suggested Next Steps and Action Plan

1. Improve information systems and national data compilation, including ability to report on the level of reservation. A national workshop is proposed to develop consistent classification and reporting approaches in the States.

2. Promotion and establishment of informal reserves. Whilst the aim of achieving 10% of the current extent in the protected area system is laudable, the significant levels of loss of temperate grassland demand that approaches be developed to secure protection of as much of remaining areas as possible. There needs to be more emphasis on the sympathetic conservation management of the 90% of temperate grasslands not in conservation networks.

3. In perpetuity protection of public land such as Travelling Stock Reserves, cemeteries, local government reserves that could add to the levels of protection. Many of these small reserves have extremely high conservation values, by virtue of long-term livestock exclusion. Additionally, linear roadside and stock reserves provide important landscape connectivity.

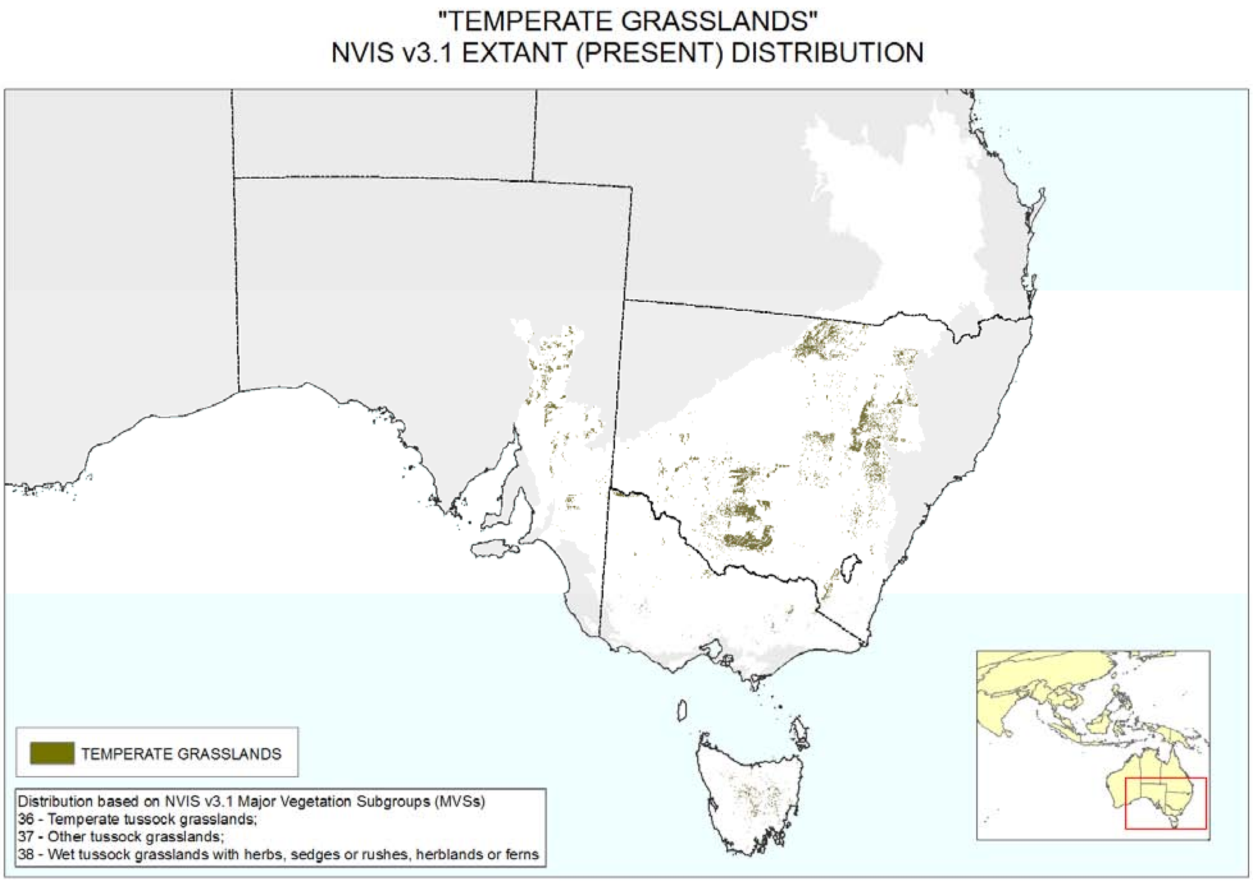
4. Enhanced management of grasslands, especially those on public land, to promote biodiversity, especially using targeted burning and grazing regimes. The conservation values of many important remnants have declined due to a lack of appropriate disturbances.

5. Restoration and regeneration of important grassland remnants. Recent research has focused on restoration techniques to deplete exotic plant species and promote natives (for example, Cole & Lunt 2005, Prober & Thiele 2005).

6. Improved public understanding and appreciation of the value of indigenous grasslands.

13.7 Appendices

Map 1: Current extent of indigenous temperate grassland types in Australia



Map 2: Estimated pre-1750 distribution of indigenous temperate grassland in Australia

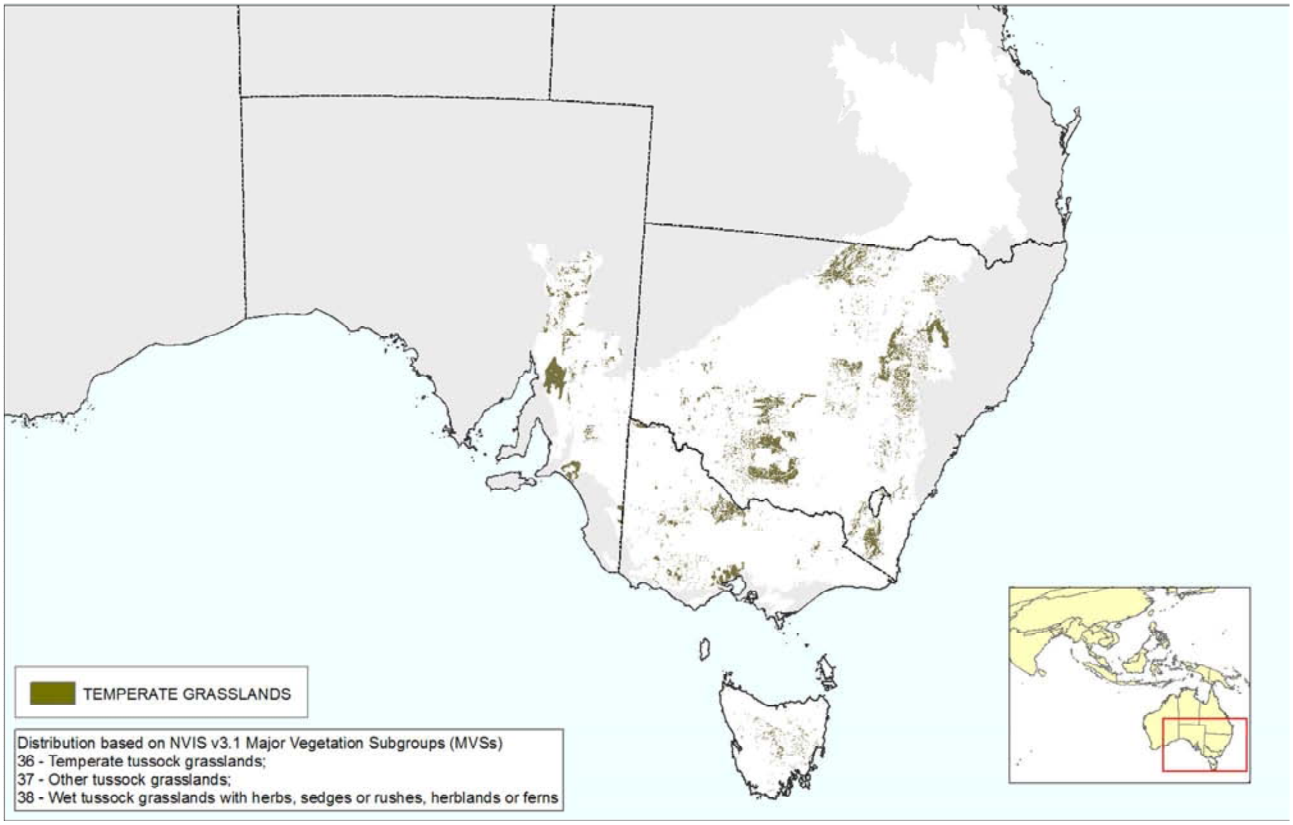


Table 1: Original and current extent of temperate grasslands in Australia, area in conservation reserves

State	Region	Grassland Type	Original extent (hectares)	Current extent (hectares)	% extent	Conservation Reserves (hectares)
South Australia	South Australia	*Lomandra multiflora, Lomandra effusa* lowland tussock grassland	1,500,000 [1]	5,000 [1, 2]	0.33	unknown
Victoria	Victorian Volcanic Plain	*Themeda triandra, Poa labiliardierei, Austrodanthonia, Austrostipa* lowland tussock grassland	257,000 [1]	5,000 [2, 3]	0.3	2,097 [3]
	Victorian Wimmera	*Austrodanthonia-Austrostipa, Themeda triandra* lowland tussock grassland	100,000 [1] - 400,000 [2]	100 [1]	0.1	0 [1]
	Victorian Riverina	*Austrodanthonia* tussock grassland	1,000,000 [1]	10,000 [3]	1	2,903[3]
	Victorian Gippsland Plains	*Themeda triandra* and/or *Poa labiliardierei* lowland tussock grassland	36,000[3] - 60,000 [1]	25-30 [3]	0.4	21[3]
New South Wales	NSW Riverina	*Austrodanthonia*, *Austrostipa*, lowland tussock grassland (including that derived from shrublands)	2,500,000 [1]	22,500 [2] - 25,000 [1]	1	c. 15,000
	NSW/ACT Southern Highlands (incl. Monaro)	*Themeda triandra, Poa labiliardierei, Austrodanthonia, Austrostipa* lowland tussock grassland	270,000 [1]	1,400 [2] - 3,500 [1]	1.3	6 [1]
	NSW/Vic Australian Alps	Upland *Poa* tussock grassland	125,000 [2]	125,000 [2]	100%	majority

State	Region	Grassland Type	Original extent (hectares)	Current extent (hectares)	% extent	Conservation Reserves (hectares)
	NSW Liverpool Plains/Moree	*Austostipa aristiglumis* lowland tussock grassland	270,000 [1]	25,000[1]	9.3	unknown
Tasmania	Tasmanian Midlands	*Themeda triandra* and/or *Poa labiliardierei* lowland tussock grassland	130,000 [4]	14,000 [4]	9.0	1,604 [4]
	Tasmanian Central Highlands	*Poa labiliardierei* upland tussock grassland	unknown	22,000 [4]	majorit y	16,500 [4]
Total	***Total Lowland tussock grassland***		5.5 million [2] – 6 million[1]	**87,850** (<100,000 [1] - 144,000 [2])	<2%[1, 2]	21,631
	Total Upland tussock grassland		>125,000 [2]	**146,000** [2]	c. 90%	>120,000

Source:

[1] Carter et al. (2002)

[2] National Vegetation Information System, DEWHA, 2008

[3] Vanessa Craigie, Dept. Sustainability & Environment, Victoria (pers. comm.)

[4] Dept. of Primary Industries & Water, 2007 unpublished data)

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14. NEW GUINEA

Template information was not received at time of report production.

15. TEMPERATE GRASSLAND REGION: NEW ZEALAND

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15.1 Major Indigenous Temperate Grassland Types

New Zealand Region: 267,840 km2, located in the SW Pacific; 34-47°S; 167-178°E
Three main islands (North, South, Stewart) with indigenous grasslands
Elevation to 3764 m (Mt Cook)

New Zealand was one of the few countries that evolved without indigenous terrestrial mammals and also one of the last major land masses to be settled by humans. The extent and dominance of grasslands fluctuated over the Quaternary and Holocene, reflecting climatic conditions. With the arrival of people (Polynesian Maoris ~1200 AD), fires became more frequent and extensive, with some associated extinctions.

Plant-herbivore relationships, which had evolved over millennia, were disrupted and sometimes decoupled. The biota was still essentially indigenous until the 1840s when European settlement and many alien plants and animals, both herbivores and predators, further transformed the land and its associated ecosystems.

Changing plant-herbivore-fire relationships and ecosystem transformations since settlement, makes establishing the nature and distribution of vegetation types immediately prior to settlement somewhat faught, especially given that a significant component of the fauna from those times is now extinct. In this context, 1840 (immediately pre-European) was chosen as the most appropriate baseline for assessing indigenous grassland types and status: they were then at their maximum extent (82,432km^2; ~31% of the mainland area).

The five major grassland types were mapped by Mark & McLennan (2005a; see also 2005b) as follows:

a. Low-alpine (~1200-1800m) tall snow tussock grassland (dominated by *Chionochloa* spp.): ~13%
b. Montane-subalpine (~400-1200m) tall snow tussock grassland (*Chionochloa* spp. dominant): ~18%
c. Montane-low-alpine (~400-1800m) tall red/copper tussock grassland (*C. rubra* dominant): ~23%
d. Montane-subalpine (~400-1200m) short tussock grassland (*Festuca-Poa* dominant): ~44%
e. Lowland (to ~400m) mixed sward grassland (mixed dominance): ~2%

<u>Note</u>: Areas where indigenous grasses were assumed to have attained at least local dominance in 1840 were mapped as grassland by Mark & McLennan (2005a). High-alpine areas above the limits of low alpine snow tussock grassland (~3.2%), as well as the nival zone (0.5%) were similarly assessed (Fig. 1).

15.2 Impact of Human Settlement

With European settlement there was almost immediate and considerable modification of the grasslands, especially in the lowland-montane zones, regardless of grassland type. The most remote western, wet, high mountain regions were grazed locally but later mostly protected for their landscape and conservation values, and now contribute much of the ~31% of the land area managed by the Department of Conservation.

The lower hills and plains were cleared, cultivated, or converted to exotic pasture and grazed, regardless of plant cover. Moderately sloping areas followed somewhat later. Less accessible uplands were used as rangeland for pastoralism, with burning and grazing as the only forms of management. Stock management suffered with inadequate fencing and high stock densities, and overgrazing was rife, especially in the early years. At lower altitudes rabbit plagues ensued. Altogether, serious degradation soon became apparent.

Most of the rangelands (~10% of the mainland area) remained in government ownership because of their general vulnerability though pastoral use was vested in the lessees who have permanent rights of lease renewal. Leases are a tradable commodity. There have been periodic attempts to address rangeland management issues with subsidies and legislative amendments to encourage more sustainable management of this leasehold land but with limited success. All grassland areas are now variously modified or degraded.

Government recently introduced a tenure review process whereby pastoral lessees can renegotiate their lease tenure and obtain freehold title to the more productive, mostly lower altitude parts of their leases in exchange for returning mostly higher altitude, more vulnerable lands, to full government control and management for soil and water conservation, biodiversity, recreational and landscape values. This process is on-going; to date about 20% of the original 340 leases have completed the reforms and ~200,000 ha have become conservation lands. An additional ~100,000 ha have been acquired through outright purchase of leasehold titles by the Government for the same purposes.

15.3 Current Status

Mark & McLennan (2005a) assessed the indigenous grassland status in each of five main types, as at Sept. 2002 (Fig. 2) These were estimated for four major geographic regions (Fig. 3): i) North Island, where the grasslands are more limited and variable; ii) the South Island wet western non-rangeland region (now mostly formally protected); iii) the South Island rangeland region (the central uplands, in the rainshadow of the Southern Alps); and iv) the South Island eastern lower altitude non-rangeland region.

Only indigenous grasslands in the South Island rangeland region have changed in status from the 2002 assessment to 2007 (Fig. 4), with increases in conservation lands associated with the tenure review (mainly at higher elevations) and some outright property purchases by the Government. . In the period to July 2008, seven new conservation parks have been created (Korowai/Torlesse (20,328 ha), Te Papanui (20,591 ha), Ahuriri (46,655 ha), Ruataniwha (37,221 ha), Eyre Mountain/Taka Ra Haka (65,160 ha), Hakatere (39,138 ha), Ka Whata Tu O Rakihouia/Kaikoura (88,066 ha), and two have been formally proposed, Hawea (105,000 ha) and Oteake (64,950 ha). These parks comprise mostly indigenous grasslands and mosaics, and the areas involved were mostly previous conservation land, so have had little effect on the total area protected. In this period, protected areas in the rangeland region have increased from 9.1 to15.2% of the baseline area of 47,286 km^2 (Fig. 4). For the country as a whole this represents an increase from 12.3% to15.4% of the original baseline grassland area.

15.4 Opportunities for Improving the Level of Protection and Conservation

Significant opportunities for increasing protection and conservation of indigenous grasslands remain only in the central South Island rangeland region where the Government is continuing with tenure reviews, although this remains optional with leaseholders. Government's policy is to create up to 23 conservation parks in this region through continued tenure review and perhaps some more whole-property purchases.

15.5 Constraints Against Improving the Level of Protection and Conservation in the Region

Virtually no unprotected indigenous grasslands remain other than in the South Island rangeland region. Continued tenure review of pastoral leasehold properties is likely to achieve satisfactory protection for the upland grasslands which, apart from other values, are known to contribute significantly to water production (Mark & Dickinson 2008). The remaining lower elevation montane to subalpine grasslands are rapidly being lost to development (viticulture, dairying, subdivision), following their privatization. Government has recognized the limitation of tenure review, in inadequate retention of representative indigenous biodiversity and some other public-interest values, and has undertaken to address it but the methods remain unclear.

15.6 Suggested Next Steps and Action Plan

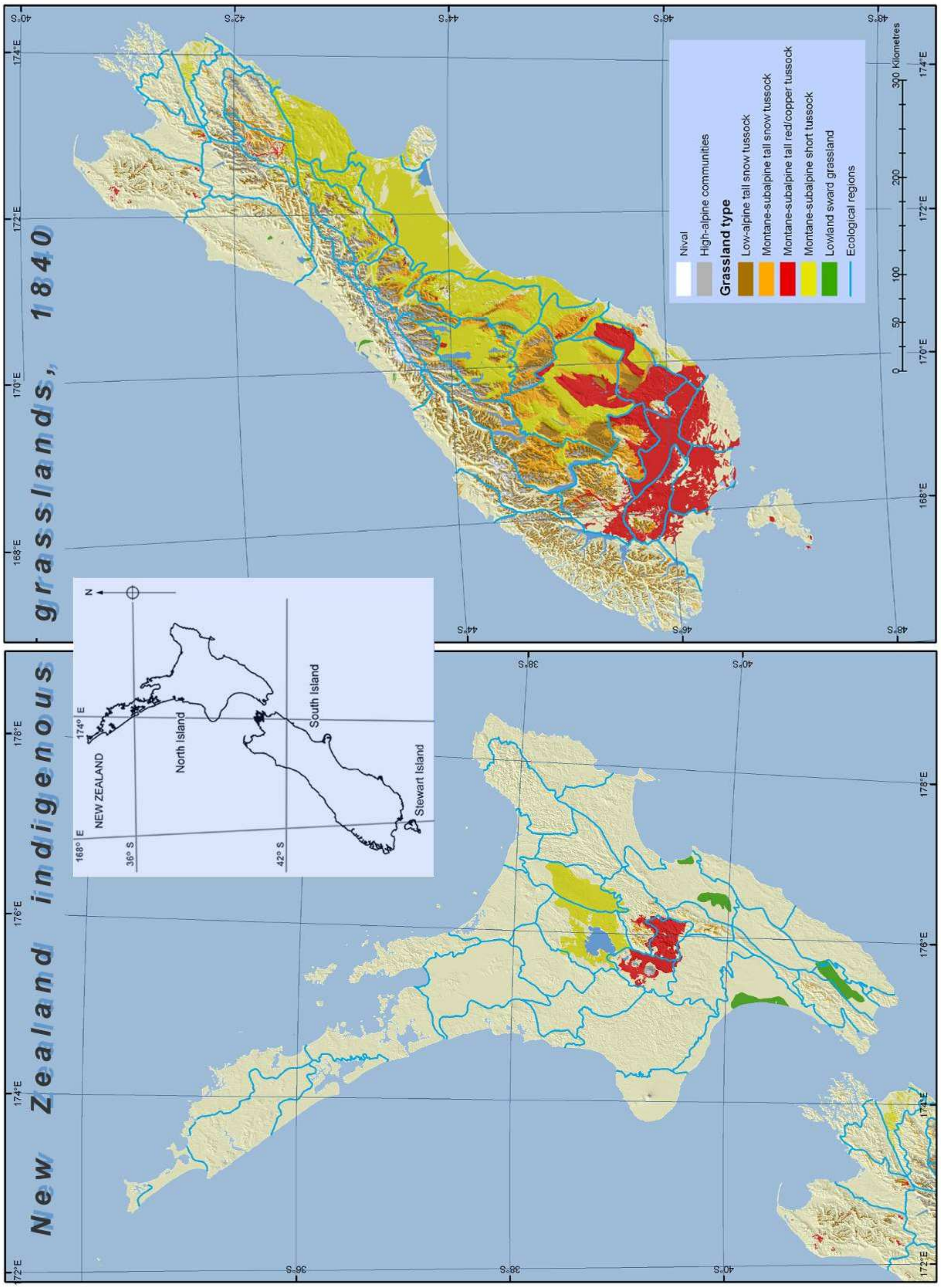
1. Continue to encourage the Government to fulfill its policies on achieving adequate conservation of the indigenous grasslands through continued tenure review and purchase of leasehold rangeland properties, and achieving protection of adequately representative indigenous grassland ecosystems at all elevations.

2. Convince New Zealand authorities to register the protected indigenous grasslands in the IUCN category of Temperate Grasslands since, being a small country, it has been decided to register all of the protected natural areas in a single category: Subtropical/Temperate Rainforests/Woodlands. With protected grasslands now comprising ~17% of New Zealand's conservation lands, they should be registered as such with the IUCN.

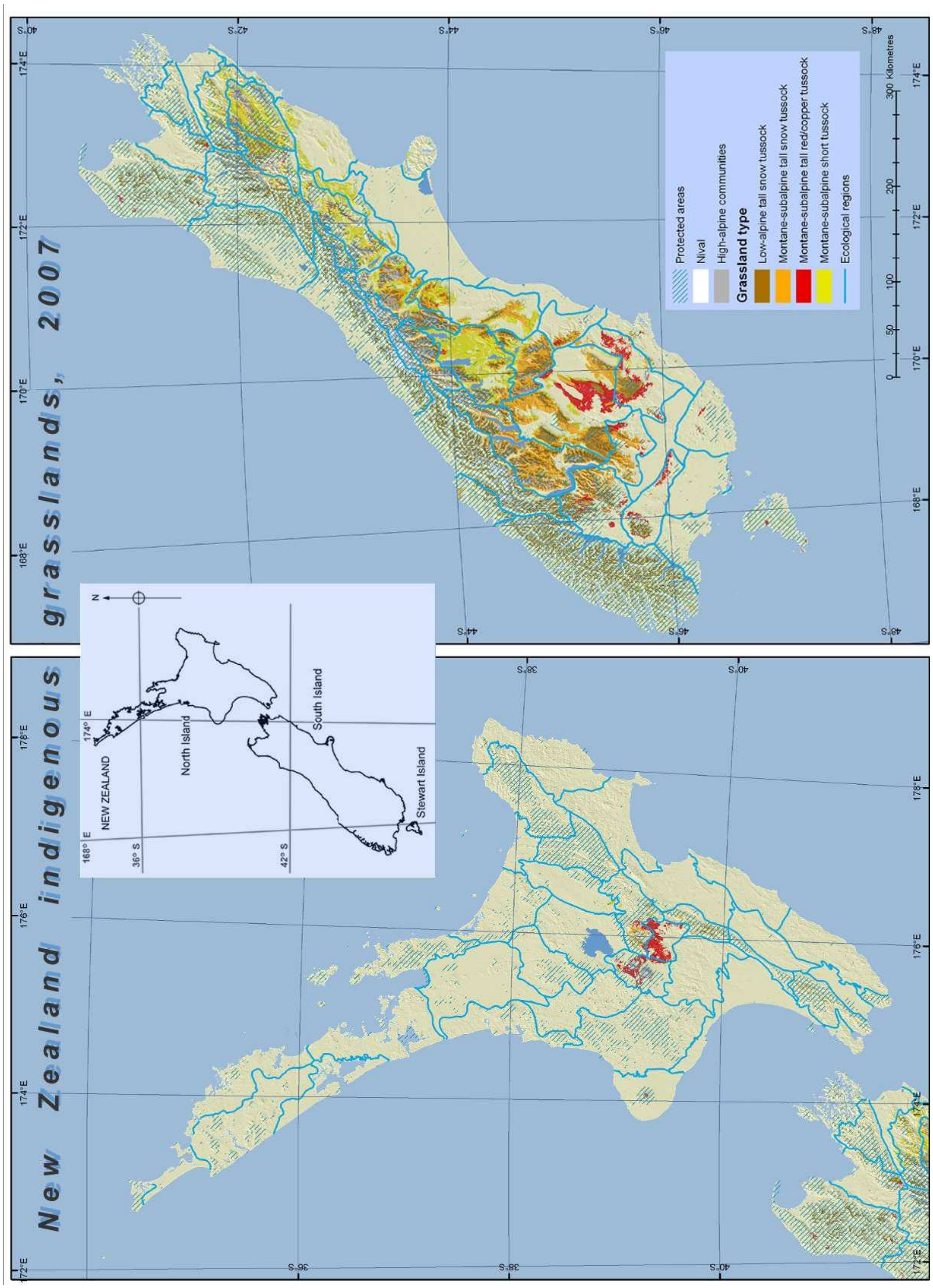
15.7 Appendices

Map 1: Mainland New Zealand, showing assumed baseline distribution of the five major indigenous grassland types at the time of European settlement in the 1840s

(Ecological region boundaries are also shown. Reproduced from Mark & McLennan, 2005a)



Map 2: Map showing distribution and extent of the same grassland types as in Map 1, at December 2007, together with areas formally protected and managed by the Department of Conservation
(Revised from Mark & McLennan, 2005a)



Map 3: Mainland New Zealand, showing the four main geographic regions from this exercise, and distribution of the 77 mainland ecological regions which have been similarly assessed

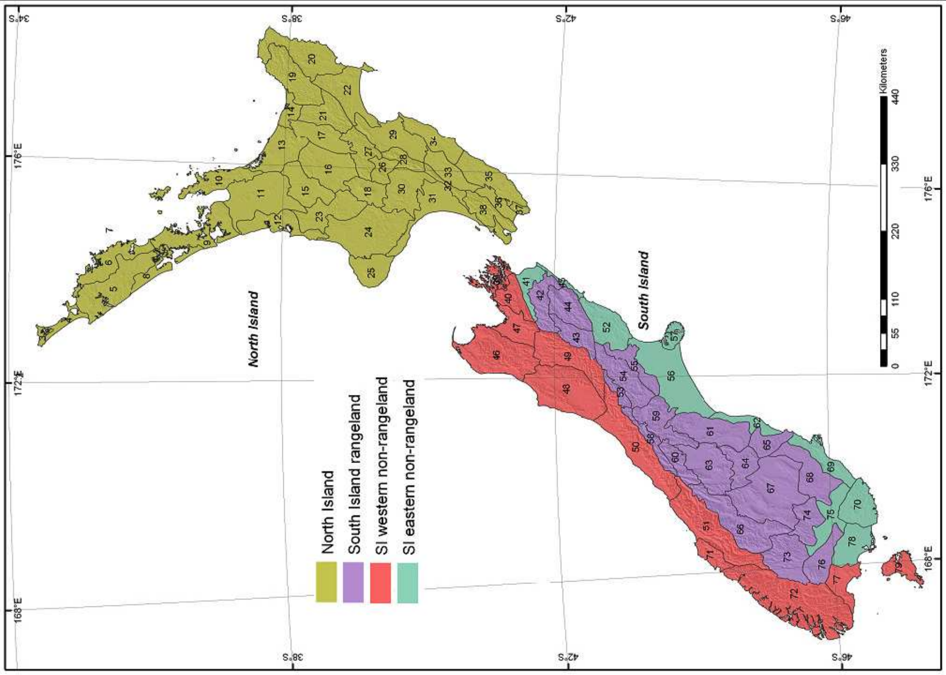
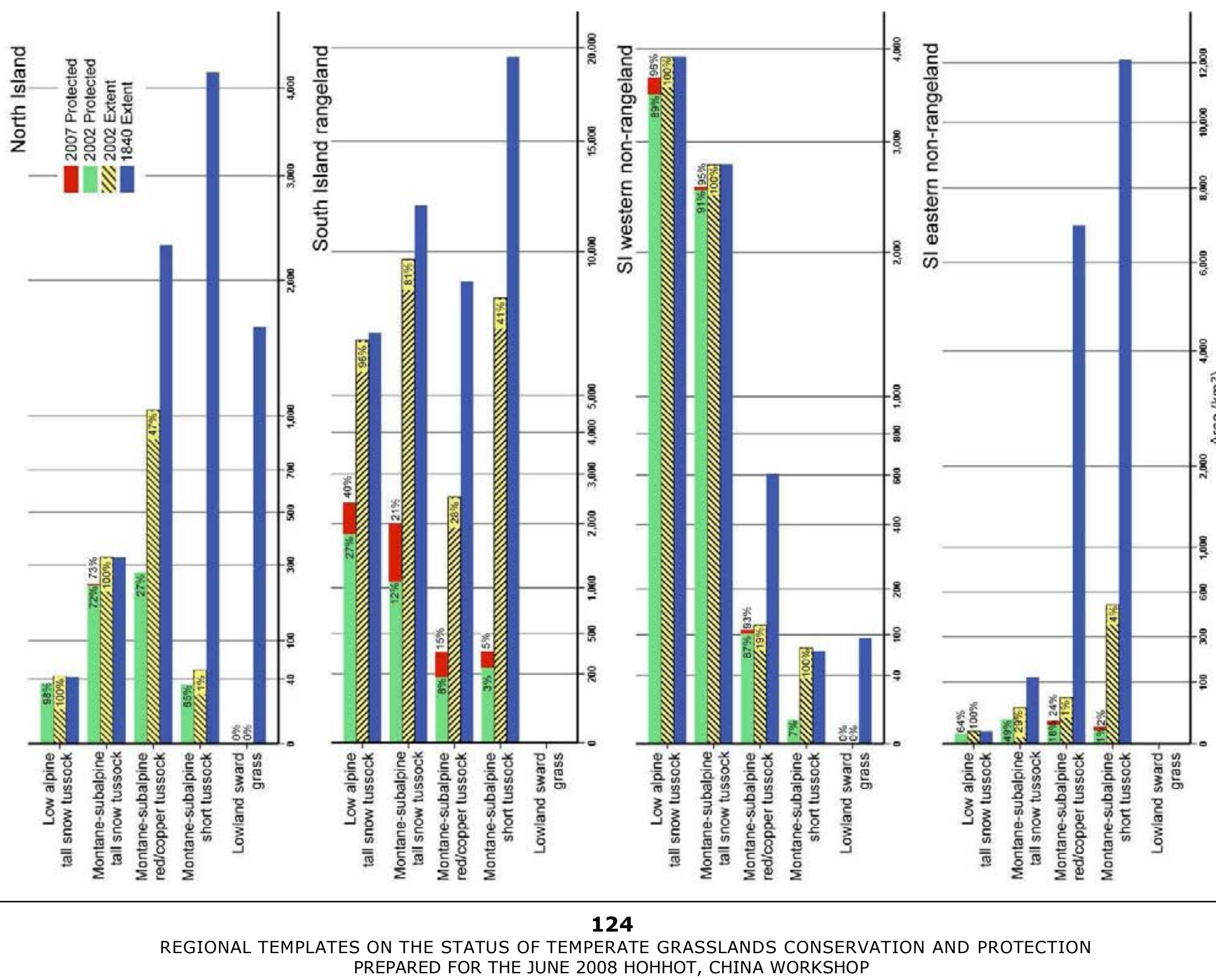


Table 1: Area extent of the five major indigenous grassland types in each of the four main geographic regions (see Map 3), with values for the baseline (1840), current (2007) extents, and that formally protected in Sept. 2002 and 2007



Acknowledgements

The Conservation Department provided a CD of their conservation lands, as at December, 2007. Staff of the University of Otago's Surveying Department provided technical support.

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16. BULGARIA/ROMANIA

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16.1 Major Indigenous Temperate Grassland Types

Grasslands form a significant group of habitat types with an enormous value for biodiversity in the region. In accordance with the differences in climate conditions grasslands show a great variety across Central and Eastern Europe.

In South-Eastern Europe, grasslands are still well represented and four main types are distinguished: dry grasslands, mesophilous grasslands, high-mountain grasslands and wet grasslands. Due to historical reasons, a high percentage of local and regional endemics in the flora and vegetation are characteristic for the Balkan Peninsula.

Bulgaria and Romania are characterized by a temperate climate, a variety of relief forms and a remarkable diversity of vegetation on a relatively small territory. In Bulgaria and Romania, the main zones of natural and semi-natural vegetation are correlated with latitude and altitude as follow: (1) latitudinal units (steppe zone, forest-steppe zone and oak tree forests zone), (2) altitudinal units (nemorose level, boreal level, sub-alpine and alpine levels). Typical for the temperate zone are the predominant presence of deciduous forests. Steppic bioclimatic influence flows in from the northeast and determines the presence of steppe plant communities and their elements in the vegetation cover. The Black Sea basin in the east conditions the Pontic bioclimatic influence and the Pontian elements of vegetation related to it. South Euxinian bioclimatic influence comes in from the southeast of Bulgaria and conditions the formation of some unique European plant communities, with a strong presence of South Euxinian elements, which are characteristic for the Caucasus. In the South of Bulgaria, along the valley the rivers Struma, Mesta and Maritsa, and partially along the Black Sea coast, some typical Mediterranean and Sub-Mediterranean elements of the flora and vegetation are observed as a result of the Mediterranean bioclimatic influence.

Dry grasslands
This includes among others dune grasslands, pontic salin grasslands, semi-mediterranean grasslands and steppes. Dry grasslands are less managed than the other three grassland types. They are low productive and are in general managed by grazing. In particular steppes were historically well represented in the East Danube plain (Northeast-Bulgaria/Southeast-Romania) and the Moldavian Plane (East-Romania). Steppes become increasingly scattered due to anthropogenic influence. Semi-dry forest-steppes with a rich grass cover are still relatively well represented. In Bulgaria, dry grasslands are more significant grasslands type than Romania with dry and half-dry grasslands with Mediterranean and Sub-Mediterranean elements of the flora and vegetation occurring widely in South-Bulgaria.

Mesophilous grasslands
The significant part of the pastures and meadows are mesophilous grasslands (in Romania the most significant type, in Bulgaria about 30% of the grasslands) and they can be found at lower and middle mountain level and in hilly regions. Among them are the more productive grasslands in the region, some of them are manured. Alternation of mowing and aftermath grazing is their typical management, with mowing done two or three times per year. Most of these grasslands are privately owned. In altitude, they correlated with the extensive nemorose zone, and the boreal zone covering less extensive areas in some of the mountain areas with semi-natural grasslands over 1600-1850m altitude.

High-mountain grasslands
Alpine and subalpine grasslands (roughly above 1800-2000 m) remain very close to a natural state and exhibit a high biodiversity that includes many endemic species. Grazing is a frequent management practices, taking place when the climatic conditions allow it (summer). High-mountain grasslands are covered by short grass pastures, sometimes in complex with short shrubs vegetation or accompanied by open woodlands. Most high-mountain pastures are state-owned.

Wet grasslands
Wet grasslands include fen, marsh and reed vegetations as well as grass-covered strips among streams and in valleys in mountainous and hilly regions. The most significant category of this type are however the floodplain grasslands which occur along all rivers in the region. Grazing is the most common farming practices, but in particular in floodplain habitats mowing plays an important role. Ownership is typically private, with extensive farming taking place without fertilizers.

16.2 Impact of Human Settlement

Ultimately, the combined influence of natural, historical and anthropogenic factors has led to the rich diversity of environmental conditions and, hence, to the great diversity of flora and vegetation in the region. Disturbance by humans (in particular low-intensity farming practices) is recognized as the key-factor for the species richness of grasslands.

In Romania, according an inventory that mapped about 10% of the Romanian grasslands in 2001-2003, 77% of mapped grasslands are managed, 8% are not managed and there are no data about the management for another 15%. The dry grasslands are 60% managed, especially by grazing (35%) but also by mowing (25%) and 30% are not managed. The mesophilous grasslands are 85% managed, especially by mowing (48%) but also by grazing (37%). The high mountain grasslands are 85% managed by grazing. The wet grasslands are 80% managed, 60% by grazing and 20% by mowing.

In Bulgaria data (from 2001-2004) is not available per grassland type. Abandonment is the main threat to 21% of the grasslands, while 17% suffer from intensification (ploughing up). 44% has an unchanged management.

16.3 Current Status

According to the existing, incomplete data, 11% of the Romanian's total area is covered with grasslands, with a significant floristic diversity and value. Some of them are less disturbed semi-natural habitats and exhibit a high floristic diversity. In Bulgaria about 30% of the farmland is believed to be of high importance for nature conservation objectives, that is -excluding arable farmland and permanent crops- probably about 10% of the country.

Most grasslands in the region, with the exception of alpine zones, are semi-natural and have taken over the place of natural grasslands of another type after the latter's destruction by natural or anthropogenic factors. Reference is made here to the forest glades, hay meadows and pastures in the central and lower mountain belts and parts of the hay meadows and most of the pastures in the hilly and flatland regions.

There is no data on the level of formal protection of the grasslands. In particularly for dry, mesophilous and wet grasslands estimates are difficult to make. A very significant part of these semi-natural grasslands is in Natura 2000 and are protected under the Habitat and Bird Directives of the European Commission. Land owners and users have to comply with a set of management prescriptions and get financial compensation; however these schemes are still to be elaborated. Most alpine and subalpine pastures are situated in protected areas, e.g. National and Nature Parks.

16.4 Opportunities for Improving the Level of Protection and Conservation in the Region

Within the framework of the protected territories, grassland should not be placed under a strict protection regime applicable in the reserves. With the exception of the high-mountain regions, such a regime would lead to natural succession replacement with shrub and forest communities. In the National and Nature Parks moderate grazing is recommendable, in order to maintain the high biological diversity in the pastures.

The fate of natural and semi-natural meadows and pastures is directly bound to the system of their use. Traditionally intended to provide fodder for livestock breeding, their ways of utilization, total area and practical maintenance measures obliges the Government to develop new directions for management of these grassland areas for livestock breeding. Funding for high nature value farming practices, mountain transhumance and rare livestock breeds is available as part of the European Common Agriculture Policy. Another way of supporting these farming systems is more related to marketing, e.g. labelling of products, promotion of region, etc.

In both countries enlargement of existing or establishment of new protected areas is proposed. However at least as important is raising awareness among existing park administrations of the benefits of certain, low-intensity farming practices for the conservation of species-rich grasslands, e.g. through their management plans and the work with local farmers.

In general for our region, not so much the delineation new protected areas but the improving the socio-economical situation of these marginal farmers to keep farmers on the land and have grasslands grazed under a low or moderate grazing pressure is seen as the way forward.

16.5 Constraints Against Improving the Level of Protection and Conservation in the Region

With the accession to the European Union, legal frameworks are improving in both countries. The development of agriculture since 1990 induced different and even contrasting damages to the natural environment, ranging from intensification to abandonment. Therefore improving the level of protection and conservation is a complex matter.

In the European Union, this is addressed in two ways. Firstly by increasing the baseline of environmental services for all agricultural land, mainly targeting more intensive farming systems to become more environmental sound businesses, and secondly by offering farmers who are producing public goods such as biodiversity compensation payments and other types of support. Measures to support farmers are often well targeted and designed, however many farmers don’t receive payments as they are not eligible for various reasons, e.g. not meeting certain eligibility criteria or bumping on administrative obstacles.

In general, profitability of extensive livestock rearing is low, as is the farmer’s education and social status. This is an important constraint to attract young people in the farming business.

16.6 Suggested Next Steps and Action Plan

On the ecological side, improve the understanding of the relation between farming system and biodiversity (in particular for meadow and pastures) and identify indicator species for monitoring of the ecological quality of grasslands.

On the economical side, improve the economy of these farming systems by making sure that targeted EU funding is reaching these farmers and by marketing their products. This requires intensive partnerships with a range of stakeholders from government, business and civil society at all levels in order to make the most of opportunities and overcome bottlenecks.

On the social side, improve education and social status of marginal farming and improve the quality of life in rural areas in the region.

16.7 APPENDICES

References

Data is based on two main sources:

> The Joint European Grassland Inventory Project, a series of national grassland inventory projects in Central and Eastern Europe, mostly funded by the Government of The Netherlands, started in 1999 and ongoing. More information and all national reports and maps (also for Bulgaria and Romania) can be found on http://www.veenecology.nl.
>
> WWF's work in the Danube-Carpathian region focused on ensuring the continued (and sustainable) management of grasslands and other farmlands of High Nature Value, achieved through a mixture of European agriculture policy funding and market support. More information can be found on http://www.panda.org/dcpo.

Detailed grasslands inventory reports from several countries in Central and Eastern Europe can be found on http://www.veenecology.nl

Pictures of high nature value farmlands in the region can be found on http://www.flickr.com/photos/vlahi_volunteer/collections/72157604651411448/

17. TEMPERATE GRASSLAND REGION: NORTH AMERICA

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17.1 Major Indigenous Temperate Grasslands Types

The Grasslands of North America are largely found in the central west of the continent. There are two generic Grassland divisions used here in this paper: the Central Grasslands, including the Great Plains; and the Intermontane Grasslands (Map 1) that covers the Chihuahua desert. These Grassland regions are relatively continuous regions, covering about 5 841 675 km^2 and extending longitudinally for about 1 500 km. The intermontane plains and most westward grasslands reach from lower British Columbia, south through the Columbia Plateau in the USA and onwards into the Mexican plateau in northern and central Mexico. To the east of the Pacific Mountain Ranges, the central plains start in the lower regions of the Prairie provinces in Canada, extend south through the Great Plains of the United States and further into northern Mexico, into states such as Chihuahua and Coahuila. In their natural states, these grassland areas are known as having distinguishing features such as relatively little relief, deep soils, grassland communities and semi-arid climates. The boundaries of the two main Grasslands regions merge in various ways into neighbouring desert and forest ecosystems. The mix of stands of deciduous trees and grasslands communities in the Aspen Parklands are examples.

In general physical terms, the Grasslands range mainly from smooth to hilly plains that are of low to moderate relief (100-175 m); the central plains are generally lower (800-1200 m above sea level [asl]) than the intermontane plains (1200 – 2400 m asl) or basins. The Grasslands do occasionally extend into the mountains and valleys. The soils are commonly deep and were derived from glacial moraine and lacustrine deposits as well as from eolian and residuum sources, while the origin of the Chihuahan desert soils are marine. The climatic regimes are dry and continental, characterized by hot summers and cold winters. These semi-arid areas have about 200-650 mm of annual rainfall (typically drier in the western and southern parts), and mean temperatures ranging from 12 to 20°C (typically warmer in the southern areas). The areas are subject to periodic, intense droughts and frosts. The Grasslands lack significant numbers of water bodies. Most of the rivers that are associated with the Grasslands have their origins in the Rockies and Sierra Madres outside the Grasslands; rivers commonly flow eastwards in the central plains and westwards from the intermontane plains. Closed basins and their pools in the form of potholes in the north and, lakes and playas toward the south are of crucial importance for migratory species, especially waterfowl.

The initial wealth of biological assets in the grasslands was strongly influenced by physical factors such as climate. For instance, following temperature and rainfall trends, in the central plains, the native short-grass communities occur more in the west sides, in the rain shadow of the mountains, with mixed-grass prairie in the central plains and tall-grass prairie in the wetter eastern reaches. More to the south, prickly scrub and grassland vegetation dominates the landscape. For the Chihuahuan desert its 15% of grasslands are primarily found towards the west and north of this ecoregion with shrublands dominating the rest. For the intermontane plains, grasslands and sagebrush steppes were once common in the northern parts and these communities become more dominated by sagebrush, cacti and scrub in the far southern regions. The Grasslands were productive home grounds for bison, pronghorn antelope, elk, mule deer, grizzlies, wolves, birds and reptiles. However, many native habitats have been radically transformed and many Grassland species have been reduced owing to agricultural developments. At a North American scale the decline of grasslands has resulted in grassland birds being the guild showing in the last 40 years a decline of 60%, steeper compared to bird guilds related to any other habitat,

17.2 Impact of Human Settlement

The long-term periods of human activities and land/water uses have led to the impoverishment of native Grasslands and biodiversity at all levels. Ironically, human activities and land/water uses are the critical ingredients to stabilize and rebuild the natural assets.

Over several centuries, the original Grasslands have been replaced by some of the most extensive farming and ranching areas of the Earth. Most of the Grasslands are now under private ownership and control. They range from being 94 % privately owned in Mexico to 30% in Canada. The valued agricultural activities and pursuits have, in particular, placed cumulative stresses on natural grassland areas and less than 15-20 % of the natural grassland areas remain with these communities, with the tall grass areas being impacted the most. The Grasslands with the greatest potential for agriculture (i.e. tall and mixed grasslands) have been disrupted primarily by croplands. Crop types vary from north to south owing to the differences in growing seasons and temperatures. Spring wheat and other grain crops such as barley and oats are common in the north. Corn is grown along the eastern, and moister northern and central portions, whereas winter wheat and sorghum predominate in the central and southern parts. Ranching has disrupted the drier grasslands largely through continuous and excessive grazing. Agricultural developments have introduced what is considered to be the highest density of road networks (e.g. often more than 8 000- 11 000 km/ km^2) in the continent. These roads have provided people with ready access to the Grasslands landscapes and often dissected natural pathways, interfering with water flow patterns and migration routes. Many of the drier and historically low productivity areas have been temporarily “improved” through largely unsustainable irrigation measures. This has placed expanding threats on the conversion of natural areas and on limited surface and underground water resources

While the Grassland landscapes are extensively used, the number of people living in there and number of large cities is low compared many other areas. About 13 million people reside in the central plains for instance. People tend to be concentrated increasingly in urban centers. Rural depopulation is a continuing trend in Canada and the United States and is often linked to the reduction of small family farms and the growth of larger agribusiness operations. Conversely, native populations inhabiting the plains are on the increase.

Often affecting the land surfaces less so than agriculture, oil & gas and mining are other important economic sectors that alter native grassland resources. Exploration activities and site operations associated with these sectors affect Grasslands. Along with the service industries (e.g. transportation, computer and communication networking, water and electrical supplies) that support them, these sectors have caused marked population growth in urban centres and expansion of urban areas.

Today, the continuance of prosperous but largely unsustainable agricultural activities throughout the grassland plains faces various problems. While these problems vary in degree and kind from region to region, they include increasingly lose of land from growing heavily subsidized biofuels, reduced nutrient potential in soils, use of genetically modified grains/crops increasing salinity, diseases, water shortages, unsound grazing practices, urbanization, oil and gas developments, and susceptibility to wind and water erosion.

While serving many economic and social needs well, the agricultural and related resource development industries have displaced or removed a disproportionate high number of grassland species and habits. The grasslands continue to have some of the highest species/habitats at risk.

17.3 Current Status

Protected area achievements and gaps are used to illustrate the status of native Grasslands. In North America (NA), many terms may be used to describe protected areas---parks, wilderness, refuges, conservation areas, reserves, sanctuaries, wildlife areas. Depending on their management purposes, they afford various forms of protection. To provide a brief summary of the status of protected areas in NA, this analysis at the level of North America is based only on federal, provincial and state parks and the central plains grasslands. Parks are fairly exemplary of other types of protected areas.

Protected areas (PAs) are one avenue to protect natural diversity and resources. The level of protection that is given these areas, their sizes and the types of adjacent land/water uses are important considerations. North Americans have been encouraged over centuries to use and exploit grasslands for agricultural purposes. Consequently, few natural areas now exist throughout the continent. For example, less than 20% of natural grasslands in the central plains (2 850 327 km^2) remain on average, and less than 15% of the Chihuahuan desert 629,000 km^2. Using parks as representative benchmarks on how well PAs have been employed in the central plains, 5.9% has been protected overall with the USA, Canada and Mexico at respectively 6.7%, 3.5% and less than 0.1%. These PAs have many inherent limitations as few areas are large and few have adequate levels of protection to readily sustain their natural biodiversity and integrity. About 26 % of Canada's park protected areas are greater than 1 000 ha; USA has more than 74% and Mexico has less than 0.1% (Table 1). The distribution of the sites is quite uneven. In Canada, Saskatchewan contains the greatest amount (5%) of the central plains protected in areas >1 000 ha in size; within the U.S., states such as South Dakota (24.6 %), Montana (15.5%) and North Dakota (10.9%) have substantially greater amounts protected than other states Of these large PAs, approximately 5% of them fall within the International Union for Nature (IUCN) categories I – III, and therefore are not managed for high degrees of protection. Most PAs are linked to IUCN category VI. As a synopsis of PAs, they are generally too few areas, too small, too under protected and mired in surrounding agricultural land uses. It is urgent to protect the remaining quality grasslands and critical to further engage agricultural land owners and managers into effective conservation and resource protection partnerships.

Table 1: Large park-based protected areas (>1,000 ha) in the Central Grasslands according to countries and the continent

Country	Area of country (km^2)	Area (km^2) and percent of the country that is in the Central Grasslands	% of central plains in each country	Number of protected areas >1,000 ha (%)	Area (km^2) of protected areas (% of grasslands in Central Grasslands of each country that is protected)
Canada	9 970 610	457 308 (5)	16	159 (26%)	15 874 (3.5)
United States (not including Alaska or Hawaii)	7 825 161	2 287 486 (29)	80	444 (74%)	153 856 (6.7)
Mexico	1 958 201	105 532 (5)	4	0	0
TOTAL (Continent)	**1 9753 972**	**2 850 327 (14)**	**100**	**603 (100)**	**169 730 (5.9)**

17.4 Opportunities and Constraints for Improving the Level of Protection and Conservation in the Region

In the Grasslands, the key opportunities, barriers and challenges for the short through to the long term periods will vary to a degree between Mexico, USA and Canada owing to their cultures, laws and interests. As well, variations will arise due to the array of smaller jurisdictional authorities (e.g. 4 provinces, 21 states and many districts/regions) within each country. There will also be differences based on the various types of remaining native grasslands ecosystems and their particular status. Despite the differences, there are many commonalties that can be addressed and several fundamental conservation measures that require a more inclusive approach amongst partners and jurisdictions

Biodiversity: The primary biodiversity issues have been related to the declines in the types and numbers of species and habitats. The extensive application of agricultural activities in the Grasslands has removed and impoverished the native biodiversity through direct impacts and fragmentation of natural areas. Fortunately, international/national through to regional/local action plans and strategies for biodiversity have been recently developed in many areas. Supporting these newer and more inclusive initiatives (e.g. Convention on Biological Diversity; Biodiversity Action Plans) as well as the more traditional initiatives (e.g. protected area programs, wildlife management plans,) has provided continued opportunities for conservation actions.

Land-use practices and management: Issues of common high priority embrace demands for water, insufficient areas of Grasslands receiving protection, inappropriate agricultural practices, draining and filling of wetlands, impacts of resource exploration and development activities, overgrazing, poor pasture management and water depletion aquifers. There are inherently many scales over which actions should take place from the farm gate to the continent order. Improving land /water use practices requires engaging many stakeholders, interest groups and partners as the Grasslands are largely privately owned and devoted mainly to economic interests.

Prairie Conservation Action Plans (PCAP) developed by each Canadian province; several bird conservation Grasslands Joint Ventures reaching from the USA into Canada and Mexico; and the Strategy for the Conservation of Chihuahuan Desert grasslands (ECOPAD) are examples of action-oriented plans that were driven by diverse partnerships. Many groups representing industry, multi-sector federal and provincial agencies and non-government organizations, and universities are involved in the partnership ventures. The vision of the plans is basically that the native Grasslands be sustained in a healthy state in which natural and human values are respected through goals such as to: sustain a healthy native prairie grazing resource; conserve the remaining native grasslands; maintain native prairie biological diversity; promote complementary sustainable uses of native grasslands; and increase awareness and understanding of native grasslands and its values. These plans require the use of incentives, best managements practices, policies and commitments. Older plans and actions that have been geared to local and continental scales such as the North American Waterfowl Management Plans and the Bird Conservation Action Programs are also considered as complementary pillars oriented to more specific conservation goals and partnerships.

Policies and socio-economic issues: The common concerns are about the general lack of incentives for conservation, restoration and sustainable use of grasslands and lack of productive and economic alternatives that would support desired lifestyles and grasslands conservation. Other shared concerns include global subsidies and government support policies for cash crops, increasingly related to biofuels at the expense of grasslands and lack of integration of policies related to overall economic and ecological systems. The three North American countries have other issues in common, ranging from lack of confidence in the planning process, on policies, programs, regulation and enforcement; lack of adequate participation by stakeholders and non-traditional sectors in planning for grasslands conservation; lack of better connections between concerns over private property rights in relation to grasslands conservation and of fully understanding the threats to the future economic security of agricultural producers. Other policy and socio-economic concerns involve the lack of incentives and alternatives for proper range management, and the lack of linkages between production and conservation policies and between producers and specialists that would foster rangeland conservation.

Demographics: Factors such as rural population declines, aging, and the deterioration of rural services and infrastructure are concerns throughout rural communities in North America. When fewer people live in or rely on rural areas, and have no direct contact with rural conditions, then it is difficult to have effective representation in planning and assessment discussions about grassland conservation.

Education and Communication: Another shared concern is the general lack of awareness among the population about the worth of environmental services provided by grasslands; the lack of grasslands conservation programs, inadequate communication among stakeholders and inadequate knowledge or appreciation of specific regional problems. Outreach programs, general reports and publications, interactive workshops, educational films, etc. are important tools to be further developed to reach a wider public.

Sharing practical experiences in conservation efforts, practices and tools are much required as well. This could be amongst conservationists but it is increasingly important to have sessions with a variety of the stakeholders and land owners so the sharing can come from different perspectives.

Research and Monitoring: A wide array of needs for research and monitoring that would be useful in targeting conservation issues, and providing knowledge to further enhance conservation guidelines and goals. These included: increase the number and extent of permanent areas for Grasslands conservation research; focus on wildlife and habitat for their recovery; improve assessment measures (indicators) of policies and programs; focus on impacts of invasive species land use change and climate change; identify threats/stressors at different spatial and temporal scales; and focus on integrated ecological, economic and social assessments.

17.5 Suggested Next Steps and Action Plan

The conservation of native Grassland resources falls under the scrutiny of many groups --- private landholders, governments, industries, conservationists, native communities, etc. Endangered species considerations have moved to the forefront of many of their discussions regarding grasslands conservation issues and initiatives. However, they are all faced with underlying habitat health and integrity issues that are much broader. Based upon key cooperative ventures and experiences related to Grassland conservation throughout North America, it is clear that successes will be dependent upon using an integrated focus that at least:

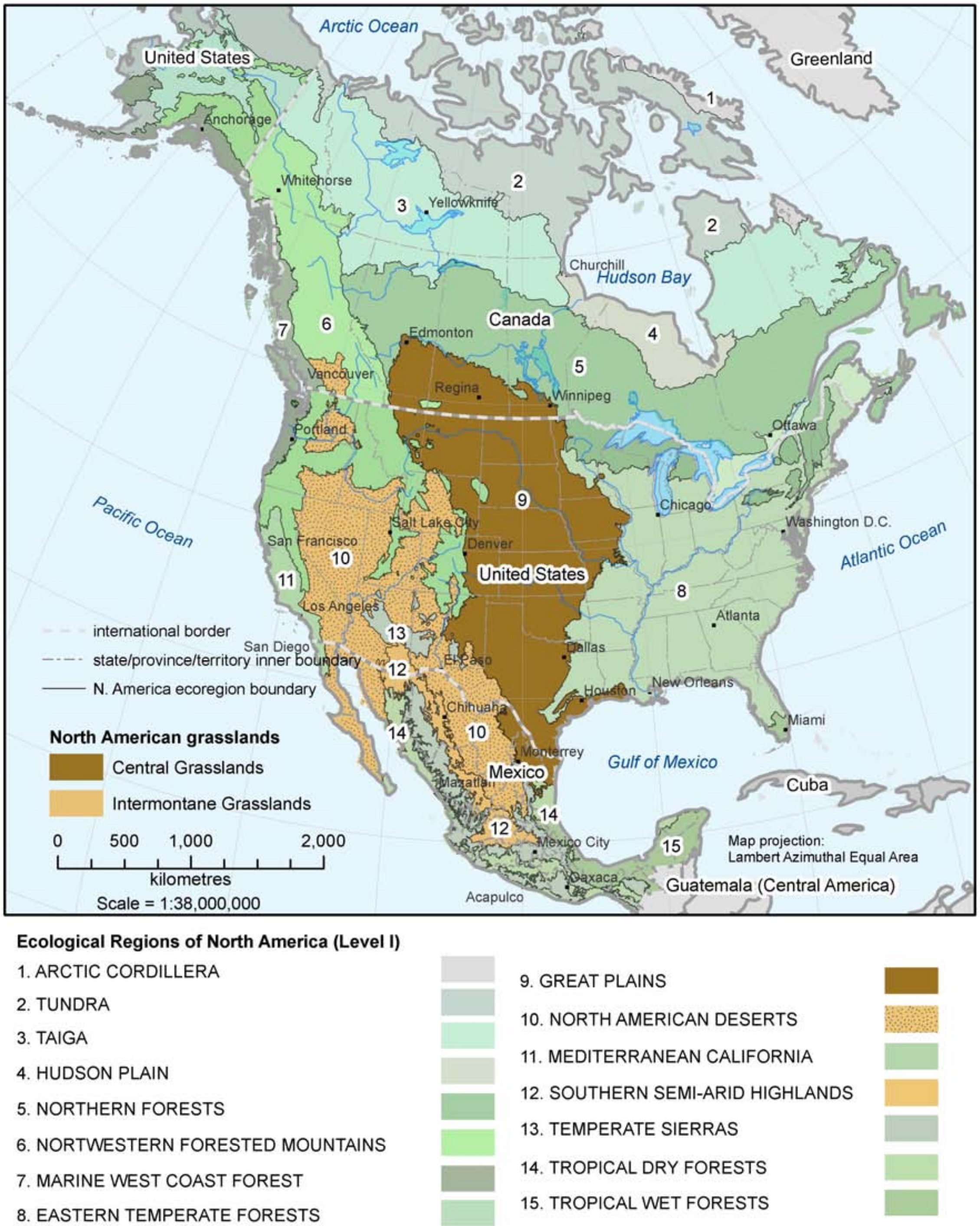
- further combines partnerships and skills among governments, First Peoples/Native Americans, industries, conservationists, private landowners and others in land stewardship;
- adopts hierarchical spatial and temporal development approaches based on habitat and ecological principles;
- sets measurable objectives and goals, and provides a means to monitor them;
- integrates biophysical, socio-economic, cultural and political considerations into planning and resource management decision-making; and
- operates according to principles of sustainable resource use, adaptive management and ecosystem based planning.

Managing Grassland regions for both conservation and traditional business reasons in a sustainable cooperative fashion is a type of contract that must be encouraged. Any such agreement should allow participants to meet their own needs without seriously compromising both the rights and needs of others and as well allows them to care for the basic environmental quality and biodiversity of the Grasslands. Its three principal goals should consider sustaining: (1) ecosystem integrity, (2) human health and well-being, and (3) natural resource conservation. Sustainability cannot be achieved without achieving all of those elements.

Ecosystem management is a key approach to achieving the goals. It requires people to shift their focus from primarily being interested in the production of goods and services to the maintenance and viability of ecosystems that are necessary to deliver goods and services. This approach when applied requires the commitment of all levels of government, businesses, industries, and all citizens to think, plan and act in terms of ecosystems. Approaches to resolving the endangerment of wildlife habitats and their associated species, should be seen as an integral component of an overall ecosystem management strategy for natural and modified areas.

17.6 Appendices

Map 1: North American Grasslands



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18. TEMPERATE GRASSLAND REGION: SOUTH AMERICA

18.1 Northern Andes (Venezuela, Colombia, Ecuador, northern Perú)

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18.1.1 Major Indigenous Temperate Grasslands Types

The tropical Andes region tops the list of worldwide hotspots for endemism and species/area ratio (Myers et al. 2007). A major contributor to the rich biodiversity and endemism of the tropical Andes is the páramo, a neotropical alpine ecosystem covering the upper parts of the tropical Andes from Venezuela south to northern Peru (6°30” S). Two isolated systems are located in the Sierra Nevada de Santa Marta in Colombia and in Costa Rica.

The páramo extends between the upper tree line and the perennial snow border (about 3200 - 5000 m altitude) reflecting a sort of island archipelago. Its total area is estimated at 35770 km2 (Josse et al. 2008). The isolated and fragmented occurrence of tropical mountain wetlands promotes high speciation and an exceptionally high endemism at the species and genera level (Sklenář and Ramsay 2001). At the regional and landscape scales, factors such as climate, geological history, habitat diversity and also human influence determine páramos´ biota diversity (Simpson 1974; Vuilleumier and Monasterio 1986; Luteyn 1992). Local climatic gradients further complicate within-mountain diversity patterns, with spatial community changes often occurring over short distances (Cleef 1981; Ramsay 1992; Sklenář and Balslev 2005). The páramo ecosystem hosts 3595 species of vascular plants distributed in 127 families, and 540 genera (Sklenar et al. 2007). About , 14 of these genera and 60% of these species are endemic to the Northern Andes (Luteyn 1999), and adapted to the specific physio-chemical and climatic conditions, such as the low atmospheric pressure, intense ultra-violet radiation, and the drying effects of wind (Luteyn et al. 1992).

The physiognomy of tropical alpine vegetation varies within and between regions but certain features are shared such as similar growth forms of the dominant plants (Coe 1967; Cleef 1978; Cuatrecasas 1968; Hedberg 1964; Monasterio & Vuilleumier 1986; Smith 1994; Smith 1977; Smith & Young 1987). Previous works that describe the páramo vegetation (i.e. Acosta-Solis 1986; Cuatrecasas 1958; Harling 1979; Cleef 1981; Acosta-Solís 1984; Ramsay 1992; Jørgensen y Ulloa 1994) define three main páramo units above the treeline, according to the physiognomy and structure of the vegetation: (1) the sub-páramo or shrub páramo, (2) grass páramo or pajonal – frequently dominated by stem rosettes of the genus *Espeletia* or *Puya* - and (3) super-páramo. *Polylepis* woodlands, probable remnants of more extensive upper Andean forest in the past (Fjeldså 1992; Lægaard 1992), also contribute to the mosaic of páramo habitats

The sub-páramo covers the ecotone between the transition of the upper montane forest and the treeline, and in many cases is dominated by upright shrub (e.g. *Valeriana microphylla*) and prostrate shrubs (e.g. *Pernettya prostrata*) of the genera *Valeriana, Gynoxys, Diplostephium, Pentacalia, Monticalia, Chuquiraga, Berberis, Hypericum, Gnaphalium, Lupinus, Loricaria, Calceolaria* and *Hesperomeles*. The grass páramo appears gradually as the effects of elevation and climate lessen the shrubby growth-forms and the dominance of the tussock grasses (i.e. *Festuca*, *Calamagrostis* and *Stipa*) is evident together with stem rosettes (e.g. *Espeletia, Puya*), small patches of upright shrubs of the genera *Diplostephium,*

Hypericum and *Pentacalia* (Ramsay and Oxley 1997), and patches of monotypic or mixed forest of *Polylepis*, *Gynoxis* or *Buddleja*.
The super-páramo vegetation is primarily found in Ecuador and Colombia, on the slopes of the highest mountains at 4100–4800 m altitude. This category can be divided in two altitudinal belts (Sklenar 2000). The lower super-páramo has a closed vegetation of postrate shrubs (i.e. *Loricaria, Pentacalia*), cushions (*Plantago rigida, Xenophyllum* spp.*, Azorella* spp.), acaulescent rosettes (*Hypochaeris*, *Oritrophium*), and tussock grasses (*Calamagrostis*, *Festuca*). The upper super-páramo at 4400–4800 m lacks postrate shrubs and tussock grasses and plant cover is patchy. Recent observations indicate that floristic composition of the super-páramo depends on site-specific water availability, which in turn is highly correlated with precipitation pattern of each mountain area (Sklenar & Lægaard 2003; Sklenar et al. 2008). Topographic variations at site scale result in azonal habitats (cushion bogs, mires and aquatic vegetation) at perhumid areas, and even finer scale differences within these habitats (Cleef 1981; Bosman et al. 1993).

This ecosystem plays a fundamental role in sustaining the livelihoods of millions of people, providing essential ecosystem services such as water production for urban use, irrigation and hydropower generation (Buytaert *et al.* 2006; Bradley *et al.* 2006). The generation and preservation of these services strongly depend on the integrity of the ecosystem, which is expressed as a delicate inter-dependency amongst three key elements: a) hydro-physical properties of the soil, b) vegetation structure, and c) water cycle. The maintenance of these properties allows the existence of different elements of this rich biodiversity aggregated at different spatial scales.

18.1.2 Impact of Human Settlement

Human activities in the páramo have increased drastically over the last two decades (Gondard 1988; de Koning et al. 1998). The páramo is progressively more used for intensive cattle grazing, afforestation with exotic species, cultivation and human inhabitance (Buytaert et al. 2006). There are strong scientific evidences that these activities have a drastic impact on the integrity of the ecosystem. Land use practices have a significant, negative effect on composition and structure of the vegetation (Hofstede 1995; Ramsay and Oxley 1997; Suárez and Medina 2001), on their above-below ground biomass ratio (Hofstede et al. 1995; Ramsay and Oxley 2001), on hydrological behaviour of the system - in particular water production and regulation capacity - (Farley et al. 2004; Buytaert et al. 2006, 2007), and on chemical/physical properties of the soils (Poulenard et al. 2001, 2004; Podwojewski et al. 2001).

18.1.3 Current Status

Natural State:
This is a very tricky question. Páramos have been described by various authors as a cultural landscape, which means extensive human use has occurred there for centuries. It is very difficult to define a boundary that allows differentiation between “natural” páramos from “transformed” ones. Nevertheless, at least 60% of the “original” páramo extension remains (F. Cuesta com.pers.). This figure includes the páramo that has been “used” for centuries. The question still to be answered is how much of that 60% can be classified as really “natural”.

Formal Protection:
In total, 43.4% of páramo biome is formally protected. This protection is distributed within the different countries, as shown in Table 1.

Table 1: Protected Areas Within the Countries

Country	Total páramo area (Ha)	Formally protected area (Ha)	Percent of protection (%)
Colombia	1,405,765	621,768	44.2
Ecuador	1,835,834	719,262	39.2
Perú	95,346	5,381	5.6
Venezuela	239,854	205,109	85.5
Total	**3,576,798**	**1,551,520**	**43.4**

18.1.4 Opportunities for Improving the Level of Protection and Conservation in the Region

The opportunities are high due to the increasing awareness of the importance of páramo in the four countries as water providers for the major Andean Cities and for irrigation. However, the creation of protected areas (such as national parks) is not the only means for improving the level of protection within the region. Conservation agreements at Municipalities and community scales to protect specific páramo areas are much more feasible nowadays. For instance, Proyecto Páramo Andino, a major UNEP-GEF initiative, is contributing to this purpose and identifying this local strategy as one of the most effective ways to protect páramo areas. It needs to be mentioned that agreements of this kind already taking place are not included in the official statistics of protected areas given above (item 5bii).

18.1.5 Suggested Next Steps and Action Plan

To define key areas for páramo protection based on a conservation planning framework.

18.1.6 Appendices

Map 1: Important existing and proposed páramo areas are highlighted in yellow

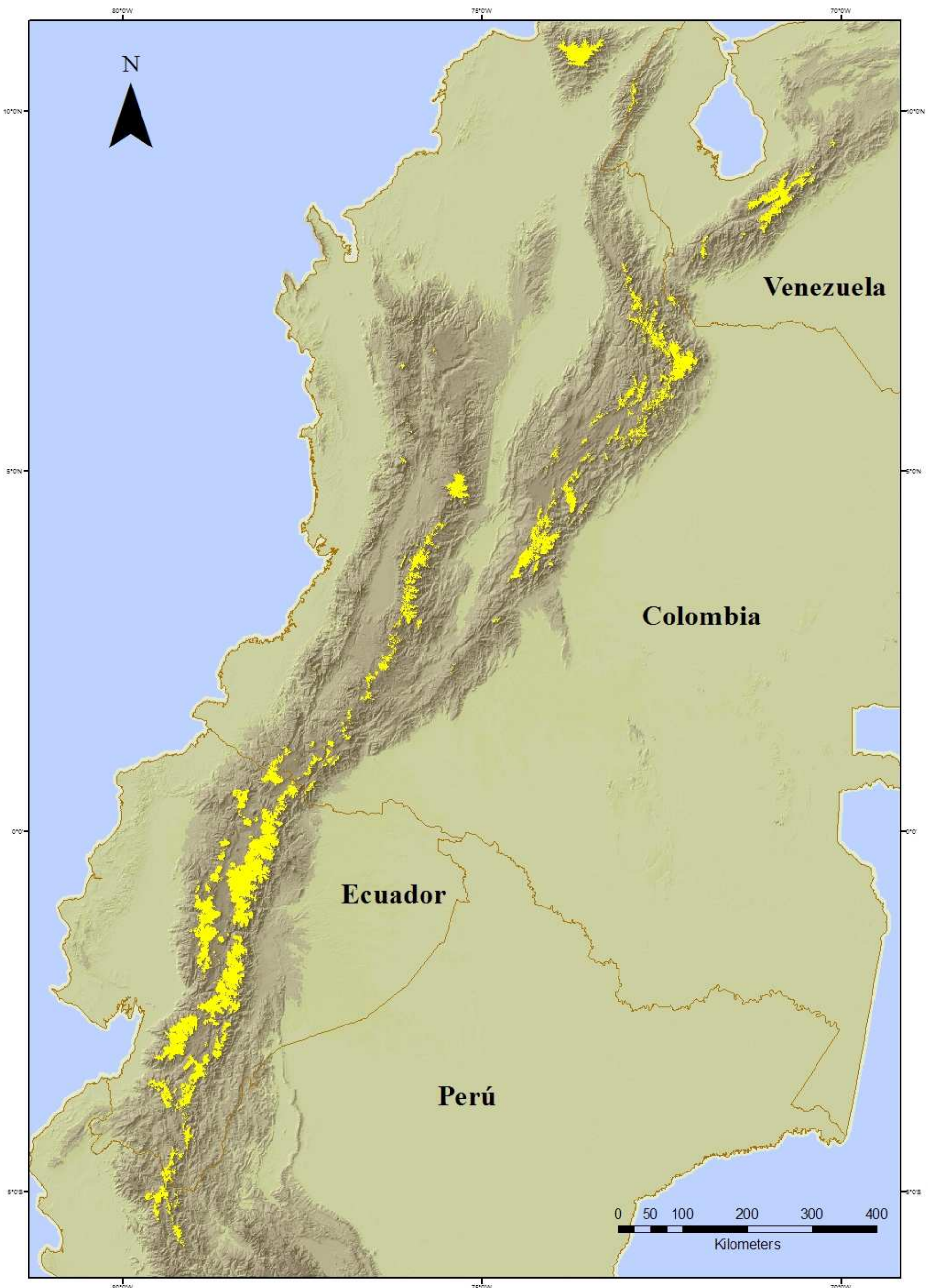

Table 2: List of legally protected grassland areas in the region and size

Extracted from: Cuesta F., K. Beltrán, B. De Bievre. *In press*. Los páramos de los Andes del Norte. Mecanismo de Información de Páramos. Proyecto Paramo Andino. CONDESAN, GEF-PNUMA.

COUNTRY	Protected Area	Area occupied by páramo ecosystem (ha)
Ecuador	Antisana	62,810
	Cajas	28,722
	Cayambe Coca	159,734
	Chimborazo	50,296
	Cotacachi Cayapas	27,449
	Cotopaxi	32,011
	El Angel	15,371
	El Boliche	41
	ILinizas	30,030
	LLanganates	93,788
	Pasochoa	252
	Podocarpus	23,964
	Sangay	194,793
Colombia	Chingaza	36,321
	Complejo Volcanico Dona Juana	6,144
	Cordillera de los Picachos	3,709
	El Cocuy	140,437
	Galeras	2,642
	Guanenta-Alto Rio Ponce	2,672
	Iguaque	2,677
	Isla de la Corota	3,045
	Las Hermosas	62,702
	Los Farallones de Cali	888
	Los Nevados	49,503
	Munchique	131
	Nevado del Huila	40,549
	Paramillo	953
	Perija	34
	Pisba	11,346
	Purace	24,217
	Serrania de los Yariguies	428
	Serrania de Minas	103
	Sierra Nevada de Santa Marta	120,556
	Sumapaz	106,350
	Tama	4,303
	Tatama	1,993
Venezuela	Dinira	3,150
	El Tama	1,326
	Juan Pablo Penialosa en los Paramos Batallon y la Negra	14,113
	Perija	10,859
	Sierra La Culata	88,553
	Sierra Nevada	73,308
	Tama	103
	Teta de Niquitao-Guirigay (Sector A)	7,397
	Teta de Niquitao-Guirigay (Sector B)	6,369
Perú	Tabaconas Namballe	5,381
	TOTAL	**1,551,523**

Table 3: Type of páramo ecosystem, size, protected surface and percent of protection
Extracted from: Cuesta F., K. Beltrán, B. De Bievre. *In press*. Los páramos de los Andes del Norte. Mecanismo de Información de Páramos. Proyecto Paramo Andino. CONDESAN, GEF-PNUMA.

Ecosystem type (páramo)	Total area of ecosystem type (Ha)	Surface within Protected Area (Ha)	Ecosystem protection (%)
Arbustales Bajos y Matorrales Altoandinos Paramunos	170,660	46,097	27.0
Arbustales y Frailejonales Altimontanos Paramunos	1,394,549	685,324	49.1
Bofedales Altimontanos Paramunos	333,800	187,730	56.2
Bofedales Altoandinos Paramunos	14,836	3,419	23.0
Bosque de Polylepis Altimontano Pluvial de los Andes del Norte	1,144	1,115	97.4
Nieve/Glaciares	23,073	22,421	97.2
Pajonales Altimontanos y Montanos Paramunos	1,277,754	435,469	34.1
Pajonales Arbustivos Altimontanos Paramunos	199,920	41,561	20.8
Pajonales Edafoxerofilos Altimontanos Paramunos	74,125	30,400	41.0
Vegetacion Geliturbada y Edafoxerofila Subnival Paramuna	98,552	93,392	94.8
Vegetacion Palustre y Acuatica Altoandina Paramuna	12,766	4,592	36.0
TOTAL	**3,601,179**	**1,551,520**	**43.08**

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18.2 Central Andean Grasslands (central and southern Perú, western Bolivia, northern Chile and northwestern Argentina)

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18.2.1 Major Indigenous Temperate Grasslands Types

Introduction: Here we describe the Central Andean Grasslands, understood in a broad way as open vegetation, mostly dominated by grasses, herbs and sometimes shrubs, without, or with sparse, tree cover, in the high Andes, mostly above 3000 m. The geographic delimitation is to some degree arbitrary and practical. The northern Andean grasslands of the páramos are treated in a separate chapter (Venezuela, Colombia, Ecuador, northern Peru). For the Central Andes we include here a variety of physiognomic and floristic types south of the northern páramos and extending along the Andes through central and southern Perú, western Bolivia, northern Chile and northwestern Argentina.

Origin and nature of grasslands discussed: As the purpose of this work is to identify conservation priorities, it must include a discussion about the origin and nature of these 'grasslands', an issue still hotly debated and far from definitely resolved. In summary, the debate relates to whether these grasslands are 'natural' (i.e. original, pre-human), or anthropically determined. What does emerge from this debate is that there is no single answer, either for the whole region, or for one of its vegetation types. Rather there will be particular answers for particular areas. Some areas now in grasslands were previously woodlands. Through fire and grazing, they have become grasslands. Conservation of these areas must therefore consider the human history of use, and define priorities based on landscape values, flora and fauna, endemism and unique representativeness.

Classification and percentage protected: There are many ways to classify the 'grasslands' within the geographic region defined above. In such a short treatment we can only superficially deal with the huge real heterogeneity, without doing justice to the abundant literature and expert opinions on the subject. In addition, whatever classification is used, mapping these categories has not been done for the whole region at a reasonable scale. Here we have therefore had to make some rough educated guesses about the equivalence of ground based classifications (such as those based on floristic and physiognomic elements described below) with satellite based large scale mapping exercises such as those of (Eva et al., 2002). One of us (Juan Carlos Ledezma) superimposed the Eva et al. (2002) classification with the IUCN protected areas shapefiles for South America to arrive at the percentages of each category under some form of protection.

General grassland types: The Central Andean grasslands are classified into types by physiognomy, floristics and bioclimates. Within the area defined, moister, denser grasslands on the eastern fringes of the Andes are called **páramos, páramo yungueño** or **Andean pastures** (pastizal andino). These are a southern extension of the northern Andean páramos, floristically and physiognomically related, extending from the northern páramos, through Perú, Bolivia and northwestern Argentina south to the mountains of Córdoba province.

To the west and in rainshadow areas, páramos are replaced by progressively drier vegetation types broadly encompassed in the term **Puna**. The term puna encompasses diverse ecosystems of the high Central Andes above 3400 m from northern Peru to northern Argentine. Troll (Beck, 1985; Ruthsatz, 1983; Troll, 1959; Troll, 1968) distinguished between moist puna, dry puna, thorn puna and desert puna. The term covers high dense grassland with some shrubs in the moist puna and transition to the páramo yungueño, open grassland, cushion vegetation (*Azorella*, *Pycnophyllum*) and tolares (evergreen resinous shrublands of *Baccharis* and *Parastrephia*) in the dry puna and thorn puna. The desert puna is dominated by the huge salt lakes with scattered halophytes around and in the depressions. The thorn puna may be included as a type of desert puna in the SW. New terms and delimitations for the puna of Bolivia were recently proposed by (Ibisch et al., 2003; Navarro, 2002).

The highest reaches above puna and páramo (mostly above 4200 m depending on areas) belong to a phytogeographically distinct unit called the **High-Andean** (altoandino) region (e.g. (Cabrera, 1976; Cabrera and Willink, 1973). Here grasses become sparser but cushions and cryptofruticetum become dominant, with a larger number of endemic species (Halloy, 1985).

Each one of these broad types can be subdivided into distinct categories, some or which are briefly discussed below.

I) Páramo

The páramo yungueño is found on the Eastern fringe of the Andes, above present day treeline, and conditioned by extremely moist and cloudy conditions (perhumid). It extends from northern Perú to central Argentina (Beck, 1998; Halloy, 1997; Rangel Ch., 2004; Troll, 1959)

The vegetation is a tall tussock grassland with *Cortaderia*, *Deyeuxia (*sometimes included in *Calamagrostis)*, *Festuca* and *Poa*, "chusqueales" with bamboos of the genus *Chusquea*, undescribed species of *Neurolepis* rare herbaceous gramineae such as *Aphanelytrum procumbens* and *Hierochloe redolens*. Between the grasses are prostrate shrubs such as *Miconia chionophylla*, herbs such as *Arcytophyllum, Oritrophium, Laedstadia*, *Jamesonia* ferns and occasionally the short arborescent fern *Blechnum loxense* (or related species). There are also shrubs and subshrubs of the compositae *Baccharis, Gynoxys, Loricaria, Senecio* (s.l.), and also *Buddleja montana*, *Escallonia myrtilloides* and *Hypericum laricifolium*. Overgrazed areas become short pastures.

Ever-wet climatic conditions are unfavorable to stock, and the human population is low. There are however ancient Inca and pre-Inca roads, terraces and houses. Mining in colonial times also increased penetration. Occasional burns in exceptionally dry years (Laegaard, 1992) seem to maintain this ecosystem. Stock raising is still dispersed nonetheless, and mining as well as extraction of firewood and canes is still performed.

The distribution of these páramos is naturally fragmented by topography and climate. Their total area is reduced. Being located in a transition between low and high areas, dry and wet, they are probably highly vulnerable to climate change and desiccation. They are also increasingly fragmented by roads, deforestation, mining and other activities.

II) Puna

The puna is dominated by grasses (*Deyeuxia*, *Festuca*, *Poa*) with prevalence in the dryer areas of *Festuca orthophylla* and several species of *Stipa*. Low herbaceous grasses of *Muhlenbergia* and *Distichlis humilis* together with halophytic shrubs cover the extended salt plains. Local fresh water cushion peat bogs or fens (bofedales or ciénagas) are dominated by vascular plants in the Juncaceae, Cyperaceae, and Asteraceae (García and Beck, 2006).

The aquatic flora of the numerous lakes is diverse with a few endemic species; playing an important role for human use (boats, handicrafts) and cattle fodder. Few trees besides *Polylepis* and *Buddleja* grow nowadays in the Puna.

Human habitation is widespread in the puna, tending to increase toward the moister eastern areas. Large areas of the central puna are cultivated with native tubers and grains. Practically all of the puna is grazed in some form or other by sheep, alpaca and llamas, with cattle, horses, donkeys and pigs in localized moister areas. Grazing is typically migratory, with extensive grasslands/shrublands used during moister parts of the year and stock concentrated in the ciénagas/bofedales in the drier part of the year. Grazing is accompanied by fire as a management tool.

In spite of altitude and extreme climatic conditions the Puna is home to about 1500 plant species with about 40 endemic genera. Most of the genera known from the Parámo and Jalca are also found in the Puna.

As described above, the puna covers an area of more than 10 degrees latitude and up to 300 km wide with a large diversity of subtypes. The following physiognomic types can be distinguished, in addition to the climatic types distinguished by Troll:

- Praires or pastures, dominated by grasses and other herbs
- Tolares or resinous shrublands, dominated by evergreen resinous shrubs (*Baccharis* and *Parastrephia*, also *Chersodoma* and other genera)
- Bosquecillos de Polylepis or open Polylepis woodlands (these woodlands raise the issue mentioned above of what the original vegetation was, e.g. (Ellenberg, 1966; Kessler and Driesch, 1993)
- Salt soils and salt flats in the central and southern endorheic basins with halophytes
- Ciénagas, bofedales, fresh water peat bogs or fens (Ruthsatz, 1993; Ruthsatz, 1995; Ruthsatz, 2000)
- Aquatic vegetation

The latter two, although of small extension, are a conservation priority. They concentrate high levels of biodiversity, endemism, provide pasture for stock, and are critical for water regulation and availability. They have also shown clear signs of vulnerability to climate change and to poor management practices (Alzérreca A. et al., 2003; Flores Cartagena, 2002; Yager et al., 2007).

Many puna areas are modified, to different degrees, depending on proximity of human settlement. Extensive grazing (with the adjunct of fire) is most widespread and threatens pastures, shrublands and woodlands, as well as being concentrated in ciénagas and at the edges of wetlands in the dry season. More locally, puna areas are affected by mining and mine tailings, by agriculture, and by urban development and waste disposal. However, the millennial development of agriculture in the northern moist puna has become part of the hybrid or comensal human-nature landscape, with large areas developed over centuries into terraced hills. This landscape itself, with its attendant sustainable agricultural methods, is worthy of preservation (Halloy et al., 2005).

III) High Andean

Above the puna region, between around 4200 or 4500 m and the highest limit of vegetation, grows a sparse vegetation dominated by a few grasses (*Deyeuxia, Poa*, and endemics such as *Anthochloa lepidula, Dielsiochloa floribunda, Dissanthelium calycinum, D. trollii* and *D. macusaniense* (Beck, 1998; Renvoize, 1998) and a large number of cushion, plaque, rosette and dwarf shrubs (*Azorella, Pycnophyllum, Nototriche, Werneria, Xenophyllum*).

At lower altitudes (4400- 4800 m), denser grass swards develop with *Deyeuxia (Deyeuxia minima), Agrostis, Poa and Stipa*. Within the graminoid mosaic there are also *Luzula racemosa* and *Gentianella* (Beck, 1988) and cyperaceae of the genus *Trichophorum* and the endemic *Oreobolopsis tepalifera*, together with mostly perennial herbs. Most common families include Asteraceae, Caryophyllaceae, Geraniaceae, and Malvaceae (Gonzales Rocabado, 1997).

Peat bogs and lakes also form large wetlands in the high Andean. These are critical areas, although small, for their inordinately large diversity, concentration of bird fauna, and water regulation for lower regions.

Being more remote, and mostly above the limits of human habitation, the high-andean has only sparse grazing impacts. However it has suffered from targeted harvesting of particular species of animals and plants (particularly medicinal plants and firewood). And given slow regeneration rates due to cold temperatures and low atmospheric pressure, combined with the insular nature of the high altitude sites, small populations of restricted endemics are threatened. Climate change has already meant a rise in the limits of cultivated plants into this region and a rise in the range of grazing camelids (Seimon et al., 2007a; Seimon et al., 2007b).

18.2.2 Impact of Human Settlement

The landscape has been modified in the past and is changing under man's action as shown by the pre-Hispanic settlements, terraces and the present intensive farming activities (Ellenberg, 1979). A lot of the humid puna has been converted in farming ground, the steeper areas and the fallow land are used for grazing by cattle, sheep, lama and alpaca, in the southern more arid areas only lama survive under hard environment conditions. Recently more areas of the dry puna in the south of Oruro are converted in mechanized quinua cultivation.

Numerous edible tubercles of *Solanum, Oxalis, Ullucus* and *Tropaeolum* are originated in the Puna, beside the pseudo cereals *Chenopodium quinoa* (quinua) and *Ch. pallidicaule* (cañahua) and many medicinal plants known by the Aymara and Quechua.

Stock grazing and attendant fire management is one of the main threats in the three broad grassland types described. This is clearly more obvious in the drier areas, where desertification has progressed over wide areas (dry puna, shrubland, and in bofedales)(Alzérreca A. et al., 2003).

18.2.3 Current Status

Conservation efforts are still poor and locally concentrated in a few protected areas.
Percentage of surface included in Protected Areas when considering the whole Puna ecoregion is minimum (Map 1 and Table 1).

Table 1: Percent of indigenous vegetation formally protected for the whole puna ecoregion according to Eva et al. (2002). (See map references for vegetation type specifications)

Ecosystem type	Total Area of Ecosystem type (km2)	Surface within Protected Area (km2)	Ecosystem protection (%)
Moorlands / heathlands	2.748	620	22,55
Closed montane grasslands	102.141	4.814	4,71
Open montane grasslands	120.278	6.053	5,03
Closed steppe grasslands	11.333	1.759	15,52
Open steppe grasslands	84.808	4.746	5,60
Sparse desertic steppe shrub /grasslands	191.622	12.532	6,54
Barren / bare soil	277.927	32.851	11,82
Desert	174.296	2.663	1,53
Closed shrublands	267.184	27.536	10,31
Open shrublands	122.800	8.826	7,19
TOTAL	1.355.135	102.401	8%

18.2.4 Opportunities for Improving the Level of Protection and Conservation in the Region

Apparently in a few areas migration of people to the urban centers reduced pressure, but mostly overgrazing and agricultural goes on. All activities must be coordinated with the local people, who are getting more interested if they find other opportunities of income.

18.2.5 Constraints Against Improving the Level of Protection and Conservation in the Region

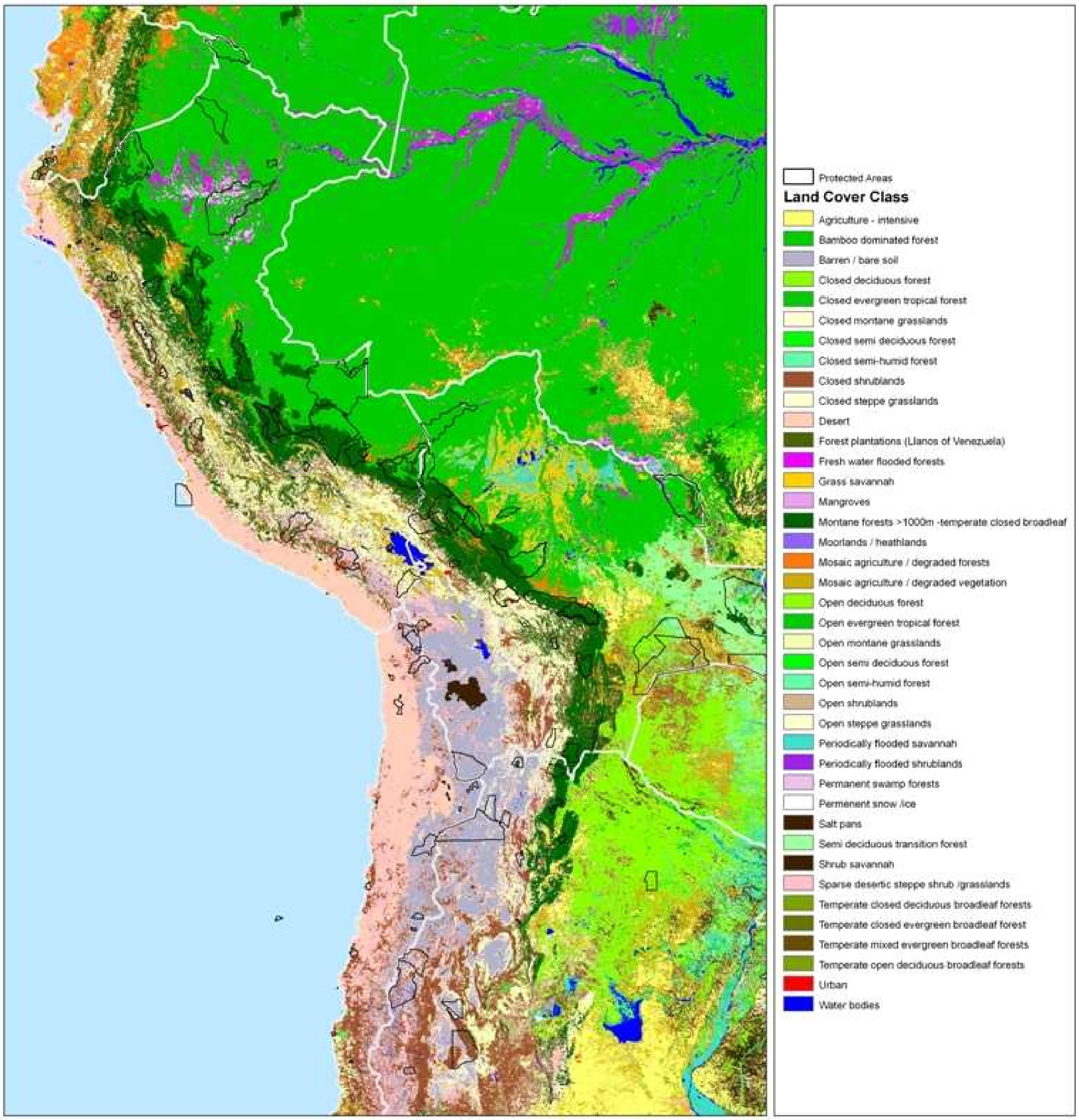
Growing population, opening of new roads, mining activities.

18.2.6 Suggested Next Steps and Action Plan

Uniform inventory and mapping activities in the 4 countries, select areas with good conservation status and concentration of endemics and vulnerable species.

18.2.7 Appendices

Map 1: Protected areas of whole Puna ecoregion (adapted from Eva et al. 2002)



Land classification system (Eva et al. 2002)

Vegetation types definitions:
Moorlands / heathlands: Ciénagas, bofedales, fresh water peat bogs or fens (too small to see in the map)
Closed montane grasslands: Paramos, partially
Open montane grasslands: Interandean valleys, mostly, little grassland
Closed steppe grasslands: Moist Puna
Open steppe grasslands: Moist Puna, partially
Sparse desertic steppe shrub /grasslands: Altoandino, rocky dry puna with thorn shrubs, partially
Barren / bare soil: Dry and desertic Puna
Desert: Only a reduced surface may be included
Closed shrublands: different areas, some prepuna and interandean valleys, also Polylepis woodlands
Open shrublands: NO PUNA, dry forest?
MISSING SURFACE:
Mosaic agriculture/degraded vegetation: Moist Puna, partially, sometimes converted to agriculture

Table 2: List of legally protected grassland areas in the region by both grassland type and size

Country	Protected Area	Area (km2)
Argentina	Baritú	1866
	Calilegua	763
	Campo de los Alisos	7257
	Copo	2081
	El Leoncito	600
	El Rey	446
	Iberá	1250
	Iguazú	493
	Ischigualasto	532
	Laguna Brava	3811
	Laguna de los Pozuelos	1131
	Laguna de los Pozuelos BioRes (National)	831
	Los Andes	2539
	Los Cardones	655
	Olaroz-Cauchari	2202
	Río Pilcomayo	513
	San Guillermo	8074
	Talampaya	1925
	Urugua-í	878
	Valle Fértil	7382
Bolivia	Aguarague	1091
	Amboró	12651
	Apolobamba	4745
	Carrasco	6964
	Cavernas del Repechón	212
	Cordillera de Sama	1054
	Cotapata	617
	Eduardo Avaroa	6854
	El Palmar	606
	Estación Biológica del Beni	1352
	Iñao	2646
	Isiboro Sécure	1026
	Kaa-Iya Del Gran Chaco	6347

	Madidi	9289
	Manuripi	7567
	Noel Kempff Mercado	1612
	Otuquis	10352
	Pilón Lajas	4012
	Sajama	1005
	San Matías	2993
	Tariquia	2482
	Toro Toro	1683
	Tunari	3292
Chile	Bosque de Fray Jorge	8989
	La Chimba	3303
	La Portada	26
	Las Chinchillas	4281
	Las Vicuñas	2081
	Lauca	1404
	Llanos de Challe	458
	Llullaillaco	3796
	Los Flamencos	738
	Nevado de Tres Cruces	1701
	Pampa del Tamarugal	996
	Pan de Azúcar	3177
	Pichasca	117
	Pingüino de Humboldt	330
	Rapa Nui (or Easter Island)	1653
	Salar de Surire	1742
	Volcán Isluga	1676
Peru	A.B. Canal Nuevo Imperial	18
	Algarrobal El Moro	308
	Allpahuayo Mishana	584
	Alto Mayo	2092
	Alto Purús	2510
	Amarakaeri	4023
	Ampay	3865
	Ashaninka	1856
	Aymara Lupaca	3207
	Bahuaja Sonene	2329

Bosque de Pomac	6097
Calipuy	5256
Cerros de Amotape	985
Chacamarca	2462
Chancaybaños	2854
Cordillera Azul	1372
Cordillera de Colan	656
Cordillera Huayhuash	688
Cutervo	2572
El Angolo	681
El Sira	6219
Gueppi	6203
Huascarán	3467
Huayllay	6869
Junín	533
Lachay	5226
Lagunas de Mejía	720
Laquipampa	9502
Machiguenga	2199
Machu Picchu	374
Manglares de Tumbes	3100
Manu	1696
Megantoni	2161
Nor Yauyos-Cochas	2243
Otishi	3077
Pacaya Samiria	2192
Pagaibamba	2084
Pampa de Ayacucho	302
Pampa Galeras Barbara D' Achille	8074
Pampa Hermosa	9694
Pantanos de Villa	268
Paracas	3407
Pucacuro	6458
Pui Pui	540
Puquio Santa Rosa	307
Purús	2020
Río Abiseo	2776

	Río Rímac	538
	Salinas y Aguada Blanca	3688
	San Matias San Carlos	1506
	Santiago Comaina	1682
	Sub Cuenca del Cotahuasi	4919
	Sunchubamba	625
	Tabaconas Namballe	348
	Tambopata	2776
	Tingo María	4847
	Titicaca	9951
	Tumbes	819
	Yanachaga-Chemillen	1118
	Llaneza	3199
	TOTAL	**344,291**

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18.3 Río de la Plata Grasslands (Argentina, Uruguay and Brazil)

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18.3.1 Major Indigenous Temperate Grasslands Types

The Río de la Plata grasslands are the largest complexes of temperate grasslands ecosystems in South America, comprising an area of approximately 750,000 km2 (Soriano et al. 1992). These grasslands include the Pampas ecoregion of Argentina (540,000 km2) and the Campos ecoregion of Uruguay, northeastern Argentina and southern Brazil (Miñarro and Bilenca 2008).

Most of the Río de la Plata grasslands occur over a vast plain, the Pampas, formed by thick Quaternary loess deposits that have experienced varying degrees of local reworking. Exceptions to this general pattern are most of the Uruguayan and Brazilian portions of the region, where a diverse array of rocks such as Precambrian granite, Carboniferous sandstone, and Jurassic basalt is exposed to surface and soil-forming processes (Paruelo et al 2007).

Pampas and Campos have a conspicuous and unique biodiversity, with thousands species of vascular plants, including more than 550 different grass species. Mesothermic grasses prevail in this region of mild climate (mean annual temperature of 10 to 20◦C) and a mean annual rainfall between 400 and 1600 mm (Soriano et al. 1992). Pampas grasslands were formerly dominated by tussock grasses that covered most of the ground. Dominants comprise several warm-season (C4) and cool-season (C3) grasses in approximately similar proportion. The most common genera among the grasses are *Stipa*, *Piptochaetium*, *Paspalum* and *Bothriochloa*. Shrubs are little represented, but in some places, probably as a result of disturbance, one of several species of *Baccharis* and *Eupatorium* may become locally dominant (Paruelo et al. 2007).

Campos grasslands are dominated by grasses of the genera *Andropogon, Aristida, Briza, Erianthus, Piptochaetium, Poa, Stipa, Paspalum, Axonpus and Panicum* (León 1991). Species composition in Northern Campos is even more enriched in subtropical species (*Andropogon*) (Paruelo et al. 2007). There are about 450-500 bird species -60 of them are strict grassland dwellers- and nearly 100 species of mammals (Bilenca and Miñarro 2004).

The community of grassland birds that make use of the southern cone grassland biome is really diverse and abundant. There are several threatened species, and the main reason of this decline is habitat loss. Perhaps the most emblematic species is the Eskimo Curlew (*Numenius borealis*), which is probably extinct, owed to habitat loss and sport hunting during late 1800s. Other species are endemic to southern cone grassland, and deserve special attention. It is important to note that among bird grassland dwellers, several grassland shorebirds that migrate from the arctic to the southern cone have suffered important global declinations owed (at least partially) to habitat loss in this region. In this sense, BirdLife partners in the region, in the framework of the Alliance for Grassland Biodiversity Conservation, is about to publish a report on the 20 most important sites for neartic-neotropical grassland shorebirds (J.Aldabe com.pers.).

Both Pampas and Campos have good aptitude for agriculture and cattle breeding (Miñarro and Bilenca 2008).

18.3.2 Impact of Human Settlement

After European colonization, Río de la Plata Grasslands have progressively become one of the most important areas of beef and grain production in the world (Miñarro and Bilenca 2008). The introduction of cattle, sheep and horses during the XVI century, and the introduction of agriculture by the end of the XIX century have deeply modified the original landscape, which led to a great loss of grassland habitat, at least in its pristine form (Soriano et al. 1992). Habitat loss, hunting pressures, zoonotic diseases and introduced alien species have threatened many native species. For example, the emblematic Pampas deer (*Ozotoceros bezoarticus*) is the most threatened mammal species of the region (Bilenca and Miñarro 2004).

During the last 40 years, human intervention in Río de la Plata Grasslands has become more intense, which has been reflected in an increase in the cultivated area, especially in the Pampas (Viglizzo et al. 2006). Between 1988-2002, over 900,000 hectares of natural or semi-natural grasslands of Pampas ecorregion have been lost (Paruelo et al 2005). More recently, agricultural expansion has been led by soybean crop (Miñarro and Bilenca 2008). In the early 1970s, soybean was a marginal crop that represented less than 3% of the sown area. Now it has become the main crop in Argentina, covering nearly 40% of the sown area (i.e., more than 14 million ha in 2003/2004; Paruelo et al. 2005). In 1996, a transgenic soybean cultivar resistant to the herbicide glyphosate was introduced on the market and rapidly adopted by farmers, so that the growth of the sown area of soybean has increased even further (Martínez-Ghersa & Ghersa 2005).

Due to these changes, strict grassland dwellers like the Greater Rhea (*Rhea americana*) or the Elegant Crested-Tinamou (*Eudromia elegans*) have shown important retractions in their distributions. Other consequences of recent agricultural intensification and expansion in the Pampas were the re-allocation of livestock to areas with less agricultural aptitude, and an increased grazing pressure in typical cattle breeding areas (Rearte 2007).

Influence of agriculture has been lower in the Southern Campos, although floristically very similar to some portions of Pampa ecoregion. This is probably due to relatively shallow soils (Paruelo et al 2007, Miñarro y Bilenca 2008).

Only 1/3 of Uruguayan Campos and 20% of Argentinian Campos have been modified for agricultural purposes and timber plantation (Miñarro and Bilenca 2008, MGAP 2008, Olmos *com.pers.*).

Although Campos ecoregion has been used less intensively than Pampas, it has suffered an important biodiversity and habitat loss. This was due to the accelerated process of agricultural expansion started in 1970´s (and which continues at the present days). More recently, this was aggravated with the current plans of converting vast areas of Campos into monocultures of exotic afforestation. From 1970 to 1996, Brazil Campos area has reduced from 14 to 10,5 million ha, which represents a 25% conversion (MMA-SBF 2007; Bilenca and Miñarro 2004).

Livestock breeding is one of main economic activities in Brazilian Campos, due to the great diversity of plants with high foraging value. As a consequence, intensive grazing has become an important cause of degradation in this ecoregion (MMA-SBF 2007).

In Uruguay, livestock grazing has demonstrated to produce the greatest impact on natural grasslands productivity, which can reach almost 20% of the original output (Olmos y Godron 1990). An equivalent drop of productivity can be obtained after an agricultural period followed by 10 years of rest.

18.3.3 Current Status

Natural State:
Nowadays, only around 30% of the Pampas in Argentina are covered by natural or semi-natural grasslands. On the contrary, up to 80% of Argentinian and 65% of Uruguayan Campos remain in a natural or semi-natural state (Miñarro y Bilenca 2008; MGAP 2008). By year 1995, 48% of Campos surface in Rio Grande do Soul, Brasil (21.800.887 ha) corresponded to natural grasslands (Bilenca y Miñarro 2004).

Formal Protection:
In Argentina, only 1.05% of the Pampas and 0.15% of the Campos are included within any kind of protected area (Burkart 2006, Moreno et al. 2008, en Miñarro y Bilenca 2008).

In Uruguay, 7 of the 35 officially protected areas include natural grasslands communities only partially. These areas occupy 35.000 ha, which represents only 0,21% of uruguayan territory (Bilenca y Miñarro 2004).

In Brazil, conservation units in Campos region occupy 62.000 ha, which represents only 0,36% of regional surface. If the 320.000 ha of sustainable use units are taken into account, protection rises up to 2,23% of the region (Bilenca y Miñarro 2004).

18.3.4 Opportunities for Improving the Level of Protection and Conservation in the Region

During recent years, two major efforts have been carried out in order to diagnose the conservation status of temperate grasslands and to perform a conservation strategy for temperate grasslands in Argentina (Miñarro y Bilenca 2008):

- The inventory of Valuable Grassland Areas (VGAs), developed by Fundación Vida Silvestre Argentina (Bilenca & Miñarro 2004), and
- The inventory of Important Bird Areas (IBAs), developed by Aves Argentinas and BirdLife International (Di Giacomo et al. 2007)

These inventories revealed that there is still a great potential for the conservation of Pampas and Campos in Argentina by both the creation and/or enlargement of existing protected areas, as well as by performing conservation strategies at eco-regional scale. In addition, many of the VGAs and IBAs are in private lands, reinforcing the idea that the ranching community has a crucial role in grassland/rangeland conservation (Miñarro y Bilenca 2008).

In Uruguay, a Protected Areas law has been recently approved (Law Nº 17.234, year 2000; Bilenca and Miñarro 2004; F. Olmos *com.pers.*). A law on Land Use Planning is currently being discussed by the Parliament, and there are two law proposals about Use and Conservation of Natural Grasslands and about

Genetic Resources. Legal improvement around conservation matters could setup the basis for the enhancement of conservation status of Uruguayan grasslands. Also, Uruguay society is currently more sensitive to conservation issues (F. Olmos *com.pers.*)

In Brazil, an effort conducted by the Environmental Ministry has led to the identification and updating of priority areas and actions for conservation, sustainable use and biodiversity benefit sharing for Campos sulinos. As a result, a map with 105 areas has been generated, among which 17 were already protected and 88 were new suggested areas. Priority areas occupy more than a half of the biome (52,9%), from which 49,3% are new areas, and only 3,6% are already under some protection regime (MMA-SBF 2007). By this effort it was revealed the aspiration of local society to improve habitat and diversity protection of Campos ecoregion by the creation of new conservation units. It was also shown their urge to revert degradation by rehabilitation of degraded areas and populations, the promotion of sustainable economic activities and the creation of ecological corridors.

An opportunity for improving the level of temperate grasslands protection is given by meat certification procedures. By this process, meat produced under practices that conserve native grassland and biodiversity have a higher price, raising producers' profit while promoting grassland protection. Aves Uruguay and Wetlands International have already worked on this alternative and documented their results (available upon request; J. Aldabe com.pers.).

Currently there is an international grassland conservation project headed by BirdLife named the Alliance Initiative in the Southern Cone (www.pastizalesdelconosur.org).

18.3.5 Contraints Against Improving the Level of Protection and Conservation in the Region

Introduction of exotic plants along with poaching and illegal trade are the most frequent threats to the conservation of the Río de la Plata Grasslands. These are followed by other threats which act over great extensions, such as the expansion of agriculture and the substitution of grasslands by forest plantations. In Uruguay, expected increase in timber plantations and agricultural expansion threat the possibility of improving grassland protection. As in Argentina, the current tendency in agricultural expansion is led by soybean crop.

Although Uruguay has approved a Protected Areas, there is a lack of prepared human and financial resources, and of proper rules for law implementation (Olmos 2006).

18.3.6 Suggested Next Steps and Action Plan

Suggested action plan is based on the following seven main actions (Viglizzo et al. 2006, Miñarro and Bilenca 2008, MMA-SBF 2007):

1. **Protected areas in public and private lands:** To create new protected areas and to provide support to existing ones within some priority areas already identified.

2. **Land use planning in rural areas:** To prevent degrading uses of the grassland ecosystem. Land planning could be done through an insightful evaluation of goods and services provided by different ecological units (ecosystem, landscape, etc.). Economic and social activities that are very degrading should be placed outside the boundaries of vulnerable grassland areas with high provision of these good and services. Regulation is also stated as a key issue to prevent degradation and misuse of natural resources. To promote the creation of ecological corridors and mosaics.

3. **Grassland management:** To establish grassland stewardship and sustainable ranching, by encouraging and facilitating the promotion of both productive and conservation-friendly management options among ranchers. To evaluate the use of conservation-friendly policies and incentives (v.g., management agreements, conservation easements). To restore degraded grassland areas and to apply good management practices in protected and not protected areas.

4. **Conservation and sustainable use of flagship species:** To reduce the extinction risk of flagship grassland species, assuring viable wild populations of these threatened species in a sustainable farmland context. One of the main goals of working with flagship species is to sensitize both urban and rural communities on grassland conservation issues.

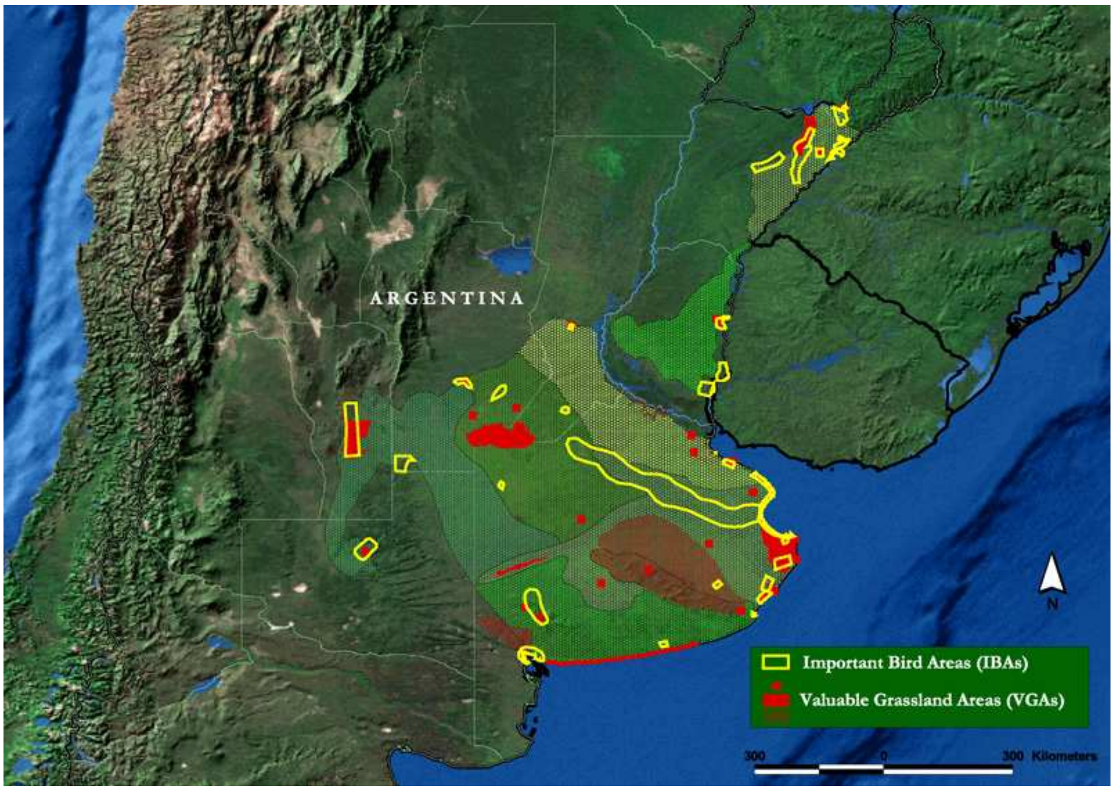
5. **Training, education and communication:** To promote and develop training, education and communication activities in order to inform and sensitize stakeholders, decision makers and public opinion on grassland conservation issues.

6. **Exchange of experience:** To strengthen links with local, regional and international experts involved in grassland conservation.

7. **Research, biological inventories:** to develop biological monitoring and inventories. To carry out local detailed studies to complement other actions as protected areas creation or degraded areas restoration.

18.3.7 Appendices

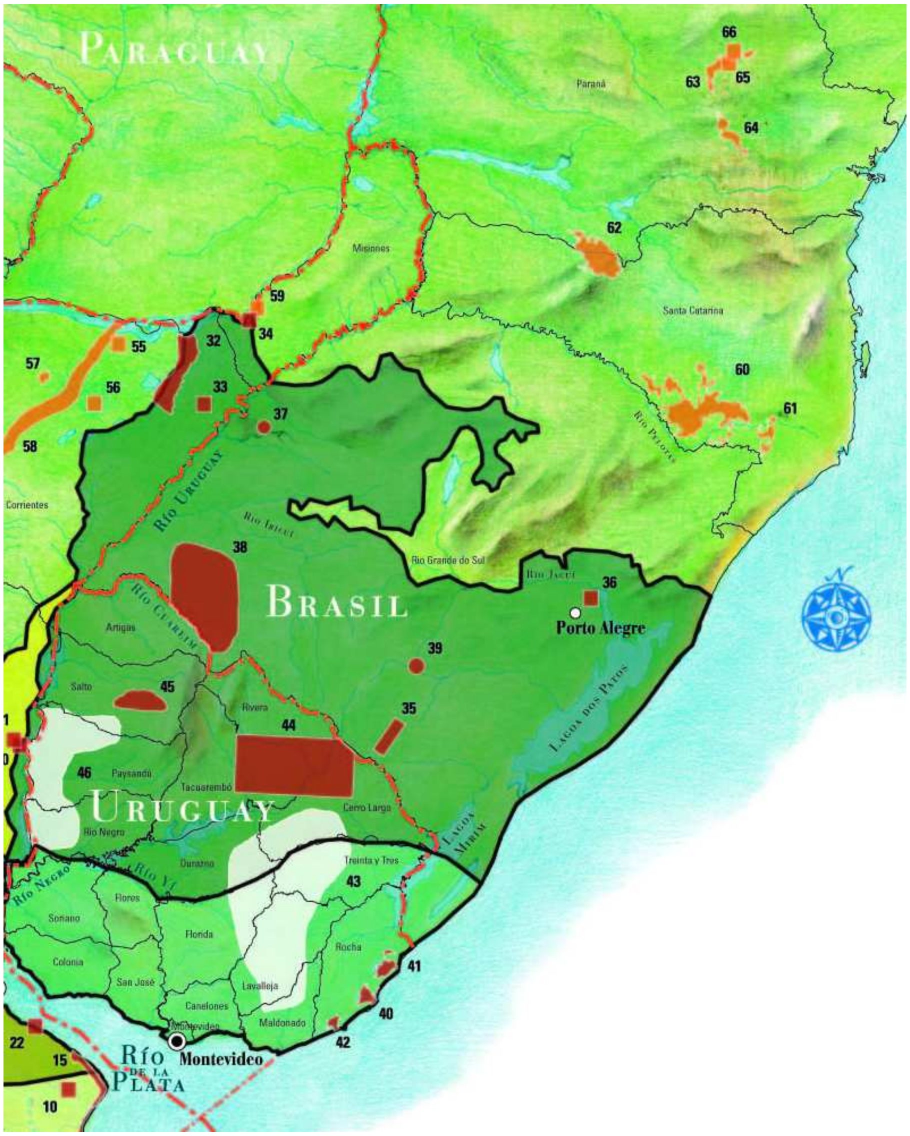
Map 1: Valuable Grassland Areas (VGAs) and Important Bird Areas (IBAs) identified in the Pampas and Campos of Central and North Eastern Argentina
Classified by eco-region and by sub-regional units (Bilenca & Miñarro 2004, Di Giacomo et al. 2007). Extracted from: Miñarro and Bilenca 2008.



Map 2: Important bird areas (IBAs) identified in the Campos of Uruguay

Provided by: Joaquín Aldabe (*in press*)

Map 3: Valuable Grassland Areas (VGAs) identified in Campos of Uruguay and South Brazil. (Red, orange and white areas and dots)
Extracted from: Bilenca & Miñarro 2004



Map 4: Priority Areas identified for Campos Sulinos, Brazil

Extracted from: MMA-SBF 2007

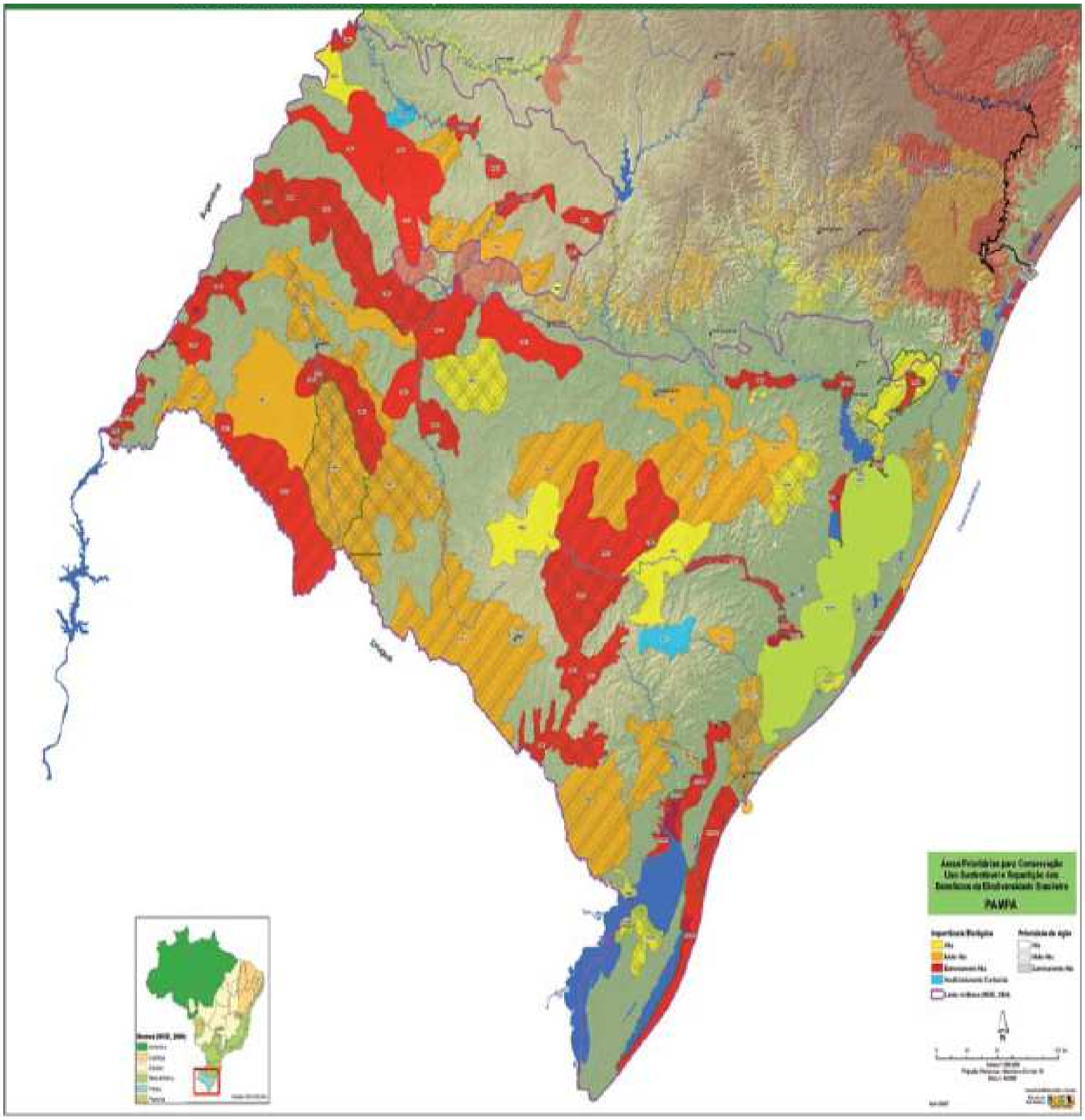


Table 1: List of legally protected grassland areas in the Río de la Plata region

The preliminary list provided below is under review. Most of the protected areas listed here do not have grasslands conservation among their priorities.

References: Viglizzo et al. 2006; Bilenca and Miñarro 2004; APN-SIB; J.Aldabe com.pers.

Country	Protected Area	Total PA Surface (ha)
Argentina	Parque Nacional el Palmar	8,500
	Parque Nacional Campos del Tuyú*	3,040
	Refugio de Vida Silvestre La Aurora del Palmar	1,093
	Reserva Natural Las Tunitas	300
	Refugio de Vida Silvestre Las Dos Hermanas	1,055
	Res. Nat. Las Tunas	16,000
	Res. Ecológica Laguna la Salada	200
	Res. Municipal Los Robles	1,000
	Res. Nat. Selva Marginal Hudson	1,200
	Res. Fund. E. S. de Pearson	1,500
	Res. Nat. Integral Dunas Atlántico Sur	1,650
	Res. Municipal Faro Querandí	5,575
	Res. Nat Sierra de Tigre	140
	Parque Prov. Ernesto Tornquist	6,678
	Res. Nat. Prov. Limay Mahuida	4,983
	Res. Nat. Prov. La Reforma	5,000
	Res. de Biosfera Parque Costero del Sur	23,500
	Sitio Ramsar Bahía de Samborombón	147,200
	Res. de Biosfera Parque Atlántico Mar Chiquito	26,488
Brazil	Refugio de Vida Silvestre Morro Santana	370
	Campos de la Frontera Oeste	770,000
Uruguay	Refugio de Fauna Laguna de Castillos	8,185
	Parque Nacional y Reserva de Fauna y Flora El Potrerillo de Santa Teresa	715
	Monumento Histórico y Parque Nacional Fuerte San Miguel	1,553
	Área de Protección de la Naturaleza Lunarejo	25,000
	TOTAL	**1,060,925**

*Currently in process of being approved as a national park

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18.4 Patagonian Steppes (Argentina and Chile)

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18.4.1 Major Indigenous Temperate Grasslands Types

The Patagonian steppes occupy a vast area in the southern tip of the continent, between latitudes 39° and 55°S. These steppes cover more than 800,000 km2 of Chile and Argentina, and are framed by the Andes to the west and the Atlantic coast to the east and south (Paruelo et al. 2007).

Patagonia has relatively low mean annual precipitation (150–500 mm MAP), 46% of total precipitation falling in winter (Jobbágy et al., 1995). Mean annual temperature is also low (0 to 12°C) (Adler et al. 2006).

The grasslands and steppes of Patagonia are very heterogeneous, both physiognomically and floristically. This high heterogeneity contradicts the common perception of Patagonia as a vast desert at the southern end of the world. Vegetation types range from semi-deserts to humid prairies with a large variety of shrub and grass steppes in between. Vegetation heterogeneity at a regional level reflects the constraints imposed by the climatic, topographic, and edaphic features (Paruelo et al. 2007). Grass steppes characterize the most humid portions of the region, which are dominated by grasses of the genus *Festuca*, accompanied by several other grasses, highly preferred by native and exotic herbivores, and sometimes by shrubs. In some portions of the steppe shrubs seem to be indicative of degradation by grazing (i.e. *Mulinum spinosum*, *Senecio filaginoides* and *Acaena splendens*) (León and Aguiar 1985; Bertiller et al. 1995), whereas in other districts shrubs are common constituents of the grass steppe (i.e. *Nardophyllum bryoides*, *Chilliotrichum diffusum* and *Empetrum rubrum*) (Collantes et al. 1999).

At a finer grain, heterogeneity is due to altitude, slope, and exposure (Jobbágy et al. 1996, Paruelo et al. 2004).

There are 1,378 recorded vascular plant species in arid and semi -arid Patagonia (Correa 1971), almost all of which are angiosperms and close to 30 percent of which are endemic species. Vegetation is characterized by the dominance of xerophytes, which have evolved remarkable adaptations to cope with severe water deficit (León et al. 1998).

The native vertebrate fauna is poor (Soriano, 1983). Guanacos (*Lama guanicoe*) are the only large native ungulate (Soriano, 1983) and although the region has generally been considered to have evolved under light grazing pressure (Milchunas, Sala and Lauenroth, 1988), pre-European numbers of guanacos may have been higher than previously thought (Lauenroth, 1998); recent counts show populations are fairly stable at approximately 500 000 (Amaya et al., 2001).
The lesser rhea (*Pterocnemia pennata pennata*) and the upland goose (*Cloephagapicta*) are the most conspicuous birds. The Patagonian hare (*Dolichotis patagonum*) and the small armadillo (*Zaedyus pichyi*), together with the lesser rheas , are important zoogeographical indicators (Soriano, 1983). There are significant numbers of predators , such as red foxes (*Dusicyon culpaeus*), grey foxes (*Ducisyon griseus*), pumas (*Felis concolor*) and skunks (*Conepatus humboldtii*) (Soriano, 1983).

18.4.2 Impact of Human Settlement

The main economic activities in Patagonia are sheep husbandry and oil exploration and extraction.

Oil industry activities are the most intensive disturbance in Patagonia, though restricted in extent (Paruelo y Aguiar, 2003). They cause extremely severe and irreversible damage in focal areas because they remove all vegetation cover, and often entire soil layers (Paruelo et al. 2007).

Sheep farming is almost a monoculture in the arid and semi -arid steppes. Intensive agricultural activities such as fruit and horticultural crops are important in a few irrigated valleys, but are almost absent on sheep farms (Borrelli et al., 1997). Cattle production has become important on mountain ranges near the Andes, where sheep farming is more difficult due to the presence of forests, steep landscapes and losses to predators (Cibils and Borrelli 2005).

Grazing affects almost all the region, but nowhere has it completely eliminated plant cover (Paruelo et al. 2007). It has been perceived to be the main agent of desertification in Patagonia (Soriano and Movia, 1986; Ares et al., 1990). Patagonian vegetation is generally described as having few adaptations to cope with grazing by domestic ungulates, since the entire region is thought to have evolved under conditions of light grazing by native ungulates (Milchunas, Sala and Lauenroth, 1988). Although this notion has recently been challenged by Lauenroth (1998), there is general consensus that vegetation throughout most of Patagonia has been modified significantly by sheep over the last century, particularly in the last 40–50 years (Golluscio et al. 1998). Deterioration of grazed vegetation has usually been demonstrated by replacement of palatable grasses by unpalatable woody plants (Bertiller, 1993a, Cibils and Borrelli 2005, Paruelo et al. 2007).

The impact of grazing varies widely among vegetation units. The grass-shrub steppes of the Occidental District (45°S, 70°W) show in general no major changes in vegetation physiognomy due to grazing (Perelman et al. 1997). In contrast, the grass steppes of Subandean District (45°S, 71°W) have experienced dramatic physiognomic changes due to grazing. Shrub encroachment is sometimes the final stage of grazing degradation of the grass steppes. Such changes reduce primary production (Paruelo et al., 2004) and modify water dynamics and herbivore biomass (Aguiar et al., 1996). In both vegetation units plant diversity is higher in ungrazed areas.

European settlement in Patagonia´s steppe and introduction of cattle only began at the end of the nineteenth century (Barbería 1995). Sheep numbers had two phases, one growing till middle of XX century (over 21 million in 1952) and the latter gradually decreasing (about 8.5 million in 1999) (Golluscio et al. 1998; Méndez Casariego, 2000).This reduction have been interpreted as the result of productivity decay and desertification of Patagonia´s steppes due to overgrazing (Soriano y Movia, 1986; Ares et al., 1990).

Impacts of sheep on this landscape have become more extensive during the past decade due to a reduction in wool prices, the lack of productive alternative land uses, and the absence of an environmental policy from federal and state agencies and governments (Cibils and Borrelli 2005).

18.4.3 Current Status

Natural state:
Although grazing affects almost all the region, nowhere has it completely eliminated plant cover (Paruelo et al. 2007). There is not information available on the percentage of indigenous grasslands in natural state.

Formal Protection:
There are twenty protected areas in Patagonia Steppe, covering around 2.500.000 ha (aproximately 5% of the ecoregion). However, this surface is considered insufficient to attain the level of protection for this ecoregion. Also, only 10 of these areas (less than 1% of ecorregion) have an acceptable and effective regime of protection (Paruelo et al. 2006).

18.4.4 Opportunities for Improving the Level of Protection and Conservation in the Region

There is a significant amount of research going on in Patagonian steppe (Cibils and Borrelli 2005). The need for management tools to regulate grazing and slow down rates of vegetation deterioration has led to the development of a number of vegetation-based pasture assessment routines over the past decade. Most of these (developed primarily by INTA) are being used in almost all provinces of Argentinian Patagonia, either by government agencies or private consultants (Borrelli and Oliva, 1999; Nakamatsu et al. 2001; Bonvissuto 2001; Siffredi et al., 2002).

TNC has recently launched a conservation initiative in Argentina that aims to achieve protection of 10% temperate grasslands in Patagonia Steppe, Monte Bajo, Espinal and Pampa ecoregions. This objective will be accomplished by consolidation of existing and future protected areas, the creation of natural reserves within private lands, and the application of sustainable livestock management (especially ovine; G. Iglesias com.pers.).

18.4.5 Constraints Against Improving the Level of Protection and Conservation in the Region

Almost the whole ecoregion is included within private properties, with less than 1% being within state jurisdiction. Environmental regulations are hard to implement within these private lands (Paruelo et al. 2006).

Probably one of the most important threatens to patagonic ecosystems is the lack of knowledge of land managers.

The reduction of cattle numbers will not allow the reduction of desertification. This can be explained by the fact that herbivores are selective in their diet, and thus it cannot be guaranteed that certain flora species are not to be consumed.

18.4.6 Suggested Next Steps and Action Plan

In order to promote best management practices for Argentinian Patagonia grasslands, Cibils and Borrelli (2005) recommend for the next five years to involve developing or adapting technology for: sustainable sheep farming systems (including the development of eco-certification protocols); management and reclamation of degraded grazing land, in particular areas that have been severely disturbed by mining or oil extraction; regional GIS to develop Decision Support Systems; genetic improvement of ultra-fine Merino sheep and Angora goats (including the use of biotechnology); and improvement of wildlife use (guanacos and rheas).

Also, Paruelo et al. 2006 recommend to design monitoring programmes for protected areas to evaluate impacts of global change through these factors: CO_2 atmospheric concentrations, N_2 deposition, land use changes, climatic change and biotic exchanges.

18.4.7 Appendices

Map 1: The location of important existing and proposed grassland areas
Extracted from: Paruelo et al.2006

Table 1: List of legally protected grassland areas in Patagonia Steppe
(Paruelo et al. 2006; APN-SIB)

Country	Protected Area	Total PA Surface (ha)
Argentina	Parque Nacional y Res. Nacional Laguna Blanca (Sitio Ramsar)	11,263
	Monumento Nacional Bosques Petrificados	61,228
	Parque Nacional y Res. Nacional Perito Moreno	115,000
	Parque Nacional Monte León	60,800
	Res. Nat. de Fauna Laguna Llancanelo (Sitio Ramsar)	40,000
	Res. Provincial de Flora Domuyo	3,620
	Parque Provincial El Tromen	24,000
	Parque Público Turístico Laguna Carri Laufquen	700
	Área Natural Protegida Meseta de Somuncurá	1,600,000
	Res. Nat. Turística Objetivo Específico Laguna Aleusco	1,200
	Res. Nat. Turística Objetivo Integral Península de Valdés	360,000
	Res. Nat. Turística Punta Delgada	2,829
	Res. Nat. Turística Objetivo Integral Cabo Dos Bahías	160
	Res. Nat. Cabo Blanco	No data
	Res. Nat. Provincial Ría de Puerto Deseado	10,000
	Res. Provincial Península de San Julián	10,400
	Res. Provincial Cabo Vírgenes	1,230
	TOTAL	**2,302,430**

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