TEMPERATE GRASSLANDS OF SOUTH AMERICA

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1 Páramo or Northern Andes (Venezuela, Colombia, Ecuador, northern Perú)

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1.1 Major indigenous temperate grassland 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.

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).

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 as 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**

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.

1.5 Suggested next steps and action plan

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

1.6 Appendices

Map1. Important existing and proposed páramo areas are highlighted in yellow.

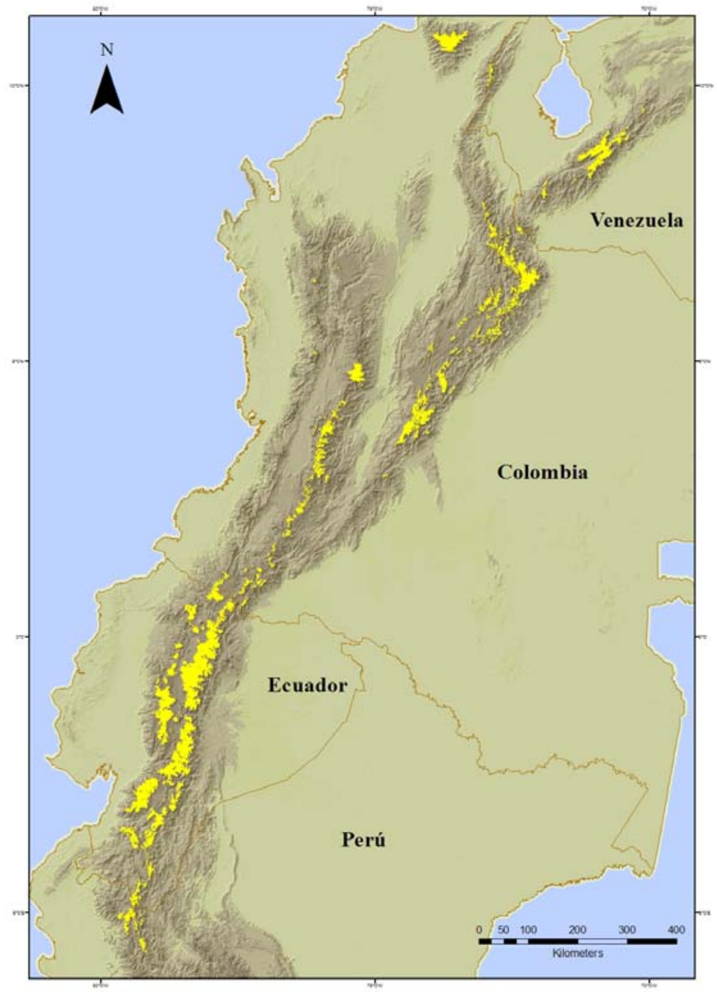

Table 2. List of legally protected grassland areas in the region and size.
Extracted from: Cuesta F., K. Beltrán, B. De Bievre. *In press*. Los páramos de los Andes del Norte. Mecanismo de Información de Páramos. Proyecto Paramo Andino. CONDESAN, GEF-PNUMA.

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 Edafoxerófilos Altimontanos Paramunos	74,125	30,400	41.0
Vegetación Geliturbada y Edafoxerófila Subnival Paramuna	98,552	93,392	94.8
Vegetación Palustre y Acuática Altoandina Paramuna	12,766	4,592	36.0
TOTAL	**3,601,179**	**1,551,520**	**43.08**

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2 Central Andean Grasslands (Páramo, Puna) and High-Andean (central and southern Perú, western Bolivia, northern Chile and northwestern Argentina).

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2.1 Major indigenous grassland 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).

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).

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 (Fig.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%**

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.

2.5 Constraints against improving the level of protection and conservation in the region

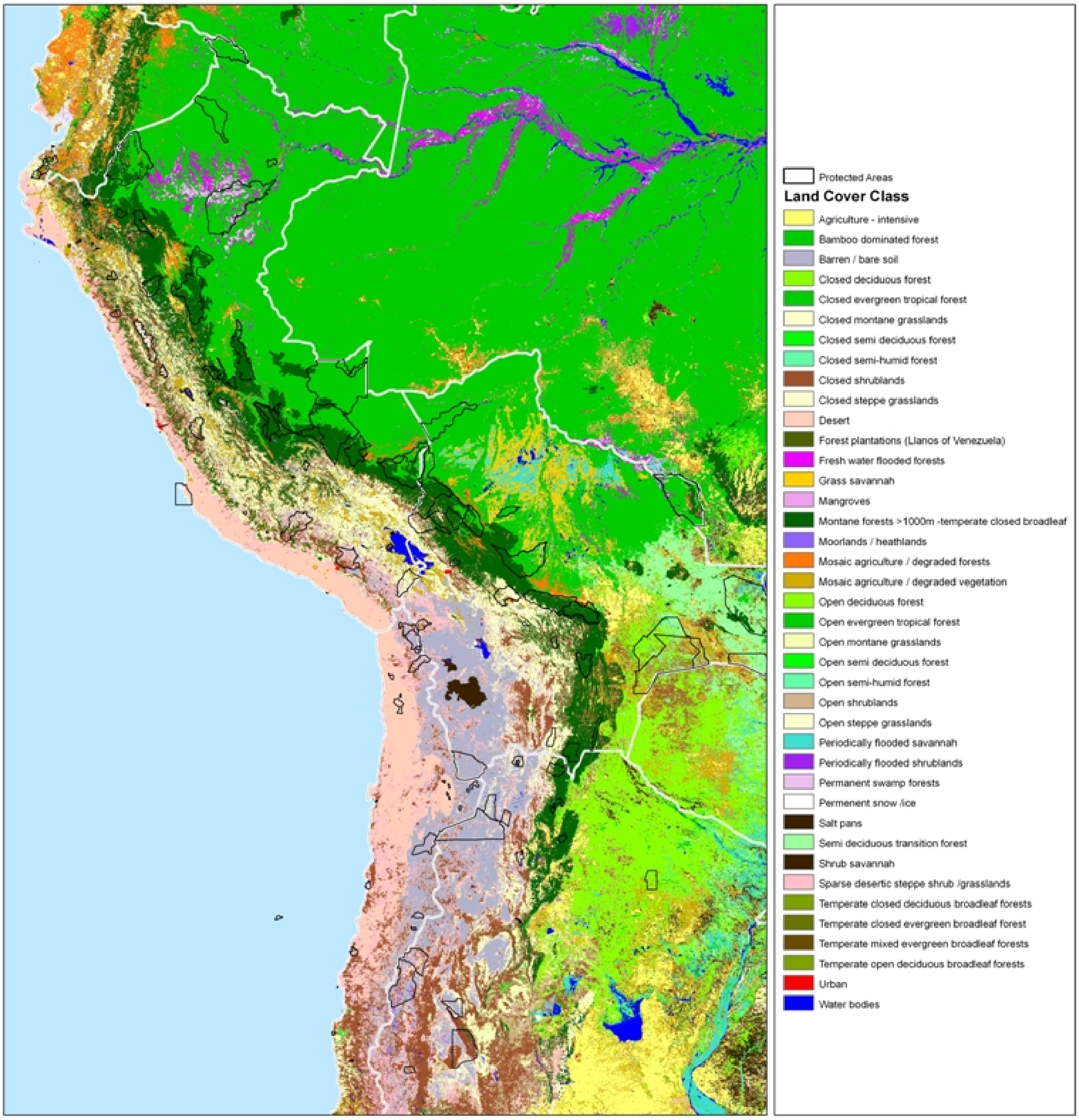
Growing population, opening of new roads, mining activities.

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.

2.7 Appendices

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



Vegetation types definitions:
Moorlands / heathlands: Ciénagas, bofedales, fresh water peat bogs or fens (to 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	Aguaragüe	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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3 Río de la Plata Grasslands or Pampas & Campos (Argentina, Uruguay and Brazil).

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3.1 Major indigenous temperate grassland types

The Rio 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).

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.

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).

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).

3.5 Constraints 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).

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):

i. **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.

ii. **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.

iii. **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.

iv. **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.

v. **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.

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

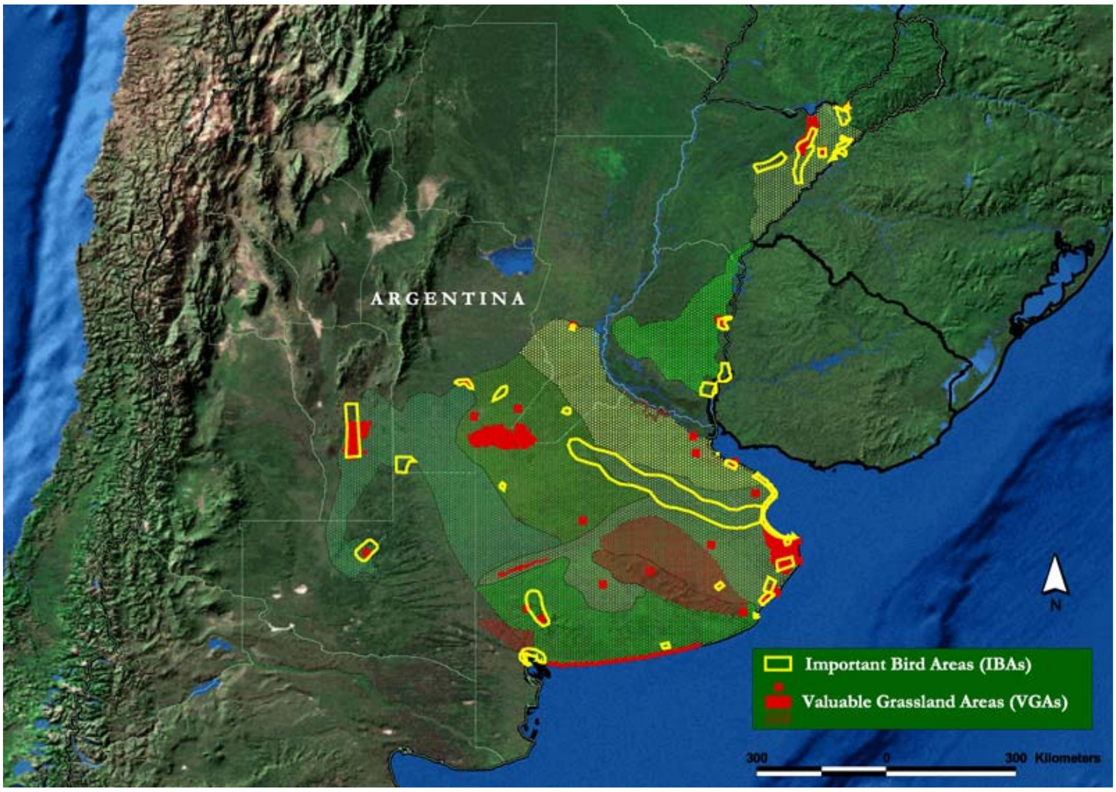
vii. **Research, biological inventories:** to develop biological monitoring and inventories. To carry out local detailed studies to complement other actions as protected areas creation or degraded areas restoration.

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).

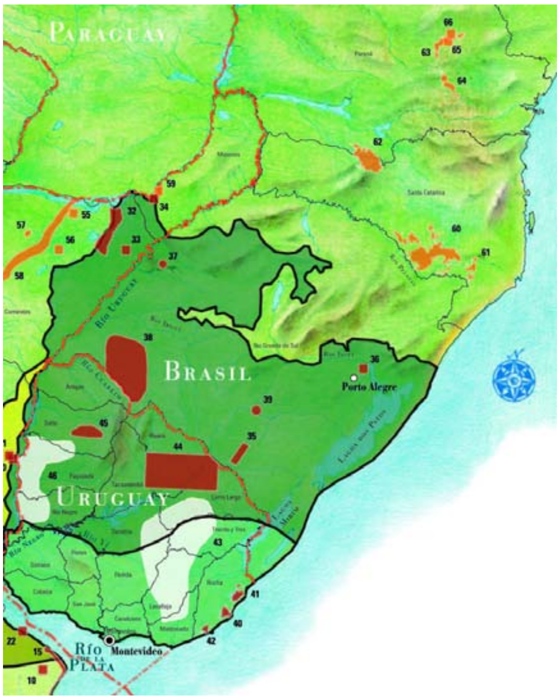
Extracted from: Miñarro and Bilenca 2008.



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.

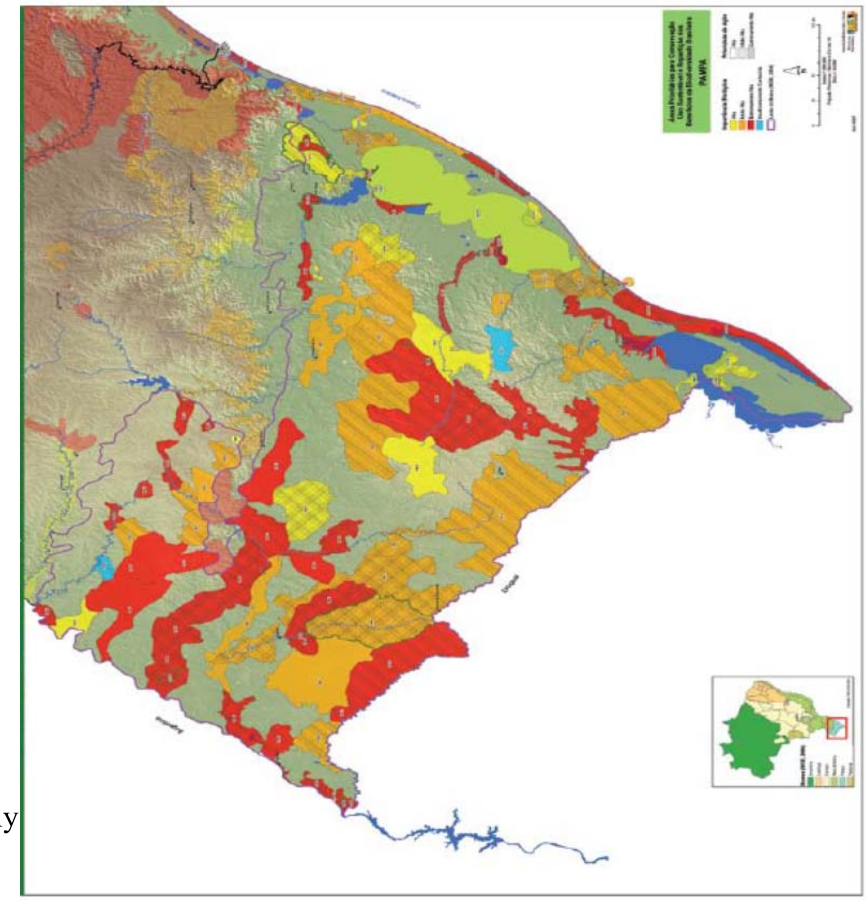


Table 1. List of legally

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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4 Patagonian steppes (Argentina and Chile)

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4.1 Major indigenous temperate grassland 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).

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).

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).

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.).

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.

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.

4.7 Appendices

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

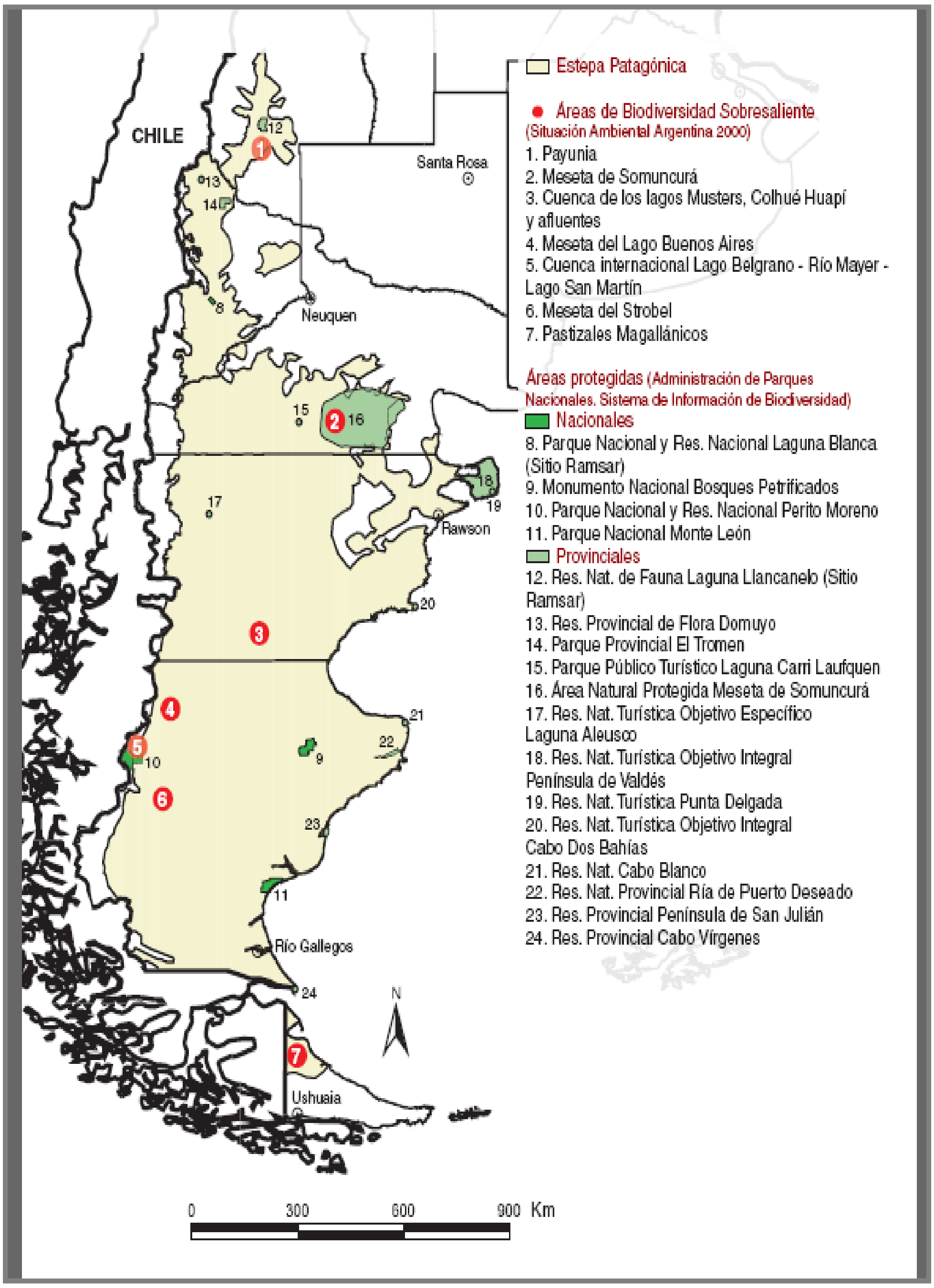

Table 1. List of legally protected grassland areas in Patagonia Steppe.
References: Paruelo et al. 2006; APN-SIB

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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