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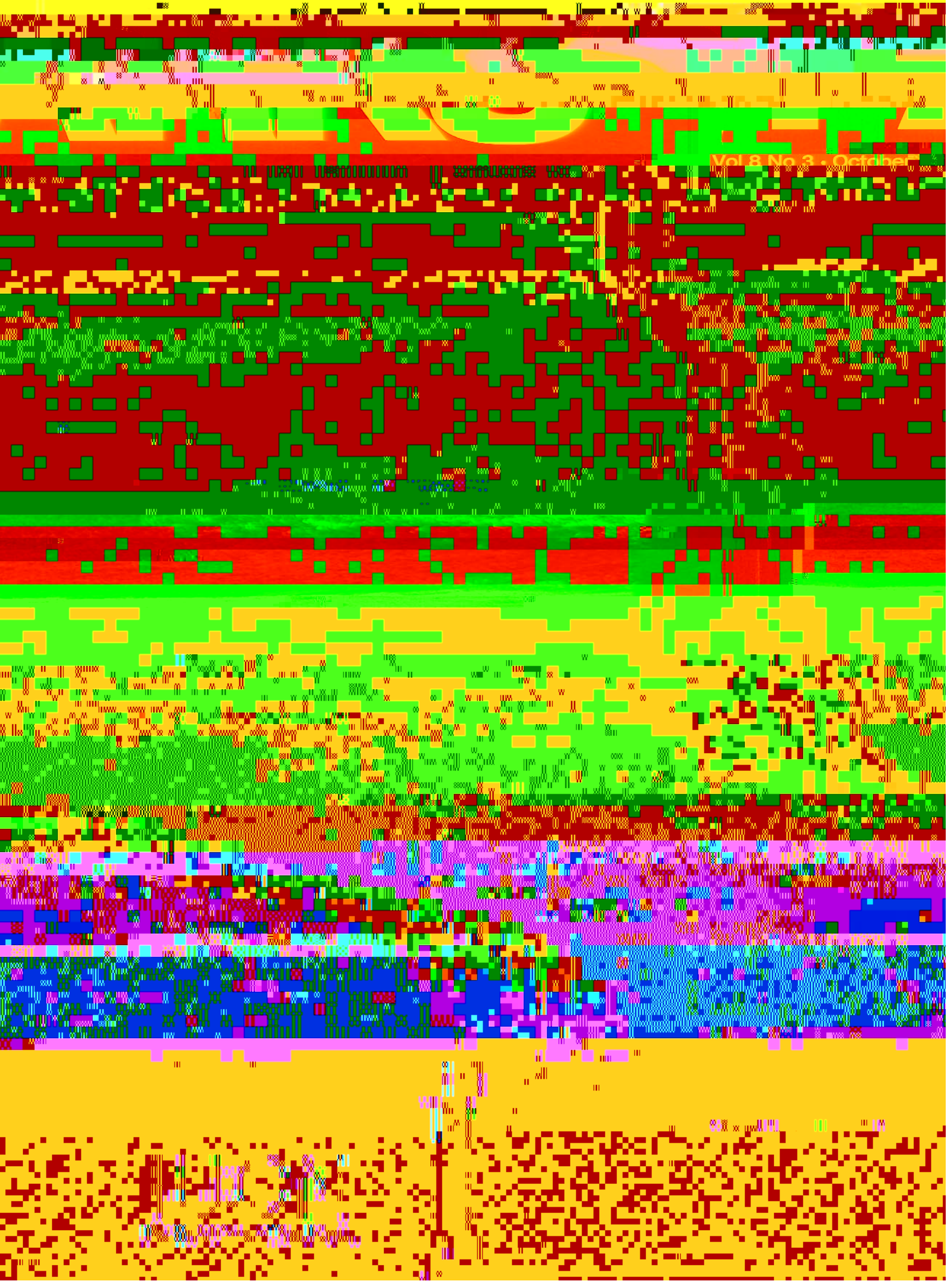

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Editorial – the world's temperate grasslands: a beleaguered biome

WILLIAM D. HENWOOD

THE TEMPERATE grasslands of the world, known variously as the prairie in North America, the pampas in South America, the steppes in eastern Europe and northern Eurasia, and the grassveld in South Africa, are among the most diverse and productive of all the earth's terrestrial biomes. Yet, without exception, temperate grasslands have received very low levels of protection. According to the 1993 United Nations List of National Parks and Protected Areas, only 0.69% of the temperate grasslands biome is under some kind of protective status. This protection level ranges from a low of 0.08% in the Argentine pampas to very modest highs of 2.01% in the lowland grasslands of south-eastern Australia and 2.2% in the South African grassveld.

This protection level is not only the lowest of the globe's 15 recognised biomes, but is the lowest by several orders of magnitude. Tropical grasslands and savannas, for example, enjoy a level of protection nine times higher than their temperate cousins. Temperate broad-leaf and needle-leaf forests receive protection levels six and eight times higher than grasslands, respectively. Temperate subtropical forests, over which so much justifiable concern has been expressed, receive 14-fold greater protection world-wide than do temperate grasslands.

Why are the levels of protection for temperate grasslands so low and, perhaps more significantly, why are these low levels so universal? What is it about temperate grasslands that has failed to inspire governments to protect them? What can we do to improve this situation? This special issue of PARKS aims to both raise awareness of this important conservation issue and also begin to answer these questions. It is also the first undertaking of a relatively new and informal working group within the World Commission on Protected Areas (WCPA), known as the Temperate Grasslands Network. Created in 1996, the Network has the following aims: to assess the conservation status of temperate grasslands throughout the biome; to analyse the constraints to grasslands protection; to develop a strategy and action plan to achieve an expanded system of protected grassland areas; and to prepare a set of management guidelines designed to conserve grassland biodiversity.

I would like to thank the authors who have prepared papers for this issue of PARKS for their part in advancing this discussion. My opening paper provides a brief overview of the current protection status for temperate grasslands throughout the world. It also advances the work of identifying priorities for grasslands protection and conservation at national and international levels, and makes suggestions for a program of work for the IUCN/WCPA and the Convention on Biological Diversity (CBD) process. This overview is followed by a series of case studies representing each realm on the planet in which temperate grasslands are found.

David Gauthier and Ed Wiken use a continent-wide ecosystem classification to analyse extent and distribution of protected grassland areas in the North American Great Plains. Steve Taylor's paper describes the relatively short but intense history of degradation in the grasslands of south-eastern Australia, their current protection status, ongoing government initiatives to increase protection levels and the many constraints encountered. This paper highlights the biome's common dilemma, where the low levels of temperate grasslands protection are accompanied by high losses of native grassland ecosystems. In such situations, the opportunities for substantially increasing protection levels are very limited and require innovative solutions.

Montane grasslands are a lesser-known component in this temperate biome, and are found in several areas of the world, including New Zealand, the mountain cordillera of western North America and in high elevation areas of Asia. The paper by G.S. Rawat provides an overview of the ecology and conservation of high elevation

Table 1. Protected areas coverage of the world's temperate grasslands (adapted from: IUCN 1994).

realm and biogeographic province	area (km²)	number of protected areas	protected area (ha)	protected area (%)
Nearctic: Grasslands	2,442,342	126	1,240,185	0.51
Palaearctic realm:				
Mongolian-Manchurian steppe	2,605,123	19	2,302,980	0.88
Pontian steppe	1,945,402	27	1,313,837	0.68
Neotropical realm:				
Argentinian pampas	512,152	10	42,235	0.08
Australian realm:				
Eastern grasslands and savannas	527,831	58	1,059,030	2.01
totals	**8,032,850**	**240**	**5,958,267**	**0.69**

In the lowland grasslands of central and eastern Europe, the situation is repeated. Though few precise figures are available, it is generally recognised that only "...a minute fraction of the potential grassland area remains in a natural state..." (IUCN 1991). In contrast to North America and Australia, where the impacts of settlement have occured within the last 150 years, grasslands in much of Europe have been influenced by human use and activity for thousands of years. In much of eastern Europe and the former USSR, steppe grasslands remained relatively intact until the 1950s and 1960s, when they too were largely transformed through cultivation. In the Ukraine, up to 88% of the steppe has been converted to agricultural use, with only 3–5% remaining in its natural state (Goriup 1998). South Africa's grassveld is found mostly in that country's high central plateau. These grasslands are extensively used for agriculture and are the mainstay of South Africa's dairy, beef and wool production. This biome also supports much of the country's maize, wheat and sunflower crops (Low and Rebello 1996). Urbanisation, industrialisation and mining are also significant threats. The levels of transformation in the lower elevation grasslands in South Africa are between 55% and 89% (Low and Rebello 1996).

The lower elevation grasslands of North and South America, Australia, Europe and South Africa have been changed far more by man than the higher elevation grasslands of the steppes in northern Eurasia and eastern Asia. In these latter regions, there remain significant expanses of grasslands that have not been significantly altered through such practices as cultivation. Most of these high elevation grasslands, as in China (Inner Mongolia, Xinjiang and Tibet), Outer Mongolia, Kazakhstan and Uzbekistan, have been grazed for thousands of years and today continue to support millions of sheep, goats, cattle, camels and horses (WRI 1994). The relative degree of alteration among the world's temperate grasslands is an important indicator of the potential for the long-term protection and, where possible, the restoration of grassland ecosystems.

The changes wrought by humans include irreparable destruction from building and flooding and significant alteration from cultivation, overgrazing, desertification or irrigation. More moderate alterations and associated extirpation or reduction of native species, have been caused by less intensive land-use or introduction of exotic species.

The role of protected areas in temperate grasslands

Historically, protected areas have not played a significant role in the management and use of temperate grassland ecosystems. In fact, it is only recently that grasslands in temperate climates have been perceived as a valued ecosystem that is worth

Areas, through the Temperate Grasslands Network, will identify strategic priorities and develop an action plan to improve protection of temperate grasslands. This will be done in conjunction with other international efforts, such as the Convention on Biological Diversity, through development of a program of work for dryland ecosystems, including grasslands. A global assessment of the condition of the world's grasslands ecosystems is being undertaken by the World Resources Institute and this will provide essential information. In addition, several regional initiatives are already working towards a similar goal. In Europe, much is already under way through the Pan-European Biological and Landscape Diversity Strategy (Goriup 1998).

This action plan will rest on a comprehensive and systematic analysis of existing levels of protection, and an assessment of the potential for improvement and the means for such improvement, within each region of the biome. The analysis of temperate grasslands protected areas and remaining natural areas would be undertaken at the ecoregion level. This work would record the number, average size and distribution of protected areas, the location and size of remaining natural areas and begin to identify those lands where the potential for additional protection exists.

Grassland species like the Denham's Bustard of Africa are at risk from declining habitat. Photo: Dave Richards.

This analysis would also include the identification of:

- Historical events and impact types leading to the alteration of current incentives or disincentives to conserve grasslands;
- Socio-economic and cultural factors influencing use and management of grasslands; and
- Other constraints impacting upon the potential to improve protection.

Considerable work will be required to examine the potential for restoring altered grassland ecosystems to convert intact grasslands under other uses into protected lands, and to develop policies and mechanisms to halt the continuing decline of grasslands and their dependent wildlife.

The action plan would also need to include a way of building awareness of the values of grassland ecosystems. To a great extent, temperate grasslands have been a victim of how people perceive them. Significant change in their use, management and long-term protection is unlikely to occur without a dramatic shift in that perception. Historically, while grasslands have been recognised for their rich soils and utility for agriculture, they have also been described as "barren wastelands" and the "quintessence of monotony" (Brown 1989).

Grasslands do not currently incite the same passionate demands for their protection as witnessed for tropical or temperate rainforests, mountain landscapes or coral reefs. There are, however, recent indications that this is changing, and a renewed interest is emerging that recognises the ecological value of grasslands and a need to conserve what remains of their rich biodiversity.

References

Brown, L. 1989. *Grasslands.* The Audubon Society Nature Guides, Alfred A Knopf, Inc., New York, USA.

CPAWS 1996. BC's grasslands Facing Extinction. *Parks and Wilderness Quarterly* 8(3): 1–4.

Curry-Lindahl, K. 1981. *Wildlife of the Prairies and Plains.* Harry N Abrams, Inc., New York, USA.

Goriup, P. 1998. *The Pan-European Biological and Landscape Diversity Strategy: integration of ecological agriculture and grassland conservation.* Parks 8(3): 37–46.

IUCN 1991. *The Lowland Grasslands of Central and Eastern Europe.* World Conservation Union, East European Program, Gland, Switzerland.

IUCN 1994. *1993 United Nations List of National Parks and Protected Areas.* Prepared by the World Conservation Monitoring Centre (WCMC) and IUCN Commission on National Parks and Protected Areas, Gland, Switzerland and Cambridge, UK.

Krapovickas, S. and Di Giacomo, A.S. 1998. The conservation of pampas and campos grasslands in Argentina. *Parks* 8(3): 47–53.

Low, B. and Rebello, A.G. 1996. *Vegetation of South Africa, Lesotho and Swaziland.* Department of Environmental Affairs and Tourism, Pretoria, South Africa.

Mack, R.N. 1989. *Temperate Grasslands Vulnerable to Plant Invasions: Characteristics and Consequences. A*s quoted in Parsons, R.F. 1994, op. cit.

McDougall, K. and Kirkpatrick, J.B. (eds.) 1994. *Conservation of Lowland Native Grasslands in South-Eastern Australia.* World Wide Fund for Nature, Australia.

McNeely, J.A., Harrison, J. and Dingwall, P. (eds.) 1994. *Protecting Nature: Regional Reviews of Protected Areas.* IUCN, Gland, Switzerland and Cambridge, UK.

Parsons, R.F. 1994. Preface. In: McDougall, K. and Kirkpatrick, J.B. (eds.) 1994. *Conservation of Lowland Native Grasslands in South-Eastern Australia.* World Wide Fund for Nature, Australia.

Island Press, Washington, DC, USA.

Samson, F.B. and Knopf, F.Lrks an2n2alia R. *Prairie Conservation: Preserving North America's Most Endangered Ecosystem. Island Press, Washington, DC, USA.*

Taylor, S. C. 1998. South-eastern Australian temperate lowland native grasslands: levels of protection and impediments to their conservation. *Parks* 8(3): 21–27.

Tarboton, W.lia. Birds and Birding 2(4): 41–44.

World Resources 1994–95. A report by the World Resources Instit1io, Oxford University Press, New York, USA.

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The Great Plains of North America

DAVID A. GAUTHIER AND ED WIKEN

Using a standardised ecosystem classification system for North America and the IUCN classification system for protected areas, data is presented summarising the distribution and extent of protected areas for the Great Plains of North America. The Great Plains consists of five major ecological sub-divisions, and three federal and 24 state or provincial jurisdictions. The USA contains 80% of the Great Plains, while Canada contains 16% and Mexico 4%. Around 6% of the Great Plains is contained within areas managed for conservation purposes. The USA contains 74% of the protected areas >1,000 ha while Canada contains the remaining 26%. Of the area protected, 99% occurs within only three of the five ecological regions that comprise the Great Plains. Of those three ecological regions, the majority of the area protected occurs in the west-central semi-arid prairie. Eighty percent of the protected areas are coded as IUCN VI, while 5% fall into IUCN classes I to III.

NFORMATION ON the extent and distribution of protected areas throughout North America is often difficult to locate and interpret. Protected area information is often collected and maintained by different agencies. National Park databases are often separate from state, provincial or territorial park databases. Park databases also tend to be separate from databases for wildlife reserves, heritage rivers or forest reserves. Where such information is combined, it is generally organised at the level of states, provinces or territories. Seldom is protected area information presented in terms of ecosystems.

In this paper, information on various types of protected areas is drawn together from across North America. Information is presented for major North American ecosystem units, particularly the Great Plains, and for administrative units. The rationale is presented for an ecosystem approach, then protected area information is summarised for each major ecosystem of North America. Descriptive information characterising the Great Plains of North America is then presented as context for summary information that follows on a variety of protected area types for the Great Plains. The Great Plains protected area information is presented according to ecological sub-unitstate or provincial jursi ju(ical su1re Greatorthcteri4ıTnRı˝-0.015 Tcı˝(A8sm24s that comp understand the extent and distribution of resource assets at various scales. Ecological changes can be evaluated and documented. The occurrence and extent of protected areas constitute one measure or indicator of ecological health or integrity. While there are very important reasons for examining those measures according to political jurisdictions, it is also useful to place them within the context of ecological regions.

Viewing protected areas according to ecological regions allows the dialogue to focus on ecological issues rather than primarily administrative or jurisdictional mandates, permits an analytical focus on specific themes, such as the extent of protection within North American deserts or forests and promotes cooperation and collaboration in environmental planning among diverse agencies and groups.

In the context of current day issues like biodiversity, protected areas serve other needs. They are used as a measure of success in ecosystem biodiversity protection. Promoting the conservation of whole ecosystems protects the inherent complement of species and gene pools that exist within ecosystems. Table 1 provides information on the three hierarchical levels of ecological regions of North America developed by the Commission for Environmental Cooperation's (CEC) Ecosystem Working Group (EWG 1997). The CEC's Level I and II ecological regions are used as the ecosystem units for this analysis. Table 2 provides information on the names and size of Level II ecological regions.

North American protected areas

In North America, there are many terms that may be used interchangeably for protected areas. These include parks, wilderness, refuges, conservation areas, reserves, sanctuaries and wildlife areas. They afford various forms of protection, depending on their management and purpose. To date, most of the areas protected in North America are associated with the landscape and far fewer are linked to the seascape. To provide a brief overview of the status of protected areas in North America, this analysis at the level of North America is based only on federal, provincial and state parks. Parks are fairly exemplary of other types of protected areas. The data are taken from a number of sources. The Canadian Council on Ecological Areas (CCEA) has been working with many organisations (e.g. World Conservation Monitoring Centre, Commission for Environmental Cooperation) to develop a standardised database of protected areas for North America. This database builds upon the Canadian Conservation Areas Database (CCAD) developed by Environment Canada.[1]

The database contains information on the distribution of national, state and provincial parks for North America according to both political jurisdictions and ecological regions. Table 3 summarises some information about these parks according to Level I ecological regions.

Some of the earliest park areas were established in the late 1800s. The numbers and area of parks have increased significantly towards the mid-1900s. By 1997, over 3,000 had been established. Tables should be interpreted cautiously as the database has yet to be completed and not all sites are represented.

The pattern of occurrence and distribution of parks often mimics the human population map. The Pacific and Atlantic coastal areas and the Great Lakes area show a marked concentration of parks. In North America, about two thirds of the parks are

[1] More details on the CCEA WWW home page: http://www.cas.uregina.ca/~cprc/ccea/

located in three ecological regions – the Eastern Temperate Forests, the Great Plains and the Northern Forests (Table 3).

The distribution within an ecological region is not necessarily even. The Great Plains, for example, show a heavy weighting of parks toward the northern end of the region. In part, this distribution pattern is a mirror image of the cultural patterns. In Canada, for example, political, cultural and economic factors have strongly influenced development along the 49th parallel, whilst in Mexico, Mexico City has been the centroid of culture and economics for thousands of years.

The location pattern gives no indication of the size of parks. Within Canada and the USA, the bulk of the larger parks and the area under overall park management authority is larger in the northern parts of the continent even though fewer individual parks are shown there. The Arctic Cordillera, a relatively small ecological region, has few parks, but those few parks cover a large proportion of the region.

Examination of data for the frequency of parks locations shows a number of the ecological regions to be well represented. However, the actual area of each ecological region contained within the parks is generally very low. Of course, this picture is incomplete as data is not presented for all categories of protected area.

The North American Great Plains ecosystem setting

The protected areas database can be examined in more detail for any of the ecological regions. This paper, however, focuses on the Great Plains. The prairies that occur around the world share common characteristics. Whether they are called prairies, grasslands, pampas or steppes, they are relatively large areas dominated by grasses and forbs. Grasslands are one of the largest ecosystems occurring in many relatively dry climates in both temperate and tropical regions world-wide. They cover about one quarter of the earth’s land surface.

The Great Plains ecological region (Figure 1) occupies the central part of the continent and extends over the widest latitudinal range of any single North American ecological region. It is a relatively continuous, roughly triangular area covering about 3 million km^2. They extend for about 1,500 km north to south, from Alberta, Saskatchewan and Manitoba in Canada, south through the Great Plains of the USA to southern Texas and adjacent Mexico. The Plains also extend approximately 600 km east to west, from western Indiana to the foothills of the Rockies and into north-eastern Mexico. The majority of the Great Plains, approximately 80%, is found within the USA, with 16% in Canada and 4% in Mexico. This large ecological region is

Table 1. *Levels of ecological regionalisation, North America.*

	Level I [1]	Level II [2]	Level III [3]
number of ecological regions	15	52	approx. 200
scale of presentation	1:20 million	1:10 million	1:2 million
geographical perspective	continental	national/regional	regional

Sources:
[1]Satellite imagery and appropriate natural resource maps at broad scales (approx. 1:10 million–1:20 million).
[2]Satellite imagery and appropriate natural resource maps at broad scales (approx. 1:5 million–1:10 million).
[3]Remote sensing techniques and appropriate regional natural resource maps (approx. 1:1 million–1:2 million).

generally distinguished by the following characteristics: relatively little topographic relief; grasslands and a paucity of forests; and a sub-humid to semi-arid climate.

Physical setting

The prairies range from smooth to irregular plains. In Canada they are generally flat to slightly-rolling plains but sizeable portions in the USA are hilly or classified as tablelands with moderate relief (100–175 m). The Mexican landscape alternates between flat areas and low hills. The landscape of the Canadian prairies (as well as the northern prairies of the USA) has been shaped by a variety of glacial deposits consisting mostly of undulating and kettled glacial till, and level to gently-rolling lacustrine deposits associated with intermittent sloughs and ponds. Surficial geology in the remainder of the Great Plains ecological region is varied. Major portions are eolian, others are stream deposits, and much of the region is comprised of thin residual

level	name	area (km^2)
1.1	Arctic Cordillera	218,225
2.1	Northern Arctic	1,495,255
2.2	Alaska tundra	390,490
2.3	Brook's Range Tundra	162,835
2.4	Southern Arctic	808,270
3.1	Alaska Boreal Interior	459,780
3.2	Taiga Cordillera	223,870
3.3	Taiga Plains	701,625
3.4	Taiga Shield	1,413,955
4.1	Hudson plains	334,530
5.1	Softwood Shield	1,427,115
5.2	Mixed Wood Shield	569,245
5.3	Atlantic Highlands	367,465
6.1	Boreal Cordillera	647,830
6.2	Western Cordillera	1,141,120
7.1	Marine West Coast Forest	692,970
8.1	Mixed Wood Plains	490,590
8.2	Central USA Plains	253,665
8.3	South-eastern USA plains	943,770
8.4	Ozark Ouachita, Appalachian Forests	518,690
8.5	Mississippi Alluvial, and South-east USA Coastal Plains	368,720
9.1	Boreal Plains	644,560
9.2	Temperate Prairies	785,400
9.3	West-central Semi-arid Prairies	911,425
9.4	South-central Semi-arid Prairies	1,003,375
9.5	Texas-Louisiana Coastal Plain	64,615
9.6	Tamaulipas-Texas Semi-arid Plain	134,500
10.1	Western interior Basins and Ranges	1,014,840
10.2	Sonoran and Mojave Deserts	

Table 3. *Occurence of level I ecological regions within national parks (IUCN II), and state and provincial parks, and extent of protection by national parks.*

Level I ecological region	number of national parks	national parks protected area (%)	number of state and provincial parks
Arctic Cordillera	3	33	0
Tundra	2	<1	4
Taiga	2	<2	31
Hudson Plains	0	0	4
Northern Forests	14	<1	575
North-western Forested Mountains	17	<2	322
Marine West Coast Forests	2	1	246
Eastern Temperate Forests	7	<1	961
Great Plains	9	<1	772
North American Deserts	13	1	201
Mediterranean California	2	<1	50
Southern Semi-arid Highlands	2	<1	2
Temperate Sierras	41	<1	4
Tropical Dry Forests	6	<1	0
Tropical Wet Forests	4	1	5

sediments. The Mexican portion is underlain by Cenozoic sedimentary rocks with recent continental deposits on the coast. Most rivers of the northern and central Great Plains have their origins in the Rockies where rainfall, snowmelt and glacial run-off in the north contribute to their formation. The soils are commonly deep and were originally highly fertile throughout most of the region. Today, soils of agricultural potential throughout the Great Plains face problems of reduced nutrient potential, increasing salinity and susceptibility to wind and water erosion. The climate is dry and continental, characterised in the north by short hot summers and long cold winters, with periodic intense droughts and frosts. High winds are also an important climatic factor in this ecological region.

Biological setting

The Great Plains ecological region was once covered with natural grasslands that supported rich and highly specialised plant and animal communities. The interaction of climate, fire and grazing influenced the development and maintenance of the Great Plains. Rainfall increases from west to east, defining different types of native prairies. Short-grass prairie occurs in the west, in the rain shadow of the Rocky Mountains, with mixed-grass prairie in the central Great Plains and tall-grass prairie in the wetter eastern region. In the Mexican Great Plains, prickly scrub vegetation dominates the landscape in transition between the desert conditions and the warmer and wetter conditions of the Prickly Tropical Forest (warm, dry jungles). Because of the suitability of the Great Plains for agricultural production, many native prairie vegetation types have been radically transformed. The short-grass, mixed-grass and tall-grass prairies now correspond to the western rangelands, the wheat belt and the corn/soybean regions. In the northern Canadian prairies, the remaining natural vegetation is dominated by spear grass, wheat grass and blue grama grass, while local saline areas feature alkali grass, wild barley, greasewood, red samphire and sea blite. Drier northern sites are home to yellow cactus and prickly pear, with sagebrush also abundant.

olive, barreta, corbagallina, and ocotillo. Salt-tolerant communities are common in the lower portions of the Mexican Great Plains near the Laguna Madre.

Wetland concentrations are generally greatest in the glaciated, sub-humid northern grasslands and adjacent aspen parkland of the northern Great Plains, where up to half of the land can be wetland. Significant wetlands are also found in the Nebraska Sandhills and a large area of playas located in south-western USA. During winter, Mexican bodies of water provide habitat for numerous migrant waterfowl from Canada and the USA. Prairie wetlands provide major breeding, staging and nesting habitat for migratory waterfowl using the central North American flyway. Prior to European settlement, the Great Plains supported millions of bison, pronghorn antelope, elk, mule deer, plains grizzly bears and plains wolves. Today, this area is home to a disproportionately high number of rare, threatened, vulnerable and endangered species. Drainage of wetlands and conversion of wildlife habitat for agriculture, industry and urban development are significant issues in this ecological region.

Human activities

The Great Plains is currently a culturally-moulded ecosystem. The first European settlers began their move westward into the northern and central Great Plains from the eastern forest regions. At first, settlers considered the prairies to be infertile, so they stayed where trees persisted, but soon they realised that the prairie soil was one of the most productive soils in the world. Today, the prairie grasslands are among the largest farming and ranching areas on the Earth. Agriculture is the most important economic activity as well as the dominant land-use and main cause of stress to this ecological region.

Crop types vary from north to south with 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 moister northern and central portions, whereas winter wheat and sorghum predominate in the central and southern parts. While agricultural activities dominate the rural landscape, population is centred in urban areas and rural depopulation is a continuing trend in Canada and the USA.

There is a general trend in Canada and the USA away from small and medium-sized farms towards large agribusiness operations. The change to a more complex economic structure in this region, influenced by international market forces, is also reflected in a growing service sector. Mining, gas and oil extraction are also important activities. In the southern Great Plains, irrigation agriculture along the Rio Grande is very important, as it is in the southern portion of the Mexican Great Plains. The main cultivated crops are sorghum, corn, sunflowers, canola and beans. In the undulating and drier land of open scrub vegetation in the north-west, there is extensive cattle and goat ranching. In portions of the region, scrub vegetation has been replaced by hay meadow. The Rio Grande crosses this region, acting both as an international border for 650 km and as an area of extensive commercial activity. Overall, approximately 34 million people live within this ecological region, with some 32 million occupying the USA portion alone.

Great Plains protected areas

The Great Plains ecological region of North America includes 3 national and 24 state or provincial jurisdictions. There are five major ecological sub-divisions of the Great

Plains (Figure 1). Figure 1 also shows the distribution of protected areas (greater and less than 1,000 ha) throughout the five sub-divisions. The remainder of the analysis in this paper will focus on the areas greater than 1,000 ha.

There are 603 protected areas over 1,000 ha occurring in the Great Plains of North America. Table 4 shows that, in total, the protected areas occupy just under 6% of the Great Plains. Of the area protected, 99% occurs within only three of the five ecological regions that comprise the Great Plains. Of those three ecological regions, the majority of the area protected (72%) occurs in the West-central Semi-arid Prairies. The Texas-Louisiana Coastal Plain and the Tamaulipas-Texas Semi-arid Plain contain less than 1% of the area protected in the Great Plains.

The IUCN protected area category system is useful for comparisons of protected areas across ecological and jurisdictional boundaries (Table 4). Of the area classed as protected area in the Great Plains, 60% has been coded using the IUCN criteria. Of this coded area, 80% has IUCN VI status. Only 5% of this coded area falls into IUCN categories I to III, those considered to be managed for the highest degree of protection.

It is also useful to examine these data by country (Table 5). Canada contains 16% of the Great Plains in two ecological regions, the Temperate Prairies and the West-Central Semi-arid Prairies. These two regions comprise the prairie ecozone of Canada, occupying 5% of Canada's total land area. Of the protected areas above 1,000 ha in the Great Plains of North America, 26% occur in the Canadian Great Plains.

The Great Plains occupy approximately 29% of land area within the continental USA and that country contains 80% of the Great Plains of North America. Almost three-quarters of Great Plains protected areas larger than 1,000 ha are in the USA. When all IUCN classes are considered, those areas provide protection for approximately 7% of the Great Plains within the USA.

Five percent of Mexico's land area is prairie, representing 4% of the total area of the Great Plains of North America. While there are protected areas within the Mexican

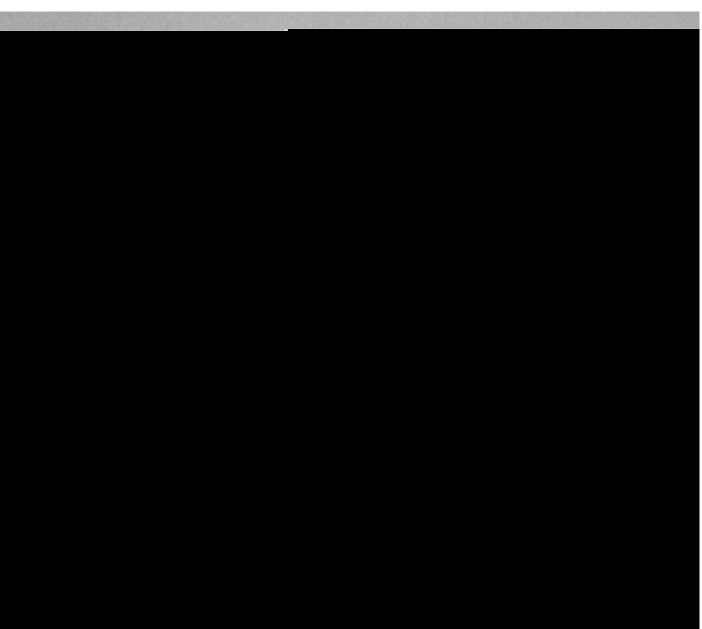

Table 4. *Frequency and area of coverage of protected areas >1,000 ha in size for the ecological regions of the Great Plains of North America according to IUCN categories.*

IUCN Category	Temperate Prairies	West-central Semi-arid Prairies	South-central Semi-arid Prairies	Texas-Louisiana Coastal Plain	Tamaulipas-Texas Semi-arid Plain	Great Plains total
IUCN I:						
number of sites	2	8	1	1	0	12
area (ha)	6,253	46,492	5,526	50	0	58,321
area (%)	0.008	0.05	0.006	0.0005	0	0.02
lIUCN II:						
number of sites	8	10	1	0	0	19
area (ha)	162,963	252,964	1,056	0	0	416,983
area (%)	0.21	0.29	0.001	0	0	0.14
IUCN III:						
number of sites	4	6	4	0	0	14
area (ha)	7,014	15,154	3,188	0	0	25,356
area (%)	0.009	0.02	0.003	0	0	0.008
IUCN IV:						
number of sites	46	47	13	9	0	115
area (ha)	307,459	647,741	76,484	118,124	0	1,149,808
area (%)	0.39	0.7	0.08	1.23	0	0.40
IUCN V:						
number of sites	22	6	18	3	1	50
area (ha)	128,529	29,445	49,924	36,233	7,563	251,694
area (%)	0.16	0.03	0.05	0.56	0.05	0.09
IUCN VI:						
number of sites	31	78	3	0	0	112
area (ha)	620,223	7,238,411	636,596	0	0	8,495,230
area (%)	0.80	7.9	0.65	0	0	2.93
unclassified:						
number of sites	107	97	71	8	1	284
area (ha)	752,484	3,929,975	1,872,338	19,273	1,620	6,575,690
area (%)	0.97	4.6	1.93	0.29	0.01	2.27
all IUCN categories:						
number of sites	220	252	111	21	2	606 [1]
area (ha)	1,984,925	12,160,182	2,645,112	173,680	9,183	16,973,082
area (%)	2.6	13.3	2.7	2.7	0.07	21.37
Great Plains area (%)	0.7	4.2	0.9	0.06	0.003	5.9

[1] Some protected areas overlap across ecological region boundaries and hence are recorded in more than one ecological region yielding a frequency count that is higher than the actual count of 603.

Table 5. *Protected areas (>1,000 ha) according to ecological region and country for the Great Plains of North America.*

country	area (km^2)	prairie area (km^2)	prairie area (%)	Great Plains area (%)	number of protected areas	protected prairie area (km^2)	protected prairie area (%)
Canada	9,970,610	457,308	5	16	159	15,874	3.5
USA[1]	7,825,161	2,287,486	29	80	444	153,856	6.7
Mexico	1,958,201	105,532	5	4	0	0	
total	19,753,972	2,850,327	14	100	603	169,730	5.9

[1] Excluding Alaska or Hawaii.

of attempting to achieve coordinated ecosystem management over such a large ecological region.

In Canada, Saskatchewan contains the greatest area of the Great Plains. It also has the greatest number of protected areas over 1,000 ha and the largest proportion (5%) of protected prairie in Canada. Within the USA, states that have at least 70% of their land area as prairie (e.g. North Dakota, Nebraska, Kansas, Iowa, Montana, South Dakota, Texas and Oklahoma) vary widely in the proportion of that prairie that is protected. Less than 1% of Iowa's prairie is protected, whereas up to 25% is protected in South Dakota.

Ecosystem analyses are initial assessments. A more formal gap analysis is now required to build on this grassland ecosystems review. The work of the Canadian Council on Ecological Areas (Gauthier 1992, Gauthier *et al.* 1995) could serve as a possible model in that regard.

Acknowledgements

South-eastern Australian temperate lowland native grasslands: protection levels and conservation

STEVE C. TAYLOR

South-eastern Australian temperate lowland native grasslands are the most threatened ecosystems in Australia. Since European settlement in 1788, Australia has lost over 99.5% of these grasslands. Some of the causes of this loss are clearing and conversion to crops, invasion by exotic plants, altered fire regimes and overgrazing by introduced herbivores such as cattle and sheep. In recent years there has been a commitment by governments to fund remnant grassland projects through nationally-coordinated grants and programs such as Bushcare, Landcare, the Grasslands Ecology Program and Save the Bush. New reserves are planned, reflecting growing community awareness of the importance of our remaining native grasslands. The main impediments to conservation of what remains include lack of resources to deal with overgrazing and weed invasion, inadequate fire management and the small size of many remnants, making them prone to further degradation.

USTRALIAN TEMPERATE native grasslands have an irregular distribution, located across the statee antw˝[(locat 0.0 overgr0.0584 Twı˝[oA),are povergrWalt 0(NSW˝[oThr4222 clim4 Twırathe oseafud Sarelı˝0 -lytanldre manatcmoun˝0in013 Tde 354.45 ı˝0 0 0 cesTı˝gimversio loss of 99.5% of these native ecosystems (Kirkpatrick *et al.* 1995). The remaining areas are highly fragmented and found in diverse locations, including travelling stock routes, railroad reserves, private grazing properties, cemeteries and in urban open space.

Biodiversity protection

Rare orchids, lilies and pea species are characteristic of south-eastern temperate lowland native grasslands. One reason for their rarity is a sensitivity to grazing by introduced herbivores (rabbits, sheep and cattle). Only 7 of the 24 nationally rare or threatened grassland flora species are adequately protected (Kirkpatrick *et al.* 1995).

There is also a range of rare lowland-grassland fauna. These include the plains wanderer (*Pedionomus torquatus*), the striped legless lizard (*Delma impar*) and the golden sun moth (*Synemon plana*). Long-term species survival depends on maintaining native grasslands, which themselves are also listed as threatened or endangered in some states. For example, in the ACT natural temperate grassland is listed as an endangered ecological community under the Nature Conservation Act (1980), while in Victoria a number of natural temperate grassland communities are listed as threatened under the Flora and Fauna Guarantee Act (1988) (ACT Government 1997). Such legislation, combined with clearance control legislation, provides the legal backing for grasslands conservation. However, protective legislation is only as good as the level of political commitment to enforce it. There also needs to be a balance between legal sanctions and incentives. Incentives are discussed later.

Temperate lowland native grassland types

Tables 1–4 summarise the reservation status for south-eastern Australian temperate lowland native grassland based on the community definitions developed by Kirkpatrick *et al.* (1995).[1] Further details about these and other communities can be found in ACT Government (1997), Benson (1994), Benson *et al.* (1997), McDougall and Kirkpatrick (1994), and Hyde (1995), cited in Davies (1997).

The grassland communities listed in Tables 1–4 are grouped into the following four categories, which are named after the dominant native perennial grass species:

- Kangaroo grass (*Themeda triandra*) communities;
- Tussock grass (*Poa* spp.) communities;
- Spear grass (*Stipa* spp.) communities;
- Wallaby grass (*Danthonia* spp.) communities.

Kangaroo grass and tussock grass are mainly found in higher rainfall areas. In drier areas spear grass and wallaby grass are mixed with herbland (Kirkpatrick *et al.* 1995).

Tables 1–4 show that most of the south-eastern temperate lowland native grasslands are either unreserved (e.g. Wimmera herb/grassland-W2), or inadequately reserved (e.g. Tasmanian valley grassland-T2). This low level of reservation is reflected in all temperate grassy ecosystems. For example, in the riverine plains of NSW less than 1% of native grasslands and grassy woodlands are reserved (AACM 1995).

The threats to remaining areas include overgrazing, changed fire regimes and weed invasion, for example the Tasmanian flood plain grassland-T3, the South Gippsland kangaroo grass grassland-G1 and the basalt plains grassland-B1, respectively.

Some of the small remnants in cemeteries, rail reserves and airfields have a disproportionately large number of rare species (Kirkpatrick *et al.* 1995). An example is the Central Gippsland kangaroo grass grassland. Rare plant species survive, mainly because these sites have not been continually over-grazed or ploughed. However, these remnants are at high risk from not being burnt frequently enough, ill-informed

Table 2. *SE temperate lowland tussock grass-dominated communities.*

community	region	reservation status and comments
Monaro basalt grassland-M3	southern NSW	A reserve is planned along with voluntary conservation agreements on private land.[1]
Monaro grassland-M5	ACT & southern NSW	Some of the best examples are reserved. A voluntary conservation agreement is also planned for one private land site.[2]
Tasmanian valley grassland-T1	mid- & eastern Tasmania	Inadequately reserved. Most of what remains is under threat from agricultural practices.
Tasmanian valley grassland-T2	eastern Tasmania	Inadequately reserved.
Tasmanian flood plain	eastern Tasmania	Inadequately reserved. Threatened by grassland-T3 over-grazing

Conclusions

In conclusion most of the lowland temperate native grasslands are either unreserved or inadequately reserved. Furthermore around half of the rare or threatened grassland plant species are found on private land (Kirkpatrick *et al.* 1995). This indicates that conservation of what remains is highly dependent on appropriate management practices by private landholders. This is one reason why there has been an increased commitment to programs like Bushcare and protection measures such as conservation covenants and Land for Wildlife schemes.

The main threats and impediments to conservation of what remains (apart from lack of resources), include:

- Lack of political will to enforce legislation that would conserve native grasslands, in contrast to strong will to conserve rainforests. Two reasons for this are:

(i) it is harder to persuade the public about the importance of native grasslands than to persuade them of the importance of native forests; and

(ii) farmers and other private land-holders sometimes mistrust government agencies, leading them to misunderstand reasons for legal prescriptions to protect native grassland;

- Ad hoc management. This includes fencing off a remnant native grassland without having a management plan in place;
- Continuous grazing in one location (overgrazing). Lower stocking rates and appropriate fencing would allow a switch to short bursts of grazing in the most appropriate seasons. This requires further government financial assistance;
- Invasion by exotic plants. Exotic plants represent around one third of temperate grasslands species (Kirkpatrick *et al.* 1995). There is increasing knowledge about the control of weed infestations (Davies 1997) but more resources are needed to apply the weed control techniques; and
- High edge effects due to the small linear nature of many remnants, making such areas more prone to catastrophic disturbances.

A commitment of government resources combined with community participation can deal with many of these threats. A growing public awareness of the importance of the remaining temperate lowland native grassland biodiversity will hopefully create the political will to allocate further government resources.

References

AACM 1995. *National Grassland Conservation Overview.* Final Report, June 1995 for the Australian Nature Conservation Agency.

ACT Government 1997. *Natural Temperate Grassland: An Endangered Ecological Community.* Action Plan No. 1. Environment ACT, Canberra. <http://www.act.gov.au/environ/actionplans/GRASLAND.html>

Barlow, T. 1998. *Grassy Guidelines. How to Manage Native Grasslands and Grassy Woodlands on your Property.* Trust for Nature (Victoria).

Benson, J.S. 1994. The native grasslands of the Monaro region: southern tablelands of New South Wales. *Cunninghamiana* 3(3): 609–650

Benson, J.S, Ashby, E.M and Porteners, M.F. 1997. The native grasslands of the Riverine Plain, New South Wales. 13):48stralian0.76″-2.0229 -1.1314 T9ı″0.013571cı″0.14tions , R.J.P.vernment 1997.

Temperate and alpine grasslands of the Himalaya: ecology and conservation

G.S. RAWAT

The ecology and conservation of grasslands within the Himalayan region are reviewed. Five grassland types are defined and described: warm temperate grasslands; cool temperate grassy slopes; sub-alpine meadows; alpine meadows; and steppe formations of the trans-Himalaya. The floral structure, successional trends in meadow and forest regions, and biomass productivity are examined. Mammalian and bird species are listed as an indicator of biodiversity. The human effects of pastoralism, collection of medicinal herbs, and collection of fuel wood are then described. The paper concludes by looking at aspects of conservation and management, touching on the sustainability of different land-use.

HE HIMALAYAN region, one of the most astounding physical features on the surface of the earth, is well known for its diverse landscapes and aesthetic, cultural, biological and hydrological values. It has witnessed a series of changes in its geomorphology, climate and biota since its origin during Cretaceous-Oligocene periods (Vishnu-Mittre 1984). These changes, coupled with more recent human activities, have given rise to present day vegetation which ranges from lower montane, wet, evergreen forests to cold, arid, steppe communities and several secondary formations (Singh and Singh 1988, Mani 1974). Of these, the natural and semi-natural grasslands are of particular interest due to their relatively recent origin, dynamics and close co-evolution with grazing ungulates.

The grassland vegetation in the Indian Himalaya occupies nearly 35% of the geographical area and includes the warm temperate grasslands, sub-alpine and cool temperate grassy slopes, alpine meadows of the greater Himalaya and the steppe formations of cold arid regions or alpine dry scrub. These grasslands form distinct categories of their own and differ from one another in terms of origin, structure and composition. However, like all other grasslands of the world, these formations support a large number of wild herbivores, domestic livestock and several agro-pastoral cultures.

The temperate and alpine grasslands of the Himalaya have been studied by a large number of ecologists, e.g. Patil and Pathak (1978), Gupta (1990), Numata (1986), Ram *et al.* (1989), Rikhari *et al.* (1992), Sundriyal (1989, 1995), Bawa (1995), Bhat and Kaul 1989, and Kala *et al.*

and the author's own experience of

classification of Himalayan grasslands is being suggested based on their origin and geographical distribution. Various associations and community types identified by earlier workers can be grouped under these types:

- Warm temperate grasslands;
- Cool temperate grassy slopes;
- Sub-alpine meadows;
- Alpine meadows; and
- Steppe formations of trans-Himalaya.

Warm temperate grasslands

The warm temperate belt (1,500–2,500 m) in north-western, western and central Himalaya, especially on the south and south-eastern slopes, are characterised by extensive grassy slopes dotted with scattered trees and shrubs. Most of these grasslands or 'hill savannas' have been derived as a result of frequent burning and livestock grazing on gentler slopes. According to Dabadghao and Shankarnarayanan (1973) the grass cover in these areas fall under the *Themeda-Arundinella* type. This category also includes the hay fields intensively managed for grass production by local people. Such grasslands are locally known as 'ghasnis' in Himachal Pradesh (HP) and the hills of Uttar Pradesh (UP). Quite a few slopes with abandoned agriculture are dominated by more fire-hardy species such as *Imperata cylindrica* and *Cymbopogon distans*, and can be termed semi-natural or secondary grasslands.

Cool temperate grassy slopes

The steeper (>45°) slopes with thin soil in the cool temperate and sub-alpine zone (2,600–3,300 m) do not favour the tree growth and generally support herbaceous or grassland vegetation. The common species of grasses in such areas in the west are *Chrysopogon gryllus*, *Dactylis glomerata*, *Koeleria cristata*, *Andropogon munroii*, *Danthonia jacquemontii* and *Themeda triandra*. These areas also burn during winter, either accidentally or intentionally.

Sub-alpine meadows and 'thaches'

Forest blanks within the cool temperate and sub-alpine forests have been created by communities and associations of grasses have been reported from the alpine regions of the western Himalaya: *Deyuxia-Deschampsia*, *Danthonia cachemyriana* patches, species of *Festuca* and *Poa*. Kala *et al.* (1998) have reported as many as 22 herbaceous communities from the alpine meadows of the Valley of Flowers National Park in the western Himalaya.

Steppe formations of trans-Himalaya

The cold arid regions in the trans-Himalaya are characterised by the Mediterranean type of vegetation, i.e. scattered low shrubs with sparse grasses and forbs. Several communities are reported from the cold arid regions of Ladakh and Spiti regions of north-west Himalaya, e.g. *Artemisia-Caragana* nature and would be changed to forest vegetation if kept free from human interference.

The alpine meadows exhibit a complex mosaic of plant succession. The species which occur on frequently grazed sites include *Danthonia cachemyriana*, *Calamogrostis* sp., *Stipa* spp. and *Agrostis munroana*. Kala *et al.*, (1998) have suggested two parallel courses of succession for the alpine meadows near the treeline (3,500+200 m) in the Valley of Flowers National Park, western Himalaya:

- *Meadow succession*: The moss-lichen (pioneer) community in a glaciated valley on the terminal and south-facing lateral moraines give rise to several annual herbaceous formations. The *Cyananthus-Kobresia-Anaphalis* association and *Danthonia cachemyriana* patches form the climatic plant community on such slopes; and
- *Forest succession*: The north and north-eastern aspects, due to higher moisture regime and less exposure to sun and wind, promote the growth of shrubby species which thrive well under heavy snow, i.e. snow-bed communities. Some of these shrubby intermediate communities will eventually give way to a birch-rhododendron (*Betula utilis-Rhododendron campanulatum*) community on more stable slopes with deeper soil.

Biomass productivity

The above-ground biomass in these grasslands varies from 1,000 kg/ha to 10,000 kg/ha for warm temperate grassland and 400–5,000 kg/ha for high altitude grasslands (Gupta 1990, Sundriyal 1995). It has been estimated that due to increase in the cover of unpalatable species the herbage production in the Himalayan grasslands has decreased by 20–50% in terms of quantity and 10–15% in terms of quality compared with their potential (Patil and Pathak 1978). In parts of Garhwal and Kumaon Himalaya the standing biomass of grasses was found to increase with increasing altitude up to about 3,750 m (Dabadghao and Shankarnarayan 1973). However, no detailed studies on the productivity are available along the entire gradient. The dry matter yields (in kg/ha) of certain indigenous fodder grasses (within pure stands) are reported to be up to 7,440 for *Andropogon pumilus*, 11,040 for *Apluda mutica*, 6,986 for *Arundinella nepalensis*, 6,951 for *Bothriochloa intermedia*, 4,975 for *Chrysopogon fulvus*, 6,941 for *Chrysopogon gryllus*, 6,925 for *Heteropogon contortus*, 9,918 for *Pennisetum orientale* and 4,836 for *Themeda anathera*. In terms of nutrient value, i.e. crude protein content, *Apluda mutica*, *Bothriochloa intermedia* and *Chrysopogon fulvus* are considered to be the best grazing (Singh and Saxena 1980).

Unlike the tropical grasslands, the temperate and alpine grasslands exhibit a strong seasonality. While the growing season in the temperate region generally begins in April, the sub-alpine and alpine grasslands start sprouting in June to July. Thus, the biomass production in these grasslands is lower than in tropical grasslands (Misra 1987, Ram *et al.* 1989) due to the shorter growing season.

Wildlife

The Himalayan grasslands support a diverse array of animal communities. The typical mammalian fauna inhabiting grassland habitats in these mountains include wild sheep, goats, goat antelopes and rodents. In addition, a number of avian communities, especially partridges and other members of the phasianidae, depend on the grasslands and meadow vegetation for their survival (Table 2).

Mammals

Goral (*Nemorhaedus goral*), Himalayan tahr (*Hemitragus jemlahicus*), blue sheep (*Pseudois nayaur*), Himalayan ibex (*Capra ibex sibirica*), Tibetan antelope (*Pantholops hodgsoni*), Tibetan gazelle (*Procapra picticaudata*), Ladakh urial or shapu (*Ovis vignei vignei*), Tibetan argali or nayan (*Ovis ammon hodgsoni*) and Tibetan wild ass (*Equus kiang*) are the typical grazing ungulates of the high altitude grasslands and scrubs. Mishra and Johnsingh (1996) studied the habitat use by goral in western Himalaya and found that this species feeds almost entirely on grasses (92.2% in the cold season and 98.3% in the warm season) and prefers ibeon DTfı˝9.9030.273Shicus

Human use and abuse

Pastoralism

Most of the grasslands in the lower temperate belt of western and central Himalaya are grazed by domestic livestock throughout the year. It is estimated that the Himalayan region supports nearly 12 million sheep and goats, 10 million cattle, 3–4 million buffaloes, 400,000 horses and donkeys, and up to 350,000 pigs (Kawosa 1988). Since the lower altitude grazing lands are limited in area and the livestock population in these areas far exceeds the carrying capacity, the practice of summer migration to the higher altitude alpine meadows has become necessary to sustain the number of livestock. It has been observed that agro-pastoralists in the western and central Himalaya generally keep more cattle than they really need because of easy access to free grazing areas and their inability to dispose or cull the population due to religious sentiments. Uncontrolled grazing on the steeper slopes reduces water holding capacity and compaction reduces the permeability of the soil. Continuous grazing also creates channels or paths on hill slopes which remove huge quantities of soil during rains. Over-grazed areas near mid- and high-elevation villages in Nepal shows a decrease in grasses and an increase in the unpalatable species such as *Rhododendron anthopogon*, *Berberis* spp. *Euphorbia wallichii*, *Euphorbia longifolia* and *Iris kumaonensis* (Numata 1986). However, Brower (1990) has stressed that the migratory lifestyle of Sherpa communities in Nepal was better for the conservation of rangelands than a sedentary lifestyle would have been.

A flock of migratory sheep and goats on their way to higher pastures in the Himalaya. Photo: G. S. Rawat.

Despite the fact that domestic animals are an integral part of agro-pastoral ecosystems and that grazing-based animal husbandry is the mainstay of the economy in many parts of the Himalaya, no studies and policy guidelines are available for optimal use of grazing resources. Plantation of agroforestry trees and round the year production of fodder would be the best option for the agro-pastoralists, but excessive use of resources for horticulture (orchards) and heavy use of pesticides to promote fruit production may, as practices in the states of HP, and Jammu and Kashmir (J&K) show, have severe ecological consequences and loss of biodiversity in the long run.

Collection of medicinal herbs

Alpine meadows, besides being popular summer grazing grounds for a large number of migratory livestock, harbour numerous medicinal herbs which are extracted in large quantity by many local communities for their own consumption, as well as for sale. Over-exploitation of some of the herbs from high altitude areas has caused serious concern amongst conservationists (Edwards 1996 and Tandon 1997). Most of the medicinal plants growing in the alpine meadows have tuberous or rhizomatous roots. Digging of fragile alpine soil for such medicinal herbs and subsequent trampling and grazing by livestock spreads weeds and causes soil erosion. In the western Himalayan meadows, exploitation pressure is particularly high on

Dactylorhiza hatagirea, *Picrorhiza kurrooa*, *Jurinea macrocephala* and *Aconitum heterophyllum*. Presently, there are only a few protected areas in the western Himalaya where extraction of medicinal herbs is prohibited. Kala *et al.* (1998) compared the density and abundance of various medicinal herbs in and around the Valley of Flowers National Park and found that some of the rare and threatened medicinal plants were completely absent in the grazed and unprotected alpine meadows.

Collection of brush from the steppes has been a major anthropogenic factor influencing the vegetation in the trans-Himalaya. Photo: G. S. Rawat.

Collection of fuel wood

Livestock grazing and extraction of woody plants by the pastoral communities go together. Consumption of firewood is very high around treeline and sub-alpine zones of the greater Himalaya and thickly populated areas of trans-Himalaya. There are clear indications that the natural treeline in many parts of the Himalaya has lowered considerably as a result of regular camping and removal of woody vegetation (Rawat and Uniyal 1993). Selective removal of highly preferred species such as *Juniperus macropoda* and *J. communis* can also lead to local extinction of such species. Extraction of fuel wood, particularly from the low productive areas of trans-Himalaya, is one of the burning issues in the conservation of steppe communities. In the absence of larger trees and shrubs local people dig out the low shrubs and undershrubs in large quantities in order to warm their houses and cook during long and severe winters (Manjrekar 1997). In addition, collection of livestock dung from the higher pastures for fuel is a common practice in the trans-Himalaya. The ecological implications of such practices have not been fully understood so far.

Conservation and management

The mid-elevation grasslands, particularly the hay fields, or 'ghasnis', are maintained by regulation of livestock grazing and winter season burning. This system has been successful in many parts of western Himalaya through village level cooperatives and personal care of ghasnis which are passed on within families. However, no management system has evolved for the village grazing lands which are considered to be common property. Raina (1960) has pointed out the plight of such grazing lands, locally known as 'charand' in HP, stating that these areas have been "nobody's child". Despite a number of government departments operating in the region, including Revenue, Animal Husbandry, and Agriculture and Forestry, none are responsible for the restoration of grazing lands. Thus it is imperative to develop a better management system for village pastures to increase fodder production and to reduce pressure on the natural grasslands which act as refuges for the wild grazing ungulates.

The sustainability of seasonal grazing by large flocks of migratory sheep and goats in the alpine meadows in summer and the Himalayan foot-hills in winter has been much debated recently (e.g. Saberwal 1996, Mishra and Rawat 1998). Alpine pastures play an important role in relieving the grazing pressure on the forests and grazing lands of the lower altitudes, but the increased number of livestock and overuse of certain pastures can lead to degradation of high altitude grasslands including habitats for wild herbivores (Bhatnagar 1997). Restriction of grazing by migratory livestock in crucial wildlife areas, especially within the national parks, and limiting the number of livestock in other areas would be the most practical solution. Johnsingh *et al.* (1998) have given more recommendations for the conservation of various species and ecosystems in the trans and alpine areas of the Greater Himalaya.

Ecodevelopment plans to address the problems of fuel wood and non-timber forest products (including medicinal plants) in the high altitude areas are needed, especially for the people living in and around the protected areas in the Himalaya. More concerted efforts in monitoring the health of threatened grassland ecosystems and representative biota will be crucial in achieving the long term conservation goal.

References

Ali, S. and Ripley, S.D. 1983. *A Pictorial Guide to the Birds of the Indian Subcontinent.* Bombay Natural History Society and Oxford University Press, Bombay, India.

Agarwal, B. and Tiwari, S.C. 1988. Effects of prescribed fire on plant biomass, net primary production and turnover in a grassland at Garhwal Himalaya. *Proc. Nat. Acad. Sci. India* 58(B-2): 291–302.

Bawa, R. 1995. Biomass dynamics of Himalayan grassland. *International J. of Ecol. & Environmental Sci.* 21: 25–36.

Bhat, S.A. and Kaul, V. 1989. Grassland communities of Dachigam, Tebal Catchment, Kashmir. *Indian Forester* 115(8): 567–577.

Bhatnagar, Y.V. 1997. *Ranging and Habitat Utilization by the Himalayan Ibex (*Capra ibex sibirica*) in Pin Valley National Park.* PhD Thesis. Saurashtra University, Rajkot, India.

Blow, R.A. and Hamilton, N. 1975. Palaeomagnetic evidence from DSDP cover of northward drift of India. *Nature* 257: 570–72.

Brower, B. 1990. Range conservation and sherpa livestock management in Khumbu, Nepal. *Mountain Research and Development* 19(1): 34–42.

Chundawat, R.S. 1992. *Ecological studies of Snow Leopard and its Associated Prey Species in Hemis High Altitude National Park.* PhD Thesis. University of Rajasthan, Jaipur, India.

Dabadghao, P.M. and Shankarnarayan, K.A. 1973. *The Grass Cover of India.* Indian Council of Agricultural Research, New Delhi, India.

Edwards, D. 1996. *Non-timber Forest Products from Nepal: Aspects of the Trade in Medicinal and Aromatic Plants.* FORSEC Monograph 1/96. Ministry of Forest and Soil Conservation, Kathmandu, Nepal.

Gupta, S.K. 1990. Structure and functioning of grassland ecosystems in the western Himalaya (Garhwal Himalaya) I. Altitudinal variation in carrying capacity. *Tropical Ecology* 31(1): 89–95.

Johnsingh, A.J.T., Rawat, G.S., Sathyakumar, S., Karunakaran, P.V. and Kaur, J. 1998. *Prioritization of Areas for Biodiversity Conservation of Trans- and Greater Himalaya, India.* Wildlife Institute of India, Dehra Dun, India.

Kala, C.P., Rawat, G.S. and Uniyal, V.K. 1998. *Ecology and Conservation of Valley of Flowers National Park. Technical Report* # RR-98/003, Wildlife Institute of India, Dehra Dun, India.

Kawosa, M.A. 1988. *Remote Sensing of the Himalaya.* Natraj Publishers, Dehra Dun, India.

Lal, J.B., Gulati, A.K. and Bisht, M.S. 1991. Satellite mapping of alpine pastures in Himalayas. *Intern. J. Remote Sensing* 12(3): 435–443.

Mani, M.S. (ed.) 1974. *Ecology and Biogeography in India.* Dr. W. Junk, The Hague, Netherlands.

Manjrekar, N. 1998. *Feeding Ecology of Ibex (*Capra ibex sibirica*) in Pin Valley National Park, Himachal Pradesh. PhD Thesis.* Saurashtra University, Rajkot, India.

Misra, R. 1987. *Ecology of the Grazing Lands of India, National Rangeland Symposium*, IGFRI, November 9–12, Jhansi, India.

Mishra, C. and Johnsingh 1996. On habitat selection by the goral *Nemorhaedus goral bedfordi* (Bovidae, Artiodactyla) J. Zool. Lond. 240: 573–580.

Mishra, C. and Rawat, G.S. 1998. Livestock grazing and biodiversity conservation: comments on Saberwal. *Conservation Biology* 12(3): 712–714.

Numata, M. 1986. Conditions of semi-natural pastures in the humid Himalayas. *Intecol Bulletin* 13: 65–68.

Patil, B.D. and Pathak, P.S. 1978. Grassland development in the Himalaya. pp. 204–215, in Anon. (ed.) *Resources Development and Environment in the Himalayan Region.* DST, New Delhi, India.

Raina, V. 1960. Grazing lands in Himachal Pradesh. *Indian Forester* 82: 80–84.

Ram, J., Singh, J.S. and Singh, S.P. 1989. Plant biomass, species diversity and net primary production in a central Himalayan high altitude grassland. *J. of Ecology* 77: 456–468.

Rawat, G.S. and Uniyal, V.K. 1993. Pastoralism and plant conservation: the Valley of Flowers dilemma. *Environmental Conservation* 20(2): 164–167.

Rawat, G.S. and Rodgers, W.A. 1988. Alpine meadows of U.P. Himalaya: an ecological review. *Proceedings of the National Rangeland Symposium*, Jhansi, India, November 9–12, 1987: 119–137. IGFRI, Jhansi, India.

Rikhari, H.C., Negi, G.C.S., Pant, G.B., Rana, B.S. and Singh, S.P. 1992. Phytomass and primary productivity in several communities of a central Himalayan alpine meadow, India. *Arctic & Alpine Research* 24(4): 344–351.

Saberwal, V.K. 1996. Pastoral politics: Gaddi grazing, degradation and biodiversity conservation in Himachal Pradesh, India. *Conservation Biology* 10: 741–749.

Sathyakumar, S. 1994. *Habitat Ecology of Ungulates in Kedarnath Musk Deer Sanctuary, Western Himalaya.* 244 pp. PhD Thesis. Saurashtra University, Rajkot, India.

Schaller, G.B. 1977. Observations on Himalayan tahr (Hemitragus jemlahicus). *J. Bombay Natural Hist. Soc.* 70(1): 1–23.

Singh, J.S. and Saxena, A.K. 1980. *The Grass Cover in the Himalayan Region.* National seminar on resources, development and environment in the Himalayan region. 164–203.

Singh, J.S. and Singh, S.P. 1988. Forest vegetation of the Himalaya. *The Botanical Review* 53: 80–192.

Singh, P. 1994. Recent bird records from Arunachal Pradesh. *Forktail* 10: 65–104.

Sundriyal, R.C. 1989. Assessment of the grazing ability of an alpine pasture in the Garhwal Himalaya, India. *Environment & Ecology* 7(1): 247–249.

Sundriyal, R.C. 1995. Grassland forage production and management in the Himalaya: a review. *J. of Hill Research* 8(23): 135–150.

Tandon, V. 1997. *Report on the Status of Conservation, Trade, and Potential for Growth in Sustainable Use of Major Medicinal Plants in Great Himalayan National Park.* H.P. Report submitted to the Wildlife Institute of India, Dehra Dun, India.

Tsuchida, T. and Numata, M. 1983. Grassland vegetation in the Arun Valley and Sedua district eastern Nepal. In: Numata, M. (ed.) *Ecological Studies in the Arun Valley, East Nepal and Mountaineering of Mt. Baruntse.* 113–127. Chiba University, Chiba, Japan.

Uniyal, B.P., Balodi, B. and Nath, B. 1994. *The Grasses of Uttar Pradesh: a Checklist.* Bishen Singh Mahendrapal Singh, Dehra Dun, India.

Vishnu-Mittre 1984. Floristic changes in the Himalaya (southern slopes) and Siwaliks from Mid-Tertiary to recent times. In: Whyte, R.O. (ed.) *The Evolution of the East Asian Environment. Vol II. Palaeobotany, Palaeozoology and Palaeoanthropogy.* 483–503. Centre of Asian Studies, University of Hongkong, China.

Yadava, P.S. and Singh, J.S. 1977. *Grassland Vegetation: Its Structure, Function, Utilization and Management.* 132 pp. Today and Tomorrow's Printers and Publishers, New Delhi, India.

Whyte, R.O. 1976. Bioclimatic and taxonomic consequences of tectonic movement and orogeny. *Annals of Arid Zone* 15: 247–69.

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The Pan-European Biological and Landscape Diversity Strategy: integration of ecological agriculture and grassland conservation

PAUL

Ministerial Conferences. It covers all UNECE countries from Iceland to Uzbekistan (Council of Europe *et al.* 1996).

The fourth ministerial conference on Environment for Europe took place in June 1998 at Aarhus (Denmark). The conference endorsed a number of initiatives, among others a special resolution on biodiversity and landscape and further endorsement of PEBLDS expressed in the Aarhus Declaration (see web-site http://www.mem.dk). The Declaration points out that land use has a strong impact on biological and landscape diversity in Europe and that the process of enlarging the EU gives wide opportunities to take initiatives to integrate biodiversity considerations into agricultural policy. The Declaration also calls on all the participating States, international organisations, NGOs and the private sector to increase their support for the implementation of the Convention on Biological Diversity, including through the PEBLDS, by exploring new and innovative financing means. In the resolution, the ministers underlined that the agricultural sector deserves special attention and should

8. Grassland Ecosystems (led by IUCN, ECNC).
9. Forest Ecosystems (led by UNEP).
10. Mountain Ecosystems (led by IUCN).
11. Action for Threatened Species (led by CoE – Berne Convention Secretariat).

Dry grasslands in Europe and north Eurasia

The discussion in this paper is confined to the lowland dry grasslands of the region as there is not enough space here to give proper treatment to wet and montane grasslands. Most of the dry grasslands in Western Europe result from forest clearance for agricultural purposes (especially grazing) over the last 10,000 years or more, and the associated biodiversity closely follows human land-use history (Goriup 1988). More extensive and natural dry grassland (or steppe) ecosystems persisted in eastern Europe and the former USSR until fairly recently, but between 1954 and 1960, the virgin lands programme in the former USSR converted some 41 million ha of steppe to arable farmland. This proved a disastrous economic failure due to insufficient attention being paid to soil and climate conditions, as well as there being overgrazing and over-cultivation in the prime black soil agricultural belt. In the Ukraine, for example, steppes once covered over half of the country. Today, arable land in the steppe zone is between 72 and 88% of the land surface, with only 3–5% of the remaining steppe area existing in a relatively natural condition.

Today, the relationship between dry grassland and agricultural land-use in Europe and north Eurasia is so intimate that they cannot easily be treated separately. Indeed, steppes are a particularly good example of a land-use where agriculture can co-exist with high natural and scenic values. In the absence of wild herbivores, for example, extensive grazing systems may actually serve as indispensable management substitutes. Even cereal crops (or 'pseudosteppes') can be attractive for a range of steppe wildlife because of the availability of food and cover. Where low intensity of cultivation has persisted in the region, it has supported reservoirs of species that are capable of rapid expansion. Not surprisingly, Birdlife International treats the two ecosystems together in their recent analysis of bird habitats in Europe (Tucker and Evans 1997). They found that 173 priority bird species were dependent on agriculture/grassland habitats, more than in any other major habitat type. Of these, 70% had an unfavourable conservation status in Europe.

The statistical compendium that accompanied the Dobríš Assessment provided data on 186 'representative' scrub/grassland sites across Western Europe, extending as far as the Caspian Sea (Figure 1). These sites comprise about 14 million ha of land, most of which is in the Mediterranean region. Indeed, over half is in Spain, and it is no coincidence that Spain now holds the largest single population of the threatened great bustard *Otis tarda* anywhere (about 16,000 birds out of a world population of about 30,000). By contrast, in Austria, once famous for its Pannonic plains, native dry grassland now amounts to a pathetic 30 ha. In any case, much of the 14 million ha is highly fragmented, and less than half of that area enjoys any semblance of conservation protection.

Figure 1 also clearly indicates the dearth of information from the former USSR at that time. In the former USSR, steppe reserves were created mainly in central Asia; hardly any exist in the western part and only Askania Nova (Ukraine) and the Central Black Soil Reserve (Russia) exceed 2,000 ha in extent. To help address this problem, between 1996 and 1998 the IUCN European Programme carried out a project on

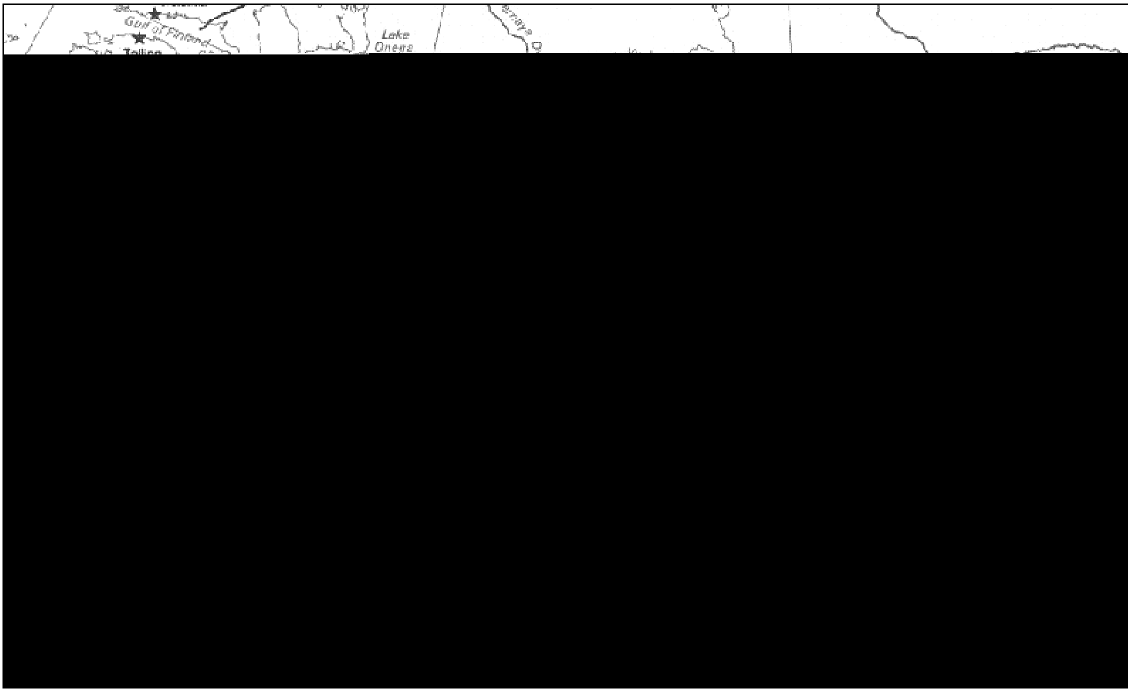

Figure 3. Location of important steppe areas in south-western oblasts, Russia, derived from IUCN project on steppe biodiversity and sustainable agriculture.

in the south-western oblasts around the Caspian and Black Seas. However, site protection levels were poor or non-existent in both countries.

Maintaining the ecological quality of agricultural and grassland habitats, including protection of key sites, is the main conservation priority. In Western and central Europe, the quality of these habitats is declining due to increasing intensity of land use (e.g. crop improvement and specialisation, application of chemicals, loss of marginal habitats and field rotations, and higher levels of livestock grazing). The planned extension of the European Union, its single market and its Common Agricultural Policy eastwards is already exacerbating these problems in Hungary and Poland as investors move in to buy land cheaply and claim EU subsidies for 'improving' it. However, government support for agriculture in Ukraine, Russia and Kazakhstan has almost collapsed, especially in the less productive regions. Here there are great opportunities for restoring steppe habitats. There is a window of opportunity over the next few years to show how future agricultural development in eastern Europe can integrate sustainable production with biodiversity conservation in the steppe zone. There could also be significant lessons for landscape management and reform of the Common Agricultural Policy in the European Union itself. However, this paper now returns to a discussion of PEBLDS as the best available platform to pursue these opportunities for conservation and integration.

PEBLDS action plan for grasslands

Action Theme 8 of PEBLDS sets out the main challenges and opportunities to be addressed and considered in implementing an Action Plan for European grasslands. Three Pan-European objectives and five regional level activities are set out in Action Theme 8, which can be summarised as:

Pan-European objectives

1. Encourage the development of action plans for natural and semi-natural grasslands (especially the most important and threatened), ensuring that they contribute to the Pan-European Ecological Network.
2. Develop grassland agricultural management schemes supported by concrete financial and legal measures, case studies and information exchange that maximise land manager participation to ensure maintenance and expansion of landscape and grassland diversity.
3. Encourage the incorporation of grassland and agricultural zone monitoring into the data gathering programmes of environmental management authorities and research agencies.

Regional focus

1. Prioritise the conservation of grasslands of high biological and landscape diversity in different types of grassland habitats and biogeographical zones.
2. Request the development of an outline action plan for semi-natural grasslands, linked to Natura 2000, which could be the basis for future options on reform of the Common Agricultural Policy; and further to request the development of a policy on land use in the EU taking account of agricultural surpluses and changing afforestation needs.
3. Apply successful mechanisms for maintaining extensively managed grasslands in the wider landscape.
4. Consider how to make cross-compliance in the framework of Common Agricultural Policy reform support biological and landscape values.
5. Develop public and private participation schemes for the sell-off of agricultural land in central and eastern European countries and promote them as case studies.

The IUCN convened an expert meeting in Newbury (UK) in October 1996 to consider the implications of the activities described in Action Theme 8. The participants recommended that four main project groups were needed to construct an Action Plan that met pan-European and regional objectives. The PEBLDS Executive Bureau examined these proposals the following November and, after making some amendments, approved the schedule set out in Table 1. A corridor approach is being adopted to better focus in situ project efforts, especially in the east of Europe and north Eurasia where the largest tracts of intact grassland and steppe remain. The corridor extends from the judet of Tulcea in Romania, across Moldova and the southern oblasts of Ukraine and Russia, to western Kazakhstan and central Uzbekistan (Figure 4). It includes about 30 more or less autonomous local government regions where site-specific measures will be concentrated. Outside the corridor, attention will be paid mainly to communication and information exchange between steppe reserve managers, and to promote public awareness and policy development. As increased resources are mobilised in future, the corridor will be expanded to adjacent regions, eventually

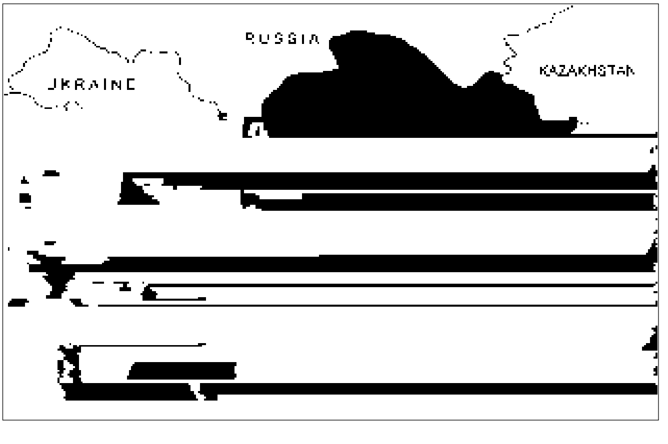

Figure 4. *Grassland corridor (black) from eastern Romania, across Moldova, southern oblasts of Ukraine and Russia, through to western Kazakhstan and central Uzbekistan.*

Table 1.

forming a steppe ecosystem network across the whole of Europe that is integrated into the lowland farming landscape.

Ecological farming and grassland conservation

The PEBLDS Action Plan for Grasslands recognises the close relationship between grassland conservation and agriculture, which also relates to Action Theme 2 on integration of biodiversity into the main economic sectors. The IUCN project on Sustainable Agriculture and Steppe Biodiversity in Russia and Ukraine has already laid some groundwork in this regard by developing an economic model for encouraging ecologically sustainable agriculture. This model includes arable reversion to steppe through farm-level management plans. The specific objectives of this component of the project were:

1. To prepare a plan for the management of a real farm in a steppe ecosystem to find out whether ecologically sustainable agriculture and conservation of biodiversity in

Russia can work at the present time. The plan would focus on (i) products, (ii) local (community-based) services and (iii) means.

2. To involve local farming communities, local authorities and other stakeholders in preparing the management plan by inviting them to two workshops to discuss the issues concerned.

A case study from Russia

The IUCN farm management studies from both Russia and Ukraine provide many insights for the future restoration and sustainable management of steppe landscapes. The farms operate within similar political, legal, economic and social contexts, but their ecological circumstances differ and so the proposed strategies are also different. There is only space here to deal with one study, and the Russian one has been selected since the farm, which covered 17,800 ha, was large enough to constitute a grassland landscape in its own right.

The farm is called Druzhba ("friendship") and is located on the central left (eastern) bank of the Volga River in Rovno raion, Saratov oblast (Figure 5). It was constituted as a Limited Company in 1992 by the reformation of a state collective farm of the same name, and directly employs 433 people. The founders of the enterprise were 593 owners of property and land shares.

The region where Druzhba is located is characterised by an arid, moderate to hot climate, with large annual fluctuations in temperature (annual mean of 6°C from 1961 to 1977, and range of 3.6 to 7.9°C) and rainfall (annual precipitation between 230 and 470 mm from 1961 to 1982). The territory occupied by Druzhba is on light chestnut soils, which often form complexes with alkaline (salty) soils. It lies in a transition zone between dry feather-grass (*Stipa*) steppes and arid to semi-arid wormwood (*Artemisia*) shrub steppes in which areas of grass and shrub steppe are distributed in a mosaic. It is tentatively estimated that Druzhba supports about 300 species of vascular plants, about 2,500 species of invertebrates, 180 species of birds (including migrants) and 50 species of mammals. Several species, including the great bustard (*Otis tarda*), the mantis *Bolivaria brachyptera* and the tulip *Tulipa gesneriana* are listed as globally threatened.

The gross output of crops in recent years has undergone significant annual fluctuations, partly caused by climatic and soil conditions, and partly by management problems. Thus, the average gross yield for the period 1992 to 1996 was 5,785 tonnes, but it was 10,430 tonnes in 1993 and only 2,132 tonnes in 1995. The production statistics for the farm livestock operations between 1992 and 1996 clearly indicate a declining trend of about 40% for milk and 72% for meat, as a consequence of the reduction in numbers of cows and pigs on the farm, and the lack of adequate forage (in terms of both quantity and quality). The poor results from agricultural production, combined with rapidly growing costs, have led to a very difficult financial position in the company. In 1995, production costs amounted to about US$802,000, but in 1996 grew by 60% to US$1.2 million, with

Figure 5. *The location of Druzhba farm in Saratov oblast, Russia, a site for ecologically-sustainable agriculture.*

steep increases in the prices of seeds, oil and fuel, spare parts and electricity. In the same period, the value of gross agricultural production from crops and livestock remained constant at about US$456,000.

In 1996, the farm had a commodity debt with the Saratov food corporation amounting to about US$242,000. Accordingly, almost the entire marketable cereal and other crop production had to be handed over to the food corporation in repayment of the previous year's debt. The credit arrangement was not economically beneficial for the farm, as the food corporation bought agricultural produce at the lowest market prices and sold industrial items at the highest market prices. It was impossible to change this situation since the farm operations were unprofitable and there were no alternative sources of financing. Thus, the farm has been forced to accept the commodity credit from the food corporation each year. The farm has barely survived only because of additional income from its facilities for processing cereals to flour and groats that can be used to make barter deals for raw materials.

Arketable

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protected areas in Europe and north Eurasia and the management of the remainder is dependent more on agricultural policies than conservation strategies. Apart from some military training areas, grassland conservation in Europe and north Eurasia will mean the reversion of surplus arable land. There is little if any likelihood of recreating the vast steppes found fifty years ago, let alone those of two centuries past.

On the other hand, grassland conservation will be an ideal testing and proving ground for some of the new approaches for protected area management in the wider environment, including bioregions, ecological corridors and networks, ecologically sustainable development and landscape-scale management. Moreover, relatively small changes in the financing of agriculture, for example through promoting an ecological approach on marginal lands, would enable more suitable private investment and really bring the PEBLDS Action Plan for Grasslands to life. Hopefully such matters will be on the agenda for any future agriculture/environment forums including the inter-ministerial meeting in the Environment for Europe process.

References

Council of Europe, UN Environment Programme and European Centre for Nature Conservation 1996. *The Pan European Biological and Landscape Diversity Strategy. A Vision for Europe's Heritage.* Council of Europe, Strasbourg, France.

Goriup, P.D. 1988. The avifauna and conservation of steppic habitats in Western Europe, North Africa and the Middle East. In: Goriup, P. D. (ed.) *Ecology and Conservation of Grassland Birds.*

Conservation of pampas and campos grasslands in Argentina

SANTIAGO KRAPOVICKAS AND ADRIÁN S. DI GIACOMO

The pampas and campos grassland ecosystems in the southern part of the plains in north-eastern Argentina are described. Details of the vegetation and fauna are given and agricultural land use is evaluated. The effects of human activities on soil erosion and nutrient impoverishment are mentioned, along with the implications of

mostly native (León 1991). Most of the plant taxa are shared with the Chaco biome, although there are several of Andean origin (Cabrera 1976). Endemic species are scarce and the total number of grass species present in the pampas is 230, of which 190 are native and 40 introduced. The native grasslands have often been described as 'flechillar', due to the dominance of "flechillas" (little darts) of the genera *Stipa*, *Piptochaetium* and *Aristida*. Important non-grass plant families are the Asteraceae and Fabaceae. In wet locations and years the vegetation structure is prairie-like, and in drier conditions it is steppe-like. Some internal heterogeneity is distinguishable within the pampas, varying with natural gradients and landscape features.

The campos is a subtropical savanna that constitutes the northern expression of the pampas, with which it shares many plant taxa. Characteristic grass genera include *Andropogon*, *Aristida*, *Briza*, to herd the animals, undoubtedly caused important changes in the grasslands (Soriano and Deregibus 1991). Nevertheless, in the words of Soriano and Lavado (1991), “the principal means by which the grasslands of this region have been changed has been through agricultural activities”. The livestock industry and arable agriculture developed strongly in the pampas during this century. The area of cropland in Argentina increased from an average of 6 million ha at the beginning of the 1900s to 26 million ha in 1984 (Soriano 1991). The main crops are wheat, maize, soybean and sorghum.

of this cervid (*O. b. leucogaster*), although present in Uruguay and southern Brazil, is also threatened in Argentina, with a small population remaining in the campos of Corrientes Province (Parera pers. comm.).

The jaguar has been completely extinct in the pampas and campos of Argentina since the first half of this century. Besides the undoubted effect of habitat conversion and hunting (Chebez 1994), it has been hypothesised that Holocene climatic changes could have contibuted to this species' retreat (Ringuelet 1978).

The long-term use of several agrochemicals has potential negative impacts on biodiversity. Monocrotophos misuse has caused severe mortality incidents of Swainson's hawks (*Buteo swainsoni*), a migratory raptor, as well as of other fauna in the pampas (Canavelli and Zaccagnini 1996, Krapovickas and Lyons 1997).

Conservation efforts

Unfortunately, pampas and campos biodiversity is not preserved in the protected areas. Less than 150,000 ha are formally included in reserves, representing some 0.3% of the biome's surface area (APN 1998). Existing protected areas are located mainly in the flooding pampa (Samborombón Bay, with salty *Spartina* grasslands), the austral pampa (Sierra de la Ventana) and several scattered wetlands. No significant areas of the typical flechillar grassland (which grows on fertile, well-drained soils) have been protected and this has now practically disappeared. In addition, reserves in the flooding and austral pampas, although important for their biodiversity, are poorly protected.

The situation described above reflects both the fact that the grasslands are the most valuable ecosystem for human activities, and the fact that their conservation importance has been neglected. Recently, federal authorities have realised the need to make conservation of the pampas a high priority. The biome was included in an ambitious project to establish several newly-protected areas in the country. This project receives support from the Global Environmental Facility through the World Bank (APN 1998). An area of about 30,000 ha in the western inland pampas of San Luis province was conserved as the Parque Nacional Los Venados (Pampas Deer National Park). The present extensive cattle grazing in the area has allowed the survival of important native grassland patches (León and Anderson 1983) in which puma, pampas deer, greater rhea and other megafauna subsist. Conservation plans include the establishment of a large buffer zone in which to experiment with sustainable land-use technology, through cooperation among federal and provincial governments. Although the intentions are excellent, the project is taking too long to achieve conservation outcomes. While the bureaucrats dither, a humid climate cycle is encouraging local farmers to plow up the land and sow exotic pastures and grains. This is despite the fact that agriculture in this semi-arid environment is clearly unsustainable because of the fragile sandy soils (Maceira pers. comm.).

Recent wildlife deaths caused by pesticides have encouraged cooperative efforts to monitor and prevent such incidents. An inter-agency committee was established, comprising members of federal and provincial governments, and NGOs. This group is achieving important goals in research and public awareness, so helping to minimise the impact of pesticides (Krapovickas and Lyons 1997).

The Asociación Ornitológica del Plata (AOP) recently launched the Pampas Argentinas Project, comprising basic research and education to convey the message that the temperate and subtropical grasslands are valuable environments for humans and wildlife. The project is inspired by the fact that birds seem to be good indicators of an ecosystem's health and the risks for man. The popularity of Swainson's hawk is being used to promote habitat conservation and sustainable use in this species' key areas.

Recent development projects

Public concern over the social value of nature is slowly growing in Argentina. This is reflected by the growing importance assigned to environmental impact assessments for development projects. There are at least two projects that could have serious impact on grassland relics in Argentina, for which the probable consequences and alternatives should be carefully studied.

Besides federal government plans to encourage tree plantations in the campos, provincial agencies are promoting a plan to build several dams along the Aguapey River in Corrientes. This would allow the enlargement of the area devoted to rice, but will have a dramatic impact on important grasslands and riparian forests.

On a broader scale, the government of Buenos Aires Province is preparing the Salado River Basin Master Plan to improve agricultural conditions in a large area of semi-natural grasslands in the flooding pampa. Since the Salado Basin is the last big semi-natural area of the province, this could have important effects on terrestrial and aquatic biodiversity on a regional scale (Di Giacomo and Krapovickas 1998).

Conclusions

Long-term survival of pampas and campos biodiversity depends on public education about the value of grasslands. Particularly, it is essential to convey a good understanding of the services provided by the ecosystem (maintenance of the composition of the atmosphere, genetic library, amelioration of weather, conservation of soil, etc.) in the sense suggested by Sala and Paruelo (1997).

There are some urgent actions that could help in this educational goal, whilst providing solutions for short-term problems. One of these is to encourage sustainable use of the grasslands through all possible means. Perhaps a combination of integrated pest management, no tillage cropping, crop and cattle rotations, cattle grazing in natural grasslands and habitat protection could have the desired result. Much research, as well as governmental and private support, is needed.

Protected natural areas also need a strong boost in support in the pampas and campos. The important Parque Nacional Los Venados project could fail if it does not receive clear political and financial support. Existing reserves also need to be implemented properly. This could be partially achieved through increased cooperation between federal and provincial agencies, an issue often neglected in the past.

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References

APN (Administración de Parques Nacionales) 1998. *Las Áreas Naturales Protegidas de la Argentina.* Administración de Parques Nacionales unpublished report, Buenos Aires, Argentina.

Cabrera, A.L. 1976. *Regiones Fitogeográficas Argentinas. Enciclopedia Argentina de Agricultura y Jardinería, Part II.* 2nd Edition. Acme, Buenos Aires, Argentina.

Canavelli, S.B. and Zaccagnini, M.E. 1996. *Mortandad de Aguilucho Langostero (*Buteo swainsoni*) en la Región Pampeana: Primera Aproximación al Problema.* INTA Technical Report 5/96.
Chebez, J.C. 1994. *Los Que Se Van. Especies Argentinas en Peligro.* Albatros, Buenos Aires, Argentina.
Collar, N.J., Gonzaga, L.P., Krabbe, N., Madroño Nieto, A., Naranjo, L.G., Parker, T.A., III and Wege, D.C. 1992. *Threatened Birds of the Americas: The ICBP/IUCN Red Data Book, Part 2.* 3rd Edition. Smithsonian Institute Press and ICBP, Washington, DC, USA.
Deregibus, V.A. and Soriano, A. 1991. Present and future trends. In: Soriano, A. (ed.): *Río de la Plata Grasslands.* In: Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 400–402. Elsevier, Amsterdam, Netherlands.
Di Giacomo, A.S. and Krapovickas, S. 1998. *Diversidad de aves silvestres en la Cuenca del Río Salado, provincia de Buenos Aires, Argentina.* Unpublished report. Asociación Ornitológica del Plata (AOP), Buenos Aires, Argentina.
Di Pace, M.J. (ed.) 1992. *Las Utopías del Medio Ambiente. Desarrollo Sustentable en la Argentina.* Centro Editor de América Latina, Buenos Aires, Argentina.
Fraga, R.M., Casañas, H. and Pugnali, G. 1998. Natural history and conservation of the endangered saffron-cowled blackbird *Xanthopsar flavus* in Argentina. *Bird Conservation International* 8: 255–267.
Guerschman, J.P. 1998. *El uso de la tierra en regiones templadas de Argentina. Patrones, determinantes ambientales e impacto sobre el funcionamiento de los ecosistemas. Trabajo de intensificación.* Unpublished data. Facultad de Agronomía, Buenos Aires University, Argentina.
Haene, E. 1994. Recuerdos del venado en Entre Ríos. *Todo es Historia* 319: 16–23.
Iolster, P. in prep. *Los Plaguicidas en Uso en la Argentina: Riesgos Para las Aves Silvestres.* Technical Report. Asociación Ornitológica del Plata (AOP), Buenos Aires, Argentina.
Krapovickas, S. and Lyons, J.A. 1997. Swainson's hawk in Argentina, international crisis and cooperation. *World Birdwatch* 19: 12–15.
Krauczuk, E. 1996. Aves del sur misionero. *Nuestras Aves* 34: 6–7.
Lavado, R.S. 1991. Soils. In: Soriano, A. (ed.): *Río de la Plata Grasslands.* In: Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 377–380. Elsevier, Amsterdam, Netherlands.
Lemcoff, J.H. 1991. Climate. In: Soriano, A. (ed.): *Río de la Plata Grasslands.* In: Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 376–377. Elsevier, Amsterdam, Netherlands.
León, R.J.C. 1991. Vegetation. In: Soriano, A. (ed.): *Río de la Plata Grasslands.* In: Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 380–387. Elsevier, Amsterdam, Netherlands.
León, R.J.C. and Anderson, D.L. 1983. El límite occidental del pastizal pampeano. *Tuexenia* 3: 67–82.
Narosky, T. and Di Giacomo, A. 1993. *Las Aves de la Provincia de Buenos Aires: Distribución y Estatus.* AOP-Vazquez Mazzini Editores-LOLA, Buenos Aires, Argentina.
Milchunas, D.G., Sala, O.E. and Lauenroth, W.K. 1988. A generalised model of the effects of grazing by large herbivores on grassland community structure. *Amer. Nat.* 132(1): 87–106.
Reboreda, J.C. and Rabuffetti, F. in prep. *The Impact of Trade Policies on Biodiversity Conservation: the Case of Grasslands in Argentina.* Asociación Ornitológica del Plata (AOP), Buenos Aires, Argentina.
Ringuelet, R.A. 1978. Dinamismo histórico de la fauna Brasílica en la Argentina. *Ameghiniana* 15: 255–262.
SAGPyA (Secretaría de Agricultura, Ganadería, Pesca y Alimentación) 1996. *Anuario Estadístico 1996. Régimen de Promoción de Plantaciones Forestales 1992–1995.* WWW: <siiap.sagyp.mecon.ar/forestal/rppf.htm>
Sala, O.E. and Paruelo, J.M. 1997. Ecosystem services in grasslands. In: Daily, G.C. (ed.) *Nature's Services: Societal Dependence on Natural Ecosystems.* 237–251. Island Press, Washington, DC, USA.
Soriano, A. (ed.) 1991. Río de la Plata Grasslands. In: Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 367–407. Elsevier, Amsterdam, Netherlands.
Soriano, A. and Deregibus, V.A. 1991. History of land use. In: Soriano, A. (ed.): *Río de la Plata Grasslands.* Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 398–399. Elsevier, Amsterdam, Netherlands.
Soriano, A. and Lavado, R.S. 1991. Impact of agriculture. In: Soriano, A. (ed.): *Río de la Plata Grasslands.* In: Coupland, R.T. (ed.) *Natural Grasslands: Introduction and Western Hemisphere.* 399–400. Elsevier, Amsterdam, Netherlands.

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La Estrategia Biológica y de Diversidad del Paisaje Paneuropea: integración de la agricultura ecológica y conservación de praderas

PAUL GORIUP

Siguiendo la adopción de la Estrategia Biológica y de Diversidad del Paisaje Pan-Europeo (PEBLDS) por los ministros del Medio Ambiente europeos en 1995, la UICN ha sido el líder en el desarrollo del Plan de Acción de Praderas Europeas. Las praderas en Europa y Noreuroasia han visto reducida su extensión desde hace incluso cincuenta años, incrementando también su fragmentación. El plan toma en cuenta la interacción real entre la conservación de las praderas y las políticas agrarias en Europa, llamando a una mejor integración de los planteamientos. Estudios en granjas llevados a cabo por IUCN en Rusia y Ucrania sugieren que esta integración no es tan solo posible sino que en tierras marginales es probablemente el único planteamiento rentable económicamente. El aprovechar inversiones financieras de fondos éticos podría ser un mecanismo útil para fomentar la integración de la conservación de las praderas y la agricultura ecológicamente sostenible, siempre que las políticas gubernamentales de granjas adopten los incentivos adecuados.

Conservación de los campos y pampas en Argentina

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-

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