Introduction: A Review of Rangeland Conservation Issues in an Uncertain Future

Monica L. Wrobel and Kent H. Redford

Wildlife Conservation Society, NY, USA

Rangelands are typically those areas used by people to graze their livestock, converting plants into products of use to humans, like meat, milk, blood, leather and wool (Brown 2001). In ecological terms, there is no one habitat type for which the term *rangelands* applies; instead, these areas are typically classified as grassland, savanna or scrublands, or some combination of these. In fact, livestock can be grazed in any type of ecosystem where there is sufficient accessible food and may include dry forests, coniferous forests, broadleaf riparian forests, deserts (Chapter 9) and even agricultural lands after crops have been harvested.

Around 40% of the earth’s land surface supports the world’s grazing domestic animals. An estimated 200 million people are pastoralists tending cattle, sheep or goats (Brown 2008), and with increasing demand for animal products in human diets, the number of livestock is expected to grow substantially. Additionally, a large number of wild animals that also graze or browse share these rangelands. Millions of wild ungulates, such as Tibetan antelope, guanaco, bison, antelope, elk and zebra uneasily share the plant resources with cattle, camels, yaks, sheep and goats. To wild animals, these are not rangelands, but their grassland homes. This book addresses the opportunity to conserve wildlife in places where people manage livestock and to safeguard these places as wild rangelands.
As human populations shift geographically, so also do rangelands; organizations such as the Food and Agriculture Organization of the United Nations keep data on the evolving importance of livestock grazing to national economies. The most expansive areas of semi-arid grassland, savanna and shrub land supporting domestic livestock across several countries are on the African continent: across the band of countries in the Sahel region south of the Sahara and in east and southern Africa (EOE 2009), where populations depend heavily on livestock economies for food and employment. Similarly, the Middle East, Central Asia, Mongolia, Northwest China and the Indian subcontinent depend on domestic livestock economies and on open access to rangeland to support local livelihoods (Brown 2008; EOE 2009). Rangeland is dominant in Australia, and grass-based livestock economies predominate in several countries in South America. The Great Plains of North America support grazing cattle as a form of land use in semi-arid land that is not otherwise suited to growing grain (Brown 2008).

Rangelands are therefore globally important and are some of the last, great wild lands. They are important for conservation as many of them continue to sustain wildlife outside of national parks but are under no formal protection. Amongst the millions of people also supported there, many are very poor and dependent on access to land for their livestock. Despite concern by researchers, conservationists and development practitioners, these rangelands and their inhabitants have not been adequately addressed in national or international policies.

The low and variable productivity characteristic of semi-arid ecosystems and the resulting need for extensive areas means that large, connected areas are essential for both domestic animals and wildlife. However, the new century finds that patterns of habitat fragmentation, typical of the world’s forests, now extends to rangelands and threatens the existence of all who rely on them. Similarly, the drivers of deforestation—unclear land tenure, short-term profit-taking, underrated values of natural systems and poor resource management—are poised to further wreak havoc worldwide on rangelands. It is vital to better understand these systems and their residents and develop approaches that ensure the resilience of these coupled socio-ecological systems in the face of economic, social, environmental and climate changes.

To address the issues, in early 2006, the Wildlife Conservation Society joined the Zoological Society of London in the lecture hall at Regent’s Park, London, convening speakers from around the world for the symposium
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‘Wild Rangelands: Conservation in the World’s Grazing Ecosystems’. The symposium set out to explore a variety of strategies for conserving wildlife on rangelands centred on: rangeland ecology; the interface of people, wildlife and livestock; and policy, planning and economics. Over 2 days, the discussions involved the challenges in maintaining livestock and wildlife in rangelands and ways to assist and engage the human population dependent on them. Since that symposium, the world has witnessed an increase in food and biofuel prices and land conversion, an unprecedented economic collapse and predictions of increasing stressors from climate change. These recent changes have made it even more urgent for conservationists, cultural advocacy groups, development planners and landholders to unite in the common agenda of ensuring the integrity of rangelands and the value of wild lands. This book seeks to share the outputs of the symposium and to highlight the challenges and opportunities for averting the loss of functioning ecosystems where historically humans, domestic animals and wildlife have coexisted.

Global drivers threatening rangelands

At the beginning of this century, the Millennium Ecosystem Assessment (MA) employed a scenario-building technique as a holistic, integrated and participatory approach to help in the understanding of intrinsic heterogeneity and uncertainty in ecosystem management (Lebel et al. 2005). The key driving forces of the scenarios in the MA included population, income, technological development, changes in consumption patterns, land use change and climate change (Alcamo et al. 2005).

The scenarios identified three regions as susceptible to rapid changes in ecosystems services. The first region was Central Africa because of increased population, expansion of agriculture, increase in food and water consumption, intensified use and contamination of ground waters. The second region was the Middle East, predicted to experience an increased population and income and therefore increased demands for food, meat and a higher dependence on food imports. In South Asia, the third region, the MA predicted intensified agriculture and a breakdown in ecosystem services (Alcamo et al. 2005). Across all the MA scenarios, a resounding message is that 10–20% of current grassland and forestland will be lost, mainly because of the expansion of agriculture and secondarily because of the expansion of cities and infrastructure (Alcamo et al. 2005).
Land degradation

The majority of the world’s 3.3 billion cattle, sheep and goats graze on 40% of the earth’s land surface, almost half of which is lightly to moderately degraded, with 5% being severely degraded (Brown 2008). Desertification, where soil cover is lost through wind and rain erosion driven by overgrazing and disappearance of vegetation, is increasing and affecting about a third of the world’s dry lands (Montgomery 2007). In some rangelands like those of Argentina’s Patagonian steppe, desertification has affected nearly 30% of the habitat (del Valle 1998). Dust storms appear to be increasing and moving great distances, for instance, depositing dust from Sahelian Africa westward across the Atlantic Ocean and landing in Caribbean reef systems (Brown 2001, 2008).

Better management, recovery and planning for use of grassland systems are rare, but possible. If intervention against land degradation comes early enough, at least for croplands, experience in Kazakhstan has shown that some recovery to grassland can occur (Brown 2001). In the United States, the U.S. Congress created the Conservation Reserve Program (CRP) in 1985 to reduce soil erosion and control overproduction of basic commodities. By 1990, 10-year contracts existed for 14 million hectares of highly erodible land with permanent vegetative cover. Farmers received payment to plant fragile cropland with grass or trees. The soil erosion in the United States decreased from 3.1 billion tons to 1.9 billion tons over 15 years (Zinn 2001; Brown 2008).

Internationally, the United Nations Convention to Combat Desertification (UNCCD) was created in 1994 with an increase in development aid targeted at this serious threat. The Conference of Parties (COP) met for its eighth session in September 2007 and adopted a 10-year strategic plan and framework for 2008–18. The four strategic objectives are to improve the living conditions of affected populations, improve the condition of affected ecosystems, generate global benefits through effective implementation of the UNCCD and mobilize resources to support implementation of the Convention through building effective partnerships between national and international actors. The primary form of the implementation is through National Action Programs (NAP) complemented by sub-regional and regional action programs where appropriate (UNCCD 2009).

The United Nations Environment Program (UNEP) estimates that an effective 20-year global effort to combat desertification would cost $10–22 billion per year. UNEP estimates that desertification currently costs countries
$42 billion per year in lost revenue (UNCCD 2009). This foregone income does not include estimates of ecosystem services yet to be quantified (Brown 2008). Since 2003, the Global Environmental Facility adopted land degradation as a focal area, increasing available financial resources (UNCCD 2009). In addition, synergistic approaches are being explored with the other international conventions, the UN Framework Convention on Climate Change and the Convention on Biodiversity (Mouat et al. 2006). Incorporating considerations about wildlife within rangelands to protect ecosystem functions and combat land degradation warrants much further attention.

Food demand, food prices and biofuel

Threats of over-exploitation and conversion of rangelands were once primarily driven by local livelihood issues. Now threats driven by increasing global markets for food and biofuels are intensifying the challenges to sustaining rangelands. All of the four scenarios of global change outlined in the MA predicted 50% increases in the world’s total production of grain (Alcamo et al. 2005). Some of the gains in agricultural land will be at the expense of yet uncultivated natural land – much of which may be rangelands. Examples have been emerging in 2008, such as a reported deal by Abu Dhabi to develop 30,000 hectares of land in Sudan to ensure food security in the emirate. Other Middle Eastern countries are securing land deals from Brazil to Pakistan to guarantee supplies of cereals, meat and vegetables (Rice 2008).

The labelling of rangelands as ‘marginal’ lands or ‘wastelands’ – regarded as marginal for traditional agriculture – is commonplace in national and international policies and makes such areas prime targets for the kinds of predicted growth in some form of production system. Much of the increasing crop and biofuel production involves bringing such lands under agricultural production worldwide. A story in 2008 in the New York Times reported that thousands of farmers in the United States were taking their fields out of the government’s biggest conservation program that otherwise paid farmers not to cultivate, to realize more profitable land use under wheat, soybean, corn or other crop production in response to price increases for those commodities (Streitfeld 2008). Elsewhere, rangelands are threatened by the rise in the planting of *Jatropha*, an arid-adapted succulent plant with high potential as a source of biofuel. Often, the areas cited to be of potential suitability for its production are marginal lands, a term that includes rangelands.
Increased income has resulted in growing demand in developing countries for animal products. Meat demand in developing countries rose from 11 to 24 kg/capita/year during the period 1967–97, achieving an annual growth rate of more than 5% by the end of that period (FAO 2006; Smith et al. 2007). By 2020, Rosegrant et al. (2001) forecast a further increase of 57% in global meat demand, mostly in South and Southeast Asia and sub-Saharan Africa (Smith et al. 2007). Grazing livestock is not the source of all of the increased demand, which includes that from fish and poultry. Nonetheless, processed feed from cereals for raising meat or poultry adds to an overall demand for bringing land under cultivation.

There are several reasons for including wildlife as grazers in rangeland systems and keeping stocking levels of domestic livestock low, despite pressures to use the land otherwise. Wild herbivores represent a suite of species that have evolved in the wider ecosystem that graze in less concentrated ways, avoid the risk of soil erosion and soil compaction and have a reduced need for water. Wild grazing species, converting vegetation for their energy and growth (i.e. meat) and depositing seeds and nutrients, altogether distribute biomass across the landscape. Wild species maintain environmental services over great lengths of time, in ecosystem processes that have co-evolved. Removing or displacing wild grazers from rangelands and creating the mixed crop–livestock food production systems recommended by development and agriculture sectors result in the transfer of nutrients in dung from the grasslands to pens. This interrupts the critical nutrient cycle by not returning nitrogen and phosphate in the form of manure to the rangeland itself, essentially ‘nutrient mining’ the landscape.

Increasing incentives for biofuel production, increasing demand for food with a concomitant intensification and expansion in area for crops and mixed crop/livestock systems will undoubtedly be at the expense of wildlife, pastoral peoples and native ecosystems. This multi-pronged threat highlights the need for the sustainable management of rangelands as rangelands and indeed as wild rangelands.

Poverty

The first of the UN Millennium Development Goals (MDG) is to halve extreme poverty and hunger by 2015. The World Bank states that this goal is
within reach for all regions of the developing world, except for sub-Saharan Africa, where 800 million residents are in countries sliding deeper into poverty (Brown 2008). Rangelands play a key and under-appreciated role in development strategies for addressing global poverty.

When measuring the wildest areas on a spectrum from the completely wild to the extremely transformed (Sanderson et al. 2002), a spatial analysis of global poverty undertaken within that spectrum showed that the greatest number of the world’s most poor, 7.2 million people, live in tropical and subtropical grasslands, savannas and shrub lands. Additionally, 3.3 million people live in desert and xeric shrub lands and 1.2 million live in montane grasslands and shrub lands. These areas, defined as the most wild places by Sanderson et al. (2002) are collectively sustaining the largest number of the world’s most poor people (Redford et al. 2008). Especially in the areas where people are striving to live off the land, conservation groups are well positioned to develop new partnerships for the delivery of benefits and to ensure sustainable environments for some of the least accessible poor people in remote places in the world. There are opportunities and imperatives to combine conservation, donor and development attention, to improve the chances of sustaining rangelands, wild rangelands in particular. Redford et al. (2008) recognize that a new socially responsible, long-term approach to conservation of the world’s wildlife and wild places may present a circumstance of an unusual synergy of poverty alleviation efforts for approximately 16 million people, along with conservation of the wildest places.

_Climate change effects_

Though only limited modelling work has been done, rangelands are predicted to be affected both directly and indirectly by climate change. Direct changes will affect species, ecosystems and livelihood systems. It will also change the area and distribution of the rangelands themselves. Indirect changes will include those resulting from mitigation efforts to diminish the causes of climate change, such as greenhouse gas emissions generated by agricultural or land conversion practices.

The Intergovernmental Panel on Climate Change (IPCC) produced an updated report in 2007, citing a prediction that a 1 to 2°C increase in temperature over that of the 20-year period preceding the year 2000 would
place up to 30% of species at a higher risk of extinction. Effects might include
a shift in species’ ranges with the possibility of disrupting ecosystem functions
(Bernstein et al. 2007). Rangelands are still generally regarded as relatively
unimportant to global CO₂ levels compared to forest, but changes in their
woody vegetation and/or release of carbon stored in soils warrant further
evaluation. Neither rangeland nor semi-arid habitats are a focus *per se* in the
IPCC report and therefore extrapolations from the agriculture data must be
made. At mid to high latitudes, cereal productivity may increase and this could
be through existing land under cultivation or by bringing new land (such as
wild land) under cultivation. The predictions include tendencies for cereal
productivity to decrease in low latitudes; in warmer regions, yields of most
crops would be lower; crop damage and failure are expected; and drought
and livestock deaths are expected to increase (Bernstein et al. 2007). Increases
in the extent of arid and semi-arid land are predicted for Africa, and semi-
arid vegetation is likely to be replaced by arid vegetation in Latin America.
Worldwide decreases in freshwater availability are expected (Bernstein et al.
2007).

Livestock, predominantly ruminants such as cattle and sheep, are notable
sources of methane gas (CH₄) from eructation and manure production,
accounting for about one-third of global anthropogenic emissions of methane
(EPA 2006; Smith et al. 2007). The IPCC notes that the intensive production
of beef, poultry and pork is increasingly common with concomitant green
house gas (GHG) emissions such as methane and nitrous oxide (Barker et al.
2007). Technological advances with the use of intensive systems – such as
providing higher quality feed and producing lower emissions from better
gut fermentation – are not sufficiently developed to counteract the effects
to a great degree (Barker et al. 2007). Even so, the conversion of land to
produce such modified, higher quality feeds could likely be at the expense of
rangelands.

An increasing use of ‘marginal lands’ is expected to further contribute to
climate change through degradation and loss of carbon storage in soils and
vegetation. Loss of these natural rangelands, with their greater resilience to
climate change, will further compound this problem. The risks associated
with failures of traditional crops and vulnerability of livestock will deem such
practices unjustified in degrading what wild rangelands remain. Despite these
predictions, there is a poor understanding about the future of rangelands in a
climate-changed world.
Seven global case studies

To understand the complexity of the issues and illustrate the lack of globally coordinated efforts towards rangeland conservation, this book presents seven case studies from around the world. These cases exemplify the challenges not only for sustaining grasslands, savannas and shrub lands for livestock production but also for restoring and maintaining the ecological integrity of those same landscapes as wild lands and as homes for their native fauna. These cases document examples in which livestock grazing or introduced plant species have led to degraded systems and economic collapse, ecological damage and extensive fires. They address issues such as access to benefits at individual and state levels, as well as inadequacies of conservation measures for either. They discuss how global market demands can drive stocking rates beyond sustainable limits, the effects of trans-boundary strife and the uncertainty of the effects of climate change on vegetation and grazing practices. Collectively, these case studies provide a glimpse into the global future of rangelands and their multiple values.

Global themes for rangeland conservation

The next section of the book presents a thematic approach to the problem of conserving the resilience of rangelands as socio-ecological systems. The emphasis in these chapters is on identifying global challenges and suggesting solutions. The authors do not shy away from recognizing the challenges posed by the dual objectives of wildlife conservation and livestock production. The chapters in this section span all levels of ecological and institutional organization from the micro-realm of soil decomposer communities to disease and health dynamics, the functional properties of top predators, management institutions, global economics and climatic effects. The authors map out the complexity of the issues and the spectrum of expertise and dialogue that would be available for conserving wild rangelands.

Lessons from the rangelands

Finally, ‘lessons’ are extracted from each chapter and presented not only as a synthesis of the book but and perhaps more importantly, also as a call
for concerted action from the conservation community and policymakers at large to exploit every opportunity for conserving wild rangelands on a global scale. While the world attempts to monitor and regulate forestry and reduced deforestation, rangeland conservation needs much greater attention than currently exists in the global policy arena.

This multifaceted and practical book is itself an illustration of the scope of expertise that has come of age for tackling what has been an inexorable and recently accelerated degradation of a unique suite of ecosystems, on which initially wildlife and then mankind has depended for thousands of years. The very existence of these habitats has become imperilled more quickly than their managers have had the opportunity to learn about them. This book takes vital, early steps in addressing significant challenges and articulating what is necessary to sustain wild rangelands.

To move from the lessons laid out in this volume and begin to address the challenges, rangeland scientists and conservationists will need to work with economists and policymakers to define how productive intact systems can be valued as wild lands – far beyond the view of fodder for livestock or marginal land ready for conversion. There has been too little consideration of the roles of wild rangelands as providers of carbon storage, erosion prevention, nutrient cycling and moisture retention, as gene banks for drought-resistant species and sources of future drugs. With 50% or more of the world’s rangelands being overgrazed, an alternative valuation will level the playing field for conservation, wildlife and the people living there and remove other short-term and destructive overuse of these fragile soils. At appropriate stocking levels of domestic herds in rangelands or indeed in appropriately ‘under-stocked’ wild lands, rangelands can serve as a means for cultural retention and poverty alleviation in some of the remotest, poorest and most vast areas. Conserving the ecological integrity of wild rangelands and their suite of ecosystem services will increase their resilience in the face of climate and economic change and offer a more robust future for both people and wildlife.

References


