

CHAIRS' SUMMARY PAPER: Temperate and Tropical Native Grasslands

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Native grasslands are represented by areas that have not been cultivated or extensively invaded by introduced species and that are dominated by vegetation of indigenous plant species. Whether in the tropics or temperate regions, the extent of these areas has diminished as human immigrants replaced the aboriginal people and introduced the cow and plow. This was done with the primary objective of increasing agricultural output and profits but sacrificed the largely unknown inherent values of the native grasslands. These values consisted of diverse genetic material in plants and animals, their function towards the contribution to global water and energy cycles, and the intangible values that enrich human existence. These losses, and the greater risks to environmental degradation brought on by cultivation, has made the remnant native grasslands much more valuable and has attracted the need to protect them and understand them better.

The invited and poster papers presented themes that addressed the primary issues of concern to native grasslands. In general, these include the consequence of replacing them with introduced species, their management, and assessment.

SPECIES INTRODUCTIONS

Forage species have been introduced to improve livestock production and as a conservation cover to prevent soil erosion. While cropped land was generally seeded to achieve the conservation objective, native grasslands were often cultivated to "improve" their productivity for livestock grazing. However, these species were introduced without adequate knowledge of their value or function within the ecosystem. The species may become "weedy" as they "escape" into other areas or their management is inadequate to profitably exploit their potential.

Considerable effort has been directed toward improving introduced species at the expense of protecting native grasslands and introductions have been made on such a large scale that benefits to agricultural output is impaired. In Brazil, up to 40 million ha have been colonized by *Brachiaria decumbens*, a species introduced from Africa, while in North America a comparable situation exists with *Agropyron cristatum*, a species introduced from western Siberia. These species have made a useful contribution to livestock production in their respective regions where they have been seeded, but their extensive distribution and the obvious limitations of monocultures have created other problems. In Brazil, lack of knowledge in managing *Brachiaria decumbens* has led to the deterioration of soil fertility, loss in pasture productivity, increased soil erosion, and subsequent soil degradation. On the other hand, *Agropyron cristatum* has been seeded to prevent soil erosion and provide early spring grazing. But its early maturation results in poor quality forage later in summer and its growth habit, in particular a high shoot to root ratio, results in a loss of soil carbon. Corrective measures are costly as they invariably require the input of cultural energy.

A secondary concern, related to introduced species, are their ability to invade native grasslands. The early growth of *Agropyron cristatum* makes it more competitive than the native species and allows its establishment and eventual dominance. A similar concern was identified with *Trifolium repens* in Bhutan, where it is considered to

be weedy in certain areas, and with *Bromus tectorum* in the Intermountain region of the United States. Problems associated with species introductions leads to the observation that many were made recklessly without adequate control and understanding of their impact.

MANAGEMENT

Grazing/fire effects. Grazing and fire impacts have been instrumental in creating and maintaining the native grasslands. Livestock have replaced native ungulates in many ecosystems and caused shifts in plant communities because of differences in animal behaviour but mostly because of their management with the use of fences, stocking rates, and grazing times. Although some effort has been directed at simulating the earlier conditions by redirecting management efforts, the success of these practices are questionable to the purist who wish to see the return of bison in North America. However, the conditions found in North America before European settlement can never be restored but may be reenacted in some fashion on specific landscapes with the use of livestock. In fact, livestock may realistically be, and have been, the only managed influence that can impact grasslands because of widespread regulations preventing the use burning.

The selective behaviour of livestock has been used in attempts to modify the species composition in south-east Australia and control woody vegetation in Slovenia. Observations in western United States report selective feeding based on the sex of *Atriplex canescence* that resulted in a shift in the sex ratio where it had been grazed in relation to protection.

Livestock impact cannot replace fire partly because of their selective behaviour for forage and habitat. Livestock tend to avoid heavy accumulations of senesced biomass and are attracted to new herbage while fire behaves virtually opposite to that. Therefore, shrubs remain intact and thrive with grazing but are destroyed with fire. Both heavy grazing pressure and fire can produce a more arid ecosystem by removing plant litter that buffers the soil-air interface thereby reducing water evaporation and by removing plants that trap snow and intercept water run-off. However, the proper application of grazing impact can enhance biodiversity despite the presence of fences, highways, and cities that has closed a previously open system.

While grasslands have developed under the influence of fires, fires are not necessarily beneficial in all cases and must be applied judiciously. Fire protection can result in an abnormally high build-up of fuel and extremely hot fire that destroys the soil organic matter. Wildfires in Hawaii also favour the expansion of *Pennisetum setaceum*, a weedy grass species.

Sustainable ecosystems. The historical development of native grasslands defines the nature of their sustainability and the conditions for their maintenance. The present rules for their management with livestock grazing follows certain ecological principles that, if followed, will sustain those ecosystems. Violation of those rules, which generally relate simply to the timing and rate of grazing pressure, leads to degradation of the grassland typified by an increase in weedy species and increased soil erosion. The challenge for the

grazing manager is to ensure that the energy and nutrients extracted are not greater than the inputs. Ecological sustainability is independent of economic sustainability and does not rely on cultural inputs but on those resources provided by the environment through the natural cycles and from the impacts of grazing animals. However, economic sustainability is dependent on reducing the inputs of cultural energy and a factor in the cost of outputs. On the most degraded sites the preferred solution has been to cultivate and reseed with an introduced species when the least costly option might have been to reduce the grazing pressure and allow succession to rejuvenate the grassland. Both solutions have costs associated with them. Sustainability in Brazil and, perhaps, other tropical areas is directed toward seeded pastures and loss of productivity. The issue is at least partly related to economic sustainability as the problem is addressed with the application of phosphorus fertilizers and the reduction of stocking rates. The challenge is to identify indices that provide an early warning to environmental degradation.

Future direction. Native grasslands have been poorly understood and this has resulted in their elimination and exploitation. The remaining native grasslands need to be preserved using long-term planning with a look to the past in order to understand the forces that were responsible for their character. Planning requires knowledge on how the grasslands should function and a vision on what they should look like. Therefore studies are needed to understand the present condition and its relationship to the goal. This requires that the role of fire and herbivory are defined in the management of temperate and tropical grasslands and the impact of projected climate change be predicted. Since human intervention is a foregone conclusion, indices of sustainability need to be developed that provide a benchmark of grassland health.

The remnant native grasslands are demanding greater attention for diverse uses and there must be better communication and planning among the users, and more effort in planning, developing, and conducting integrated activities, to ensure optimal enjoyment by the greatest number of people. Alternative farming systems may be needed to be developed that protect the grasslands yet support human occupation.

The native prairie has been viewed as a resource that needs improvement; and it's been "improved" with a vengeance. Now we need to focus on understanding the resources and protecting them while they still exist.