White Paper Supporting SRM Climate Change Position Statement
SRM Climate Change Synthesis Authors
Modified by SRM PPAC 4 January 2013
27 February 2013

A pattern of anthropogenic climate change has been emerging since the mid-20th century that lends support to projections that Earth's climate is shifting and becoming more variable. Although substantial gaps exist in our ability to predict future climatic trends, the potential human and ecological consequences of additional climate change are enormous. The existing climate change footprint and potential risks posed by future change warrant development of adaptive strategies to prepare for an increasingly uncertain future. The rangeland profession is in a pivotal position to effectively address climate change because it represents the intersection of management and scientific knowledge, includes diverse stakeholders who derive their livelihoods from rangelands, and advises social organizations responsible for rangeland stewardship.

Atmospheric science models project warming and altered precipitation regimes, including greater variability expressed as more frequent or severe droughts and storms, as a consequence of the continuing increase in atmospheric concentrations of carbon dioxide (CO_2) and other trace greenhouse gases (GHGs). Although no singular weather event can be attributed to climate change, observations of warmer temperatures, rapid glacial retreat, accelerated plant phenology, modified precipitation patterns, and greater incidence of wildfires are consistent with a warmer and more variable climate.

Climate and weather variability are important determinants of ecosystem function and the numerous services derived from rangeland ecosystems. Therefore, long-term changes in mean climatic trends and greater climatic variability may challenge our ability to maintain resilient and productive rangelands. The anticipated consequences of climate change include large regional variations with greater warming and precipitation at high latitudes, but less warming and precipitation at lower latitudes. Regional variation in the expression of climate change and the positive effects of CO_2 on plant growth, combined with the inherent variation that exists among rangeland ecosystems, indicate that responses to climate change will be varied and complex.

Warming and drying are anticipated to reduce soil water availability, net primary productivity, and other ecosystem processes in the southern plains, southwest, and northern Mexico, but warmer and generally wetter conditions will likely enhance these processes in the northern plains and southern Canada. The northwest is anticipated to warm considerably, with little change in annual precipitation despite a large decrease in summer precipitation. Reduced winter snowpack and earlier snow melt may further affect hydrology and riparian systems in this region.

The three climate change components ─ atmospheric CO_2 enrichment, warming, and precipitation modification ─ may interact to reduce forage quality by reducing crude protein content and digestibility, even though their impacts on forage quantity are highly variable. Climate induced changes in species composition, especially the relative proportion of functional plant groups, and the timing and duration of the growing season may further influence forage quality and quantity. Livestock production may be further suppressed by negative effects of warming on animal metabolic function and reproduction and an increase in parasite loads.

Rangelands function as tightly coupled human-ecological systems so that goals and values, cultural norms, and socio-economic considerations will exert a large and often decisive influence on how rangeland management responds to the challenges posed by climate change. Therefore, it is essential that both ecological and socio-economic components of these systems be considered when devising adaptation and mitigation strategies. Human perceptions contribute to the inability of many rangeland enterprises to effectively adapt to current climatic variability, as evidenced by limited adoption of flexible grazing strategies and insufficient drought management planning. Limited adaptation to current climatic conditions partially originates from the perception of climatic consistency, as exemplified by the implementation of policies to manage for 'crises' that result from variability in 'normal' weather patterns. Limited adaptation to current variability underscores the tremendous challenge posed by increasing climatic variability.

Effective adaptation strategies are needed to minimize ecological and social consequences while capitalizing on opportunities associated with climate change. Rangeland ecosystems, enterprises, and management systems will need to be adapted to local geographical and climate

conditions. Viable adaptation strategies for specific locations may be developed by identifying how rangeland ecosystems, enterprises and management strategies vary over geographic and climatic gradients as well as how they have responded to previous weather extremes. Specific adaptation strategies for livestock production systems include the adoption of conservative stocking rates, a shift from *Bos taurus* to *Bos indicus* breeds of cattle, increased use of pest-resistant livestock breeds, a shift toward stockers in addition to cow-calf operations, diversification of land uses, and development of alternative revenue sources.

Rangeland ecosystems and enterprises likely have an important, but limited, role in reducing GHG emissions and enhancing carbon (C) storage as a means to mitigate climate change. Mitigation strategies to sequester C do not appear economically viable at the level of individual enterprises, given the small and highly variable C02 fluxes of semiarid rangelands. However, given the large extent of rangelands, potential may exist to develop regional or national policy to conserve rangeland soil C and reduce emissions of other greenhouse gases (i.e., methane and nitrous oxide) by livestock operations.

The uncertainty that climate change poses for rangeland ecosystems and the enterprises that are dependent upon them justifies a comprehensive assessment of current management strategies, research initiatives, and policy recommendations. New approaches are required to anticipate, plan for and minimize the detrimental consequences of climate change and to recognize and capture opportunities that arise from these altered conditions. These approaches will involve a diverse scope of options, including altered risk perception and aversion by individuals, greater flexibility of production enterprises, and modifications to social organizations that will collectively emphasize the variability, rather than the consistency of climatic conditions. The Society for Range Management seeks to maximize the opportunities and minimize the hazards associated with climate change, while promoting productive rangeland ecosystems that ensure food security, human livelihoods, and continued provisioning of diverse ecosystem services.