CHAPTER I

Introduction

BACKGROUND

Rangelands constitute about 770 million acres, or one-third, of our Nation's land base—yet they are relatively unknown to most Americans, especially in comparison to forests, agricultural lands, and urban areas. When interest in rangeland management began in the early 20th Century, "range" was commonly considered to be those lands, located almost exclusively west of the 100th Meridian, used for livestock grazing (Secretary of Agriculture 1936). As such, rangeland was understood more in terms of being a use of land than a kind of land.

A fundamental shift occurred in the discernment of what rangelands are, partly in response to the environmental movement of the 1970s when other important uses for these lands became recognized and more appreciated – particularly for amenity values like wildlife, recreation, and aesthetic viewscapes. For the past 30 years, rangeland managers, scientists, and other stakeholders have defined rangelands as a kind of "land on which the indigenous vegetation is predominantly grasses, grass-like plants, forbs, or shrubs, and is managed as a natural ecosystem" (Glossary Update Task Group 1998). Regardless, some confusion still exists when rangeland is inappropriately considered to be lands used only for livestock grazing (The H. John Heinz III Center 2002).

Rangelands, like forests, are vital to the continuing well-being of local communities, counties, regions, and the United States as a whole. They provide commodity, amenity, and spiritual values (Shields et al. 2002). Among these products and values are forage for grazing animals, both domestic and wild, wildlife habitat, water storage and filtering, environments for critical species (rangeland-dependent and threatened/endangered), sequestration of carbon to mitigate global warming, multiple recreational opportunities, a way of life for people living on the land and in rangeland-dependent communities, and other economic and social benefits.

Rangelands vary widely where they are found throughout the United States – from the Arctic tundra in Alaska to high mountain meadows to the different grasslands of the Great Plains, from the sagebrush steppe of the Great Basin to the desert ecosystems of the Southwest, and from California to Florida. Savannas in the Southern Plains and scattered woodlands in the West are also rangelands.

About two-thirds of U.S. rangelands are privately owned (Joyce 1989); the rest is managed by federal, state, and local governments. The two principal federal agencies responsible for managing rangelands are the USDA Forest Service and USDI Bureau of Land Management (Mitchell 2000). Today's rangelands are in large part a legacy of the "manifest destiny" of the western movement in the 19th Century (Berkin et al. 1995), the era of "wise use" in the early 20th Century (Pinchot 1947), and increasing public participation in the management of federal lands in recent years (Dana and Fairfax 1980).

The area of rangeland in the United States has been slowly declining at a rate of about 1.5 million acres per year since the mid-1960s, or about 1 percent every 4 years (USDA-ERS 1997). The amount of land available for livestock forage production is expected to continue to slowly decrease over the next 50 years; the actual rate depends upon environmental concerns,

government policies, urban and exurban sprawl, and increased demand for recreation. Conversely, use of U.S. grazing lands for wildlife habitat, as well as wildlife-related human activities, is projected to increase during the same period (Van Tassell et al. 2001).

Interest in sustainable social and economic development has risen dramatically, both nationally and internationally, over the past 30 years. During this time, public concern over irreversible environmental degradation and depletion of finite natural resource reserves moved to center stage. A recent analysis of the United States' natural resource trends by Cordell and Overdevest (2001) noted that overwhelming majorities of survey respondents indicated that they care deeply about the environment, global ecosystems, and a sustaining future for natural lands.

Sustainable resource management has evolved as the logical extension of the application of sustainable development principles to land management (Shields and Bartlett 2002). The United States has opted to approach identification of resource-specific criteria and indicators (C&I) for quantification of social, economic, and ecological factors through a series of stakeholder roundtables focusing individually on forests, rangelands, minerals and energy, and water resources.

The Sustainable Rangelands Roundtable (SRR), comprised of representatives from conservation organizations, the livestock industry, local, state and federal agencies, and universities, is engaged in an ongoing program designed to identify measures of rangeland sustainability at a national scale. The SRR is working to develop C&I to form a framework for national assessments of rangelands and rangeland use patterns. It operates as an inclusive, open partnership with all interested representatives having an equal voice in the criterion and indicator development.

Selecting indicators for monitoring is one step in a larger process that includes classification, inventory, monitoring, assessment, and management. From a broad perspective, a Nation's values and objectives are reflected in strategic planning goals of agencies and organizations, which, in turn, drive classification and monitoring protocols that allow assessments of progress towards these goals (Mitchell et al. 1995). The SRR C&I will elucidate trends in environmental conditions, management actions, economic benefits, and social values provided by rangeland resources. Ultimately, SRR products will offer a flexible framework for standardized data collection and reporting on the status of U.S. rangelands to enhance national resource prioritization and planning efforts.

SRR's C&I will describe elements that can be used to assess trends in resource conditions, resource management, ecological variables, economic costs and benefits, legal and institutional frameworks, and social values. Benefits that land management agencies and stakeholders may derive from this process include: directing monitoring emphasis to areas identified by indicators as being important; providing for development of common data collection techniques; focusing research by agencies, universities, and organizations on developing methods to measure C&I; facilitating agency performance planning and shifting funding priorities to at-risk areas; and providing opportunities to better evaluate and improve management to meet social, economic, and ecological goals.

A broadly accepted set of indicators will improve accountability for rangelands stakeholders and Congress, through activities such as: multi-level, coordinated data reporting; assessing compliance with applicable laws; and expanding general understanding of rangelands sustainability. While interpretation and conclusions derived from C&I may be contentious, the inclusive, open nature of the roundtable process will ensure that they provide

common ground for discussion. Effective communication and implementation of C&I will enhance the quality of debate about rangeland management issues.

SUSTAINABLE DEVELOPMENT

The roots of sustainable development began in the second half of the 20th Century when various organizations and governments began to become concerned about perceived excesses in the use and harvest of various natural resources, particularly in the tropics. The United Nations Conference on the Human Environment, held in Stockholm, Sweden, June 1972, was the first international venue to point out widespread evidence of pollution, disturbance to ecological processes in forests and other biomes, and depletion of natural resources (Hopgood 1998).

In 1987, a report by the World Commission on Environment and Development (1987), entitled "Our Common Future," sounded an alert for needed progress in achieving sustainable development. Commonly called the Brundtland Report after its chair, Gro Harlem Brundtland, the report defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The Brundtland Report was troubled by a lack of global equity, but suggested that economic growth, social equity, and environmental quality are simultaneously feasible.

Building upon the Brundtland Report, the UN Conference on Environment and Development (commonly called the Earth Summit), met in Rio de Janeiro, Brazil, in June 1992 to help governments reassess economic development and accompanying losses of natural capital. The Conference was widely attended, represented by 172 governments, including 108 governments at the level of head or secretary of state, and almost 2,500 representatives of non-governmental organizations (NGOs). Five different agreements emanated from the Earth Summit, including conventions on biodiversity, global climate change, principles of forest management, and Agenda 21, a blueprint for sustainable development in the 21st Century (Panjabi 1997).

The primary focus on forest management at the Earth Summit was on tropical rainforests. Following the Earth Summit, Canada convened an international seminar on the sustainable development of boreal and temperate forests, held in Montreal in 1993. Subsequent to this seminar, an initiative was begun among representatives of non-European countries having temperate or boreal forests to develop a set of C&I of sustainable forest management at a national scale. The protocol for accomplishing such an initiative became known as the Montreal Process. The first meeting of the new group, called the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests, was held in 1994.

Criteria constitute explicit goals of sustainability. Criteria are too general in scope to monitor directly but are characterized by a set of indicators that can be monitored over time. Indicators are measures of an aspect of a criterion; that is, they are qualitative or quantitative variables that can be measured or described, and which, when observed periodically, demonstrate trends (National Research Council 1999).

At their sixth meeting in Santiago, Chile, held during February 1995, 10 participating nations, including the United States, agreed to a set of seven criteria and 67 indicators of forest conservation and sustainable management. The formal endorsement of these C&I is called the Santiago Declaration. Since that time, two other countries have joined the original

signatory nations. A listing of the C&I may be found on the Montreal Process web site at http://www.mpci.org/criteria_e.html.

The 12 signatory nations to the Montreal Process agreed under the Santiago Declaration to produce individual first approximation reports in 1997, detailing conditions of their forests and availability of data supporting the 67 indicators. The USDA Forest Service led the U.S. effort and released a *Report of the United States on the Criteria and Indicators for the Sustainable Management of Temperate and Boreal Forests* that year (USDA Forest Service 1997). The report identified a number of key indicators having either no data or little short-term opportunities for data. Even where data were available, the report concluded that definitions and sampling protocols were often inconsistent, making conclusions about national conditions and trends problematic. The U.S. First Approximation Report is available on the Internet at http://www.fs.fed.us/global/pub/links/report/candi.htm.

At about the same time, the National Association of State Foresters (NASF) passed a resolution recognizing that C&I can offer a framework to enable a mechanism for obtaining data and the reporting of knowledge needed for the sustainable management of U.S. forests (http://www.stateforesters.org/resolutions/res_97.html#97-6). It asked the Chief of the Forest Service to co-chair with NASF a coordinating group (this became the Roundtable on Sustainable Forests or RSF) to implement mutually determined actions toward achieving such a national policy. Among its goals, the group was to review the 67 Montreal Process Indicators and design a more effective forest inventory system.

The interests of rangelands began in July 1998 when Dr. Kendall Johnson, Chair of the Rangeland Resources Department at the University of Idaho and First Vice President of the Society for Range Management, attended the Roundtable and requested inclusion of rangelands as part of the sustainable management process. He emphasized that forests and rangelands form mosaics across a broad landscape and, due to inconsistencies in definitions, it is often unclear where forests end and rangelands begin. Partly in response to Dr. Johnson's request, a study at the Rocky Mountain Research Station of the Forest Service reviewed the applicability of Montreal Process C&I to rangelands. This review concluded that the C&I did, for the most part, apply to rangelands.[1]

The RSF decided to concentrate only upon forests. They believed achieving the goals relating to sustainable forest management would be sufficiently challenging to require their entire attention. Subsequently, the RSF removed language from its charter implying that sustainable rangelands would be an equal focus with sustainable forests. Leaders in the RSF, nonetheless, promoted the idea of a separate, but parallel, effort for rangelands. For a description of the RSF, see http://www.sustainableforests.net/.

On 27-28 April 1999, the Director of Range Management, USDA Forest Service, convened a workshop on rangeland C&I for sustainability, held in Denver, CO. The purpose of the workshop was primarily to ascertain whether adequate support existed among rangeland stakeholders, both commodity users and the environmental community, to initiate a roundtable dealing with C&I for sustainable rangeland management at a national scale. The consensus was to promote such a strategy (USDA Forest Service 1999).

[1] The Rocky Mountain Research Station study of how well the Montreal Process C&I apply to rangelands was published as a series of eight papers in two issues of *The International Journal of Sustainable Development and World Ecology.* Six papers evaluating criteria 1 through 5 were published in Vol. 7, No. 2 (June 2000), and three papers evaluating criteria 6 and 7 were published in Vol. 9, No. 2 (June 2002).

At about the same time, the Sustainable Minerals Roundtable (SMR) was established as a means for appraising the status and trends of minerals, materials, and energy systems in the United States. The SMR is guided by an agreement between USDA Forest Service and the University of Nevada, Reno. It maintains a web site at http://www.unr.edu/mines/smr/.

SUSTAINABLE RANGELAND ROUNDTABLE

The Sustainable Rangeland Roundtable (SRR) was convened at a meeting in Denver, CO, on 10-11 April 2001. At this meeting, participants drafted a list of important, future-focused issues that could be used to frame C&I for sustainable rangeland management. The issues transcended agency and other artificial boundaries because broad-scale sustainability concerns have been shown to cross boundaries (Knight and Landres 1998). SRR members then subjectively clustered individual issues into groupings of similar topics characterizing broader-scaled issues facing rangelands. Attendees also worked on initial mission and vision statements, as well as a set of guiding principles.[2]

SRR Mission

The SRR will promote ecological, economic, and social sustainability of rangelands through the development and widespread use of C&I for rangeland assessments, and by providing a forum for dialogue on rangeland sustainability.

SRR Vision

We envision a future in which (1) rangelands in the United States provide a desired mix of economic, ecological, and social benefits to current and future generations; and (2) C&I for monitoring and assessing the economic, social, and ecological sustainability of rangelands are widely accepted and used.

SRR Guiding Principles

1. Collectively, indicators should guide monitoring efforts to measure rangeland sustainability in the United States at the national scale. Where possible, indicators should guide monitoring efforts to measure rangeland sustainability at multiple scales.[3]

2. We will employ indicators at the appropriate temporal and spatial scales for assessing their associated criteria.

[2] The mission statement was adopted by SRR in Salt Lake City, June 2001. The vision statement and guiding principles were agreed to in Reno, July 2001. Both the mission and visions statements were revised in December 2002 at the SRR planning meeting in Phoenix. The revised statements are included here.

[3] To help achieve this principle, the SRR formed a Scale Working Group (SWG) to make recommendations regarding the interpretation of scale to the process. Specifically, the SWG advises where aggregation between scales is appropriate and where interpretation of indicators can change at different scales. The SWG maintains a web site at http://www.pwrc.usgs.gov/brd/srrscale.htm.

3. Collectively, C&I will address social, ecological, and economic aspects of sustainability.

4. A C&I framework will be used as a common language and operational framework for defining and assessing sustainability. We will begin by considering the C&I framework of the SFR (Montreal Process).

5. We will review and consider, as appropriate, other indicator initiatives.

6. Numerous rangeland-related policy questions exist. We will focus upon the SRR vision and mission.

7. The SRR process will feature outreach to stakeholders, open dialogue, and respect for differing opinions.[4] Having a broad and inclusive perspective of rangelands is deemed critical for achieving wide acceptance of the SRR C&I after their development.

8. SRR supports and strives to be compatible with improved on-the-ground rangeland management.

SRR functions through several tiers of involvement, comprised of core staff, a Steering Committee, working groups on outreach, scale, definitions, and coordination with other roundtables, and criterion groups. The core staff handles administrative duties and is responsible for communications. The Collaborative Delphi technique, discussed below, is one important communications tool.

The Steering Committee is comprised of representatives from entities that fund or closely support SRR. These include the Forest Service, Bureau of Land Management (BLM), U.S. Geological Survey (USGS), Natural Resources Conservation Service (NRCS), Colorado State University, and the Ecological Society of America. Among the Steering Committee's duties are keeping the SRR's general direction and progress focused, reviewing and helping plan outreach, ensuring a broad representation of interests on the Roundtable, and coordinating with the facilitator to ensure that meetings run smoothly.

A facilitator is a critical part of the roundtable process. The SRR was fortunate to obtain the services of Mr. Lou Romero, a widely respected professional facilitator who has decades of experience in natural resource management and science issues.

THE "COLLABORATIVE" DELPHI

The Delphi technique is a method for systematically gathering and integrating the informed judgment of a group of experts concerning a subject. Its goal is to enable the reaching of agreeable conclusions. Delphi is named for a meeting site in ancient Greece where Oracles held council and gave wise advice and opinions. Today's Delphi was first applied in

[4] To assist with this guiding principle, the SRR formed an Outreach Working Group (OWG) that serves to build awareness of the C&I as a tool for assessing rangeland sustainability by helping the SRR engage stakeholders in dialogue, and help SRR participants conduct outreach within their organizations and constituencies. OWG members represent NGO's, universities, professional societies, research institutions, and government land management agencies.

the 1950s in military strategic planning; later, the methodology became widely used in business planning (Linstone and Turoff 1975). Delphi techniques have been employed to establish research results where traditional data-driven methods are infeasible, to aid in policy decision-making, to resolve environmental disputes, and to facilitate economic planning (Miller and Cuff 1986, Smit and Mason 1990)

Conventionally, Delphi is an iterative process whereby experts answer a set of questions; individual responses are tabulated and returned to the participants, along with summary analyses and comments. Individuals are then afforded an opportunity to revise their original answers in response to the group feedback. The process continues until a pre-determined level of consensus is achieved.

Individual anonymity is a critical attribute of the Delphi technique. Without it, the free exchange of ideas is stifled. The legitimacy of the process also relies upon the ability of the people designing questions and analyzing answers to remain unbiased. The SRR employed a research associate at Colorado State University, Ms. Helen Rowe, to conduct the Delphi process supporting its work.

The SRR has used what Rowe designated as collaborative Delphi. It is distinctive because the Delphi is part of a larger process that includes meetings where consensus is also established. The Delphi maintains progress between scheduled meetings by eliciting feedback on material produced during meetings, and allowing work groups to continue with tasks at hand. In addition, the Delphi technique allows SRR members who miss a meeting to continue involvement in salient issues and decisions of the SRR. A more complete discussion about the Collaborative Delphi and how it has been used within the SRR process can be seen in an unpublished proceedings paper by Rowe, found on the SRR web site at http://sustainablerangelands.cnr.colostate.edu/symposium%20proceedings/rowe.pdf.

DEVELOPING CRITERIA AND INDICATORS

The SRR met 11 times to carry out its objective of producing a first approximation report of C&I for assessing sustainable rangeland management in the United States (Appendix 1-1). During the course of these meetings, more than 100 scientists representing about 50 agencies, universities, professional societies, NGOs, and private businesses participated in the process (Appendix 1-2).

By the second meeting in Salt Lake City, SRR participants converged upon a clustered group of six “issues” that formed the basis for criteria for Sustainable Rangeland Management. They were: Soils, Rangeland Health, Invasives, Change of the Range, Capacity, and Social Goods and Commodities. At the third meeting in Reno, participants began to recognize that it would be useful to merge the “issues” with the seven criteria being considered by the RSF. After intensive discussion, the SRR settled upon five criteria**:** (1) conservation and maintenance of soil and water resources of rangelands; (2) maintenance of ecological health and diversity of rangelands; (3) maintenance of productive capacity on rangeland ecosystems; (4) maintenance and enhancement of multiple economic and social benefits to current and future generations; and (5) legal, institutional, and economic framework for rangeland conservation and sustainable management.

No criterion relating to the contribution of rangelands to global carbon sequestration, such as the Montreal Process has as Criterion 5, was accepted. Our rationale was that most carbon in rangeland systems is stored as soil organic matter, a component subject to very little

and very slow change. Thus, those interested in monitoring soil carbon could do so using one or more of the soil-based indicators associated with the first SRR criterion, above, particularly the area/percent of rangeland soils with significantly diminished organic matter and nutrient content.

The other major difference between the SRR criteria and Montreal Process (RSF) criteria was the combining of two Montreal Process criteria (Conservation of Biodiversity and Maintenance of Forest Ecosystem Health and Vitality) into the second SRR criterion, above. Our perspective was that biodiversity is considered a part of ecosystem health.

Only one change was made to the SRR criteria after the Reno meeting. Fifteen months later, at San Diego, the working group responsible for the rangeland health and biodiversity criterion led a discussion that resulted in changing the criterion's name to "Conservation and Maintenance of Plant and Animal Resources on Rangelands." Several SRR participants had been troubled with the original name because a high proportion of indicators commonly associated with rangeland health at local levels (Committee on Rangeland Classification 1994) were actually found under other criteria. The criterion's new name has two advantages: (1) it more closely represents the indicators that evolved under it, and (2) its name logically complements the first criterion. The final list of criteria developed for sustainable rangeland management at a national scale is:

- Conservation and Maintenance of Soil and Water Resources of Rangelands.
- Conservation and Maintenance of Plant and Animal Resources of Rangelands.
- Maintenance of Productive Capacity on Rangeland Ecosystems.
- Maintenance and Enhancement of Multiple Economic and Social Benefits to Current and Future Generations.
- Legal, Institutional, and Economic Framework for Rangeland Conservation and Sustainable Management.

INDICATOR DEVELOPMENT

SRR employed a multifaceted approach to develop indicators supporting the five criteria. Initial discussions took place at meetings, primarily within the five criterion groups. The criterion groups sometimes used the Delphi process to maintain progress between meetings. Later, we engaged in interaction sessions with technical experts on the RSF and SMR to share information and minimize obvious conflicts in definitions, indicators, etc.

The SRR criterion groups all began by considering the RSF (Montreal Process) indicators. It quickly became apparent that a number of indicators, especially those of an economic nature, did not apply to rangelands, so that list was eliminated as a package early in the process. The collaboratively developed framework for indicator selection included the indicators' scientific importance (based upon literature); how relevant their temporal and spatial scales were to national monitoring and assessments; and their robustness to changes in technology – in a manner described by the Committee to Evaluate Indicators for Monitoring Aquatic and Terrestrial Environments (2000).

Criterion groups applied a six-point framework to the examination of each indicator (Appendix 1-3). Five of the components were composed as questions that ask what the indicator represents (both directly and in relation to the criterion to which it applies), how important it is in all parts of the country, whether its scale is appropriate for monitoring trends across all rangelands, and how understandable the indicator should be to the general public.

The sixth point asked criterion group members to judge the adequacy of currently available data collection protocol and data sets needed to monitor the indicator by placing the indicator into one of four categories relating to data availability and degree that sampling protocols are standardized.

A great deal of attention was given to scale issues. Systems, including ecological, economic, and social systems, exist at different levels of integration, a concept that has received attention by an evolving body of science called hierarchy theory (Allen and Starr 1982). In hierarchies, data are collected at many scales, from the pedon, to the ecological site, to landscapes and watersheds, to counties and states, to Major Land Resource Areas and Ecoregions, to biomes, and to the Nation as a whole, for many different purposes. Recent work in ecology has shown that patterns or processes taking place at small scales do not necessarily have meaning at broader scales (Schneider 2001).

In nested hierarchies, upper levels can be described totally in context of levels below them (Allen and Hoekstra 1992). Thus, data in nested hierarchies can be aggregated for one or two levels without losing an excessive amount of information. In fact, data are commonly collected at least one scale finer than the level of interest, if for no other reason than to show spatial dynamics and the mechanism for the system in question (Cooper 1969). Non-nested hierarchies are not suited for data-aggregation because the upper levels are not composed of the lower levels; e.g., a food chain hierarchy. Aggregating data in non-nested hierarchies fails to consider the synergistic effects of systems (Allen and Hoekstra 1992).

The SRR Scale Working Group served as a resource for the five criteria working groups, helping understand and resolve scale-related issues pertaining to potential indicators. The Scale Working Group maintains a web site at http://www.pwrc.usgs.gov/brd/srrscale.htm.

EXAMINATION OF DATA SETS

One important attribute of any indicator of sustainable rangeland management is data availability. In general, where data already exist, someone has conducted analyses that show or fail to show relationships between the variable(s) in question and system response. Here, the term “system” can include ecosystems, economic systems, and social systems, all at various scales. In many instances, however, data do not exist for indicators. Lack of comprehensive data can result from high costs, a lack of technology, disagreement over how an indicator should be measured, and other reasons.

The SRR devised, after extensive discussions and debate, a data matrix to be used as a format for describing known data sets associated with the indicators (Appendix 1-4). The matrix has a column for each data set. Information about the data can be entered in rows. Each row asks a specific question about the data. The rows are divided into six sections dealing, respectively, with: the availability of data (A-D, based on the same conditions as described in paragraph 5 of the six-point framework – see Appendix 1-3); a title and point of contact for the data set; a description of the data set and any associated restrictions to its use; the spatial and temporal grain of the data; an overview of data quality; and a section for other comments. A glossary of terms found in the questions is provided below the data matrix.

REPORT BACKGROUND

We should note that this report does not include a comprehensive description of the status of data sets or of the relationships that may be derived from analyses of these data. The first step for the SRR was to report on C&I for sustainable rangelands. What follows is a description of each of the five criteria of sustainable rangeland management, considered for the United States as a whole. The report describes why each criterion was chosen and what it entails. The indicators are also described following the framework shown in Appendix 1-3.

Insufficient data are currently available for most indicators; consequently, it is not feasible to undertake a discourse on the status of U.S. rangelands. It is SRR's hope that, within the next five to seven years, adequate monitoring data will be available to allow the issuance of a more comprehensive report on the state of our Nation's rangelands, much like the Federal government has committed to do for U.S. forests in 2003 (http://www.pwrc.usgs.gov/brd/SFDReportProspectus.htm). Doing so will be an important step in the progress toward achieving sustainable rangeland management in the United States, and constitutes a challenge to policy makers at all levels.

Finally, we should recognize that a comprehensive suite of C&I will benefit a number of important national and regional rangeland monitoring programs, including the National Resources Inventory (NRCS), an expanded Forest Inventory and Analysis (Forest Service), and EMAP (Environmental Protection Agency).

REVIEW PROCESS

SRR C&I have been subjected to both internal and external review before being presented here. Review comments and other feedback were solicited at symposia/workshops held at three professional society meetings.[5] Following that, both internal and external peer reviews were obtained and addressed.

The most important feedback will come from how well SRR's work is received by those individuals, agencies, and organizations that have the potential to positively influence both rangeland ecosystems and rangeland-dominated social systems in the United States. Increased application of assessment and monitoring-based management strategies should increase sustainability while supporting a broader variety of desired economic, ecological, and social outcomes.

[5] Symposium at Society for Range Management Annual Meetings in Kansas City, MO (Feb. 2002) and Casper, WY (Feb. 2003); Ecological Society of America Annual Meeting in Tucson, AZ (Aug. 2002); and the Society and Natural Resources International Meeting in Sardinia, Italy (Oct. 2002). The workshop in Sardinia was co-hosted by the SRR and the Sustainable Minerals Roundtable.

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APPENDIX 1-1. Sustainable Rangeland Roundtable meetings.

Location	Dates	Major accomplishments
Denver, CO	10-11 Apr 2001	Reviewed work on Sustainable Forest Management. Developed issues pertaining to criteria.
Salt Lake City, UT	4-5 June 2001	Created initial issue groups. Agreed to operational plan, mission. Formed Scale, Coordination and Outreach working groups.
Reno, NV	24-25 July 2001	Agreed to vision and guiding principles. Converged issues into five criteria.
San Antonio, TX	7-8 Nov 2001	Developed a system to evaluate indicators. Agreed to use Society for Range Management definition of Rangeland. Began identification of indicators.
Tucson, AZ	9-10 Jan 2002	Continued work on indicators. Developed initial outreach plans.
Denver, CO	26-27 Mar 2002	Agreed to timeline for finishing work on C&I. Reviewed feedback from symposium at SRM Annual Meeting, Kansas City, MO.
Washington, D.C.	29-30 May 2002	Conducted briefing to Congressional staff, agency and NGO leaders, 30 May 2002, Rayburn House Office Building. Continued work on C&I, and associated data sets.
Billings, MT	30-31 July 2002	Employed 6-point framework for evaluating data. Agreed to publication mechanism for reporting work of the SRR.
San Diego, CA	29-31 Oct 2002	Conducted interactions sessions with members of RSF and Sustainable Minerals Roundtable. Froze indicators. Began effort to identify data sets for indicators.
Fort Myers, FL	14-16 Jan 2003	Finalized time line for reporting upon SRR work. Worked on data matrix. Reviewed outreach plan and SRR strategic plan. Drafted criteria chapters for First Approximation Report.
Albuquerque, NM	18-20 Mar 2003	Reviewed internal review of criteria chapters and revised chapters for external review. Planned outreach efforts for Washington, D.C. in May.
Jackson Hole, WY (planned)	3-5 June 2003	Report on Washington, D.C. outreach. Transition to future SRR efforts.

APPENDIX 1-2. List of individuals and organizations participating in Sustainable Rangeland Roundtable meetings.

1 Sam Albrecht, Society for Range Management
2 Barbara Allen-Diaz, UC Berkeley
3 Jennifer Atchley, World Wildlife Fund
4 Hugh Barrett, USDI-BLM
5 Ann Bartuska, The Nature Conservancy
6 Tom Bartlett, Colorado State University
7 Rodney Baumberge, NRCS
8 Robert Belcourt, Chippewa Cree Tribe
9 Martin Beutler, South Dakota State University
10 Roger Blair, EPA
11 Ben Bobowski, USDI-NPS
12 Steve Borchard, USDI-BLM-WO
13 Bob Broscheid, Arizona Fish & Game Department
14 Mark Brunson, Utah State University
15 Larry Bryant, USDA-FS-WO
16 Larry Butler, USDA-NRCS
17 Evert Byington, USDA-ARS
18 Larry Cadwell, Pacific Northwest National Laboratory
19 Jason Campbell, National Cattlemen's Beef Association
20 Jim Cash, USDA-ERS
21 R. Dennis Child, Colorado State University
22 Charles Curtin, Malpai Borderlands Group and Society for Conservation Biology
23 Jim Cropper, USDA-NRCS
24 Brian Czech, USF&WS
25 Elena Daly, USDI-BLM
26 Tom Davis, USDI-BIA
27 Janelle Downs, Pacific Northwest National Laboratory
28 Lynn Drawe, Welder Wildlife Federation
29 Greg Eckert, USDI-NPS
30 Larry Ellicott, USDA-NRCS
31 Gary Evans, se4 consulting, inc.
32 Joe Feller, Arizona State University
33 Maria Fernandez-Gimenez, University of Arizona
34 Bill Fox, Texas A&M University
35 Jan Fox-Holl, Malpai Borderlands Group
36 Herman Garcia, USDA-NRCS
37 Paul Geissler, USGS
38 Noelle Grether, Colorado State University
39 Bill Haglan, USF&WS
40 Stan Hamilton, National Association of State Foresters
41 Jon Hanson, USDA-ARS
42 Linda Hardesty, Washington State University

Aaron Harp, University of Idaho
H. Theodore Heintz, Jr., White House, Council on Environmental Quality
Rod Heitschmidt, USDA-ARS and Society for Range Management
Bob Hetzler, USDI-BIA
Lori Hidinger, Ecological Society of America
Alison Hill, USDA-FS-WO
Lynn Huntsinger, University of California, Berkeley
Eric Hyatt, EPA
Nelroy Jackson, Invasive Species Advisory Committee
Phil Janik, USDA-FS-WO
Leonard Jolley, USDA-NRCS and Society for Range Management
Linda Joyce, USDA-FS-Rocky Mountain Research Station
Sherm Karl, USDI-BLM
Mike Kemmerer, Florida Fish & Wildlife Conservation Commission
Linda Kennedy, National Audubon Society
Linn Kincannon, Idaho Conservation League
Mort Kothman, Texas A&M University
Keith Kulman, Western States Land Commissioners
Matthew Loeser, University of Northern Arizona
Dick Loper, Wyoming State Grazing Board and National Public Lands Council
Daryl Lund, USDA-NRCS
Tom Lustig, National Wildlife Federation
Kristie Maczko, Colorado State University
Mike Manfredo, Colorado State University
Clayton Marlow, Montana State University
Dan McCollum, USDA-FS-Rocky Mountain Research Station
John McLain, Resource Concepts, Inc.
Guy McPherson, University of Arizona
Mike Mecke, San Antonio Water Service
Dan Merkel, retired, Past President, Society for Range Management
John Mitchell, USDA-FS-Rocky Mountain Research Station
Chris Moller, Idaho State University
Tischa Munoz, University of Northern Arizona
Kenneth Nelson, USDA-ARS
Arnold Norman, USDA-NRCS
Robin O'Malley, Heintz III Center for Science, Economics and the Environment
Toney Ott, EPA
Duncan Patten, Montana State University
George Peacock, USDA-NRCS
David Pyke, USGS-BRD
Tim Reuwsaat, USDI-BLM-WO
Tom Roberts, USDI- BLM
Lou Romero, DeLaPorte and Associates
Helen Rowe, Colorado State University

Nathan Sayre, Quivera Coalition
Terri Schulz, The Nature Conservancy
Gerald Schuman, USDA-ARS
Ronald Shafer, EPA
Pat Shaver, USDA-NRCS
Robert Shaw, Colorado State University
Mark Simmons, Lady Bird Johnson Wildflower Center
Philip Sims, USDA-ARS
Ken Spaeth, USDA-NRCS
John Spence, USDI-NPS
John Stednick, Colorado State University
Lawrence Strong, Northern Prairie Wildlife Research Center
Lou Swanson, Colorado State University
John Tanaka, Eastern Oregon Agricultural Research Center and Society for Range Management
Arnold Taylor, Hopi Tribe
Doug Tedrick, USDI-BIA
Dennis Thompson, USDA-NRCS-WO
Allen Torell, New Mexico State University
Bill Travis, University of Colorado
Paul Tueller, University of Nevada
Bob Unnasch, The Nature Conservancy
Greg Venson, USDI-BIA
Jeanne Wade Evans, USDA-FS-WO
Robert Washington-Allen, Oak Ridge National Laboratory
Bob Wellig, Ridley Block, Inc.
Neil West, Utah State University
David Wheeler, USDA-FS
Bill Ypsilantis, USDI-BLM

APPENDIX 1-3. Six-point framework used by the Sustainable Rangeland Roundtable to evaluate indicators.

1. **Indicator:** What is the indicator (descriptive title)?

2. **Importance:** What does it measure and why is it important to sustainability?

3. **Geographic variation:** Is the indicator meaningful in different regions?

4. **Scale:** Is the indicator meaningful at different spatial and temporal scales?

5. **Data:** Categorize the availability of data sets for this indicator:

    A. Methods and procedures for data collecting and reporting; and data sets of useable quality exist at the regional-national level.

    B. Standardized methods and procedures for data collecting and reporting exist at the regional-national level, but useable data set(s) do not exist at the regional-national level.

    C. Some data set(s) exist at the regional-national level, but methods and procedures are not standardized at the regional-national level.

    D. Conceptually feasible or initially promising, but no regional-national methods, procedures, or data sets currently exist.

6. **Clarity:** Do stakeholders understand the indicator and indicator unit?

APPENDIX 1-4. Data matrix (adopted following the Billings, MT, meeting) describing and evaluating individual data sets associated with each indicator.

Data Matrix for Indicator #_____

	Data set # 1	**Data set # 2**	**Data set # 3**
Response from #5 of 6-point evaluation framework (A-D)			
Brief description of data set (including source and content):			
Contact person (email, phone, address):			
Website (if available):			
Additional information on data set:			
What is the most recent year of reported data?			
In what format is the data available? (map only, data point, …)			
Are data nominal, ordinal, or interval?			
What will be the approximate cost of collecting data?			
What barrier(s) prohibit access or use of data? (Restricted use, exorbitant cost, technical or legal barriers, confidential barriers, etc.?) Or are data easily accessible?			
What is the spatial grain of the data?			
What is the spatial extent of the data?			
At what spatial scales can these data be aggregated and reported?			
What is the temporal grain of the data?			
What is the temporal extent of the data?			
At what temporal scales can these data be aggregated and reported?			
Quality: Can data be adequately reported over time in a consistent form? (Consistent methodology.)			
Quality: Are existing data repeatable? (Estimates of independent observers not significantly different $p<.2$)			
Quality: Is the sampling method biased?			
Quality: are existing data precise? (Standard error <20% of the mean?)			
Quality: Are existing data valid?			
Quality: Are existing data responsive?			
Quality: How well does this data set meet the data needs for this indicator?			

APPENDIX 1-4 (Continued).

Matrix Glossary

Nominal scale: Observations that fall into mutually exclusive, collectively exhaustive categories, like male-female and burned-unburned, and cannot be ranked.

Ordinal scale: Observations that are not only different from category to category, but can be ranked according to some criteria; e.g., poor, fair, good, excellent range condition classes.

Interval scale: A scale consisting of equal-sized units. On an interval scale the distance between any two positions is of known size.

Grain: Size of the observational units. Grain sets the fineness of the distinctions that can be made from the observations.

Extent: Size of the sampling universe. Inferences cannot be beyond the range of the observations.

Repeatable: Independent observers would obtain similar results.

Bias: The sampling population differs from the true population.

Valid: The indicator measures what is intended.

Precise: Replicate observations have similar values (low variance).

Responsive: Relates to the ability of the measurements to detect changes in the phenomena. Measurements are not responsive if they show little change when the phenomena changes or if changes in the measurement lag changes in the phenomena. [Note: We want leading not lagging indicators. For example, the number of endangered species may not be responsive because the species are already in serious trouble before the problem is reflected in the data. Population levels or recruitment might be more responsive. We will probably want to include some data that are not responsive such as the number of endangered species, but we should be aware of their limitations and also include more responsive measures.]