Rangeland Health

RCA Issue Brief #10 August 1996

Did you know...

...that rangelands provide not only grazing for domestic animals, but also important habitat for wildlife and opportunities for outdoor recreation?

...that rangelands trap and store carbon and thus reduce atmospheric greenhouse gases, store water, and filter impurities from water? The vastness of American rangelands--1 in every 4 acres of the United States--only serves to underscore their importance.

Are our rangelands healthy?

That depends on whom you ask. Some argue that these lands are in better condition today than at any time this century. Others, often using the same data, claim that much of the Nation's rangeland is degraded and getting worse. Many simply do not know but are concerned about both the health of the land and the lack of definitive information.

Most agree, however, that America--s rangelands deteriorated rapidly and significantly during the latter part of the 19th century. Initial rangeland condition assessments, based on visual observation, were descriptive in nature. For example, in 1895--only a few decades after grazing began on much of the Nation's rangeland--Jared G. Smith of the U.S. Department of Agriculture wrote:

There has been much written during the past 10 years about the deterioration of the ranges. Cattlemen say that grasses are not what they used to be; that the valuable perennial species are disappearing, and that their place is being taken by less nutritious annuals. This is true to a very marked degree in many sections of the grazing country.

Methods to document "change on the range"

The succession-retrogression model

Observations such as Smith's provided early ecologists and rangeland managers not only an assessment of range condition, but also the foundation for the theories of succession and retrogression. The succession theory holds, basically, that increasingly developed soils and more complex mixes of plants replace less developed soils and less complex mixes on the land. According to the theory, succession ultimately results in a plant community in equilibrium with the environment, particularly climate and soil. This is the "climax" plant community. Disturbance of this plant community for any reason causes it to retrogress to an earlier stage of development. Smith's description of turn-of-the-century rangeland is a story of retrogression.

The ecological theories of succession and retrogression were developed into a method of rangeland condition assessment in the 1940's. This method required rangelands to be classified into range sites--areas of land capable of producing a different kind or amount, or both, of climax vegetation. Range site descriptions included information about soils, climate, topography, and other landscape characteristics of the site, and a description of the climax plant community.

Using the succession-retrogression method, rangeland can be described as being in "excellent," "good," "fair," or "poor" condition, depending on how closely the current composition and production of the vegetation on a site resemble the climax vegetation defined for the site. This method of determining rangeland condition was first used in the 1940's to help ranchers determine the value of their land for livestock grazing. This model worked well in the grassland region of the United States where climax vegetation was mostly made up of highly productive and nutritious grasses and forbs that also protected the soil from erosion. In this region, rangeland classified in excellent condition, using this ecological theory, also correlates to those lands that were most productive for livestock use, especially cattle. Likewise, poor-condition rangeland, as described above by Smith, was degraded for both ecological and livestock production reasons. In the 1960s, range conservationists and scientists further developed this classification system to include ecological condition and values. Where the succession-retrogression model works, it is a powerful tool to explain and predict how rangelands change with use and management.

Unfortunately, the succession-retrogression method of evaluating rangeland condition has not worked so well to describe both ecological condition and value for livestock grazing in other parts of the United States. The Society for Range Management concluded in 1995 that "current range condition assessments do not provide answers to the questions that Congress and the public want answered about the status of our rangelands." Why are range scientists re-examining the succession-retrogression method?

- Defining the climax plant community for a site is difficult at best and impossible on some sites.
- The two-attribute approach--plant species composition and production--is inadequate to address the complexity of rangeland ecosystems.
- Ecosystem change may not follow the linear pathway suggested by the traditional succession-retrogression model.
- Succession or retrogression may not occur--or may occur slowly--on some sites because of long-lived or otherwise dominant plants.

The state and transition model

The state and transition model is of most value in explaining rangeland ecosystem change--

- when a system can evolve in several ways rather than follow a single pathway;
- when change occurs very rapidly;
- when some changes are near-permanent; and
- when detailed explanation of the transitions that cause change is required.

The vegetation types are called "states," and the processes that cause states to change from one to another are called "transitions."

Where states are resistant to change, they are called "steady states." An example of a steady state is where long-lived or otherwise dominant plants occur on a site. These steady-state plant communities change only as a result of such transitions as long periods of above-average moisture or drought, fire, an insect or disease outbreak, or human action. The site factors that impose this high level of stability on a site are called "thresholds." Examples of thresholds include:

- Soil erosion and nutrient loss so severe that some plants cannot grow.
- Invasion of a site by a plant that is so dominant that other plants cannot compete.
- Change in the water cycle, such as more rapid runoff because of a lower rate of water soaking into the soil, to the point that plant growth is restricted during part of the growing season.
- Change in plant community structure--arrangement of plants on the site--so that fire, a naturally occurring event that directs ecosystem change, cannot occur or occurs in a more destructive way.

Ecological site descriptions

The state and transition model provides extensive knowledge of existing and possible states, transitions, thresholds or other barriers to change, opportunities for management intervention, and what changes can occur through mismanagement. All of this information can and should be captured in the ecological site description.

As a result of new knowledge developed in the United States and other countries, important changes have been made in the range site concept, including changing the name from "range site" to "ecological site." This is more than a semantic change. Ecological site descriptions include the known plant community types that may occur on a site as well as the single climax plant community. Ecological site descriptions should relate degree of soil development, hydrologic and ecosystem functions, and other ecological knowledge to the known plant communities. The ecological site description also outlines the processes of change that may occur on a site as well as showing change as a deviation from the climax or natural plant community. Because of the more thorough evaluation of ecological factors at work on an area of rangeland, the ecological site description provides information needed for management of rangelands for many uses and values.

New ways to evaluate the ecological well-being of rangeland

Both the succession-retrogression and state and transition models help explain how rangeland ecosystems change, but change and ecological well-being are not always the same thing. Two new concepts--rangeland health and site conservation threshold--attempt to fill in the gaps.

Rangeland health

The rangeland health model was developed by the National Research Council (NRC) Committee on Rangeland Classification, which was established to evaluate the methods used by Federal agencies to classify, inventory, and monitor rangelands. The NRC recommended that the U.S. Departments of Agriculture and the Interior jointly--

- define and adopt a minimum standard--independent of current or intended use--of what constitutes acceptable range conditions;
- develop consistent criteria and methods of data interpretation to evaluate whether rangeland management meets this standard; and
- implement a coordinated and statistically valid national inventory to periodically evaluate the health of the Nation's rangeland.

In the NRC's 1994 report "Rangeland Health: New Ways to Classify, Inventory, and Monitor Rangelands," the Committee defined rangeland health as "the degree to which the integrity of the soil and ecological processes are sustained." It recommended further that the "minimum standard for rangeland management should be to prevent human-induced loss of rangeland health." The Committee recommended that rangelands be considered--

- healthy "if an evaluation of the soil and ecological processes indicates that the capacity to satisfy values and produce commodities is being sustained";

- at risk "if the assessment indicates an increased, but reversible, vulnerability to degradation"; and
- unhealthy "if the assessment indicates that degradation has resulted in an irreversible loss of capacity to provide values and commodities."

Healthy rangeland can be described as land where erosion is not occurring at an accelerated rate, where most precipitation infiltrates into the soil and is used onsite for plant growth or flows as ground water to stream systems. The plant community effectively and productively takes advantage of the nutrients and energy that occur on the site. While plant species composition is dynamic, there is a tendency on healthy rangelands for soils, the plant community, and ecological functions to maintain or recover health following release from natural (drought, insect outbreak, wildfire) or human-caused stress.

What causes loss of rangeland health? The most common reasons are overgrazing by domestic and wild animals, and change in the historical pattern of fire. Overgrazing reduces the productivity and competitiveness of plants desired by the grazing animals. Overgrazing can reduce plant cover and expose bare soil to erosion. A shift in the competitive balance between plants may result in a near-permanent change in plant species composition from plants desired by grazing animals to plants that are seldom grazed. Woody shrubs and low-growing trees often increase with overgrazing and lack of fire. Accelerated soil erosion and near-permanent changes in plant species composition represent a change in the values and commodities that can be obtained from an area of rangeland, and, by definition, a loss of rangeland health.

Loss of rangeland health, initiated by overgrazing, may continue even if grazing management is improved unless some compensating event occurs. Fire, which tends to kill the shrubs and trees that compete with grasses and forbs, is such an event. Fortunately, rangelands can be maintained in a healthy state with grazing, and properly managed grazing can sustain or enhance rangeland health. Likewise, fire can be used to direct ecosystems toward healthy states.

Rangeland health was recommended by the NRC as a minimum ecological standard. Where rangeland health is preserved, a variety of management options and uses may be appropriate.

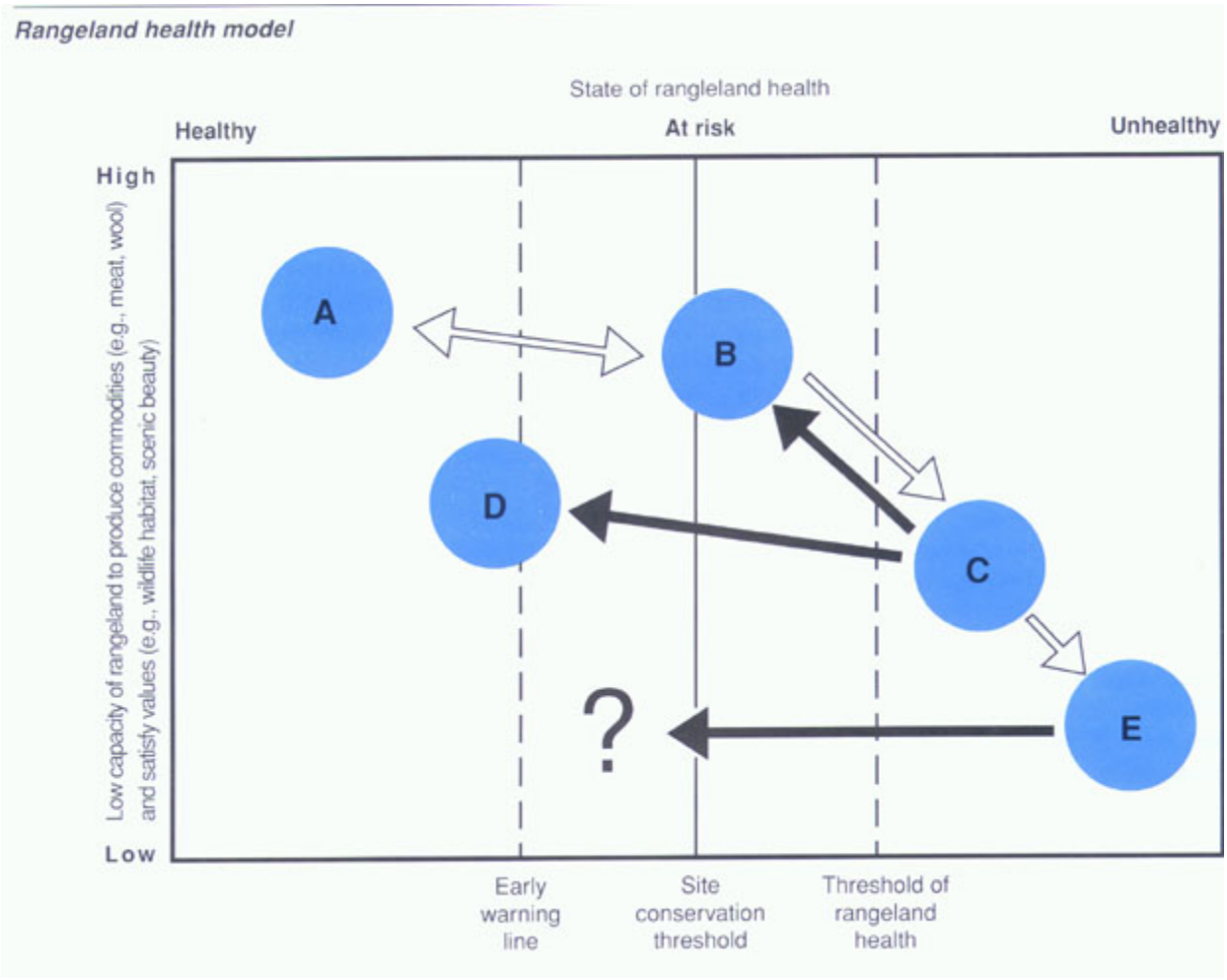
Site conservation threshold

The Society for Range Management (SRM) Task Group on Unity in Concepts and Terms was formed in 1989 to "continue to seek agency commonality and unity in technology and methodology relating to rangeland condition and trend." In its 1995 report, the Task Group recommended three strategies to improve rangeland condition assessments:

- Evaluate rangelands from the basis of the same land unit classification, the ecological site.
- Evaluate plant communities likely to occur on a site on the basis of their ability to protect the site against accelerated erosion.
- Select a desired plant community for an ecological site considering both site conservation and management objectives for the site.

To assess the sustainability of rangeland management, SRM has recommended the site conservation threshold concept: "The kind, amount, and/or pattern of vegetation needed as a minimum on a given site to prevent accelerated erosion." According to SRM, the threshold is the point where the erosion rate increases significantly. Vegetation that provides, at a minimum, the protection necessary to prevent accelerated erosion is considered by SRM to be above the threshold and would be rated satisfactory or sustainable. Vegetation that does not provide adequate protection would be rated unsatisfactory or unsustainable.

The figure below combines the concepts developed by NRC and SRM. The "early warning line" was proposed by the NRC as the point where negative changes in ecosystem characteristics are first noticed--changes that may indicate ecosystem degradation and a threat to long-term productivity of the site. The "threshold of rangeland health" represents the point where degradation is so severe that improvement will be possible only through application of improvement practices such as chemical or mechanical control of weeds or brush and seeding of desired species. The site conservation threshold concept proposed by SRM represents the mid-point between the early warning line and the threshold of rangeland health.



Arrows represent transitions between different ecological states or conditions, which are represented as circles (A-E). Solid arrows represent changes that are difficult to achieve. A shift from 'A' to 'B' indicates that some deterioration has occurred; recovery is possible through good management. A continuing shift to 'C' represents a loss of rangeland health; recovery to healthy 'D' or at-risk 'B' condition is difficult but possible if rangeland improvement practices such as brush or weed control and range seeding are applied. 'E' represents rangeland that has continued to deteriorate; soil erosion and other ecosystem changes associated with 'E' make recovery to a more healthy condition difficult.

Source: National Research Council Committee on Rangeland Classification, 1994. The site conservation threshold is from the Society for Range Management, 1995.

Developing indicators to help rangeland managers identify states in the zone between the early warning line and the site conservation threshold may be the most important rangeland research work to be done. These are the states that retain considerable capacity to respond to management of

ecological processes--control of grazing or prescribed burning. The zone between the site conservation threshold and the threshold of rangeland health would seem to represent situations where ecosystem functions are changing in ways or rates that threaten sustained capacity to produce commodities and satisfy values.

The rangeland health and site conservation threshold concepts represent ways to evaluate the ecological condition of rangeland. Both require that indicators representing "good" and "bad" characteristics of ecosystem condition and trend be established and that the current status of the ecosystem be judged against these indicators. Both concepts emphasize that multiple indicators are needed to evaluate the health or sustainability of the land.

Finding the answers

Are our rangelands healthy? Is our management accomplishing what we want? To answer these questions about ecological quality of the Nation's rangelands, a set of indicators that address key questions must be developed and used in a statistical inventory. Indicators of range health must be scientifically sound, yet understandable by the public and relevant to the public's interests in rangelands. The Natural Resources Conservation Service (NRCS) Grazing Land Technology Institute, working with scientists in other organizations, is developing such indicators. The NRCS National Resources Inventory (NRI) is the most likely vehicle for obtaining this information. Planning for the rangeland health components of the 1997 NRI is underway.

Literature Cited

National Research Council. 1994. Rangeland Health: New Ways to Classify, Inventory and Monitor Rangelands. National Academy Press. Washington, DC.

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