Historical perspectives on rangeland soil science and conservation practices

Leonard Jolley, PhD
Rangeland Ecologist Retired USDA NRCS

SCIENCE OF RANGELAND SOIL HEALTH AND MANAGEMENT IMPLICATIONS

- Historical context of soil health and implications for the future
- Thread I will follow:

  Range health – soil quality – soil health
- NRCS embrace of each of these in advance of supporting science
- My perspective is colored by my participation in the science-centric Conservation Effects Assessment Project (CEAP)
- Must move beyond the seeming 'fad' and customize for California

My opinion only:

UC Davis grad 1975 BS, 1976 MS Rangeland Management
Colorado State University PhD 2006 Riparian Ecology

Nearly 40 years with USDA
Lakeport CA, Santa Maria CA, Bishop CA, South Lake Tahoe CA/NV, Davis CA, Fort Collins CO, Lakewood CO, Portland OR, Washington DC (Beltsville MD), Petaluma CA

Soil Scientist, Rangeland Management Specialist, District Conservationist

Visiting Scientist UC Davis
Lecturer Humboldt State Univ.
Research Associate Professor, University of Nevada Reno (Part Time)
Consultant

Retiree (Currently)

Closed my USDA career by shepherding two separate literature syntheses publications to completion – one for Rangeland the other for Pastureland Hayland

Range Health

Simply stated, rangeland health is the status of the soil, water and biological resources in rangeland ecosystems. Integrity was defined as the maintenance of functional attributes characteristic of a locale, including normal variability (USDA, NRCS 1997).

Previously…
Rangeland condition classification used plant composition groups (decreasers, increasers and invaders) to generate condition estimates (excellent, good, fair, or poor). Declines in rangeland condition over time often stimulated management changes. Thus, condition classes became the standard for rangeland status in the latter half of the 20th century. The preferred plants were perennials, and response to grazing was viewed and linear. California did not fare well.

In the late 1900.s, groups who reviewed techniques for evaluating rangeland status recommended development of both
benchmarks and early warning indicators

The National Research Council (1994) and the SRM Task Group (1995) recommended that assessments be conducted to compare locales with similar soils and climate that have the capacity to support similar plant communities and production. These locales are defined as ecological sites

Although NRC (1994) and SRM Task Group (1994) incorporated concepts of thresholds and early warning indicators as elements of successful assessment and monitoring program, both admitted that definitions of each were poorly understood.

Range Health

Range condition data (e.g., SRM 1989) indicated that trend in range condition was up or static on about 85% of U.S. rangelands, public and private.

Critics pointed out that the same data showed that most public rangelands are in "poor" or "fair" condition and conclude that this situation indicates a failure of current management and a need for drastic action as proposed, for example, in Rangeland Reform '94 (USDI/USDA 1994)

USDA NRCS established Grazing Lands Institute and with some reluctance (due to inertia) began to adopt Range Health in mid 1990's.

Interpreting Indicators of Rangeland Health.

One tool developed in response to these recommendations is Interpreting Indicators of Rangeland Health.

In this technique, 17 observable indicators are used to rapidly assess three ecosystem attributes: soil and site stability, hydrologic function, and biotic integrity.

During its initial development, the standard or reference status relied on information from ecological site descriptions (USDA NRCS 1997) and their associated soil survey descriptions (USDA NRCS 2001) as the primary source for the expected presence and amounts of each indicator.

However, some locations did not have soil surveys or ecological site descriptions available. Reference sheets were developed with expert knowledge.

A very capable and durable multi agency team has functioned for more than 10 years improving and training this assessment concept.

Range Health

National Research Council. 1994. Rangeland health: new methods to classify, inventory, and monitor rangelands. National Academy Press, Washington, DC. National Research Council. 180p.

Task Group on Unity in Concepts and Terminology. 1995. New concepts for assessment of rangeland condition. Journal of Range Management 48:271–282.

West, N.E., K. McDaniel, E.L. Smith, P.T. Tueller and, and S. Leonard. 1994. Monitoring and interpreting ecological integrity on arid and semi-arid lands of the western United States. Report 37. New Mexico State University, New Mexico Range Improvement Task Force.

Westoby, M., B. Walker, and I. Noy-Meir. 1989. Opportunistic management for rangelands not at equilibrium. J. Range Manage. 42:266-274.

George, M. R., J. R. Brown, and W. J. Clawson. 1992. Application of nonequilibrium ecology to management of Mediterranean grasslands. Journal of Range Management 45: 436-438

But see also…. Smith, E. L. 1999. The myth of range/watershed health. Pp. 6-11, In Riparian and watershed management in the interior northwest: an interdisciplinary perspective. Oregon State University Extension Service Special Report 1001, Corvallis, Oregon.

Soil Quality: A Concept, Definition, and Framework for Evaluation
(A Guest Editorial)
D. L. Karlen,* M. J. Mausbach, J. W. Doran, R. G. Cline, R. F. Harris, and G. E. Schuman
SOIL SCI. SOC. AM. J., VOL. 61, JANUARY-FEBRUARY 1997

This essay summarizes deliberation by the Soil Science Society of America (SSSA) Ad Hoc Committee on Soil Quality and was written to spur discussion among SSSA members. Varying perceptions of soil quality have emerged since the concept was suggested in the early 1990s

In simplest terms, soil quality is "the capacity (of soil) to function". This definition, based on function, reflects the living and dynamic nature of soil.

The concept attempts to balance multiple soil uses (e.g., for agricultural production, remediation of wastes, urban development, forest, range, or recreation) with goals for environmental quality

Simply measuring and reporting the response of an individual soil parameter to a given perturbation or management practice is no longer sufficient. The soil resource must be recognized as a dynamic living system that emerges through a unique balance and interaction of its biological, chemical, and physical components. We encourage SSSA members to consider the concept of soil quality (perhaps as a marketing tool)

Inquiries from policymakers, natural resource conservationists, scientists, and administrators regarding the concept of soil quality increased rapidly after the National Academy of Sciences published the book entitled *Soil and Water Quality: An Agenda for Agriculture* (National Research Council, 1993).

Surveys supported using soil health and soil quality interchangeably. They found that farmers favored soil health and characterized it based on descriptive and qualitative properties by using direct value judgements (unhealthy to healthy), while scientists favored soil quality because of their focus on the analytical and quantitative properties of soil and the quantitative linkages between those properties and various soil functions.

During the review process, however, the committee encountered strong opinions that *soil health* and *soil quality* should not be used interchangeably.

Soil quality perceptions

Soil survey interpretations used to define and protect "prime farmland" fail to address most biological components of soils.

General concern about soil resources is not new. Lowdermilk (1953), stated that, "if soil is destroyed, then our liberty of choice and action is gone, condemning this and future generations to needless privations and dangers".

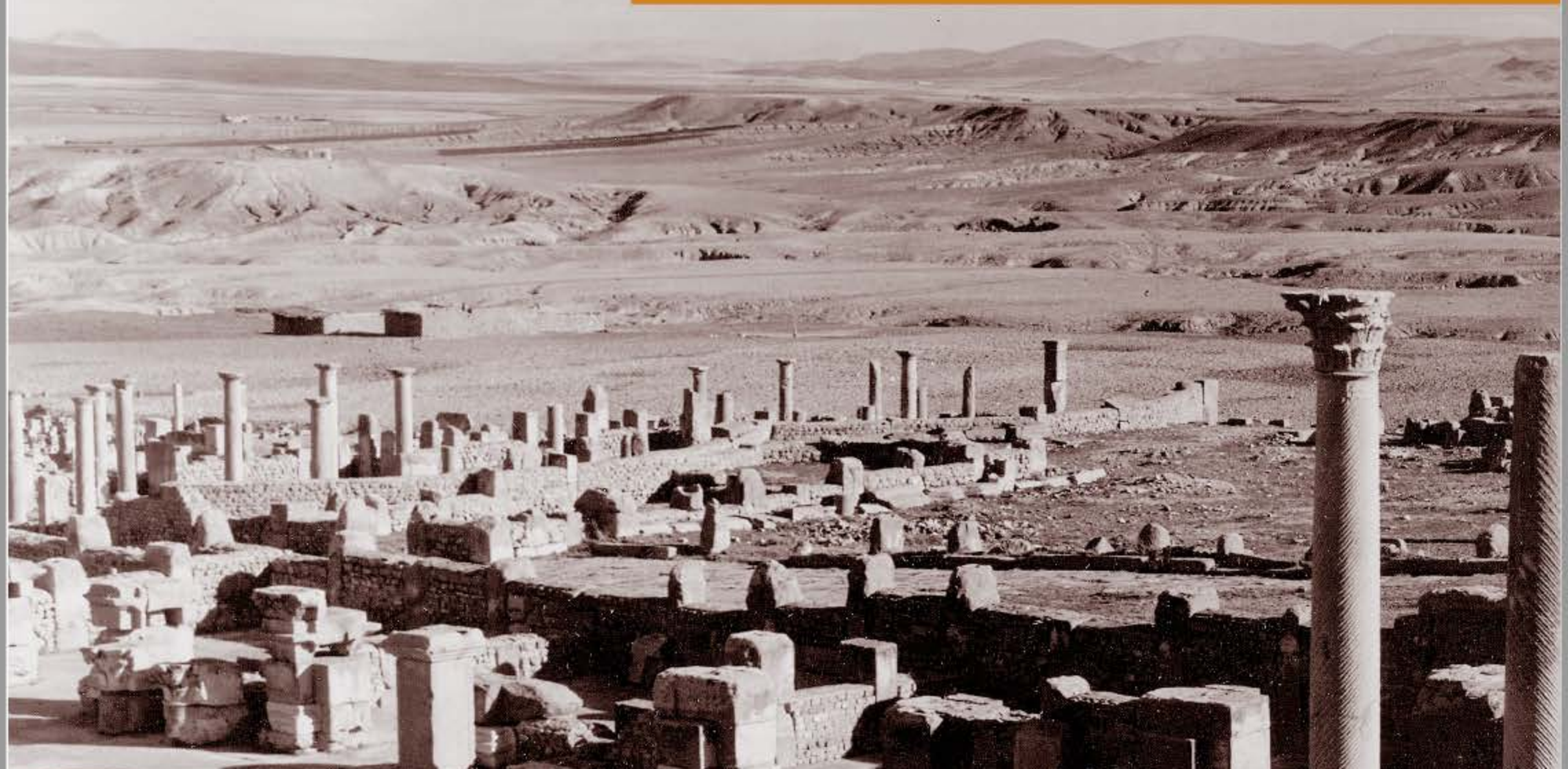
A new approach for resource evaluation was also advocated by Aldo Leopold, in his book *A Sand County Almanac*, and subsequent writings.

USDA NRCS

United States Department of Agriculture
Natural Resources Conservation Service

Conquest of the Land through 7,000 Years

AIB No. 99



NRCS Road to Soil Quality

Soil quality was identified as an emphasis area of the USDA Natural Resources Conservation Service (NRCS) in 1993 with the establishment of the Soil Quality Institute (SQI)

Institute scientists were attached to specific universities. Accelerate incorporation of science.

The mission of the Soil Quality Institute (SQI) of the was to develop and disseminate tools for soil quality assessment

The first, "the Soil Quality Card Design Guide", provides a nine-step process for conducting workshops to guide farmers in the development of locally adapted soil quality assessment cards

The second, the Soil Quality Test Kit Guide, provides instructions and interpretations for 11 field tests representing physical, chemical, and biological properties of soil.

The Soil Quality Institute (and other Technical Institutes of USDA NRCS) were abolished and staff reassigned around 2004

USDA

United States Department of Agriculture

Natural Resources Conservation Service

Soil Quality Thunderbook

Regulate Water Flow

Sustain Plant and Animal Life

Functions of Healthy Soil

Cycle Nutrients

Filter Potential Pollutants

Conservation Effects Assessment Project CEAP

The Conservation Effects Assessment Project (CEAP) was initiated in 2003 by the Natural Resources Conservation Service (NRCS) in partnership with the Agricultural Research Service and the National Institute of Food and Agriculture in response to requests from Congress and the Office of Management and Budget for greater accountability of US taxpayers' investments in conservation programs

Initiated by a substantial increase in conservation funding in the 2002 Farm Bill and recognition of the need to bring environmental management, including the numerous services provided by ecosystems, on par with traditional emphasis on sustainable agricultural production

The Rangeland CEAP Synthesis was formally initiated in 2006 and involved 40 rangeland scientists over 3 1/2 years

CEAP Grazingland Science Teams

- National Aeronautics and Space Administration
- USDI- Bureau of Land Management
- USDI- Geological Survey
- USDA-Agricultural Research Service
- USDA National Institute for Food and Agriculture
- USDA-Forest Service
- USDA-National Agricultural Library

- Auburn University
- Colorado State University
- Florida State University
- Iowa State University
- The Ohio State University
- Oklahoma State University
- Oregon State University
- Penn State University
- Texas A&M University
- Texas Tech University
- University of Arizona
- University of California
- University of Florida
- University of Kentucky
- University of Missouri
- University of Wisconsin-Madison
- University of California-Davis

Rangeland literature synthesis

Following are the seven major conservation practices and two crosscutting issues addressed within the Rangeland CEAP Synthesis:

- Prescribed Grazing
- Prescribed Burning
- Brush Management
- Range Planting
- Riparian Herbaceous Cover
- Upland Wildlife Habitat Management
- Herbaceous Weed Control
- Landscape Analysis (crosscutting chapter)
- Socioeconomics and Ecosystem Services (crosscutting chapter)

Chapters underwent rigorous peer review by three recognized experts who had not been affiliated with CEAP

This comprehensive synthesis of peer-reviewed research broadly supports the overall NRCS approach to conservation planning and validates the ecological foundations of many of the purposes addressed in the conservation practice standards. *But…*

The equivocal nature of a portion of the Rangeland CEAP findings reflects the minimal investment made by the USDA and the rangeland profession in formally assessing conservation practice effectiveness.

In essence, monitoring lacking – for a USDA expenditure of hundreds of millions of dollars.

A couple of key Rangeland Synthesis findings

- Stocking rate, in conjunction with appropriate temporal and spatial animal distribution, is a key management variable that influences numerous conservation outcomes.

The preponderance of experimental evidence indicates that all systems of grazing are similarly constrained by stocking rate and weather; thus, effective management is more important than the specific system of grazing.

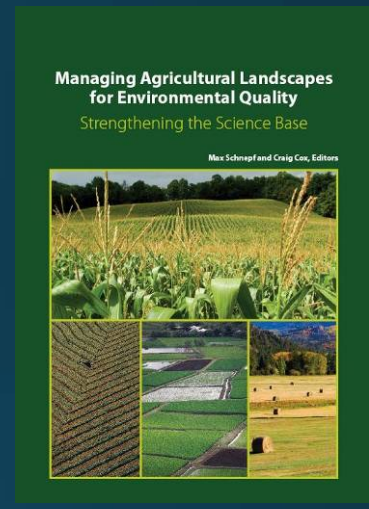
Briske, D.D. [ed]. 2011. Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps. United States Department of Agriculture, Natural Resources Conservation Service. 429 p.

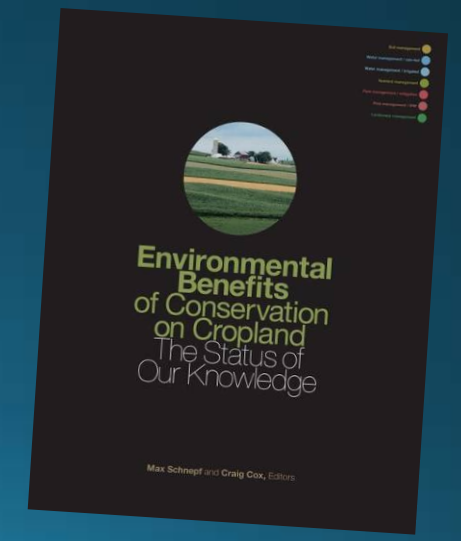
Bibliographies and Literature Syntheses

For the pasture/hayland effort, teams of prominent scientists with expertise related to four selected conservation standards were formed in 2008 to search thoroughly, compile, interpret, and synthesize the scientific literature regarding its support of production and environmental outcomes

Chapters on practice standards include:
- Planting for Hay, Silage, and Biomass
- Prescribed Grazing
- Forage Harvest Management
- Nutrient Management

Each writing team answered the basic questions of 1) does the literature document that the practice accomplishes its goals; 2) if so, how effectively does it work; 3) if not, why not; and 4) how can the practice be improved? Areas needing some or additional research were pointed out





Conservation outcomes from Pastureland and Hayland practices

Grazing intensity (i.e., stocking rate or plant height) is the most important grazing strategy on pasturelands; and conservation plans should prioritize proper grazing intensity.

Stocking method is useful for fine-tuning the system once appropriate grazing intensity is imposed. Rotational vs. continuous stocking positively affects forage accumulation and utilization as well as important measures of water quality.

Excerpt from Nelson, C.J. (ed.) 2012. Conservation Outcomes from Pasture and Hayland Practices: Assessment, Recommendations and Knowledge Gaps. Allen Press, Lawrence, KS.

Soil Health
Planning Principles/ from NRCS web site

The term "**Health**" was purposely chosen instead of "quality".

- Quality implies analysis and quantifying
- Health implies management actions that leads to a condition or state, there is something that can be done to change it in a positive trend

Soil Health
Planning Principles
Manage more by Disturbing Soil Less
Use Diversity of Plants to add diversity to Soil Micro-organisms
Grow Living Roots Throughout the year
Keep the Soil Covered as Much as Possible

My Thoughts

The Soil Health concept stands on the shoulders of Soil Quality efforts, Range Health struggles, and ultimately on Aldo Leopold's 'landscape health' writings.

Soil Health seems to me to be better marketed than was soil quality.

Soil Health research seems to be at an early stage – well behind the marketing

Soil Health is more than just Carbon and SOM

Soil Health training in California does not yet seem to address the challenges of our unique combinations of soil forming factors.

USDA expenditures on Soil Health conservation practices should be coupled to robust monitoring (CEAP) –