

## **Land Health: A Language to Describe the Common Ground Beneath Our Feet**

*by Courtney White*

Since my early teens, I have been fascinated with the skin of the earth. It began when my parents rented a dilapidated stable in what was then a remote spot in the desert east of Scottsdale, Arizona. They populated the little stable with an assortment of horses, mostly for trail riding. My favorite was Valentine, my mother's huge quarterhorse, on whose back I began to explore the desert that surrounded the stable like a sandy sea. As I rode, I watched the ground closely--rattlesnakes were Valentine's one and only mortal fear--and as a result my eyes began to see, for the first time, the rocks, the plants, the hills, and the shape of the desert's horizon. Eventually, I developed an appreciation of the land's sandy washes, flat expanses, palo verde forests, and magnificent subtle hues, whose features and colors remain with me to this day.

At fourteen, my interest in the skin of the earth expanded to include dirt. Indulging my budding interest in prehistory, my parents allowed me to join the local amateur archaeological society, which meant that my father spent weekends driving me to a dig in another remote spot in the desert. There, I dug. Under professional supervision, my fellow enthusiasts and I systematically peeled back the layers of a fourteenth-century Hohokam village, ten centimeters at a time. In so doing, I became intimate with dirt.

I kept digging. Over the years I participated in various excavations, including a project in downtown Phoenix directed by archaeologists from Arizona State University. I dug in prehistoric rooms; profiled backhoe-cut trenches; excavated ancient hearths, canals, burials, trash pits; and even helped to uncover a ball court.

My interest in the skin of the earth deepened again when I took the leap from excavation to archaeological surveying--the systematic sweep of land to look for undiscovered sites. For two memorable summers in my late teens, I served on crews whose job was to hike back and forth across the land in straight lines, no matter what the topography, often under a broiling July sun, while scrutinizing the ground for signs of prehistoric activity. I was paid (an extravagant \$3.33 an hour), in other words, to be a liminalist--to analyze the fine line between nature and culture. Was a particular alignment of rocks natural or did it indicate the wall of a building? Sometimes it was hard to say, but in the process of asking this type of question hour after hour, day after day, mile after mile, I became sensitive both to the subtleties of the earth's skin and the human imprint on it.

This sensitivity largely explains why I eschewed the usual preoccupations with wildlife and wilderness when I became active in environmental causes during college. I liked birds and animals well enough and had backpacked in countless wilderness areas, but my experience on horseback and on survey taught me that nature started below my feet, with the way water flowed across the land, with the presence of grass and other plants, and with the important way everything combined.

Years later, my experience was confirmed when I met Jim Winder, a rancher near Deming, New Mexico, and Kirk Gadzia, a range expert and educator who lives near Albuquerque. Both employed a language to describe the land that resonated with my youthful exposure to nature. They talked about "land health," employing terms like water cycle, mineral cycle, and the original solar energy--photosynthesis. Jim liked to talk

about termites and how they assisted the cycling of nutrients in the soil, a cycling that is critical to healthy plants and, ultimately, the health of the land. Curious, I kept listening.

Then during a workshop led by Kirk in 1998, my interest in the skin of the earth and my curiosity about this new language fused. Kirk took us to the Black Ranch, in the high desert west of Albuquerque (now gone to subdivision), where he pointed to two adjacent patches of ground--one grazed recently by cattle and one ungrazed--and asked, not so rhetorically, which was healthier from an ecological perspective? As an environmentalist I should have known the answer, right? I hadn't a clue. But in my cluelessness I suddenly saw an opportunity. We could start over--from the ground up.

This chapter lays a foundation for dialogue among ranchers, foresters, conservationists, land managers, students, and members of the public at large about stewardship of the nation's open lands, both private and public, based on the concept and vocabulary of land health. Much of the debate over the role of livestock and wood products on these lands, especially the nation's public lands, has been largely a struggle between competing *value systems*, rather than an emphasis on the capacity of healthy lands to produce resources that we use every day in our lives.

Mixed in with this cultural debate is an emerging question among resource professionals, especially federal land managers: What ecological condition were the nation's lands actually in? The answer, most professionals seemed to feel, was poor to middling condition, though no one really knew for sure--and this uncertainty fed the increasingly acrimonious argument between ranchers and foresters and conservationists and environmentalists at the time. A primary reason for the uncertainty was the lack of

commonly held standards for assessing land-health conditions based on ecological *function* rather than what land uses are appropriate for productive lands.

This situation changed in the mid-1990s with the emergence of the concept of rangeland and forest health--which included definitions, attributes, and indicators of land function developed by the consensus of a broad spectrum of forest and range scientists. Their idea of health was a simple but powerful one: In order for land to produce commodities and satisfy values over time sustainably, it must be functioning properly at a basic ecological level--at the level of soil, plants, and water. And if it is not functioning properly, how we value and use the land will ultimately be in jeopardy.

### **Aldo Leopold and Land Health**

The term *land health* was coined in the 1930s by the great conservationist Aldo Leopold. [1] He was referring to the ecological processes that perpetuate life--the processes of regeneration and self-renewal that ensure fertility among communities of plants and animals, including the proper cycling of water and nutrients in the soil. Metaphorically, he sometimes likened land health to a self-perpetuating engine or organism whose parts--soil, water, plants, animals, and other elements of the ecosystem--when unimpaired and functioning smoothly would endlessly renew themselves. He frequently employed words such as *stability*, *integrity*, and *order* to describe this "land mechanism," drawing an image of nature that when healthy operated smoothly and ran in top shape.

By contrast, land became "sick" when its basic parts fell into disorder or broke down. This wasn't just a scientific theory. Leopold began to recognize signs of land

illness almost from the start of his career as a U.S. Forest Service ranger in 1909. They included abnormal rates of soil erosion, loss of plant fertility, excessive floods and droughts, the spread of plant and animal pests, the replacement of useful by useless vegetation, and the endangerment of key animal species. These examples of disorder in the land mechanism, whether caused by natural catastrophe or by human interference, often led to adverse consequences for wildlife and human populations alike. That's because when nature's ability to regenerate itself over time is damaged--what Leopold called the "derangement" of nature's health--its ability to provide plants for wildlife or food for humans breaks down, as well.

To make his point, Leopold employed another metaphor. Land is like a bank account: "If you draw more than the interest, the principal dwindles." [2] Continue to draw on the interest without building the principal, and bankruptcy is inevitable.

During his lifetime, Leopold observed what happened to human communities when nature's principal dwindled to the point of ruin, the most dramatic, and tragic, example of which was the Dust Bowl. The plowing up of the shortgrass prairie topsoil by tractor for wheat production in the 1920s, followed by a severe drought in the early 1930s, created a disordering of natural and human communities on a vast scale, one that historian Donald Worster called "the most severe environmental catastrophe in the entire history of the white man on this continent." [3]

Over the course of his life, Leopold saw many other examples of the ecological and economic costs of nature's derangement. During his work for the Forest Service in the Southwest during the 1920s, for instance, he drew the connection between overgrazing by livestock in the region's arid landscapes and the widespread evidence of

soil erosion, particularly in riparian areas. The loss of plant cover due to overgrazing, he observed, exposed the soil to the erosive power of wind and rain, which quickly resulted in the “disordering” of fragile communities of plants and animals. The human cost of this disordering, he noted, ranged from lost forage productivity--thus reducing the economic viability of ranchers--to the displacement of human communities.

Leopold’s responses to these in-the-field insights about land health and sickness motivated much of his work for the remainder of his life. Expressions included: his belief that the mission of conservation is to achieve “harmony between men and land” by keeping the land mechanism in working order; his economic assertion that “healthy land is the only permanently profitable land”; his belief that wildlife populations could be restored with the same tools that had damaged them--ax, cow, plow, fire, and gun--by employing these tools with land health objectives; his demonstration that landscapes could be “read” and understood by their signs; and, ultimately, the formulation of his “land ethic” thesis, in which he argued for a cultural disposition which included people in the “land community” and that protected, restored, and maintained the land’s health.

To Leopold, these were all parts of one challenge.

“The true problem of agriculture, and all other land-use, is to achieve both utility and beauty, and thus permanence,” Leopold wrote in an essay titled “The Land Health Concept and Conservation. “A farmer has the same obligation to help, within reason, to preserve the biotic integrity of his community as he has, within reason, to preserve the culture which rests on it. As a member of the community, he is the ultimate beneficiary of both.”

## **Land Health in Today's Conservation**

It is testament to the originality and depth of Leopold's thinking that the land health idea has undergone only two serious elaborations in the ensuing decades. The first revision took place as a result of the rapid expansion of ecology as a scientific discipline after World War II. Leopold's orderly view of the natural world--the engine and body metaphors with their regular arrangement of parts working harmoniously--was replaced with a dynamic, even chaotic, vision, of nature as ceaselessly changing, subject to bouts of disruption and stress. This revised idea of ecological health still focused on self-renewal and self-organization, but now scientists see nature as fluid, not static; complex, not reductionistic.

For example, Dr. Bryan Norton, a distinguished philosophy of science professor at Georgia Tech University, has identified five axioms of the natural world:

- Nature is more profoundly a set of process than a collection of objects; all is in flux.
- All processes are related to all other processes.
- Processes are not related equally but unfold in systems within systems.
- The processes of nature are self-organizing, and all other forms of creativity depend on them; and that vehicle of creativity is energy flowing through systems that generates complexity of organization through repetition and duplication.
- Ecological systems vary in the extent to which they can absorb and equilibrate human-caused disruptions in their creative processes. [5]

In other words, the mid-century view of the “balance of nature” (which Leopold never embraced) was replaced by a view of the “flux of nature,” requiring a new set of terms and concepts, including *resilience*, *historic range of variability*, *sustainability*, *diversity*, and *stress*. Moreover, this new vision cast human impact on ecological processes in a new light. Rather than simply upsetting the balance of nature, our activities could now be evaluated according to their roles in the processes of stress, adaptation, and recovery. Those activities that encouraged resilience, for example, could be considered to be promoting land health, while those activities that reduced an ecosystem’s ability to recover from a disturbance could be considered deleterious.

This paradigmatic shift among ecologists, however, did not reduce health as a useful metaphor, or as an important goal. “Health is a noun and may therefore suggest a static condition in both organisms and ecosystems,” wrote environmental philosopher J. Baird Callicott. “But health, despite the grammar of its name, actually is very much a process, a process of self-maintenance and self-generation. Today, ecologists emphasize that ecosystems change over time, but, like healthy organisms, healthy ecosystems maintain a certain continuity and order in the midst of change.” [6]

The second elaboration to Leopold’s thinking was a filling in of the specific details that constitute land health. One particular effort began in 1994 with the publication by the National Research Council of *Rangeland Health: New Methods to Classify, Inventory, and Monitor Rangelands* (a similar movement is under way regarding forest health; see R. Emonds et al., *Forest Health and Protection* [Long Grove, IL: Waveland Press, 2005]). This effort was a response to persistent disagreement among range scientists, environmentalists, ranchers, and public agency personnel about the



health of the nation's 770 million acres of rangelands. Not only was there a substantial lack of data on the condition of the land itself, but there was also an important lack of agreement among range experts on how and what to monitor. These voids contributed significantly to the acrimonious debate raging at the time about livestock grazing on the nation's public lands. Were rangelands improving or degrading? Everyone had an opinion, which was precisely the problem.

In an attempt to resolve this situation, the authors of *Rangeland Health* provided a definition of health: "Health is the degree to which the integrity of the soil and the ecological processes of...ecosystems are sustained. [7] Echoing Leopold, they used the word "health" to indicate a condition in which ecological processes are functioning properly to maintain the structure, organization, and activity of the system over time. By "integrity" they meant vigorous energy flows, plant community dynamics, intact soil profiles, and the proper cycling of nutrients and water.

Significantly, they concluded that a "healthy rangeland has the sustained capacity to satisfy values and produce commodities." This was important because it meant that the natural processes that sustain wildlife habitat, biological diversity, and functioning watersheds are the same processes that make land productive for uses such as recreation and grazing by livestock. In other words, when the land is healthy, the ecosystem services we receive from open lands can be sustained.

In keeping with the flux-of-nature theory of ecology, the authors linked health to resilience, which they defined as the capacity of land to recover from perturbations, including floods, droughts, and overgrazing. "The integrity of the soil and ecological processes," they wrote, "determines the vegetation, habitat, aesthetics, and other

commodities and values that rangelands can provide and determines how well rangelands are able to resist the destructive effects of mismanagement or natural disturbances.”

They also tackled the idea of land “sickness.” Physical degradation, they observed, results in the deterioration of the physical properties of soils through compaction, wind or water erosion, deposition of sediments, and loss of soil structure. Biological degradation occurs when there is a reduction in the organic matter content of the soil, a decline in the amount of carbon stored as biomass, or a decrease in the activity and diversity of the organisms living in the soil. “Soil degradation,” they concluded, “primarily through accelerated wind and water erosion, causes the direct and often irreversible loss of rangeland health.”

Their summary: A healthy ecosystem is where erosion is not accelerating, where most precipitation infiltrates the soil and is used on site for plant growth or flows eventually to underground storage, where the plant community effectively takes advantage of the mineral nutrients and energy that occur on the site, where plant composition is dynamic, and where ecological functions can recover from natural or human-caused stress.

### **Land Health as Common Ground**

Following the publication of *Rangeland Health*, a collaborative effort was launched by an interagency team of scientists to develop both qualitative and quantitative criteria for assessing and measuring the health of the land. A significant step was accomplished in 2000 with the publication of *Interpreting Indicators of Rangeland*

*Health*, which identified seventeen indicators of land health, grouped into three categories:

- ***Soil stability***. The capacity of a site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water. It is a measurement of soil movement.
- ***Watershed function***. The capacity of the site to capture, store, and safely release water from rainfall and snowmelt; to resist reduction in this capacity; and to recover this capacity following degradation. It is a measurement of plant-soil-water relationships.
- ***Biotic integrity***. The capacity of a site to support characteristic functional and structural communities in the context of normal variability; to resist the loss of this function and structure due to a disturbance; and to recover from such disturbance. It is a measurement of vegetative health. [8]

There is an important caveat to these definitions and terms, however: Land health does not necessarily indicate the full realization of a land ethic. A brown trout or an exotic weed might be perfectly *functional* in a particular landscape--filling an ecological niche in a stream or holding the soil together--but it may be unacceptable to a landowner, agency, or community from the perspective of sustaining cultural or biological diversity.

These indicators, terms, and definitions (table 10.1) form a common language to describe the common ground beneath our feet. This language not only creates a solid foundation for dialogue about the future of the nation's open lands, it also provides a means to tackle "land illiteracy"--a quiet epidemic with profound consequences--among citizens of all stripes. Like any illiteracy, our modern-day inability to "read the land"

consigns us to ignorance. Or as Wendell Berry has written, “Until we understand what the land is, we are at odds with everything we touch.” [9]

**Table 10.1**

A Land Health Glossary (culled from Society for Range Management publications and the *Interpreting Indicators of Rangeland Health* manual)

<p><b>Annual Production.</b> The conversion of solar energy to chemical energy through the process of photosynthesis. It is represented by the total amount of organic material produced within a certain period of time.</p>
<p><b>Bare ground.</b> Exposed soil that is susceptible to raindrop splash erosion--the initial form of most water-related erosion. It is the opposite of ground (vegetative) cover. It is vulnerable to capping (soil crusting).</p>
<p><b>Biomass.</b> The total amount of living plants above and below ground in an area at a given time.</p>
<p><b>Cool-season plant.</b> A plant which grows generally during the early spring, late fall, and winter.</p>
<p><b>Ecological processes.</b> Includes: the water cycle (the capture, storage, and redistribution of precipitation), energy flow (conversion of sunlight to plant and animal matter), and nutrient cycle (such as nitrogen and phosphorus cycling through the biotic components of the environment). Ecological processes functioning within a normal range of variation will support specific plant and animal communities.</p>
<p><b>Headcut.</b> Abrupt elevation drop in the channel of a gully that accelerates erosion.</p>
<p><b>Infiltration rate.</b> How fast water enters the soil. When restricted (by soil crusts,</p>

compaction), water does not readily enter the soil; it moves downslope as runoff and eventually evaporates. As a result, less water is stored for plant growth, resulting in less organic matter in the soil, which weakens soil structure and can further decrease the rate of infiltration.

**Functional Integrity.** The capacity of a site to support characteristic functional and structural communities (soil and vegetation) in the context of normal variability and to resist the loss of that function by disturbance.

**Landscape function.** How well a landscape captures, stores, and uses scarce resources, including water, minerals, and organic materials. Dysfunctional landscapes lose those resources to runoff and wind erosion.

**Litter.** Any dead plant material that is in contact with the soil surface. It provides a major source of the organic material for on-site nutrient cycling. Also, the degree and amount of litter movement is an indicator of the degree of wind and water erosion.

**Oxidation.** A chemical process of decomposition whereby nutrients are released into the atmosphere instead of into the soil.

**Pedestals and terracettes.** Pedestals are rocks or plants that are elevated as a result of soil loss by wind or water erosion. Terracettes are benches of soil deposition behind obstacles caused by water movement (not wind).

**Rills and gullies.** Rills are small erosional rivulets that do not necessarily follow microtopography as normal water flow patterns do. Gullies are channels that have been cut into the soil by moving water. Both are generally caused by accelerated water flow and result in the down-cutting (rapid erosion of soil) of soil.

**Soil.** Consists of mineral particles of different sizes (gravel, sand, silt, and clay), organic

matter, and numerous species of living organisms. Soil has biological, chemical, and physical properties, some of which change in response to how the soil is managed.

**Soil quality.** The capacity of a specific kind of soil to function within natural or managed ecosystem boundaries, sustain wild and domestic plant and animal productivity, maintain or enhance the quality of water and air, and support human health and habitation.

Changes in soil quality affect the amount of water from rainfall and snowmelt that is available for plant growth, runoff, water infiltration, and the potential for erosion; the availability of nutrients for plant growth; the conditions needed for germination, seedling establishment, vegetative reproduction, and root growth.

**Soil stability.** The ability of soil structures (groups of soil particles) to resist degradation.

When organic matter (roots, litter) breaks down over time it creates a “glue” that holds soil structures together, which is critical for biological activity, root growth, and water percolation. Conversely, when soil structures become unstable due to disturbances such as raindrops, flowing water, trampling, earth moving, and other activities, structures can break apart, exposing organic material to decomposition and loss.

**Threshold.** A transition boundary that an ecosystem crosses resulting in a new stable state that is not easily reversed without significant inputs of resources.

**Transition.** A shift in plant composition that results in relatively stable states. These shifts can occur by natural forces or as a result of human activity.

**Warm-season plant.** A plant that does most of its growth during the late spring, summer and early fall and is usually dormant in winter.

**Well-managed land.** Land that has properly functioning ecological processes, biotic integrity, and soil stability associated with human uses.

## **Conclusion**

Sixty years ago, Aldo Leopold defined land health as “the capacity of the land for self-renewal” and described conservation as “our effort to understand and preserve this capacity.” [10] As we move deeper into the twenty-first century, his words take on a renewed sense of urgency. If the Dust Bowl was the major alarm bell of Leopold’s generation, a worldwide decline in ecosystem services is sounding the alarm for our generation. Both crises share a common concern--the deleterious impact on human well-being caused by environmental degradation. They also have a common root cause: an industrial economy that convinced us that we could ‘have our cake and eat it too’—that that there would be no long-term limits or consequences to relentless economic growth. Leopold gently cautioned us on this point--but seventy years after the Dust Bowl we seem to have not taken his words to heart.

On the other hand, things might still turn out differently. Fortunately, thanks to the diligent work of many researchers and practitioners, we not only have a clearer picture of what constitutes land health, we also have good, practical, and profitable models of what constitutes sustainable land use. The big job now is to put that knowledge to wider use, and quickly.

## **Notes**

1. See A. Leopold, *A Sand County Almanac and Sketches Here and There* (New York: Oxford University Press, 1948); C. Meine, *Aldo Leopold: His Life and Work* (Madison:

- University of Wisconsin Press, 1988); and J. Lutz Newton, *Aldo Leopold's Odyssey* (Washington, DC: Island Press, 2006).
2. A. Leopold, *For the Health of the Land: Previously Unpublished Essays and Other Writings*, ed. J. Callicott and E. Freyfogle (Washington, DC: Island Press, 1999); and Newton, *Aldo Leopold's Odyssey*.
  3. D. Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979), p.24.
  4. A. Leopold, *For the Health of the Land: Previously Unpublished Essays and Other Writings*, ed. J. Callicott and E. Freyfogle (Washington, DC: Island Press, 1999); and Newton, *Aldo Leopold's Odyssey*.
  5. Bryan G. Norton, "A New Paradigm of Environmental Management" in D. Rapport et al., eds., *Ecosystem Health: Principles and Practice* (Oxford, UK: Blackwell Science, 1998), p. 25
  6. J. Baird Callicott, "Aldo Leopold's Metaphor", in D. Rapport et al., eds., *Ecosystem Health: Principles and Practice* (Oxford, UK: Blackwell Science, 1998), p. 52
  7. National Research Council, *Rangeland Health: New Methods to Classify, Inventory, and Monitor Rangelands* (Washington, DC: National Academy Press, 1994).p. 4
  8. M. Pellant et al., *Interpreting Indicators of Rangeland Health, Version 3*, Technical Reference No.1734–6 (Denver, CO: U.S. Department of the Interior, Bureau of Land Management, 2000).
  9. W. Berry, *The Art of the Commonplace: The Agrarian Essays of Wendell Berry* (Emeryville, CA: Shoemaker & Hoard, 2002), edited by Norman Wirzba, p 27.
  10. Leopold, *Sand County Almanac*. Oxford University Press.