

Range Health



Overview

Rangeland Health

Resource Concerns and Tools

Attributes

Soil/Site Stability

Hydrologic Function

Biotic Integrity

Indicators

Rangeland Health

“The degree to which the integrity of the ecological processes of rangeland ecosystems are maintained”

Rangeland Health (NRC 1994)

“The degree to which the integrity of the soil, vegetation, water and air as well as the ecological processes of the rangeland ecosystem are balanced and sustained”

Society of Range Management (1995)

Determining Rangeland Health

- NRCS Resource Concerns
 - SWAPAE+H
- Interpreting Indicators of Rangeland Health (IIRH) Assessment
 - 17 indicators
- 3 Attributes
 - Soil/Site stability
 - Hydrologic function
 - Biotic integrity

NRCS Resource Concerns

Soil

- Erosion, Subsidence, compaction, organic matter depletion, concentration of salts/chemicals, soil organism habitat loss/degradation, aggregate instability

Water

- Ponding, flooding, seeps, drifted snow, depletion, nutrient/pesticide transportation, pathogens, chemicals, salts, sediment, elevated temperature

Air

- Emissions of: particulate matter, precursors, greenhouse gases, ozone precursors and airborne reactive nitrogen. Objectionable odor.

Plants

- Productivity, health, structure, composition, pest pressure and wildfire hazard from biomass accumulation

Animals

- Wildlife, invertebrates, aquatic and other organism habitat. Feed and forage imbalance. Inadequate livestock shelter, water, and distribution.

Energy

- Efficiency of equipment, facilities, farming/ranching and field operations.

Human

- Potential social, economic, and cultural resource and historic property factors.

Attributes

3 attributes define rangeland health

- Soil/Site Stability
- Hydrologic Function
- Biotic Integrity

This is measured through observable components of the 17 indicators

Rangeland Health Assessment

Soil Site Stability: slight to moderate or less

OR Wind-Scoured and/or Depositional Areas Indicator #6: Slight to moderate or less

Attributes – Soil/Site Stability

Wind and Water Erosion – Wind Erosion

Detachment and transport of soil particles caused by wind

Aim to reduce wind erosion

Rangeland Health Assessment

Soil Site Stability: slight to moderate or less

OR Wind-Scoured and/or Depositional Areas Indicator #6: Slight to moderate or less

Attributes – Soil/Site Stability

The capacity of an area to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water and to recover this capacity when a reduction does occur

Soil/Site Stability

1. Rills
2. Water Flow Patterns
3. Pedestals and/or Terracettes
4. Bare Ground
5. Gullies
6. Wind-scoured and/or Depositional Areas
7. Litter Movement
8. Soil Surface Resistance to Erosion
9. Soil Surface Loss or Degradation
11. Compaction Layer

Attributes – Hydrologic Function

Weather Resilience – Naturally Available Moisture Use

Natural precipitation is not optimally managed and does not support desired land use goals or ecological processes

Aim to manage natural precipitation efficiently

Attributes – Hydrologic Function

The capacity of an area to capture, store and safely release water from rainfall, run-off, and snowmelt (where relevant), to resist a reduction in this capacity, and to recover this capacity when reduction does occur

Hydrologic Function

1. Rills
2. Water Flow Patterns
3. Pedestals and/or Terracettes
4. Bare Ground
5. Gullies
8. Soil Surface Resistance to Erosion
9. Soil Surface Loss or Degradation
10. Effects of Plant Community Composition & Distribution on Infiltration
11. Compaction Layer
14. Litter Cover and Depth

Attributes – Soil Site Stability & Biotic Integrity

Organic Matter Depletion

Management-induced depletion of soil organic matter resulting in limited soil function and processes

Aim to maintain, increase, and/or improve soil organic matter

Soil Organism Habitat Loss

Quantity, quality, diversity, or connectivity of food, cover, space, shelter, and/or water is inadequate to meet the needs of beneficial soil organisms

Aim to improve habitat for beneficial soil organisms

Rangeland Health Assessment (for both)
Soil Site Stability: slight to moderate or less
Biotic Integrity: Slight to moderate or less

Attributes – Biotic Integrity

Degraded Plant Condition
Plant Structure and
Composition

Plant communities have
insufficient composition and
structure to achieve ecological
functions and management
objectives

Aim to improve plant structure
and composition

Livestock Production Limitation
– Forage and Feed

Feed and forage quality or
quantity is inadequate for
nutritional needs and
production goals

Aim to balance the quantity
and quality of feed and forage
to meet livestock needs and
reduce negative impacts

Attributes – Biotic Integrity

The capacity of the biotic community to support ecological processes within the natural range of variability expected for the site, to resist a loss in capacity to support these processes, and to recover capacity when losses do occur.

The biotic community includes plants, animals, insects, and microorganisms.

Biotic Integrity

8. Soil Surface Resistance to Erosion

9. Soil Surface Loss or Degradation

11. Compaction Layer

12. Functional/Structural Groups

13. Dead or Dying Plants or Plant Parts

14. Litter Cover and Depth

15. Annual Production

16. Invasive Plants

17. Vigor with an emphasis on Reproductive Capability of Perennial Plants

Attributes of Rangeland Health



Soil/Site Stability

- the capacity of an area to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water and to recover this capacity when a reduction does occur.

Hydrologic Function

- the capacity of an area to capture, store, and safely release water from rainfall, run-on, and snowmelt (where relevant), to resist a reduction in this capacity, and to recover this capacity when a reduction does occur.

Biotic Integrity

- the capacity of the biotic community to support ecological processes within the natural range of variability expected for the site, to resist a loss in the capacity to support these processes, and to recover this capacity when losses do occur. The biotic community includes plants (vascular and nonvascular), animals, insects, and microorganisms occurring both above and below ground.

Interpreting Indicators of Rangeland Health (IIRH)

Protocol is used to understand the quality of the ecological processes through appropriate quantitative measures

17 indicators



17 Indicators

- Rills
- Water Flow Patterns
- Pedestals and/or Terracettes
- Bare Ground
- Gullies
- Wind-Scoured and/or Depositional Areas
- Litter Movement
- Soil Surface Resistance to Erosion
- Soil Surface Loss and Degradation
- Effects of Plant Community Composition and Distribution on Infiltration
- Compaction Layer
- Functional/Structural Groups
- Dead or Dying Plants or Plant Parts
- Litter Cover and Depth
- Annual Production
- Invasive Plants
- Vigor with an emphasis on Reproductive Capability of Perennial Plants

17 Indicators

Soil/Site Stability	Hydrologic Function	Biotic Integrity
	1. Rills	12. Functional/Structural Groups
	2. Water Flow Patterns	13. Dead or Dying Plants or Plant Parts
	3. Pedestals and/or Terracettes	15. Annual Production
	4. Bare Ground	16. Invasive Plants
	5. Gullies	
6. Wind-Scoured and/or Depositional Areas	14. Litter Cover and Depth	
7. Litter Movement	10. Effects of Plant Community Composition and Distribution on Infiltration	17. Vigor with an Emphasis on Reproductive Capability of Perennial Plants
	8. Soil Surface Resistance to Erosion	
	9. Soil Surface Loss and Degradation	
	11. Compaction Layer	

Rills

Small, intermittent watercourses with steep sides

Typically several centimeters deep

Generally linear erosion features that run parallel to the slope



Water Flow Patterns

Paths water takes as it moves across the soil surface during periods when surface water from rain or snowmelt exceeds soil infiltration capacity

Commonly referred to as **sheet flow** or **overland flow**



Pedestals and/or Terracettes

Pedestals indicate the movement of soil by water or wind from the base of plants or from around rocks or persistent litter, giving them an elevated appearance



Terracettes are “benches” of soil deposition that form behind or between obstacles when materials are redistributed by water movement



Bare Ground

Exposed mineral soil not covered by vegetation, gravel/rock, visible biological soil crust, or litter

Ground surface cover materials intercept raindrops, reduce soil particle detachment, and reduce soil movement by water and wind



Gullies

Well-defined channels cut into the soil by ephemeral water flow

Gullies can develop from enlarged rills, but sometimes formation may be much more complex and involve: (1) volume, speed, and type of runoff, (2) susceptibility of soil to erosion, (3) changes in ground cover induced by land use and treatments



Wind-Scoured and/or Depositional Areas

Wind-scoured areas including blowouts are formed as finer particles of topsoil are blown away

Depositional areas are locations where windblown soil accumulates (on- or offsite)



Litter Movement

Litter is the uppermost layer of organic debris on the soil surface – freshly fallen or slightly decomposed vegetal material

Litter movement refers to the change in location of litter due to water or wind.



Soil Surface Resistance to Erosion

This indicator assesses the resistance of the soil surface to erosion by water

Resistance depends on soil stability and on the spatial variability in soil stability relative to vegetation and microtopographic features

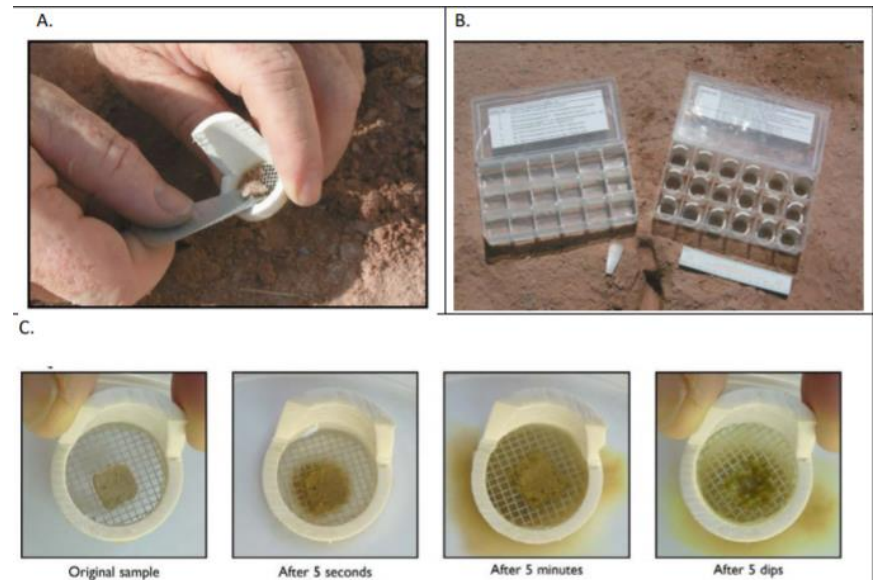


Figure 12. Overview of the soil stability test. See Herrick et al. 2017 for comprehensive instructions.

A. Collection of a soil surface sample into a soil stability testing sieve.

B. A complete soil stability kit with 18 soil samples collected.

C. Example of a soil sample "melting" after submersion and dipping in water.

Soil Surface Loss and Degradation

The reduction in soil surface depth, organic matter, porosity, and structure as a result of wind or water erosion

Indicative of long-term change in rangeland health

Loss or degradation of part or all of the soil surface layer or horizon is an indication of a loss in site potential



Effects of Plant Community Composition and Distribution on Infiltration

This indicator reflects effects of vegetation composition and spatial distribution on the infiltration capacity of the soil within the evaluation area and the amount of time water is retained on the soil surface



Reduced Infiltration

High Infiltration

Compaction Layer

Near-surface layer or dense soil caused by impact or disturbance of the soil surface

Compaction layer can be caused by application of weight or pressure at or below the soil surface

Compaction layers restrict water **percolation**, plant growth, and nutrient cycling



Functional and Structural Groups

Plant species that are grouped together on the basis of similar growth forms or ecophysiological roles

Function typically refers to the ecophysiological role that plants and biological soil crusts play on a site

Structure refers to plant growth forms within a community

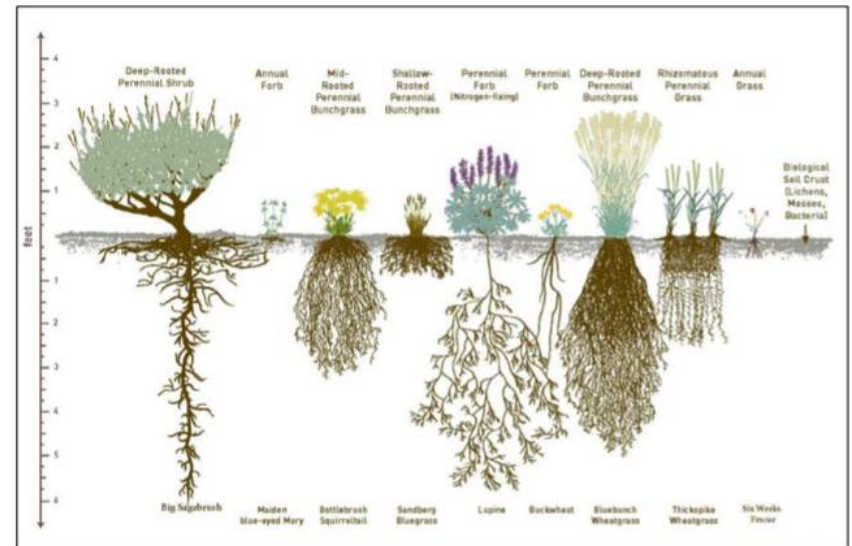


Figure 13. Root morphology of common plants in a sagebrush steppe ecosystem (adapted from Sage Grouse Initiative 2016). Refer to Natura (1995) for a similar diagram of root morphology of common plants in a mixed prairie ecosystem.

Dead or Dying Plants or Plant Parts

Dead or dying plants or plant parts (stems, branches, leaves, etc.) are a natural phenomenon in all perennial plant communities

Dormant plants are not considered dead or dying unless there are obvious signs that parts of the plant are dead



Litter Cover and Depth

The potential cover and depth of litter is related to the productivity and decomposition rates of a given ecological site

Productivity and decomposition are influenced by weather conditions

The cover, depth, and kind of litter are affected by plant community composition



Annual Production

Represents the energy captured by plants through the process of **photosynthesis** given recent weather conditions

This is the only indicator that is directly linked to the ecological process of energy flow



Invasive Plants

Invasive plants are those which are typically not found on the ecological site or should only be in trace or minor categories under the natural disturbance regime

Have the potential to become a dominant or codominant species on the site

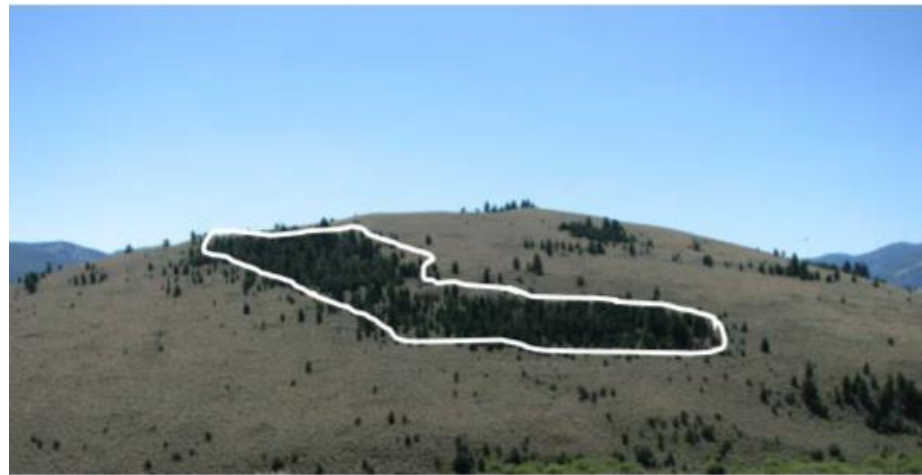
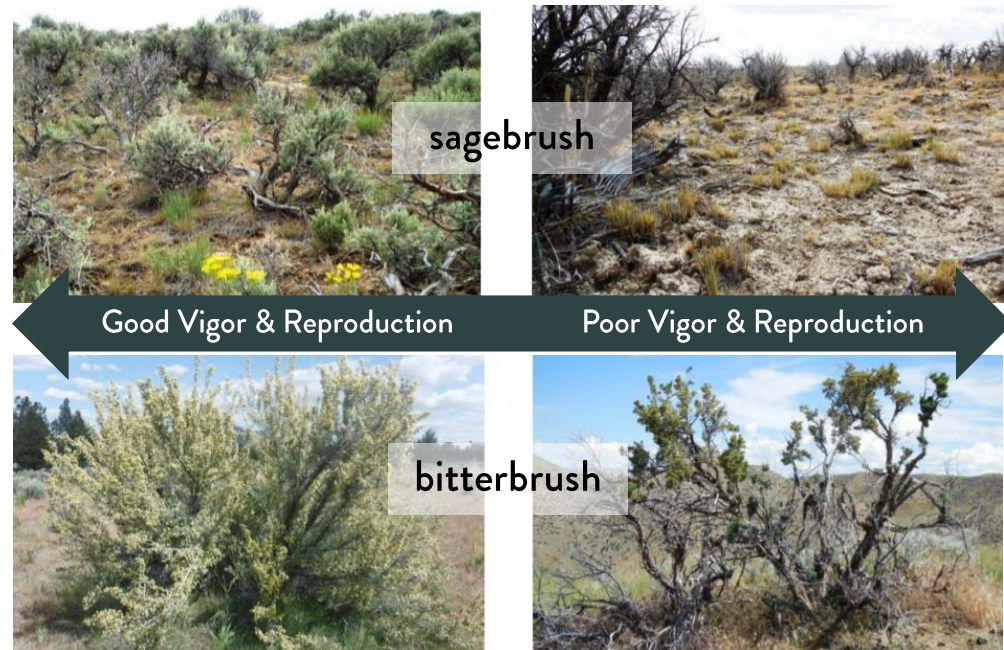


Figure 14. Juniper-dominated area in a sagebrush ecological site.

Vigor with an Emphasis on Reproductive Capability of Perennial Plants

Plant vigor relates to the robustness of a plant in comparison to other individuals of the same species

Reflected primarily by the size of the plant and its parts in relation to the plants age and the local environment in which is it growing



Indicators

Each indicator is rated into categories:

- Extreme to Total (E-T)
- Moderate to Extreme (M-E)
- Moderate (M)
- Slight to Moderate (S-M)
- None to Slight (N-S)



Example Evaluation Form

Interpreting Indicators of Rangeland Health Version 5 Evaluation Form - Page 2			
Evaluation Area ID: <u>BigSage_CM_14</u>		Date: <u>8/14/2018</u>	
Departure from Expected	Code	Instructions	
None to Slight Slight to Moderate Moderate Moderate to Extreme Extreme to Total	N-S S-M M M-E E-T	(1) Assign 17 indicator ratings, record comments and any measurements. (2) In the attribute rating tables at the bottom of the form, write the indicator number in the appropriate column for each indicator applicable to the attribute. (3) Assign overall rating for each attribute based on preponderance of evidence. (4) Provide rationale for each attribute rating in writing.	
Indicator	Rating	Comments	
1. Rills	S H N-S	No rills observed in evaluation area	
2. Water-flow patterns	S H S-M	Short, disconnected waterflow patterns 3' long and up to 1' wide in plant interspaces on slopes >5%	
3. Pedestals and/or terracettes	S H S-M	Occasional pedestalled bunchgrasses associated with water flow patterns on slopes >5%	
4. Bare ground (observed): <u>32</u> %	S H M-E	Bare ground is much higher than expected, with bare patches >2' that are occasionally connected	
5. Gullies	S H N-S	None	
6. Wind-scoured and/or depositional areas	S N-S	Minor soil deposits found around perennial plant bases; no wind scours noted - matches what is expected for the site	
7. Litter movement (wind or water)	S SM	Displacement of fine material up to 2' associated with water flow patterns on slopes >5%. Coarse litter does not appear to be moving	
8. Soil surface resistance to erosion Interspace : <u>3.2</u> Plant Canopy: <u>3.8</u>	S H B M	Observed values are consistently 1-2 categories lower than expected.	
9. Soil surface loss and degradation	S H B S-M	A-horizon is thinner (5cm) and lighter (10YR 4/2) in color than expected	
10. Effects of plant community composition and distribution relative to infiltration	H S-M	Deep-rooted perennial grasses are somewhat reduced, resulting in slightly less infiltration, especially on steeper slopes	
11. Compaction layer	S H B M	Thin, weakly developed compaction layer in interspaces, ~2" thick	
12. Functional/structural groups a. Relative dominance: <u>S-M</u> b. F/S groups not expected at the site: <u>M</u> c. Number of F/S groups: <u>N-S</u> d. Spp # in dom & subdom F/S groups: <u>N-S</u>	B M	Annual grasses are not expected for this site, but now a minor component; relative dominance has shifted towards shrubs with a decrease in perennial grasses. Biological crust cover is substantially lower than expected.	
13. Dead or dying plants or plant parts	B S-M	Approx. 20% of deep rooted bunch grasses have slight crown die-out which is not expected given the normal precipitation over the past two years	

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THANK YOU

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