

ABSTRACT

FOREST SOIL CHARACTERISTICS AFTER TWENTY-SIX YEARS OF CATTLE AND BIG GAME GRAZING IN NORTHEASTERN OREGON. Linda Hardesty, Christopher E. Gebauer and John Buckhouse, Washington State University, Pullman WA 99164-6410, 509-335-6632, lhardest@mail.wsu.edu, and Oregon State University, Corvallis, OR 97331.

Grazing cattle on transitory range in the mixed coniferous forests of the Pacific Northwest is a common practice widely recognized for its potential to create short term gains in forest productivity. Yet relatively little is known about longer term effects, especially on soil properties. This study examined soil physical and chemical properties, as well as tree and understory vegetation growth under three different grazing treatments (cattle only, big game only, and both cattle and big game) twenty-six years after tree harvest. A fifteen-acre pasture on the Hall Ranch in northeastern Oregon was clear cut in 1963, burned in 1964, seeded to grass in 1964, and planted with tree seedlings in 1965. Three five-acre exclosures were constructed to establish the grazing treatments, and cattle were grazed in the summers from 1966 to 1992 at roughly 1.3 acres per AUM. The cattle only treatment was fenced to exclude large herbivores. The big game only and cattle and big game treatments allowed free access to foraging deer and elk.

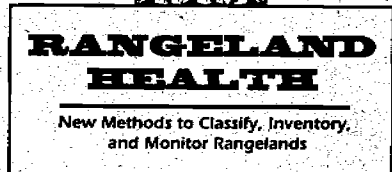
Data analyses are still on-going, but grazing treatments do affect soil P, NO_3 , and surface bulk density, while soil K, NH_4 , pH, soil organic matter and subsurface bulk density were unaffected. At least with regard to surface bulk density, and soil organic matter, tree species also influenced grazing treatment effects. Soil phosphorus levels were higher in the dual grazed treatment than in cattle only under both ponderosa pine and naturally regenerated mixed forest. Soil nitrate (NO_3) levels appeared to be greater in cattle grazed pastures than in either dual or wildlife grazed pastures. Surface bulk density was higher in the dual grazed treatment than in wildlife only, especially under ponderosa pine.

Earlier tree height measurements (1977, 1983) showed that Douglas fir and ponderosa pine were taller under dual grazing than under either cattle or wildlife. Preliminary analysis of 1996 data suggest this effect is not persistent. Tree diameters were not affected by grazing treatments.

This study demonstrates the need to continue monitoring the effects of forest grazing on soils over multiple rotation time periods.

TABLE 4-7 Relationship between Health Criteria and Thresholds

Phase	Healthy	At Risk	Unhealthy
1. Soil stability and watershed function	No evidence of soil movement	Soil is moving, but remains on site	Soil is moving off site
2. Distribution of nutrients and energy	Plant and litter distribution unfragmented	Fragmented distribution developing	Fragmented distribution developed, with large barren areas between fragments
	Photosynthetic activity occurs throughout the period suitable for plant growth	Photosynthetic activity restricted during one or more seasons	Photosynthetic activity restricted to one season only
	Rooting throughout the available soil profile	Roots absent from portions of the available soil profile	Rooting in only one portion of the available soil profile
3. Recovery mechanisms	Diverse age-class distribution Plants are vigorous	Seedlings and young plants are missing Plant vigor is reduced	Decadent plants predominate Plant vigor is poor
	Germination microsites are present and well distributed	Developing crusts or soil movement degrade microsites	Soil movement or crusting inhibit most germination



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Range Productivity

- Historically “forage”
- Traditional “range condition” concept
- 1970’s, shift to primary productivity

NONE ARE ECOLOGICALLY MEANINGFUL

“Range Health” NRC 1994

- State and transition model based
- “Preponderance of evidence”
- Judgment rather than measurement
- Management oriented?

Thresholds



- Healthy
- At risk
- Unhealthy

ECOLOGICALLY MEANINGFUL ?

Range Health Criteria

- Degree of soil stability and watershed function
- Integrity of nutrient cycles and energy flow
- Presence of functioning recovery mechanisms

WHAT ARE STANDARDS FOR STABLE, FUNCTIONING, AND INTEGRITY ?

Hall Ranch 1996

- Clearcut and burned 1963
- Planted Pipo, Psme, natural regen.
- Grazing treatments:
 - wildlife only
 - cattle only
 - wildlife & cattle
- 30 years vegetation and cattle data
- No replication

Initial Productivity Indicators

- Surface and subsurface bulk density
- Infiltration
- Saturated hydraulic conductivity
- Soil organic matter
- N, NO₃, NH₄, P, K, pH

Preliminary Results

Soil Physical Properties:

- Surface BD dual > wildlife only
- No difference in subsurface BD
- No satisfactory method for infiltration
- Saturated hydraulic conductivity wildly variable

Preliminary Results: Soil Nutrients

- NO_3 cattle only > wildlife & dual
- P dual > cattle only
- There is a tree effect
- NH_4 , K, OM, and pH unaffected

Preliminary Results: Vegetation

- 1977, 1983, Pipo & Psme taller under dual grazing
- 1996 effect not persistent
- No diameter effect
- Cattle only shrub dominated
- Long term understory cover and frequency currently under analysis

Proposed Future Work

- Pseudo-replication
- Increase sampling intensity
- Explore geostatistics
- Understory biomass measurements
- Soil micronutrients
- Microbial signature, activity & biomass