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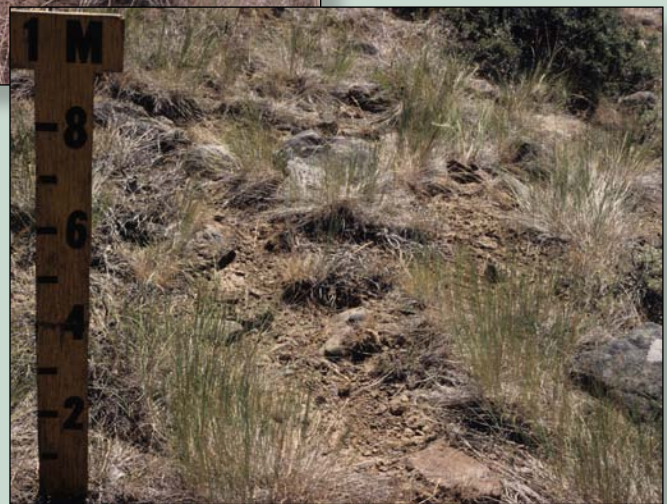
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Variation in Shrub and Herb Cover and Production on Ungrazed Pine and Sagebrush Sites in Eastern Oregon: A 27-Year Photomonitoring Study

Frederick C. Hall



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Cover photos

The photos on the cover depict the change in vegetation, from one year to the next, at the same sample point. The top photo was taken in 1994 and the bottom photo was taken one year later in 1995. Photos by Frederick C. Hall.

Abstract

Hall, Frederick C. 2007. Variation in shrub and herb cover and production on ungrazed pine and sagebrush sites in eastern Oregon: a 27-year photomonitoring study. Gen. Tech. Rep. PNW-GTR-704 Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 44 p.

Study objectives were to evaluate yearly fluctuations in herbage canopy cover and production to aid in defining characteristics of range condition guides. Sites are located in the forested Blue Mountains of central Oregon. They were selected from those used to develop range condition guides where soil, topographic, and vegetation parameters were measured as a characterization of best range condition. Plant community dominants were ponderosa pine/pinegrass, ponderosa pine/bitterbrush/Idaho fescue savanna, low sagebrush/bluebunch wheatgrass, and rigid sagebrush scabland. None of the sites were grazed during the previous 30 years or during the 27-year study. Each location was permanently marked by fence posts, and a meter board was placed 10 m down an established transect line. Photographs (color slides) were taken down the transect with closeups left and right of the meter board. Sampling was limited to August 1–4 each year when canopy cover and herbage production were determined. Both total canopy cover and herbage production varied by about a 2.4-fold difference on each site over the 27 years. Apparently “good range condition” may be something of a “running target” and lacks a well-defined set of parameters. Canopy cover is a poor parameter for characterizing range condition. Three of the four plant communities were dominated by bunchgrasses. Abundance of seedheads is commonly used to indicate good range health. But on these sites, seedheads were not produced about half the time. Because these sites were in “good range condition,” lack of seedhead production may indicate maximum competition in the community. Maximum competition and maximum vigor do not seem to be synonymous. These bunchgrass communities varied in their greenness on the first of August each year from cured brown to rather vibrant green suggesting important annual differences in phenology. The pinegrass community, being dominated by rhizomatous species, showed surprising variance in seedhead production. Pinegrass did not flower, but Wheeler’s bluegrass, lupine, and Scouler’s woollyweed were quite variable, averaging inflorescences only 75 percent of the time.

Keywords: Range condition, flowering, canopy cover, herbage production, bunchgrass, yearly variability.

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Introduction

Use of range condition guides presupposes that vegetation characteristics of good condition are reasonably consistent from year to year. The validity of this concept warrants consideration because it forms the basis for determining fair and poor range condition as part of an appraisal of range health, which determines the need for livestock adjustment. Seventeen sites representative of common range plant communities in the Blue Mountains of eastern Oregon were monitored August 1 to 4 from 1976 to 2006 for yearly changes in species dominance and herbage production at a consistent time of year. They were selected from those sites sampled to develop range condition guides by using the 3-Step Method (Parker and Harris 1959).

Plant Communities

Four common plant communities were chosen for this report: ponderosa pine/pinegrass, ponderosa pine/bitterbrush/Idaho fescue savanna, low sagebrush/bluebunch wheatgrass, and rigid sagebrush scabland.¹ Data show that there is variability in species canopy cover and total herbage production between years. The data raise questions about the concept of a single set of criteria for “good” in range condition guides. The data also raise questions about what kind of sampling system is appropriate for characterizing these guides.

Ponderosa pine/pinegrass, often with Douglas-fir and grand fir, is the most widespread forested plant community, that is also grazed, east of the Cascade crest in both Oregon and Washington. As tree cover increases, shrub and herb species density, composition, and production decreases (USDA FS 1967a).

Ponderosa pine/bitterbrush/Idaho fescue is the second most common forested plant community that is grazed east of the Cascade crest. It represents the transition from grassland or sagebrush to forest as precipitation increases. And it, like ponderosa/pinegrass, suffers from a reduction of herbaceous species with an increase in tree cover. But it occupies a unique place in forested rangeland. Tree density for 1-in diameter growth per decade (Hall 2004) is so low that tree canopy, at this density, does not significantly affect herbaceous cover or production. However, tree cover in stagnated stands does reduce herbage production. Tree density also affects tree growth in both height and diameter. Grass canopy cover can reach 70 percent and herbage production 400 kg/ha.

Low sagebrush/bluebunch wheatgrass, the third most widespread plant community, occurs within the forest zone on soils too shallow for pine or fir. Juniper

¹ See “Species List” for Latin names of species in this publication.

can colonize these sites. Grass seedhead production on these areas is a trait evaluated by photo interpretation. The parameter evaluated is the number of bunchgrass plants that flowered by August 1. Canopy cover can reach 70 percent and herbage production 600 kg/ha.

Rigid sagebrush scabland was the fourth most widespread kind of plant community studied. It occurs within the forest zone on very shallow soils, 1.5 to 3.0 dm deep, on poorly cracked bedrock. Soils are so shallow that they become waterlogged during winter. Soil protection is afforded by a gravel and stony cover with biological species such as moss and lichens intertwined. Herbaceous cover may reach 45 percent and production 250 kg/ha.

Methods

August 1 to 4 was established as the time of year to sample. It was established as a reference point for plant phenological development including greenness, seedhead production, canopy cover, and herbage production.

Photomonitoring

Photomonitoring (Hall 2002) was used to illustrate yearly changes based on recommendations by Reppert and Francis (1973) in their appraisal of the 3-Step Method. Their procedure was adapted as follows: (1) Each site was identified with steel fence posts or concrete reinforcing bars in rigid sagebrush sites. (2) The camera location was placed at the 0-ft end of the original range condition sampling transect. (3) A board 1 meter tall and marked in even decimeters was placed at the 10-m (33-ft) transect location and three images were recorded: a general view from the 0-ft end of the tape, and two at 2 m from the board, a view left of the meter board, and a view right of the board. These were used to appraise seedhead production, change in soil surface conditions, greenness of the vegetation, and as a check on estimates of canopy cover. Because of space limitations, only the right meter board image has been used.

Canopy Cover

At each side of the meter board a 1-m square plot frame was placed to document canopy cover and estimate total herbage production. One decimeter marks were placed at each corner of the meter square to facilitate canopy estimates as a 1-dm square is 1 percent cover. Continuous vegetation (no open space) over at least 66 percent of the 1-dm square constitutes 1 percent cover.

Herbage Production

Herbage production was also estimated by using the 1-dm square. Near the sample site, a 1-m square area was selected on which to adjust ocular herbage production estimates. The area would be estimated and then clipped to measure grams of dry matter. To focus attention on plant biomass, a 1-dm square area around each plant was evaluated to determine how many 1-square dm areas were covered by a plant; then grams were estimated. This simply focused my attention on plant biomass.

Herbage samples were air dried.

Other observations were noted at each site. Subsequent careful observation of recorded images revealed items missed in the field. I was surprised at how much could be “seen” by comparing images year by year. Rocks “moved,” trees came and went, bunchgrass plants shifted location, foliage color changed, foliage length varied, and seedheads were amazingly variable by number of plants, by number per plant, and by shift in plant location.

Image Identification

The USDA Forest Service Pacific Northwest Region has developed a system for archiving images, mostly color slides. About 5,000 long-term study slides have been identified and categorized to be made available online. All images used here have been identified by a code consisting of an alphanumeric site identification. For example, the ponderosa pine/bitterbrush/Idaho fescue site code is 203EPF identifying ecology plot 203 and is read as “plot 203 ecology plot forage.” Tables in this publication use the archiving codes to facilitate access to the slides.

Photomonitoring

All images used here are the same colors found on the slides. In no case was color altered. A few times brightness was altered to modify effects of shadows. Note that images from 1957 to 1960 show effects of color fade. Kodak Ektachrome² was used in preference to Kodachrome because the latter gave too much red and an unrealistic color to vegetation. Ektachrome ISO was 100 in 1957 and 200 after 1966.

Capturing the subtleties of greenness in August proved to be a challenge. The degree of greenness varied considerably.

² Use of firm or trade names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

Camera technique was important in comparing images (Hall 2002). First, both camera location and photopoint at the meter board must be permanently marked with steel fence posts or stakes. The meter board for general pictures was used to orient the camera by focusing on the "1M." Then it was used to photograph a specific tract of ground for repeat images. This requires another camera location in front of the board. For camera focal length of 50mm, the camera was held 2 m from the board. The camera was oriented to place the board at one side of the image so it reached from top to bottom.

Digital cameras usually have zoom lenses so distance is very critical if any kind of change is to be documented. For general images, the zoom was adjusted to show the meter board at 25 percent of the image height. For the closeup images, the camera is oriented 2 m in front of the board and zoomed to just fill the one side of the image with the board.

Viewing Images

Each of the following four sections is organized with an introductory page followed by four pages of images to the right of the meter board. When the pages are opened, one can view 12 years. Read from left to right across both pages.

Ponderosa Pine/Pinegrass Site: Herbage Dominance and Production

This site is located at the south edge of Big Summit Prairie, Lookout Mountain District, Ochoco National Forest. The area was historically a sheep allotment but was converted to a cattle allotment after the Second World War. It was selected because both woody and herbaceous vegetation seem near site potential for the area (USDA FS 1967a). All sampling was done between August 1 and 4 starting in 1979 to the present.

All images are shown as they appear on color slides of Kodak Ektachrome, ISO 200. In 1986, the roll of film was overexposed and the images are not presented here.

The intent was to show yearly differences in both species dominance and seasonal color.



1979: The ponderosa pine/pinegrass site during a drought. The log to the right of the meter board appears in all subsequent images of herbage species. Note the slight differences in dominance of pinegrass. This is due to variation in Mazama ash depth. Less ash means less vigor of pinegrass and more vigor of elk sedge. The image for 1986 is not included.



1979: View right of the meter board: pinegrass 40 percent cover, elk sedge 10 percent, and dried lupine 10 percent cover; 300 kg/ha herbage production. A pine seedling is next to the meter board between 6 and 8 dm. It was missing by 1982.

Soil profile shows ash depth of 0.5 to 0.6 m over a buried soil. Basalt bedrock produced a moderately stony clay-loam soil.





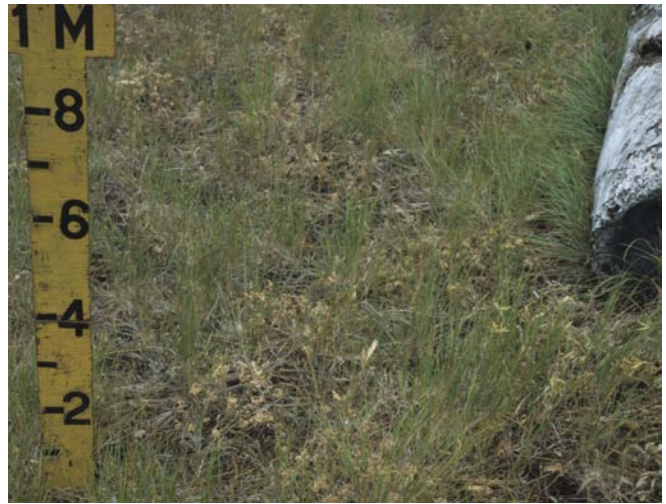
1980: Percent cover: pinegrass 55, elk sedge 20, lupine 15, Wheeler's bluegrass 5; herbage production 650 kg/ha.



1981: Percent cover: pinegrass 50, elk sedge 25, Wheeler's bluegrass 25 (seed heads), no lupine; herbage production 550 kg/ha.



1984: Percent cover: pinegrass 55, lupine 30 (white seed heads), elk sedge 20; herbage production 600 kg/ha.



1985: Percent cover: pinegrass 35, lupine (dry) 30, elk sedge 15, Scouler's woollyweed 5; herbage production 425 kg/ha.



1989: Percent cover: pinegrass 45, lupine 25 (white seed heads), elk sedge 20; herbage production 500 kg/ha.



1990: Percent cover: pinegrass 60, Wheeler's bluegrass 15 (seed heads), Scouler's woollyweed 5; herbage production 600 kg/ha.

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1982: Percent cover: pinegrass 40, lupine 20, elk sedge 15, Wheeler's bluegrass 5; herbage production 450 kg/ha. Pine now dead.



1983: Percent cover: pinegrass 50, elk sedge (dark green) 25, herbage production 400 kg/ha. Pine seedlings top right near log.



1987: Percent cover: pinegrass 40, lupine 25, elk sedge 20; herbage production 500 kg/ha.



1988: Percent cover: pinegrass 55, lupine 35 (brown), Scouler's woollyweed 10; herbage production 600 kg/ha.



1991: Percent cover: pinegrass 55, lupine 20, Wheeler's bluegrass 10, Scouler's woollyweed 15; herbage production 600 kg/ha.



1992: Percent cover: pinegrass 40, lupine 10, Wheeler's bluegrass 20; herbage production 500 kg/ha. Pine seedlings top right.



1993: Percent cover: pinegrass 55, lupine 15, Wheeler's bluegrass 10, elk sedge 10; herbage production 675 kg/ha.



1994: Percent cover: pinegrass 55, Wheeler's bluegrass 20, elk sedge 10, lupine 2; herbage production 600 kg/ha.



1997: Percent cover: pinegrass 70, Wheeler's bluegrass 20, lupine 10, elk sedge 10; herbage production 675 kg/ha.



1998: Percent cover: pinegrass 55, Wheeler's bluegrass 20, lupine 15, Scouler's woollyweed 8; herbage production 500 kg/ha.



2001: Percent cover: pinegrass 55, Wheeler's bluegrass 15, lupine 15, Scouler's woollyweed 5; herbage production 500 kg/ha.



2002: Percent cover: pinegrass 40, Scouler's woollyweed 10, lupine 10; herbage production 450 kg/ha. Pine seedlings top right.



1995: Percent cover: pinegrass 40, Scouler's woollyweed 10, lupine 10; herbage production 500 kg/ha. Pine seedlings top right near log.



1996: Percent cover: pinegrass 70, Wheeler's bluegrass 20, Scouler's woollyweed 5; herbage production 600 kg/ha.



1999: Percent cover: pinegrass 40, lupine 10, Scouler's woollyweed 5; herbage production 400 kg/ha.



2000: Percent cover: pinegrass 50, Wheeler's bluegrass 20, Scouler's woollyweed 10, no lupine; herbage production 550 kg/ha.



2003: Percent cover: pinegrass 40, Scouler's woollyweed 10, lupine 10, Wheeler's bluegrass 10; herbage production 400 kg/ha.



2004: Percent cover: pinegrass 45, Wheeler's bluegrass 25, Scouler's woollyweed 10, elk sedge 10; herbage production 450 kg/ha.



2005: View of the pine/pinegrass site after 27 years. The regenerating pines shown in 1983, 1992, 1995, and 2002 are just behind the end of the log and about 2 m tall after about 25 years. Root competition from dominant pines has greatly reduced height growth, which should be about 6 m on this site index of 23 m.

Difference in density of pinegrass, the dominant herb, is caused by variation in ash depth over the buried soil. The image for 1979 shows less contrast because the drought limited height of pinegrass.



2005: Percent cover: pinegrass 40, Wheeler’s bluegrass (seed-heads) 20, elk sedge 10, Scouler’s woollyweed 8; herbage production 450 kg/ha. Pine seedlings at the top-right are now only saplings after 25 years.

A crude estimate of herbage production may be obtained by multiplying total herbage cover by a factor of 6.2. For the example above: $40 + 20 + 10 + 8 = 78$; $78 \times 6.2 = 483$ kg/ha.

Comments

Over a 26-year period (data from table 1-BSPCF-ponderosa pine/pinegrass):

- Pinegrass, the dominant species, varied from 35 to 55 percent cover, a 1.5-fold difference, which was not affected by livestock utilization. This variation suggests that estimation of range condition by use of canopy cover is questionable.
- Sampling of vegetation to estimate range condition should consider methods that are sensitive to species presence as well as dominance. For example, lupine was measurable for canopy cover only 73 percent of the time, yet it was still rooted in the plant community. During good lupine growing conditions, it attained 25 to 35 percent canopy cover and produced heavy seeds enhancing herbage production.
- Total herbage production averaged 520 kg/ha but varied from 300 to 675 kg/ha, a 2.25-fold difference on the same good range condition site. Exercise caution when estimating allotment carrying capacity based on range condition.
- Only pinegrass had measurable canopy cover 100 percent of the time. Four other species, lupine, Scouler’s woollyweed, elk sedge, and Wheeler’s bluegrass were evident only 65 to 75 percent of the time. They were present but not measurable for canopy cover or herbage production. This situation should be considered when describing vegetation characteristics for range condition guides.

Table 1-BSPCF—Ponderosa pine/pinegrass. Yearly canopy cover by species and statistics on total yearly canopy cover, herbage production, and ratio of production to canopy cover

Year	Canopy cover by species code ^a								Herb cover	Herbage production	Ratio cover/ kg/ha
	CARU	LUCA	HISC2	CAGE2	PONE2	NOTR2	ARCO9				
	<i>Percent</i>								<i>Percent</i>	<i>kg/ha</i>	<i>Ratio</i>
1979	40	10	20						60	300	5.0
1980	50	25	5	25		2	10		95	550	5.8
1981	50			25	15				100	650	6.5
1982	40	20	2	20	10	5			80	450	5.6
1983	50			25	1				75	400	5.3
1984	55	30		20					105	600	5.7
1985	35	30	5	15					85	450	5.0
1987	40	25		20					85	500	5.9
1988	55	35	10	1	1				100	600	6.0
1989	45	25		20					90	500	5.6
1990	60		5	1	15				81	600	7.5
1991	45	20	5	1	10		5		90	600	6.7
1992	40	10		1	20				70	500	7.1
1993	45	15	5	10	10				90	675	7.5
1994	45	1		10	20				87	600	6.9
1995	40	10	10						60	500	8.3
1996	50		5	1	20				60	600	6.3
1997	50	10	5	10	20				95	675	7.1
1998	45	15	8		20				98	500	5.1
1999	40	10	5						60	400	6.7
2000	50		10		20				80	550	6.9
2001	55	15	5		15				90	500	5.6
2002	40	10	10						60	450	7.5
2003	40	10	10		10				70	400	5.7
2004	50		10		25				90	550	6.1
2005	40	18	8	10	30				83	450	5.1
Mean	46.0	18.1	6.8	13.1	15.4	3.5	7.5	Mean	83.8	520.2	6.2
Count	26	19	18	18	17	2	2	SD	13.5	94.6	0.9
Percent	100	73	69	69	65	8	8	5% CI	5.2	36.4	0.4

Note: SD = standard deviation; CI = confidence interval.

^aSee "Species List: Codes" for plant code definitions.

Ponderosa Pine/Bitterbrush/Idaho Fescue Site: Herbage Dominance and Production

This study was placed on ecology plot number 203 installed in 1957 to measure vegetation and soil attributes for development of range condition guides (USDA FS 1967b). It is located on the Lookout Mountain District, Ochoco National Forest, on the east edge of Big Summit Prairie. All sampling was done between August 1 and 4 each year starting in 1977 to the present.



1957: The ponderosa/bitterbrush/fescue community in 1957 with small, sapling sized ponderosa regeneration, hedged bitterbrush, and vigorous fescue. Color in the slide has faded over 45 years.



Soil is Mazama ash over basalt-derived residual soil. A 9-in finger spread was replaced by a meter tape for subsequent images. Total soil depth was 0.6 m.



1978: Same stand in 1978 when this study was initiated. Pine saplings have only grown about 6 dm in 20 years. The area was underburned in spring 2002 when the log left rear of the meter board was consumed. A precommercial thinning was applied in 2003.



1978: Idaho fescue is the dominant herb. The foreground individual has produced abundant seed stalks. Compare to following images. It was killed by the prescribed burn of 2002.



1979: No seedheads; percent cover: Idaho fescue 20, squirreltail 5, wheatgrass 5; herbage production 300 kg/ha.



1980: No seedheads; percent cover: fescue 15, wheatgrass 5, Ross sedge 2, squirreltail 2; herbage production 250 kg/ha.



1983: No seedheads; percent cover: fescue 15, wheatgrass 2, Ross sedge 2, pussytoes 2; herbage production 200 kg/ha.



1984: No seedheads; percent cover: fescue 15, Ross sedge 2, needlegrass 2, yarrow 1; herbage production 225 kg/ha.



1987: 50 percent seedheads; percent cover: fescue 15, wheatgrass 8, needlegrass 3, junegrass 2; herbage production 250 kg/ha.



1988: No seedheads; percent cover: fescue 15, wheatgrass 2, squirreltail 2, Ross sedge 2; herbage production 200 kg/ha.



1981: 60 percent seedheads; percent cover: fescue 25, wheatgrass 7, needlegrass 2; herbage production 350 kg/ha.



1982: 10 percent seedheads; percent cover: fescue 25, wheatgrass 2, lupine 5, pussytoes 2; herbage production 300 kg/ha.



1985: No seedheads; percent cover: fescue 20, Japanese brome 8 (heads), squirreltail 5; herbage production 325 kg/ha.



1986: No seedheads, percent cover: fescue 12, wheatgrass 2, pussytoes 1, Ross sedge 1; herbage production 150 kg/ha.



1989: 20 percent seedheads; percent cover: fescue 18, wheatgrass 2, squirreltail 3, bluegrass 2; herbage production 235 kg/ha.



1990: No seedheads; percent cover: fescue 20, wheatgrass 5, junegrass 2, Ross sedge 2; herbage production 300 kg/ha.