Conflicting Vegetational Indicators on Some Central Oregon Scablands

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Highlight: Two soil-vegetation sites were studied in central Oregon to determine why two conflicting plant indicators (antelope bitterbrush and low sagebrush), occurred on apparently uniform sites. Investigation showed that bitterbrush was not a reliable indicator of site conditions in the two study areas. Landscapes that appeared to be uniform were actually highly variable because of internal soil differences.

Knowledge of soil-vegetation relationships helps the range manager judge range condition, assess potential productivity, and determine appropriate species for use in range reseeding efforts when native plant cover has been depleted (Anderson 1956).

Site assessment is difficult where vegetative indicators conflict. We found conflicts with some central Oregon scablands.

Our investigation centered on determining why conflicting plant indicators occurred on an apparently uniform site. This situation was observed on two areas near Silver Lake in central Oregon. Scablands within the study areas generally support low sagebrush (*Artemisia arbuscula* Nutt.)[1] plant communities. Curlleaf mountainmahogany (*Cercocarpus ledifolius* Nutt.) and antelope bitterbrush (*Purshia tridentata* (Pursh) DC.), usually indicative of better sites, occur, however, as individuals or small groups within the margins of these scablands (Dealy 1971).

Study Areas

The two study areas are located on the upper edge of the Silver Lake winter range approximately 137 km (85 miles) south-southeast of Bend, Ore., and 8 km (5 miles) south-southwest of Silver Lake, Ore. (Fig. 1). Study area I (elevation 1,583 m, (5,200 ft) is situated on the Fremont National Forest at the toe of Hager Mountain (elevation 2,195 m, 7,200 ft), a volcanic cone rising out of an undulating plain primarily supporting ponderosa pine (*Pinus ponderosa* Dougl.) forest. Study area II (elevation 1,433 m, 4,700 ft) occurs 13 km (8 miles) west-northwest of study area I, on the Lakeview District, Bureau of Land Management, on a nonforested bench surrounding the Silver Lake valley.

The climate is continental with some marine influence from the west. Temperatures reach subfreezing levels during winter and highs of 32° to 41°C (90° tto 105°F) during summer. The growing season is 75 to 85 days in June, July, and August. Killing frost can occur during any month. Annual precipitation is approximately 38 cm (15 inches) with 50% in winter, 40% in spring and fall, and 10% in summer.

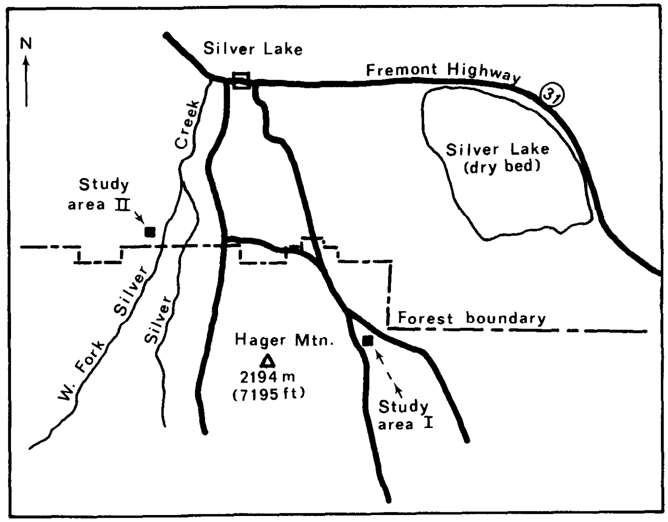

Fig. 1. *Study area locations near Silver Lake, Ore.*

Methods

Our methods were observational. Plants occurring at each study area were identified and listed in relation to their respective soils, which were described by standard survey methods (U.S. Department of Agriculture 1951). Soil pH was determined colorimetrically with a Truog soil reaction test kit.[2] Some supplemental soil investigations were also made to better define the diversity of conditions associated with observed vegetative patterns.

Results

Vegetation

Area I, a nearly level opening surrounded by ponderosa pine, contained a single shrub layer of low sagebrush with an understory of squirreltail (*Sitanion hystrix* (Nutt.) Smith) and prairie junegrass (*Koeleria cristata* Pers.). When a sufficient rise in microtopography occurred, Idaho fescue (*Festuca idahoensis* Elmer) replaced other grass dominants. Prominent perennial forbs included low pussytoes (*Antennaria dimorpha* (Nutt.) T. & G.), nineleaf lomatium (*Lomatium triternatum* (Pursh) Coult. & Rose), pink microsteris (*Microsteris gracilis* (Hook.) Greene), and scabland fleabane (*Erigeron bloomeri* Gray).

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[1] Plant nomenclature follows Hitchcock and Cronquist (1973).

[2] Mention of commercial products or companies does not constitute an endorsement by the U.S. Department of Agriculture.

Fig. 2. *Study area I with cutbank which illustrates the light colored intermittent indurated layer (right foreground) in soil associated with low sagebrush, and the finger of taller shrubs growing in the deeper soil lacking the indurated layer (right background).*

A finger of curlleaf mountainmahogany and antelope bitterbrush occurred within the low sagebrush opening (Fig. 2). One western juniper (*Juniperus occidentalis* Hook.), 1 m (3.28 ft) tall, was growing at the tip of the finger. Other vegetation associated with this finger included Idaho fescue, squirreltail, and an occasional bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. & Smith). Commonly occurring forbs were western yarrow (*Achillea millefolium* L.) and woolly sunflower (*Eriophyllum lanatum* (Pursh) Forbes).

Area II was also a low sagebrush flat with a grass layer primarily of Sandberg bluegrass (*Poa sandbergii* Vasey), Thurber's needlegrass (*Stipa thurberiana* Piper), and squirreltail (Fig. 3). Forbs included low pussytoes, nineleaf lomation, pink microsteris, and milkvetch (*Astragalus* L. spp.).

Individuals and small groups of antelope bitterbrush occurred within the low sagebrush flat just below the edge of the ponderosa pine zone. Beneath bitterbrush plants the grass layer was composed almost entirely of cheatgrass (*Bromus tectorum* L.) apparently due to past grazing; however, occasional remnants of Idaho fescue, squirreltail, bluebunch wheatgrass, and Thurber's needlegrass occurred. Forbs were rare under these shrubs. In Table 1 microsite vegetation is compared by study area.

Fig. 3. *General view of study area II showing the bitterbrush-low sagebrush mosaic of shrub vegetation.*

Table 1. Plant species comparison between study areas and soils.

Study areas	Low sagebrush	Bitterbrush
I	Low sagebrush	Antelope bitterbrush Curlleaf mountain-mahogany Western juniper
	Sandberg bluegrass Squirreltail Prairie junegrass Low pussytoes Nineleaf lomatium Pink microsteris Scabland fleabane	Idaho fescue Squirreltail Bluebunch wheatgrass Western yarrow Woolly sunflower
II	Low sagebrush Sandberg bluegrass Thurber's needlegrass Squirreltail	Antelope bitterbrush Cheatgrass Idaho fescue Squirreltail Thurber's needlegrass Bluebunch wheatgrass
	Low pussytoes Nineleaf lomatium Pink microsteris Milkvetch	

Soils

Area I soils were derived from alluvium apparently originating from Hager Mountain colluvium. This material was a mix of fines, gravels, and cobbles to 20 cm in size including basalt, andesite, pumice, ash, and obsidian. Area II soils were dominantly residual, derived from fractured basalt and andesite, with pumice and ash influence. The pumice and ash at both areas originated from Mt. Mazama or Newberry Craters (Allison 1945; Harward and Youngberg 1969).

In Figure 4, soils (A, B, C, D) associated with described vegetation are portrayed diagrammatically to scale with tentative horizon identification and horizon characteristics. Soils were not correlated with named soil series.

Area I, soil A, associated with low sagebrush, had grayish brown (dry colors are used throughout), loam surface material grading into brown, clay subsoil, with stone content increasing with depth. A prominent accumulation of medium and fine roots occurred on the surface of an indurated layer (C_m). The layer was quite hard, generally continuous at this location; it contained varying amounts of gravel and cobble-size coarse fragments. A gravelly loam layer underlay the indurated layer and resembled the subsoil at the same depth of soil B, which occurred under the finger of bitterbrush and mountainmahogany. The two soils were similar in color, texture, structural development, pH, and amount of coarse fragments in the upper horizons. They had weak platy surface structure and moderate subangular blocky subsurface structure. Soil B, under the finger, was deeper than A, horizons were thicker, and no cemented layer or rooting restriction was found. Drainage and root penetration were restricted by the indurated layer in soil A under low sagebrush (Fig. 5).

Additional soils data from a similar low sagebrush opening near area I showed a gravelly-clayey zone from 22–67 cm with an indurated layer from 65–75+ cm.

A second excavation under low sagebrush revealed a gravelly-clayey zone beginning at 12 cm, but no indurated layer was found. Two nearby soils associated with bitt rbrush con-

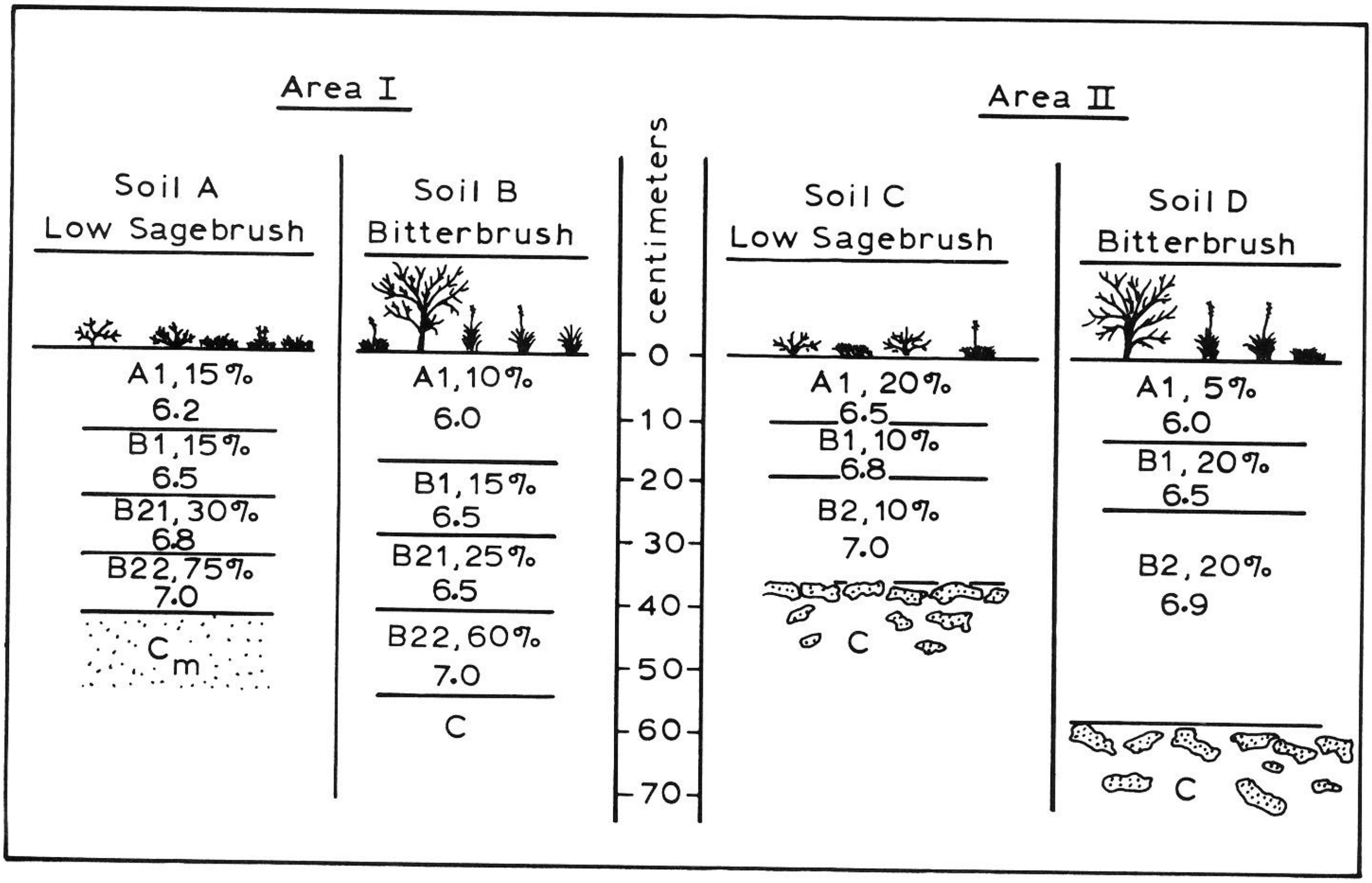

Fig. 4. *Scale diagram of soils A, B, C, and D occurring in the two study areas with tentative horizon designations, coarse fragment percentages, and pH values.*

tained gravelly-clayey zones at 35 cm in one case and at 38 cm in the other; neither contained an indurated layer.

In general, the indurated layer was variable in degree of cementation, thickness, and amount of horizontal fracturing. In some places it exhibited fine horizontal striations or bands of varied color. The upper surface of the layer was frequently coated by a thin, silicious sheet. The general color of the layer ranged from predominantly milky to yellowish brown with subtle milky markings. There were no surface soil or topographic indicators of presence or absence of the indurated layer.

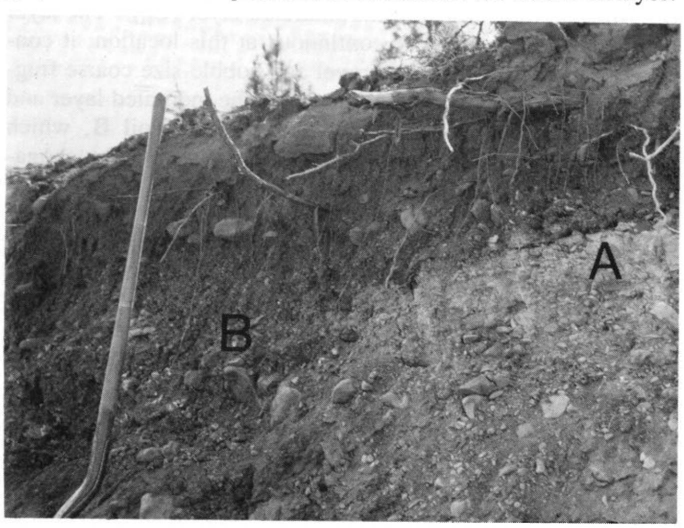

Fig. 5. *Study area I showing the discontinuity of the indurated layer from soil A to soil B.*

In area II under low sagebrush, soil C graded from a gray-colored gravelly loam at the surface to a brown clay in the subsoil (19–36 cm). Structure ranged from weak platy in the surface to moderate subangular or angular blocky in the subsoil. The two soils were similar in pH values. A broken indurated layer (Fig. 6) mixed with clay occurred from 36–69+ cm. Thin section microscopic analysis by the Oregon State University Soils Laboratory (report on file at the Range and Wildlife

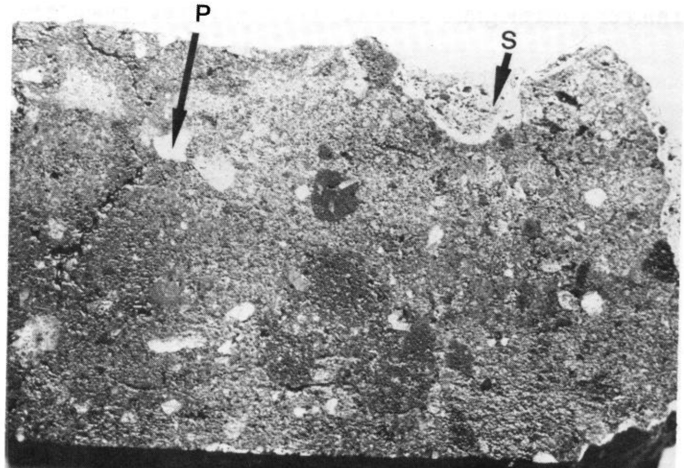

Fig. 6. *This photograph shows a portion of the indurated (cemented) layer from area II prior to thin section preparation. Dimensions are 4 cm × 2.5 cm. White material identified as silica (S) appears as a skin on the surface. White areas (P) are unweathered pumice particles bound by clays (dark color) and silica.*

Habitat Laboratory, La Grande, Ore.) showed this layer to be cemented by silica and clay. Fragments of the indurated layer ranged from gravel to cobble size and were tilted at varying degrees from horizontal. Roots showed a tendency to accumulate among the surface of the clayey-indurated zone, but accumulation was not as pronounced as in area I, soil A.

Under bitterbrush, soil D had gray surface color and loam surface texture; it graded into brown subsoil material with clay texture. Structure ranged from weak platy in the surface to moderate subangular blocky or moderate prismatic in the subsoil (24–58 cm). Roots extended through broken tilted indurated fragments mixed with clay from 58–72 cm. This latter material was similar to the 36–69 cm layer in soil C under low sagebrush, but better structure was present in soil D. The indurated layer exhibited less horizontal orientation under bitterbrush and occurred deeper than under low sagebrush.

Two other excavations near those in area II showed some similar soil profile characteristics and depth relationships, but no broken indurated layer was found within 70 cm of the soil surface under bitterbrush or 50 cm under low sagebrush.

Conclusions

Our investigations showed that neither bitterbrush nor curlleaf mountainmahogany were reliable indicators of site conditions in the study areas. Landscapes that appeared uniform from surface soil and topographic observations were actually highly variable because of internal soil variations. A thorough examination of both soil and vegetation is necessary before forage production or rehabilitation potentials can be predicted.

Under low sagebrush we found that a shallow, poorly structured, fine-textured (clayey) gravelly layer and/or presence of a shallow continuous, indurated layer restricted rooting of bitterbrush and mountainmahogany and prevented their occurrence. The latter two species, however, will grow where these influences are moderated by better subsoil structure in fine-textured horizons, fracturing of or lack of the indurated layer, or deeper, well-drained soil. The abundance of the species depends on the kind and degree of moderation. Internal soil differences in the two study areas were not indicated by pH tests in the field.

We are not implying that low sagebrush or sporadic bitterbrush occurrence is always tied to the same site factors discussed in this study. Rather, we encourage fieldworkers to look for other ecological influences. We can safely say that few single-factor, cause-effect relationships exist in nature, because a change in one factor is usually accompanied by one or more associated changes. Our attempt at untying this tenuous ecological web is only a beginning. We hope our future experiences and those of others will help to refine these interpretations.

The following is a first approximation guideline to the soil-vegetation relationships in the areas studied:

A. Expect low sagebrush without bitterbrush where rooting depth of shrubs is restricted by:
1. a continuous indurated soil layer near the soil surface, or
2. a broken indurated layer mixed with poorly structured, fine-textured material near the soil surface.

B. Expect spotty or patchy bitterbrush occurrence in low sagebrush stands where restrictive soils (described under A) are occasionally interrupted by:
1. comparatively deep, well-drained soil with moderate well developed structure, or
2. soil lacking a continuous indurated layer but having poorly structured, fine-textured material (with or without broken indurated fragments) in the lower subsoil only.

Be prepared for some digging if you want to develop a management plan or assess the reseeding potential of a site supporting scattered bitterbrush. Use soil exposures at roadcuts, gravel pits, pond sites, etc., for initial insights to profile features. Use a backhoe, if possible, to excavate trenches across visible vegetative changes. Hand excavated soil pits, dug with the aid of a crowbar to break through indurated layers, should also be situated across vegetative transitions. The knowledge gained should tell whether bitterbrush is indicating discontinuities in soil conditions or if the site will generally support a population of shrubs eliminated earlier by fire or other factors.

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THESIS: MONTANA STATE UNIVERSITY

Evaluation of Nitrogen Fertilization and Grazing Effects on a Porcupine Grass (*Stipa spartea* var. *curtiseta*) Community, by Leonard Roy Roath, MS, Range Science. 1974.

Evaluation of nitrogen fertilization and grazing treatments on a porcupine grass community was initiated on the Rohde-Langen Ranch, north of Glasgow, Montana, in 1970, to determine whether increased utilization of porcupine grass could be achieved.

Nitrogen fertilizer (ammonium nitrate) was applied at five rates, in 50-lb increments, 0–200 lb of actual nitrogen per acre. The 200 lb of nitrogen per acre treatment was applied as 600 lb of nitrogen per acre in 2-ft bands on 3-ft centers. An exclosure was established and moved each spring to create varying lengths of grazing deferment following initial fertilizer applications.

Porcupine grass yield did not respond significantly to nitrogen application. Wheatgrasses increased in yield and density with added nitrogen. The remaining vegetation demonstrated no uniform yield response to fertilization. Palatability of all species was greatly increased in the first season following fertilization but decreased substantially the following year. Extreme utilization adversely affected yield and cover of porcupine grass, but other species showed no uniform response.