Livestock on the Cascade-Siskiyou National Monument: A Summary of Stocking Rates, Utilization, and Management

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Abstract

This paper describes range management related practices to provide a historic and landscape context for studies examining the influence of livestock on objects of biological interest within the Cascade-Siskiyou National Monument. Historic records show livestock numbers increased rapidly following initial settlement by Euro-Americans. Anecdotal data suggests that stocking rates early in the last century were greater than current stocking rates by at least an order of magnitude. Historic unregulated season-long use of the uplands during the spring, summer and fall resulted in severe environmental degradation. Disagreements between livestock operators and the desire of agency personnel to improve the condition of the range led to large-scale fencing and concomitant water development projects. Such projects contributed to improved livestock control in riparian areas, a retardation of livestock movement to higher elevations, and improved livestock dispersion in the absence of herding. Observation of livestock use on upland shrubs and winter deer dieback resulted in exclusion studies culminating in more precise timing of livestock use to preserve the browse resource for native ungulates at lower elevations. While livestock use of shrubs at lower elevations has been reduced, use of upland shrubs at the end of the grazing season continues in moderate to high use areas accessible to livestock. Large-scale patterns of livestock use are associated with environmental factors such as elevation, soil texture, and management factors such as distance from water-source, distance from roads, and past vegetation manipulations. Activities associated with livestock management include: road construction, aerial fertilization, herbicide application, seed application, development of water-sources, vegetation manipulation (scarification), and prescribed fire. At the time of

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implementation, many of these activities were considered to benefit wildlife as well as rangeland condition. Large-scale vegetation manipulation was initiated in the 1950s. Since then, associated seed applications have introduced over 50 grasses and forbs across the Monument. Miles of fence construction appears bimodal over time – an initial spate of construction followed by more recent renovation. Water developments appear associated with fence construction, likely to ensure water availability within newly fenced pastures for stock later in the season compared to historic times.

Introduction

The Cascade-Siskiyou National Monument (CSNM), which includes a portion of the Siskiyou summit, serves as a land bridge between the coastal Klamath Mountains and the Cascade Mountains, facilitating migration of high elevation plants and animals. At the same time, it also serves as a barrier to low elevation species, separating the Rogue River valley from the Great Basin. The juxtaposition of eco-regions and floristic provinces, together with diverse topography and soils, contribute to the biological richness in the CSNM. This, in turn, has influenced how humans have interacted with the landscape. Native American trails followed the few accessible north-south corridors. In 1837 Ewing Young used these trails when he herded 700 animals from San Francisco to the Willamette Valley, the earliest recorded livestock traverse of the CSNM (Edwards 1932). These trails eventually became highways, Interstates and railway lines. Land near roads had been settled by European pioneers by the 1870's (General Land Office Survey; Wright 1968). The lower elevation grazing lands of the Rogue and Shasta valleys provided winter forage for livestock that were moved to higher elevations in the summer.

The Presidential Proclamation of the Cascade-Siskiyou National Monument (CSNM) called for research to examine livestock impacts on objects of biological interest (Clinton 2000). Objects of biological interest include plant and wildlife species (both common and rare), plant communities, and natural ecosystem dynamics. Historic and current stocking rates, patterns of forage use by livestock and native ungulates, and past management actions described by this paper are essential background information for studies that examine the abundance objects or composition of communities (plant or wildlife) of biological interest across a gradient of current livestock use.

Current livestock grazing in the Monument is managed as nine grazing allotments, two of which are currently vacant. Five of the active allotments account for 97% of the authorized grazing in the Monument (Figure 1).

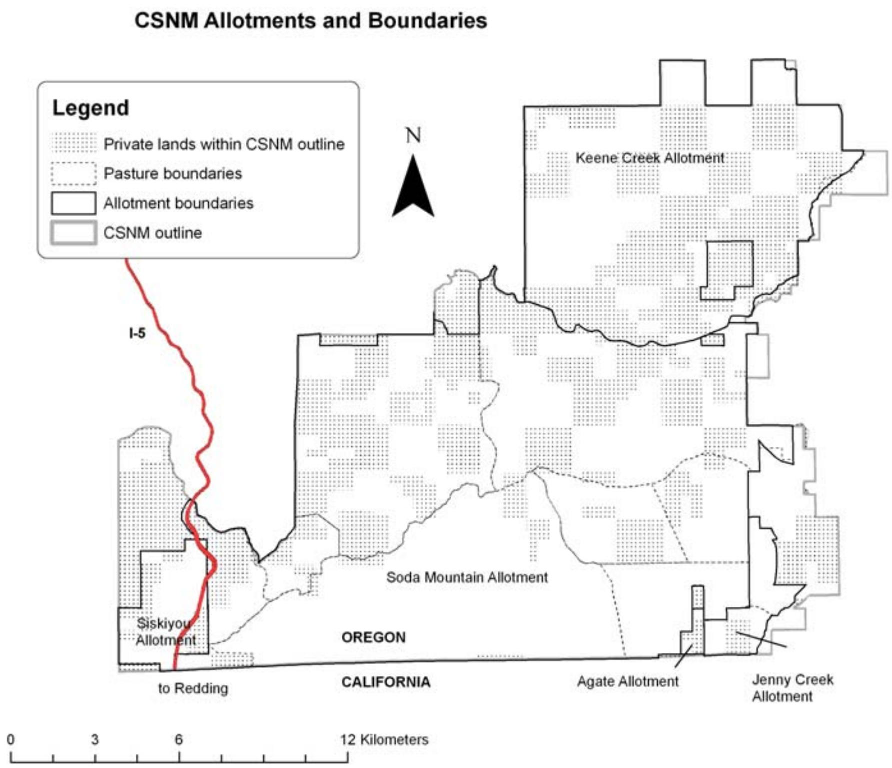


Figure 1. Major allotments and pasture boundaries within the Cascade-Siskiyou National Monument. Note that allotments and boundaries extend beyond the Monument outline, and that private lands (shown only within the CSNM boundary) are not considered part of the Monument.

Cattle grazing begins at lower elevations (450 meters) on the generally south-facing slopes of the Agate Flat pasture of the Soda Mountain Allotment. The vegetation there is a mosaic of chaparral (*Ceanothus cuneatus*), prairie, and Oregon white oak (*Quercus garryana*) woodland. By mid-season livestock have been moved to higher elevations on the steeper and more densely wooded slopes surrounding Soda and Chinquapin mountains. The component of mixed-coniferous forest increases with elevation. Late in the season cattle graze meadows and harvested forest openings within a matrix of conifer communities (mixed conifer, Douglas fir (*Pseudotsuga menziesii*), and white fir (*Abies concolor*) at elevations up to 2000 meters. Native grasses, including needlegrass (*Achnatherum*), Roemer's fescue (*Festuca roemerii*), and oatgrass (*Danthonia*) grow across the elevational range, depending on local conditions of soil, topography, and shade. At lower elevations, riparian areas are associated with perennial and intermittant streams, with relatively few springs and seeps. At higher elevations, riparian areas are more commonly associated with seeps, springs, and sag ponds. These may be dominated by sedges, rushes, or willows, depending on disturbance history and site conditions. California false hellebore (*Veratrum californicum*) and waterleaf (*Hydrophyllum fendleri*) indicate seasonally wet meadows, which usually dry out by mid-summer. Many of the open areas (meadows and roadsides) have been seeded with non-native pasture grasses after treating unwanted vegetation (*Veratrum californicum, Delphinium*, and *Marah oreganus*) with herbicide. Annual and short lived perennial weedy grasses, including cheatgrass (*Bromus tectorum*), medusahead (*Taeniatherum caput-medusae*), and bulbous bluegrass (*Poa bulbosa*) grow throughout the Monument. The major broadleaved weeds are yellow starthistle (*Centaurea solstitialis*)and dyers woad (*Isatis tinctoria*) at lower elevations, and Canada thistle (*Cirsium arvense*) at higher elevations.

In addition to the direct effects of grazing, vegetation has also been influenced by other management activities, including herbicides, aerially applied fertilizer, scarification, seeding, and road construction, most of which were done to improve forage for cattle and native ungulates. The absence of large wildfires since the 1920s has resulted in increased canopy cover in many plant communities that were formerly more open under historic fire regimes (Hosten et al. 2007a). The literature provides further information about patterns of livestock use in association with environmental factors across the landscape.

Landscape-level Use Patterns Related to Environmental Factors

Piospheres (gradients of livestock impact, usually radiating out from a watering point) have been useful for discerning between livestock-induced range degradation and natural fluctuation largely due to climatic variation (Pickup 1989; Bastin *et al*. 1993, Pickup *et* *al.* 1994). Andrew (1988) found distinct soil surface-related patterns in dung deposition, sheep track development, and lichen cover. Similar patterns were found for vegetation components. Mortality of the main forage shrub, density of short-lived forbs, and growth of short-lived grasses were all found to increase towards the watering point. Factors such as grass phytomass, shrub phytomass and percentage of individuals of a major shrub in flower decreased towards the watering point (Andrew and Lange 1986b). The general shape of measured soil and vegetation parameters is an "S" curve (Graetz and Ludwig 1978), although animal activity patterns, forage distribution, topography, water quality, and climatic factors may cause deviations (Andrew 1988). Tueller and Platou (1991) found similar patterns in sagebrush steppe vegetation grazed by cattle. Several studies have recently examined piosphere effects using remotely sensed data (Bastin *et al*. 1993, Pickup *et al*. 1994, Washington-Allen 2004).

In arid and semi-arid portions of the western U.S., riparian zones provide habitat highly preferred by cattle (Gillen *et al.* 1984, Pinchak *et al*. 1991 and others cited below). |The availability of water, high quality forage in relative abundance, shade (McIlvain and Shoop 1971) , and relatively flat ground make riparian zones highly attractive to cattle (Griffiths 1910, Pickford and Reid 1943, Ames 1977, Bryant 1982, Kauffman and Krueger 1984, Siekert *et al*. 1985, Marlow and Pogacnik 1985, Gillen *et al.* 1984, Hall 1985, Clary and Webster 1989, Hart *et al.* 1991, 1993; Kovalchik and Elmore 1992; Clary and Medin 1992; Kie and Boroski 1996; Kreycik 2001). Generally, the hotter and drier the uplands become, the more attractive to cattle the riparian areas become. Thus cattle tend to concentrate their use and associated impacts in riparian zones if allowed to do so, especially late in the grazing season (Martin and Ward 1970, 1973; Thomas *et al*. 1979b; Roath and Krueger 1982; Bryant 1982; Kauffman and Krueger 1984; Gillen *et al.* 1984; Siekert *et al.* 1985; Hall 1985; Pinchak *et al*. 1991; Bock *et al*. 1993; Yeo *et al.* 1993; Fusco *et al*. 1995; Hayward *et al*. 1997; Coe *et al*. 2001; Fuhlendorf and Engle 2001).

Slope (Pinchak *et al*. 1991, Gillen *et al.* 1984, Senft *et al*. 1983, Roath and Krueger 1982, Mueggler 1965, Cook 1966), distance from water (Pinchak *et al*. 1991, Senft *et al*. 1983, Herbel *et al*. 1967, Cook 1966, Mueggler 1965), distance from salt (Miller and Krueger 1976, Cook 1966), soil depth (Miller and Krueger 1976), plant community (Gillen *et al*. 1984, Roath and Krueger 1982), canopy cover (Miller and Krueger 1976, McIlvain and Shoop 1971), measures of forage quality and abundance (Pinchak *et al*. 1991, Owens *et al*. 1991, Herbel *et al*. 1967, Cook 1966), and abundance of brush (Owens *et al*. 1991, Cook 1966) are identified as important factors describing patterns of livestock utilization across the landscape. Efforts at modeling livestock use across the landscape rely on the grazing distribution patterns of livestock to abiotic factors such as slope and distance to water which are more reliable than biotic factors including forage quality and quantity (Bailey *et al.* 1996). The relative influences of environmental factors such as slope, water availability, and shelter on foraging patterns are generally considered more constant and easier to predict than the influence of specific plant species on utilization patterns (Senft *et al*. 1983; Bailey et al., 1996).

Seasonal weather also plays a role in the distribution of cattle. Riparian areas become more attractive to cattle as the landscape becomes hotter and drier later in the grazing season (Martin and Ward 1970, 1973; Thomas *et al*. 1979a), Roath and Krueger 1982, Bryant 1982, Kauffman and Krueger 1984, Gillen *et al.* 1984, Siekert et al. 1985 , Hall 1985, Pinchak *et al*. 1991, Bock *et al*. 1993, Yeo *et al.* 1993, Fusco *et al*. 1995, Hayward *et al.* 1997, Coe *et al*. 2001, Fuhlendorf and Engle 2001).

Objectives

The goal of this paper is to describe rangeland management related activities of the past century known to have occurred within the CSNM. This paper presents information on three aspects of livestock grazing necessary to evaluate impacts to objects of biological interest. These are 1) livestock stocking rates, 2) utilization by native and non-native ungulates, including forage preferences, and dispersal and utilization patterns at the landscape level relative to environmental factors, and 3) other range management activities. Data are derived from BLM records, including annual range allotment utilization surveys as well as utilization estimates from sites used by the BLM and participating non-governmental organizations to study the influence of livestock on objects of biological interest. The description of range related management activities are intended to provide a historic and current landscape context of livestock management for studies examining the influence of livestock management on objects of biological interest within the CSNM.

Methods and Materials

Stocking Rates

Sources of information about historic stocking rates for Jackson County (US Census of Agriculture records) and for federally managed allotments within the area of the current Cascade-Siskiyou National Monument are summarized together with allotment histories to provide a background of historic livestock management activities for the Monument.

Utilization

The Federal Land Policy and Management Act (FLPMA) and the Public Rangeland Improvement Act contain provisions requiring periodic reports on resource conditions. In 1988, the Medford District Rangeland Monitoring Plan was implemented to serve as an outline for systematic gathering of data to be used for analysis and interpretation of resource conditions and their response to management. Utilization data was collected at twenty-five point locations across the Monument, as well as landscape-level mapping of livestock utilization. An additional 159 study site locations were established to measure utilization by three standard methods described in *Utilization Studies and Residual Measurements* (USDA/USDI 1999). These included stubble height measurements, herbaceous forage removal using a key species, and browse removal using Cole Browse transects.

Individual Species

The stubble height and key species techniques were completed for point-cover transects associates with studies examining livestock influence on objects of biological interest across the Monument. Transect locations were recorded using GPS units, with readings at the beginning and end of each transect and at deviations from a straight line. Before each transect was read, the dominant palatable grass species was selected as the key species at that site. For this species, a reference plant that showed no evidence of herbivory was collected, measured and weighed. From this information we developed a height and mass ratio for estimating utilization classes for the key species at each point along the transect. Fifty-meter tapes were stretched along each transect and one stubble height measurement was recorded at each point one meter apart along the transect; if the point fell on bare ground a “0” was recorded. Surveyors recorded life form of the measured plant (AG = annual grass, PG = perennial grass, AF = annual forb, PF = perennial forb), or noted the four-letter species code if they could readily identify it. Surveyors also noted if the point fell on a hoof print (1 = < 5 cm deep, 2 = > 5 cm deep). Utilization was estimated for the key species by measuring the height of the individual closest to each point. Grazed plants were noted on the data sheet.

In addition to Cole Browse transects established in the 1980s by the BLM, Cole Browse transect and point cover transects were also established at 25 riparian study sites. Cole browse transects measured hedging (the appearance of browse plants that have been browsed so as to appear artificially clipped) and leader use on key riparian shrubs at one meter (one step) intervals. The closest individual of the key species was identified at each point and the transect continued from that individual. Leader use was estimated to the nearest percent. Length measurements were collected for ten un-utilized and ten utilized leaders. Leaders were chosen at random until all ten measurements were collected for one of the leader types, after which the other type was sought to gather the remainder needed. Cole Browse data was collected at each point along the transect following the standard methods. Upon completion of each transect, surveyors estimated overall forage utilization using the same criteria described under landscape utilization mapping [no utilization; light utilization; moderate utilization; heavy utilization; severe use; and “not mapped” (USDA/USDI 1996)].

Analysis of forage/browse utilization data

Data from 2003 and 2004 were combined and analyzed regardless of year. Where transects were repeated, only the most recent transect was incorporated in the analysis in preference to readings undertaken by more experienced technicians. Heights and weights of each vertical segment of the reference plant were used to construct a curve describing the relationship between the height and weight of the key species for each transect. In cases where plants were taller than the reference plant, the reference plant height was scaled up to avoid negative utilization values. A regression equation derived from the reference plant for each transect was used to estimate percent forage removal based on percent height reduction. This process was repeated for each key species on each transect; the overall estimate was the mean. For data derived from the Cole Browse data, percent leader use (PLU) and hedging class were similarly combined for 2003 and 2004.

Landscape-level patterns

Seven classes were used for mapping utilization by native and non-native ungulates: No use = 0-5 percent; Slight use = 6-20 percent; Light use = 21-40 percent; Moderate use = 41-60 percent; Heavy use = 61-80 percent; Severe use = 81-100 percent; and “not mapped” (USDI/USDA 1996). Visual cues based on use of seedstalks, the appearance of uniform ‘mowing,’ and other factors were used as aids in estimating utilization. Each utilization class was assigned a color. Utilization patterns were mapped as soon as possible after the cattle were removed from the allotment. A base map for displaying utilization patterns was created for each grazing allotment. Each base map contains physical features such as fences, water, and roads which could influence distribution of foraging animals, either to concentrate in small areas or to spread out over large areas.

Analysis of utilization mapping

Hardcopies of annual utilization maps (1984 to 2004) were converted to digital data by scanning and geo-referencing the resulting image to serve as a basis for hand-digitizing and creation of polygon based maps depicting annual utilization. The annual polygon based maps were converted to raster to calculate cumulative, average, and maximum utilization across the Monument on a pixel by pixel basis using the ARCGIS9 (ESRI 2004) raster calculator. Recent utilization transects (2003-2004) were compiled into a GIS layer and compared to synthesized utilization maps for all available individual years, maximum utilization, and average utilization. The absolute value of the difference between transect utilization and mapped utilization was calculated and averaged for each map. The accuracy of each map was thus assessed, with the smallest average difference representing the best congruence with data collected along utilization transects.

HYPERNICHE (MJM 2004) was used to explore the response of maximum utilization and average utilization to environmental factors, vegetative descriptors, and management activities prevalent across the Monument. Environmental factors include slope, elevation, heat-load [incorporating slope, aspect, and latitude (McCune and Grace 2002)], soil composition (percent silt, percent clay, percent sand), classification as vertisol soil, and soil depth. Vegetative factors include (NRCS derived ecological site, and canopy cover. Management factors include distance from roads, distance from water, forest canopy change, years since last grazed, past non-conifer related management actions (seeding, scarification, etc) and pasture identification. Nonparametric Multiplicative Regression (NPMR) as implemented in HYPERNICHE (McCune 2006) was used to derive best-fit models describing the pattern of the above defined response variables relative to predictor variables. The Local Mean form of the NPMR regression enables the incorporation of binary or quantitative data. The modeling process includes an initial screening for variables of interest followed by an exhaustive modeling approach. As the number of predictor variables increases, a stepwise search is initiated. All predictor variables are assessed in one variable models to determine the best one-variable model. Additional variables are added stepwise assessing improvement at each step. This approach evaluates all possible combinations of predictors and tolerances.

In addition to identifying important variables, the modeling process also provides several measures for assessing importance of individual variables and overall model quality. When a response variable is declared as quantitative, model quality is evaluated in terms of the size of the cross validated residual sum of squares in relation to the total sum of squares. The HYPERNICHE manual calls this the "cross r^2" (xr^2) because the calculation incorporates a cross validation procedure. The xr^2 value is considered a measure of variability captured by the best fit model.

Sensitivity analysis provides a measure of the relative importance of individual quantitative predictors in NPMR models. The sensitivity measure used in this paper refers to the mean absolute difference resulting from nudging the predictors, expressed as a proportion of the range of the response variable. The greater the sensitivity, the more influence that variable has in the model. With the sensitivity measure employed in this paper, a value of 1.0 implies a change in response variable equal to that of change in a predictor. A sensitivity of 0.5 implies the change of response variable magnitude is half that of the predictor variable. A sensitivity of 0.0 implies that nudging the value of a predictor has no detectable effect on the response variable.

NPMR models can be applied in the same way that traditional regression models are used (McCune 2006). A major difference is that estimates from the model require reference to the original data. Three dimensional plots of select predictor and response variables provide a visual assessment of how important predictor variables relate to response variables. The modeling approach as utilized by HYPERNICHE works well with variables defined in GIS as ASCII grids, allowing the formulation of probability estimate maps for response variables.

Further analysis of the spatial relationships between utilization and environmental factors of interest (as identified by Hyperniche) were summarized using overlap analysis in GIS. The percent of overlap occupied the environmental factor of interest are presented in tabular or graphic format at the pasture and/or landscape scales.

Related Range Management Activities

Other management activities with primary objectives aimed at improving conditions for livestock and the rangeland (usually considered to also benefit native ungulates) include herbicide application for control of unwanted vegetation, brush clearing by dozer, seeding by palatable grasses and forbs, aerially applied fertilizer, fencing, water development, and prescribed fire. While timber harvest benefits native and non-native ungulates, such activities do not have the primary objective of manipulating vegetation to favor livestock, and are therefore not considered in this document. The methods include searching of government records (archived photos and correspondence, the Range Improvements Database), for records of past activities (narrative, maps, old photos) within the Monument. The extent of activities are presented as tables and maps collated in GIS.

Results and Discussion

Stocking Rates

Historic Stocking Rates

According to US Census of Agriculture records for livestock production in Jackson County (Figure 2, as summarized by Borgias 2004), the number of sheep peaked in the late 1870s and early 1880s but remained the most numerous class of livestock until the mid-1910s. Beef cattle production peaked twice, increasing from fewer than 10,000 head prior to 1890 to more than 50,000 head in the early 1980s, then declining to fewer than 30,000 head in 1989, and increasing to a second high of over 40,000 head in 1998. Over time, the relative contribution of public and private lands to livestock production in Jackson County has shifted, with less contributed by public lands after agency control of stocking levels and more from private lands after development of irrigation systems and feedlots.

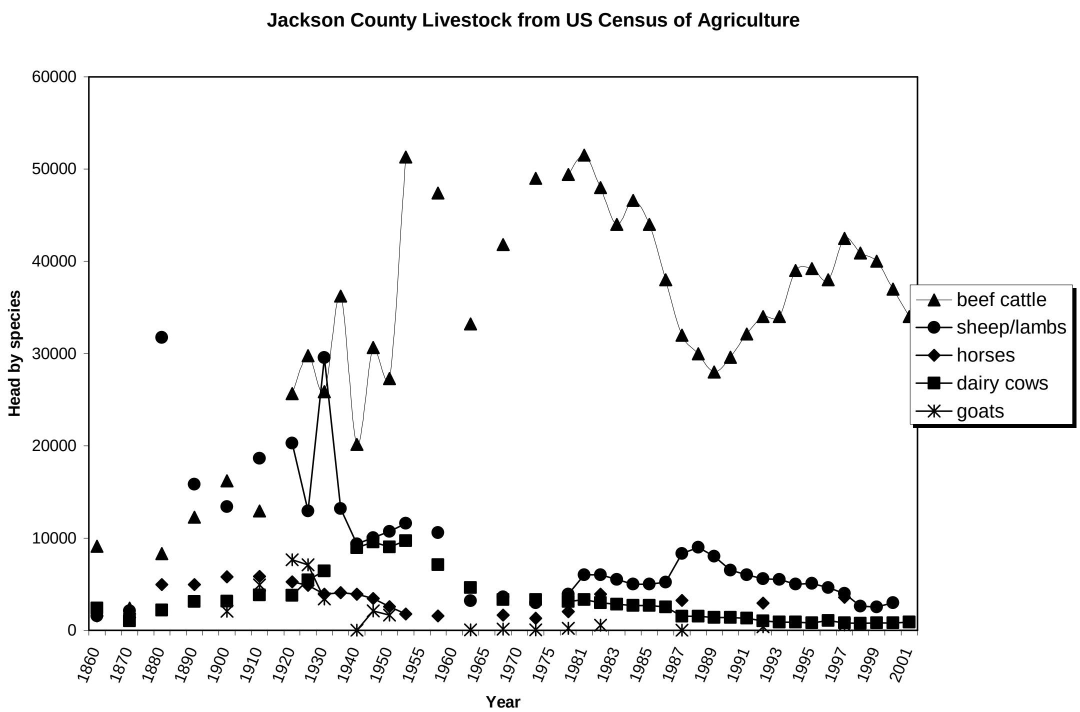


Figure 2. Animal production for Jackson County derived from US Census of Agriculture records. [from a report by Borgias (2004) for USFWS, figure redrawn with permission from USFWS].

Within the Monument, historic cattle stocking levels can be inferred from grazing association records and current systems of grazing allotments and pastures. The oldest records of livestock stocking rates on allotments that included the Monument area cannot be directly compared to modern rates for several reasons. First, older records (particularly during times of season-long grazing) indicate stocking rate as number of livestock within a given area (allotment or pasture). In contrast, modern accounting uses Animal Unit Months for a more accurate measure of livestock use based on a shorter season. Second, older tallies may underestimate livestock use, because operators often under-represented cattle numbers as a method of circumventing stocking rate restrictions. In the mid-1970s, ear tags were required on cattle grazing on the Monument, in an effort to eliminate under-representation of cattle numbers (Whitley, pers comm.). Third, the boundaries of grazing districts, allotments, and pastures have changed over time to improve management practices (exclude grazing from riparian areas, control livestock over elevational gradients or across political boundaries, and exclusion of areas with dense cover of woody vegetation).

Case histories of two allotments that overlap the Monument will be presented for a more detailed comparison of historic and current stocking rates. Of these two, Keene Creek Allotment has had more consistent boundaries over time, and Soda Mountain Allotment reveals more about the fiery politics surrounding livestock grazing on public lands.

Keene Creek Allotment

Grazing began between 1860 and 1865 on the Keene Creek Allotment, increasing greatly when the Ashland woolen mill started operating in 1867. In addition to the 10,000 sheep that moved to the region from Douglas County, there were also hundreds of horses that remained year round. Local old timers recall that there were several thousand head of cattle and sheep (Thomas 1953a). “The greatest forage use probably occurred when Homer and George Barron started running sheep in about 1900 until about 1917” (Thomas 1953a). Documents indicate sheep camps in eleven sections within the current Keene Creek Allotment boundary (Thomas 1953a). Each camp was utilized for at least two weeks between June 1st and snowfall. The Barrons, as private land owners, also ran sheep south of Hyatt Lake and east of Keene Creek. Sheep were succeeded by cattle in 1945 (Thomas 1953a). Much of this sheep range would have fallen within the Keene Creek Allotment and within the Monument.

The Keene Creek Allotment boundary changed little between 1930 and 1946 and encompassed 17,280 federal acres (Thomas 1953a). At 25,402 acres, the current Keene Creek Allotment (USDA 1993) contains the older boundaries shown on the Forest Service grazing gazeteer (Figure 3). The increase in allotment size is mitigated by the construction of Hyatt Dam, which submerged the Keene Creek Range as well as private land (Thomas 1953a). Assuming the allotment boundaries are little changes from 1917, Figure 2 indicates that actual AUMs averaged about 1,000 over the past 10 years; a sharp contrast to 12,000 equivalent AUMs in 1917 (Forest Service Grazing Gazeteer 1917). The earlier AUMs, estimated from the original stocking rates of cattle, do not appear to include sheep. Leibig (1900), and Williams attested to flocks of angora goats maintained for fiber production.

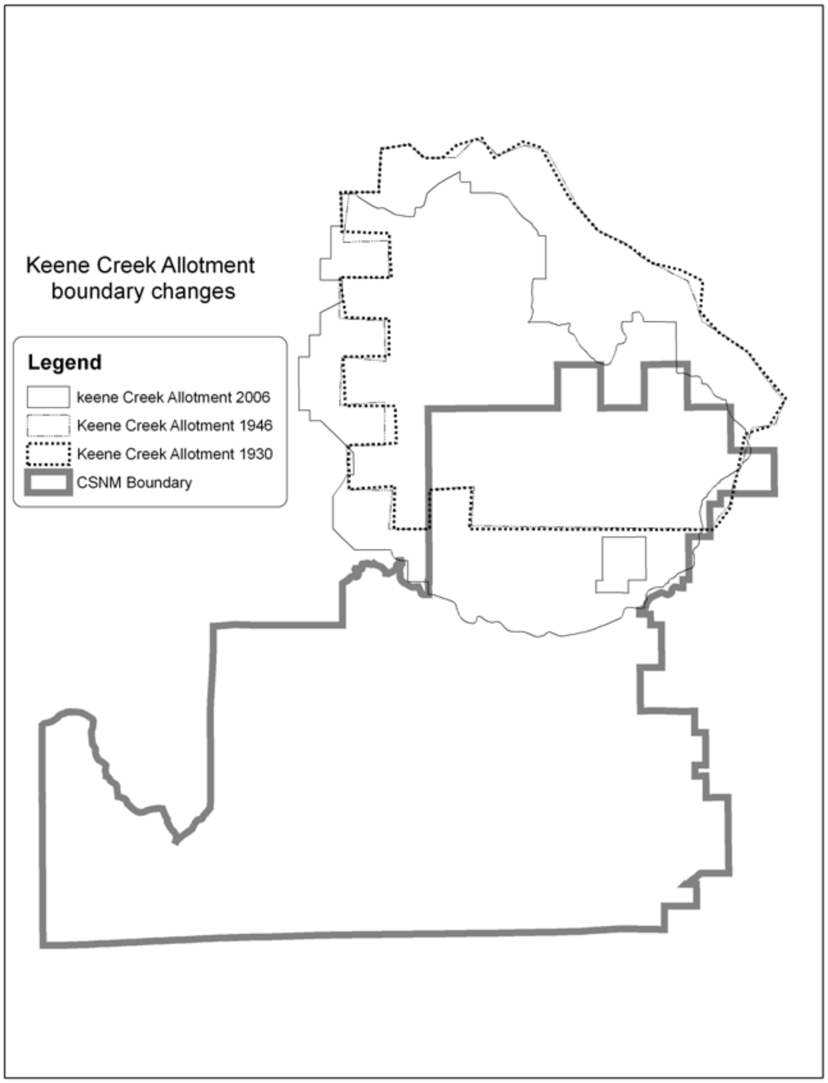


Figure 3. Overlay of 1939, 1946, and 2006 Keene Creek Allotment and boundaries.

A historic anecdote relating to grazing in the Ashland area supports this conclusion: "The livestock using the range included sheep, cattle and horses; and Chester Applegate has stated that the number of cattle on the range then exceeds present number by at least 10 times" (Thomas 1953b).

Soda Mountain Allotment

The history of grazing in the area currently occupied by the Soda Mountain Allotment is more complex than that of the Keene Creek Allotment. As a result of disagreements between grazing associations and individual cattlemen that shared the range, particularly the Camp Creek pasture just north of the California-Oregon border, grazing associations were replaced with newer organizations, and fences were built that altered the area available for grazing and impacted livestock movement and stocking rates.

As with the Keene Creek Allotment, grazing began in the early 1860s. The memoirs of George Wright indicate that his grandfather first ranged cattle on the southern portion of the Monument (Agate Flat) in 1866 (Wright 1968). Early surveyors commented that "The east half of this township [Township 41S Range 3E] … has the appearance of having been extensively used for grazing for many years" (Turner and Howard 1871). The exact number of livestock that used the Monument are unknown, but many hundreds were estimated to have ranged the landscape from early spring to late summer: "During the spring of 1889 and 1890… hundreds of cattle had just been loosed on the Rangeland to graze the southward slopes of hillsides between Hornbrook and the Pilot Rock area…" (Wright 1968). Comments about livestock-induced vegetation changes indicate that there was heavy livestock use throughout the Monument, including the area west of Bald (Soda) Mountain, Lone Pine Ridge, and the "Crooked Pine Spring Area" (along Soda Mountain Road between Hobart Lake and Soda Mountain), and areas noted as sheep camps on Soda Mountain (Wright 1968). George Wright (1968) reports that the plow land on Cold Spring Flat (Agate Flats) was sown with rye in the late 1880's. "The Cold Spring was also a watering place for cattle and horses. They came there by the hundreds" (Wright 1968). George Wright also mentions several ranches immediately south of the California-Oregon border, from which livestock would have grazed lands encompassed by the current Soda Mountain Allotment. The Madero Ranch, located where Pine Creek joins Camp Creek, had 100 head of cattle, along with saddle and draft horses (Wright 1968). In 1879 William A. Wright established a ranch where Salt Creek empties into Camp Creek. He fenced his 160 acre homestead, as well as an adjoining leased section. He raised alfalfa hay and kept 300 cattle (Wright 1968). A ranch initially homesteaded in 1865 at Camp Creek was home to 300 cattle when sold in 1932 by the De Soza family (Wright 1968). A grandson of homesteaders living on Soda Mountain told of a flock of 3,000 goats that roamed the area covering both Soda Mountain and Keen Creek Allotments (Williams, pers. comm.).

The Pilot Rock Grazing Association was organized in 1934 and functioned until 1954, when it was dissolved and new leases entered with the Greensprings Cattlemen's Corporation and the Camp Creek Cattlemen's Association (Agreement 1953, Lawrence unpublished). Disagreements arose between Oregon and California cattlemen about the use of the range south of the Siskiyous (Heath 1952, Lawrence unpublished). Ranchers in California, who historically grazed the Camp Creek area, requested that the range be divided into natural grazing units (by watershed boundaries) to facilitate livestock roundup, thus including Oregon land with the California side (Heath 1952). The issue of cattle drift appears in the minutes of meetings between cattlemen's organizations (Heath 1952, Peterson 1953). It appears that cattlemen were allowed limited livestock "drift" over the border (up to 100 head), but the 300 head rounded up at the end of a particular grazing season was considered excessive (Heath 1952).

Construction of a fence along the state line was discussed by the court and an advisory board in 1946 (Lawrence unpublished). There was conflict among cattlemen and unwillingness to finance the fencing venture (Lawrence 1954, 1955). The stateline fence was eventually constructed in three major stages (Lawrence unpublished). Five and a half miles of wing fences were constructed by the Greensprings Cattlemen's Corporation and the Camp Creek Cattlemen's Association (Agreement 1953). Later, because this fence was funneling livestock into the Soda Mountain Summit area, it was necessary to fence off Siskiyou Summit (Lawrence unpublished).

While exact stocking rates are not available for the current Soda Mountain Allotment area, it is evident from anecdotal accounts and repeat photos (Hosten et al. 2007a) that previous livestock utilization was heavier over a greater area than recent levels.

Livestock herd management

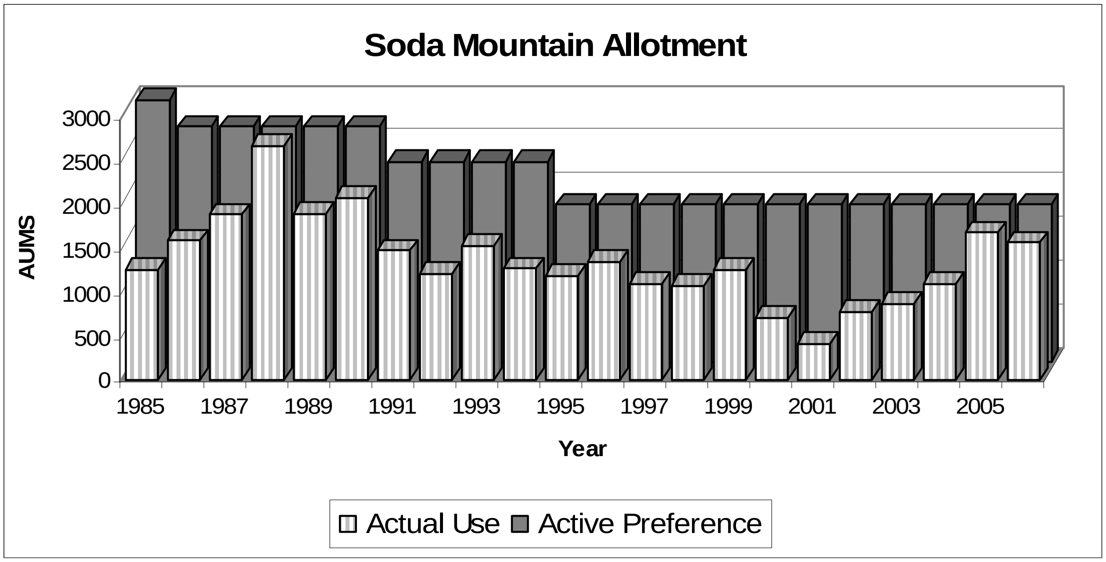
Early accounts indicate that livestock were allowed to roam freely over the Monument and surrounding southwest Oregon rangelands from early spring until snowfall (Wright 1968). Cattle were gathered in the fall to prevent them from perishing in the snow, and kept near the homestead in pastures and harvested grain fields that were fenced with brush or split rails (Beeson, unpublished). With spring green-up, cattle were allowed to follow snowmelt up to higher elevations, likely mimicking the annual movement patterns by deer and elk. An early agency reported that the intent was to use livestock to reduce the fire hazard by maintaining low fuel levels in the wildlands (Ingram 1922). Early Forest Service rangers complained that livestock utilized forage before plants had completed growth, thereby impairing productivity. Photos dated as late as April 1960 show cattle on denuded pastures at mid-elevation within the Monument, indicating early season overuse. In response to competition for the forage base, livestock grazing associations were formed to better manage and allocate forage to groups of cattlemen. This competition included strategic acquisition of range by cattlemen to put sheepmen out of business (Wright 1968). The susceptibility of sheep to predators doubtlessly played a role in the fact that herds of sheep were always accompanied by herders. Leases by the governing agencies identified the need for a herdsman to accompany livestock on the allotment. Despite the presence of herdsmen, it appeared that livestock frequently roamed in unpermitted areas. To further control livestock, fences were constructed and water sources developed.

Homesteaders always settled near a water source for domestic and livestock needs. Wright (1968) mentioned cleaning existing springs to facilitate the availability of water for livestock. Since then, many seeps and springs have been developed into livestock watering points or sources of water for combating wildfire.

Contemporary Stocking rates

Current permitted livestock grazing in the Monument is managed by the BLM as nine grazing allotments, two of which are currently vacant. Five of the active allotments account for 97% of authorized livestock use, as measured by Animal Unit Months (AUM; the amount of forage required to sustain a cow and calf for one month). Existing grazing leases authorize a total of 2,714 active AUMs (Active Preference, Figure 4) within the monument during the grazing season. The number of 2,714 AUMs is for those portions of allotments within the CSNM boundary. For example, 99% of the Soda Mountain Allotment, and 44% of the Keene Creek Allotment are located within the

CSNM boundary. The average actual use reported by permittees for the Soda Mountain and Keene Creek Allotments between 1985 and 2006 is 58%. (63% for Soda Mountain and 49% for Keene Creek Allotments). These numbers represent the entire allotments, not just the portion within the CSNM boundary (Figure 4).



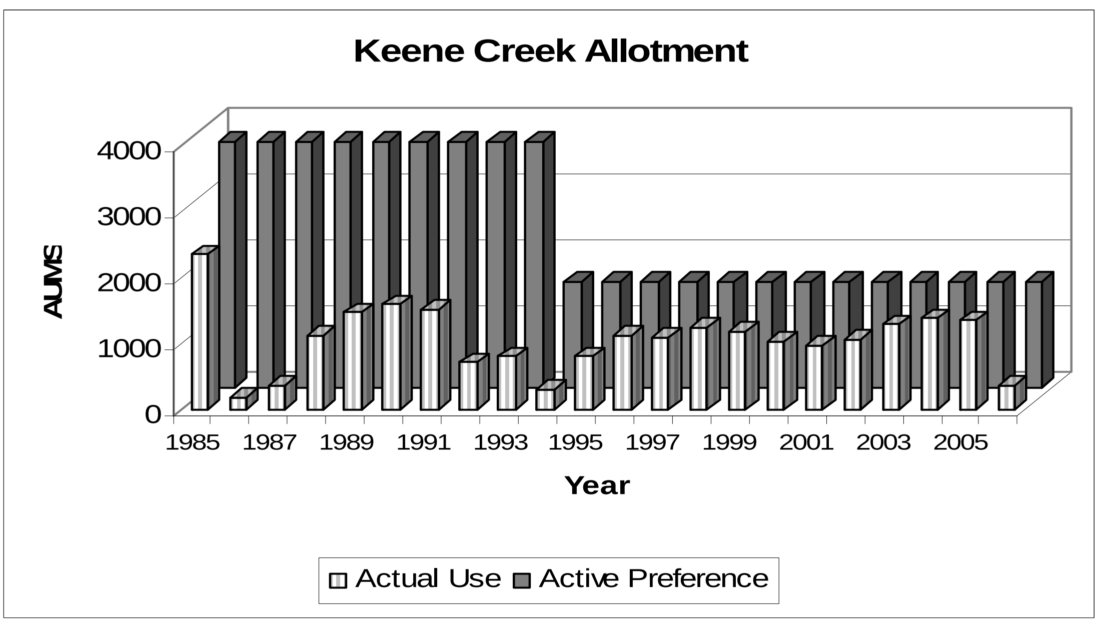


Figure 4. Resource Management Plan defined Active Preference and Actual Use reported by permittees for Soda Mountain (upper chart) and Keene Creek (lower chart) allotments.

Utilization

Individual Species

Utilization for all key species along transects ranged between 7.7 percent and 87.5 percent, with a mean of 41.1 percent ±1.4 percent standard error (SE). Mean utilization scores by species varied from 28.7 percent for *Festuca roemerii* to 46.6 percent for *Phleum pratense* (Table 1).

Table 1. Ranking of herbaceous species by utilization score.

Species or Genus	**Mean Utilization ± SE**
Festuca roemerii	28.7 ± 2.9
Dactylis glomerata	29.0 ± 14.0
Elymus glaucus	39.6 ± 7.1
Juncus sp.	41.2 ± 10.3
Achnatherum lemmonii	42.8 ± 3.5
Carex sp.	43.4 ± 2.2
Scirpus microcarpus	43.9 ± 6.0
Danthonia californica	45.2 ± 5.9
Phleum pratense	46.6 ± 5.5
Pseudoroegneria spicata	64.5 ± 3.5

Table 2. Palatability ranking for key graminoids.

High palatability	**Moderate palatability**	**Low palatability**
Danthonia californica	*Achnatherum lemmonii*	*Bromus carinatus*
Agropyron repens	*Agrostis capillaris*	*Elymus glaucus*
Carex sp.	*Glyceria striata*	*Juncus sp.*
Phleum pratense	*Scirpus microcarpus*	*Dactylis glomerata*
	Festuca roemerii	*Holcus lanatus*

Elderberry (*Sambucus mexicana)* and cottonwood (*Populus* sp.) had the highest PLU of the species sampled, with 71% and 57% respectively (Table 3). Serviceberry (*Amelanchier alnifolia*) and spirea (*Spirea douglasii)* had the lowest PLUs with 7.3% and 8.8%.

Table 3. Ranking of key shrub species by percent leader use as measured by the Cole Browse technique.

Species	Mean Percent Leader Use ± SE
Sambucus mexicana	71.0 ± 2.0
Populus sp.	56.9 ± 9.6
Crategus douglasii	47.0 ± 4.0
Philadelphus lewisii	34.9 ± 10.3
Symphoricarpos albus	33.0 ± 9.8
Salix sp.	12.2 ± 3.0
Fraxinus latifolia	10.8 ± 6.8
Spiraea douglasii	8.8 ± 4.3
Amelanchier alnifolia	7.3 ± 2.3

Observations on livestock forage preferences

In most studies, cattle prefer grasses and grass-like plants to forbs and shrubs. In northeastern Oregon, Holechek *et al*. (1982) found that grasses and grass-likes made up 80% of cattle diets, while forbs made up 12% and shrubs 8%. In the Sierra Nevada of California, cattle diets consisted of 27 to 44% grass, 30 to 43% grass-like, 16 to 33% forbs, and 0.2 to 0.7% shrubs, with shrubs and forbs decreasing in importance as the season progressed (Huber *et al.* 1995). Grasses in the Monument with high forage value include two native perennials *Danthonia californica,* and *Festuca idahoensis* (Smith 1985). Non-native grass species include *Poa pratensis* and *Phleum pratense*. Upland grass species often decrease in nutritive quality toward the end of the growing season, making wetland graminoids (e.g., *Scirpus microcarpus* and *Carex* sp.), more attractive to livestock (Oelberg 1956; Holechek *et al*. 1982; Huber *et al*. 1995). This pattern of use is also evident in seasonal fecal compositional change of native and non-native ungulate scat collected within and adjacent to the CSNM (Hosten et al. 2007b).

Rehnfeldt (1976) described cattle use of antelope bitterbrush on the Agate Flat in the southern-most portion of the Monument. Cattle browsing of buckbrush (*Ceanothus cuneatus*), an important winter forage for native ungulates was linked to winter die-off of deer (legends to unpublished photos). Cattle more often use shrubs in early spring, when shoots are more palatable and nutritious (Kie 1986; Holechek *et al*. 1982), or in riparian areas especially late in the season (Kauffman and Krueger 1984; Roath and Krueger 1982; Smith *et al*. 1992). Exclosures to study the effects of timing of livestock grazing on shrub browsing were established in the 1960's. Although any data collected has been lost, results apparently supported later turnout dates, and the delineation of critical deer winter areas. Cole browse utilization transects later showed limited use of *Ceanothus cuneatus* by cattle at the beginning of the grazing season. Observations by range technicians working within the Monument indicate a pattern of use of elderberry at the end of the grazing season, particularly during drought years (Stevens 1999, 1995, 1992, 1990). Cattle browse common shrubs in the Monument, including *Symphoricarpos albus*, *Populus spp., Sambucus mexicana, Salix spp., Ribes spp., Amelanchier alnifolia,* and *Ceanothus cuneatus*, especially in drought years (BLM Range Technician comments; Mitchell and Rogers 1985; Kie and Boroski 1996).

Landscape-level Patterns

At the pasture and allotment level, utilization scores ranged from 18.8% in the North Pasture of Jenny Creek Allotment to 60.3% in the Camp Creek Pasture of Soda Mountain Allotment. Utilization among pastures was significantly different based on one way Analysis of Variance (ANOVA; df=12, F=3.145, p=0.001).

Derived maps of utilization

Annual utilization maps were compiled into three GIS base descriptors of livestock and native ungulate utilization. These include average utilization (Figure 5), maximum utilization (Figure 6), and years of rest since the last years of grazing prior to the year of this study (Figure 7). Further quantification of the average utilization maps follows. Descriptions are restricted to average utilization since it is more representative of year-to-year utilization, and excludes possible outlier estimates from any particular year.

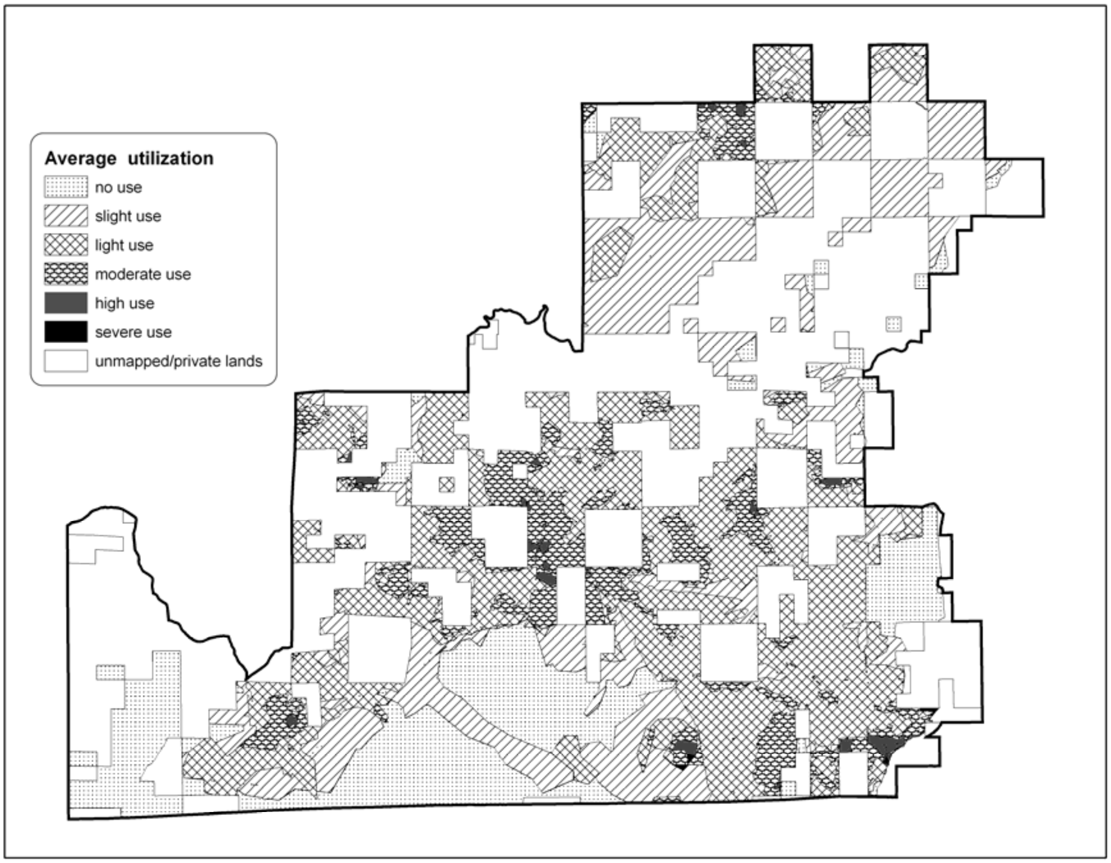


Figure 5. Average utilization calculated on a pixel-by-pixel basis for all areas of mapped, with 2003/2004 utilization transect locations.

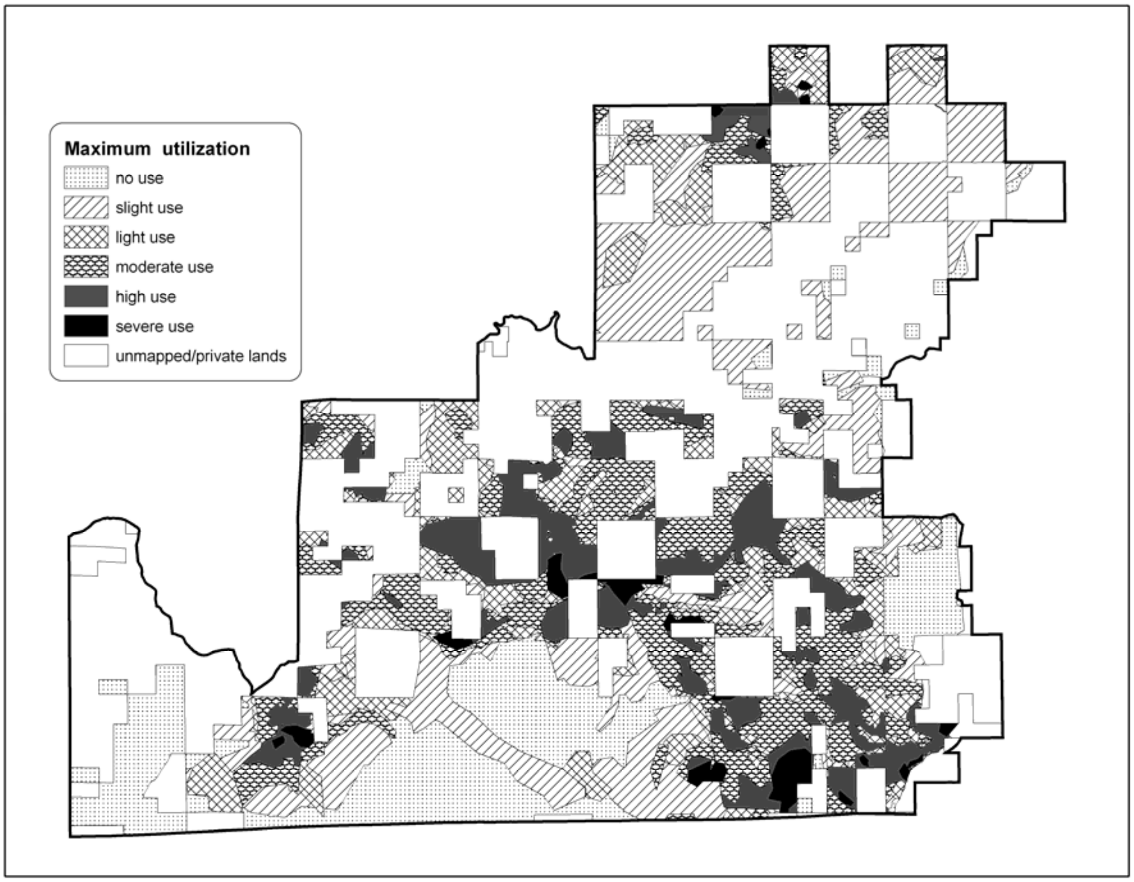


Figure 6. Maximum utilization calculated on a pixel-by-pixel basis for all areas mapped, with 2003/2004 utilization transect locations.

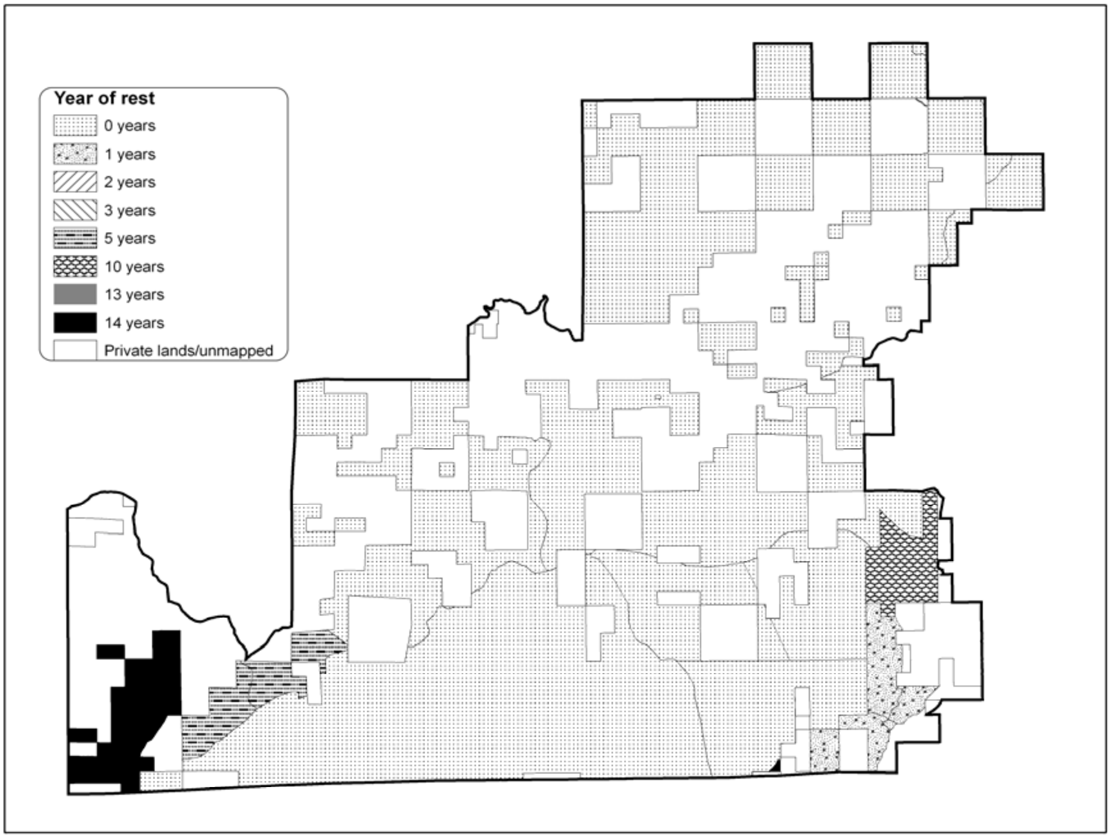


Figure 7. Years of rest prior to the completion of utilization study, with 2003/2004 utilization transect locations.

Validation of average and maximum utilization maps

The synthesized map showing average utilization values was the best fit to the utilization transect data (2003 and 2004 data), with a mean difference of 0.75 utilization classes ±0.06 SE. The maximum utilization map deviated from ground-verified data by 1.23 utilization classes ±0.08 SE. The map for the 2004 grazing season was the worst fit, with a mean difference of 2.0 utilization classes ±0.12 SE.

CSNM-wide occupation by average utilization classes

Eighteen percent of the CSNM landscape received no use over the past 15 years. Twenty-six percent of the landscape shows light use. Percent occupation by utilization class decreases with increasing utilization class so that only 11% of the landscape shows moderate use. The percent occupation of the landscape by no use and slight use for the maximum utilization map are similar to the average utilization map (Table 4, Figure 8). The area occupied by light use under the maximum utilization map is considerably less for the same class under average utilization. Moderate and severe use under the maximum utilization map are considerably higher than the equivalent classes for the average utilization map.

Table 4. CSNM landscape-wide occupation by livestock utilization classes defined by the average and maximum utilization classes.

	Percent Occupation of Public Landscape	
Utilization Class	Average Utilization	Maximum Utilization
No Use	18	21
Slight Use	26	28
Light Use	37	15
Moderate Use	11	20
Heavy Use	0	14
Severe Use	1	2
No Data	7	5

In the following discussion, utilization is confined to average utilization because it reduces the influence of incidental extreme use by livestock as well as mis-mapping. While the pattern of utilization remains the same for all pastures and allotments, the percent of unused landscape may vary. For example, the Siskiyou and Agate Allotment have been unoccupied by livestock over the period examined. Camp Creek Pasture shows more than 40 percent unused landscape, while Skookum Pasture, Oregon Gulch Pasture, Agate Flat Pasture, and Keene Creek Pasture show less than 10 percent unused landscape. Some pastures are dominated by slight use (Keene Creek Allotment, Old 99 Pasture) while others are dominated by light and moderate utilization classes (Skookum, Agate Flat, Pilot Rock) (Figure 8).

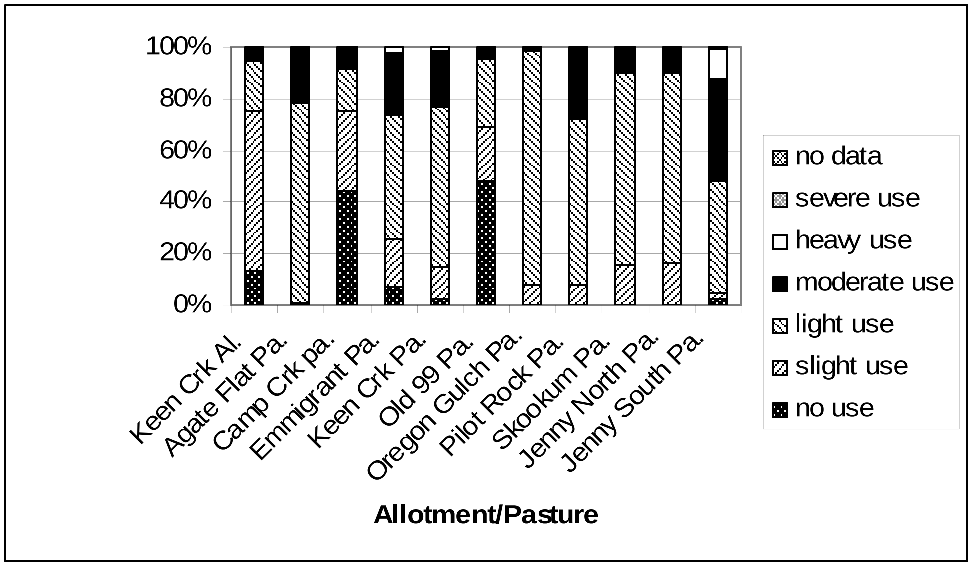


Figure 8. Percent occupancy of CSNM allotments and pastures by average utilization classes.

CSNM-wide occupation by distance from road classes

Forty percent of the public lands within the CSNM boundary fall within 100 meters of a road (Table 5). The percentage occupation of the CSNM landscape by road distance increments decreases with distance from roads (Table 5).

Table 5. Percent occupancy of the CSNM landscape by distance from road increments.

Distance From Road (meters)	Percent Occupation
100	40
200	24
300	13
400	8
500	5
600	3
700	2
800	2
900	1
1000	1

This ratio of distance from road increments of the landscape holds true for individual allotments/pastures (Figure 9), with a few exceptions. These exceptions are small allotments/pastures (Agate Allotment and the Jenny North Riparian pasture) which are not typical of the landscape.

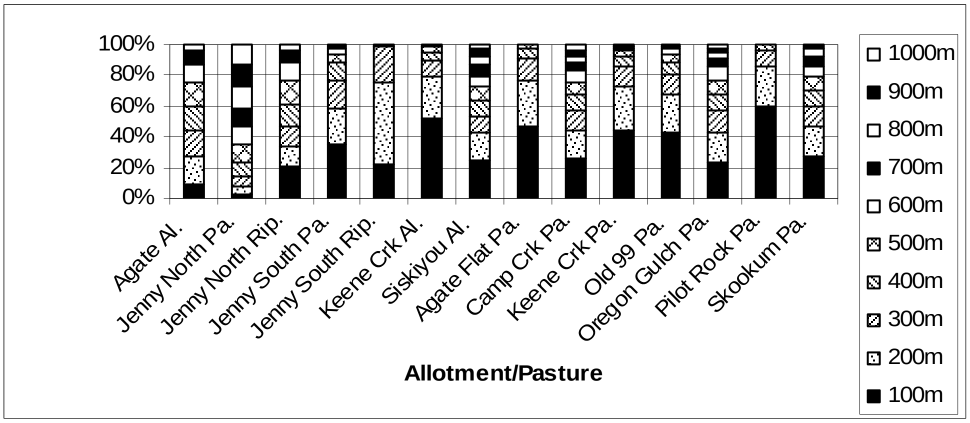


Figure 9. Percent occupation of the landscape by distance from road increment for individual allotments/pastures.

Average utilization class summarized by distance from road

Graphing of percent occupation (by area) of utilization class by 100 meter distance increments from roads for the whole CSNM shows a greater proportion of higher utilization levels adjacent roads (Figure 10).

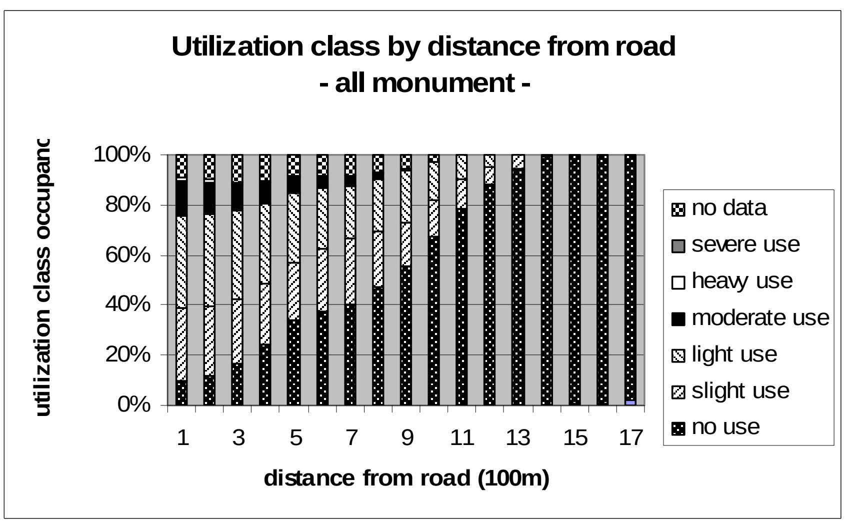


Figure 10. Percentage occupation of the landscape by distance from road increment for the entire Cascade-Siskiyou National Monument.

Modeling the relationship between utilization maps and predictor variables

Models for maximum and average utilization incorporate the same variables, differening only in tolerance and sensitivity (Table 6). The best-fir models include topographic (elevation), edaphic (soil texture and depth), and management factors. Elevation and distance show the greatest tolerance (a measure of importance across the landscape), but very low sensitivity. Edaphic factors and distance from road show lower tolerance, but much greater sensitivity, indicating their importance at more localized scales. In the case of management factors, the localized importance is due to the presence of ungrazed allotments/pastures within the analysis area.

Table 6. Variables retained for predicting maximum and average utilization across public lands of the CSNM. Tolerance and sensitivity are provided for continuous variables in brackets (percent tolerance; sensitivity).

Response Variables	Maximum Utilization	Average Utilization
Predictive Variables	Elevation (35; 0.0454) Soil depth (5, 0.2754) % clay (5, 0.5079) % silt (5, 0.1830) % sand (5, 0.3429) Years since last grazed (5, 0.1532) Distance from water (30, 0.0802) Distance from road (15, 0.2265) Non-conifer management - [R2 = 0.40]	Elevation (35; 0.0421) Soil depth (5, 0.2726) % clay (5, 0.4516) % silt (5, 0.1623) % sand (5, 0.3068) Years since last grazed (5, 0.1434 Distance from water (30, 0.0683) Distance from road (15, 0.2109) Non-conifer management - [R2 = 0.42]

Utilization is highest closest to roads and water (Figure 11), with roads having the strongest influence.

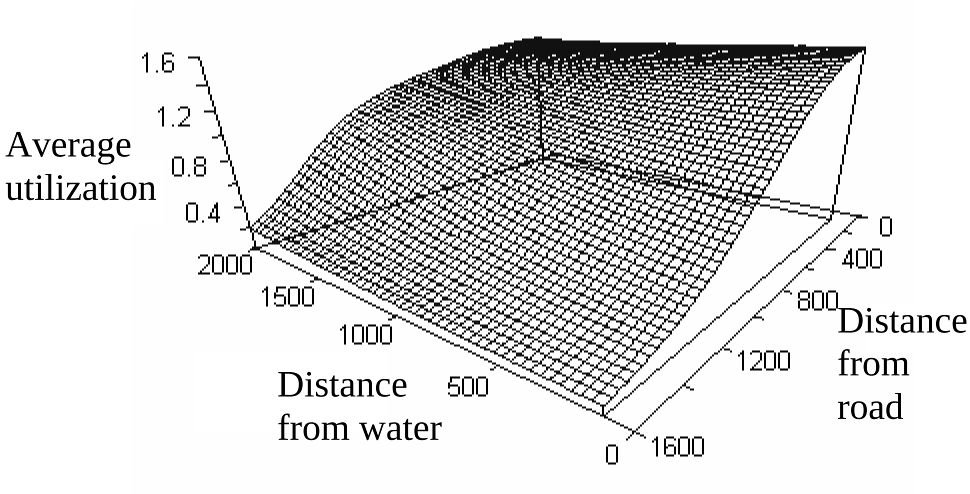


Figure 11. Model output relating distance from water and roads to average utilization.

Average utilization generally occurs on shallower soils across the elevation gradient presented by Figure 12. Average utilization is lower on deeper soils, likely because tree canopy restrict the availability of light to produce forage. Where high utilization is apparent at high soil depth, it is likely due to unmapped shallow soil inclusions within deeper soils.

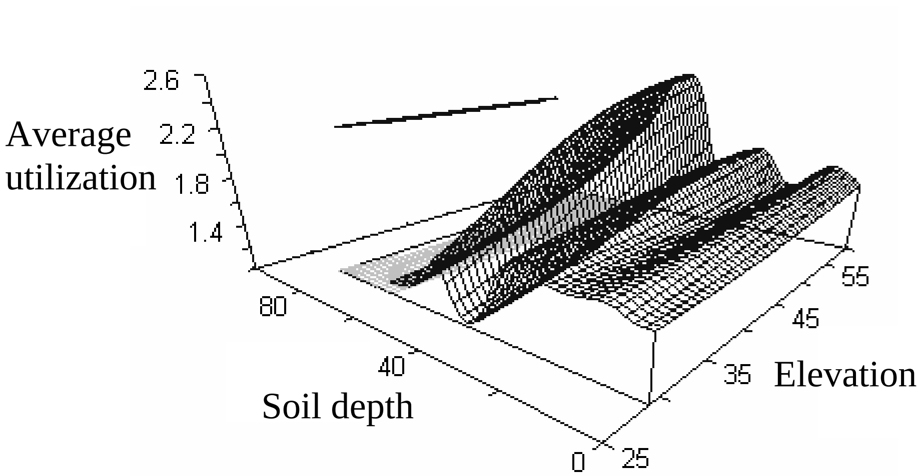


Figure 12. Model output relating elevation and soil depth to average utilization.

The relation between average utilization and soil texture (Figure 13) reflects increased ungulate presence closer to riparian areas (dominated by silts) and the role of shrink-swell clays in the maintenance of open meadows at lower elevation.

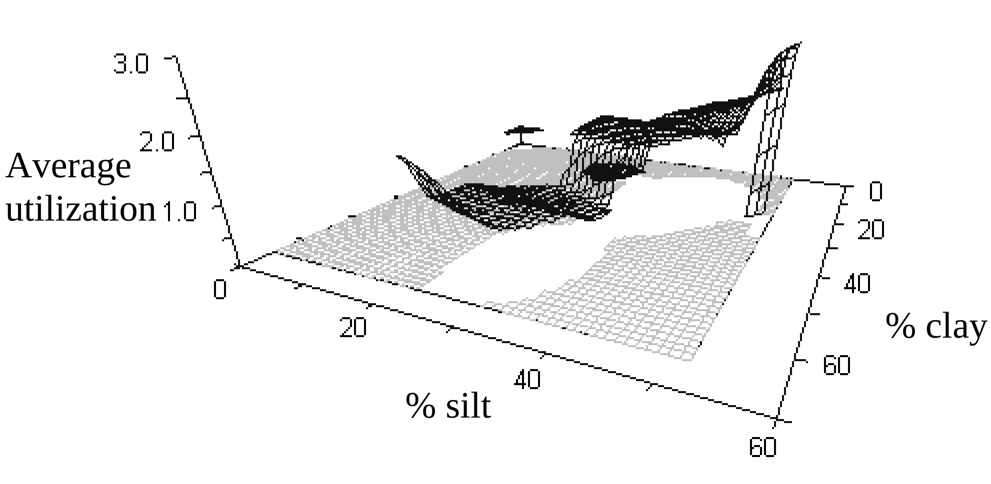


Figure 13. Model output relating soil texture to average utilization.

Range Management Activities

The Range Improvements Projects System (RIPS) reveals two major periods of fence-building and associated projects (Figure 14). Fences were built during the 1950s and 1960s to construction of the stateline fence by decreeing “Oregon grass for Oregon livestock.”. The second and ongoing increase in fence construction involves maintenance (including the initial stateline fence construction), exclusion of sensitive areas and hot spots, and the construction of livestock exclosures.

Most springs at lower elevation and many at higher elevation show sign of development. Unpublished maps of surveys for potential stockponds show proposed livestock water developments. An examination of stockpond construction projects listed within the RIPS database (Figure 15) shows that stockpond construction occurred along with fence construction. In addition to improving the dispersion of livestock across the landscape, spring development likely became necessary as water sources were fenced off in the partitioning of the rangeland into pastures and allotments.

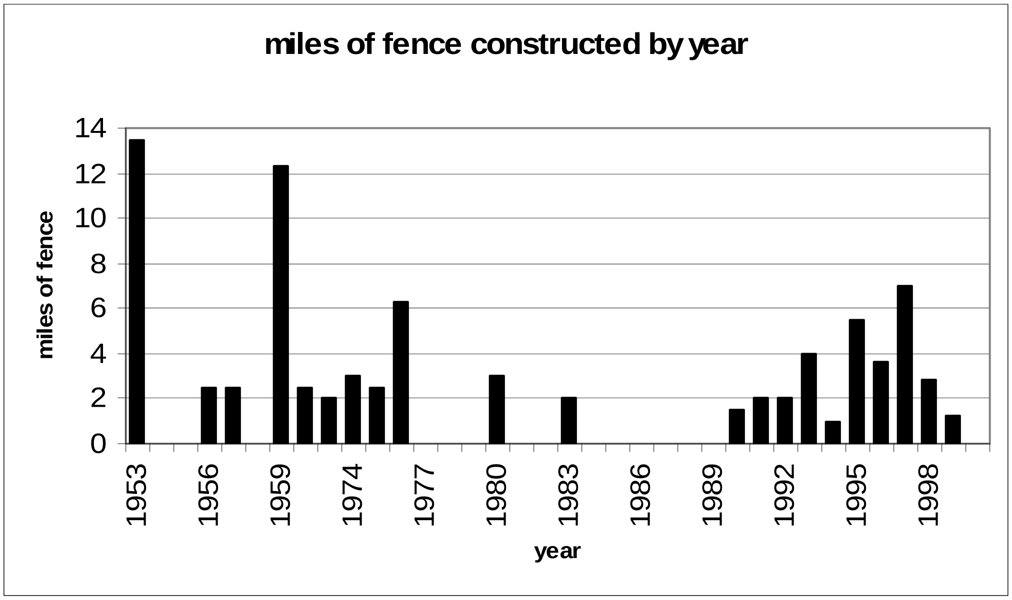


Figure 14. Miles of fence construction within the CSNM, compiled from the BLM Range Improvements Projects System.

Fencing and water enabled ranchers to keep livestock longer at lower elevations and allow the vegetation at higher elevations to develop further before grazing. Fencing off water sources and attempts to retain cattle at lower elevations required the development of springs and seeps to ensure water for stock. The continued development of the fenced allotment and pasture system likely lessened the need for herding.

Thomas (1949) reported herbicide application (2-4-D) to eradicate skunk cabbage and tall larkspur. Archived correspondence from the 1960s and 1970s discussed herbicide application to control wild cucumber in the vicinity of Soda Mountain and larkspur at other locations. Archived photos showed the application of chemicals to oak thickets on Keene ridge. More recently, the herbicide glyphosate was used to control noxious weeds, including Canada thistle and yellow starthistle. Only one instance of aerial application of fertilizer has occurred in the Monument: in the Camp Creek area with the intention of improving forage quality.

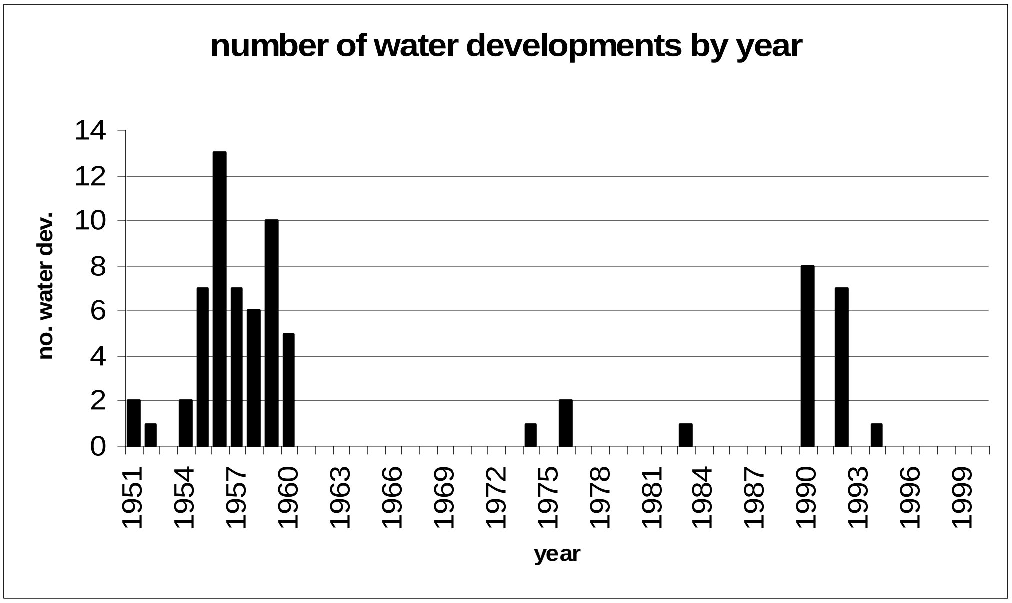


Figure 15. Number of water developments within the CSNM, as reported within the BLM Range Improvements Projects System.

The first mention of prescribed fire was an experiment in 1948 and 1949 and was accompanied by seeding (Thomas 1949). The potential for runaway fire has doubtlessly limited the use of fire as a tool within the Monument. Prescribed fire from the 1960s, 1970s, and 1980s was either limited in extent, or occurred late enough in the season that burning was very spotty, and had little impact. Prescribed fire in the 1990s was restricted to the flat pasture lands near Jenny Creek on the Box-O Ranch.

Scarification, the removal of woody overstory vegetation using a dozer, was a popular treatment of the 1960s, 1970s, and 1980s. The objective was to create openings in the woody overstory to favor herbaceous forage for livestock and native ungulates. Scarification was usually followed by seeding.

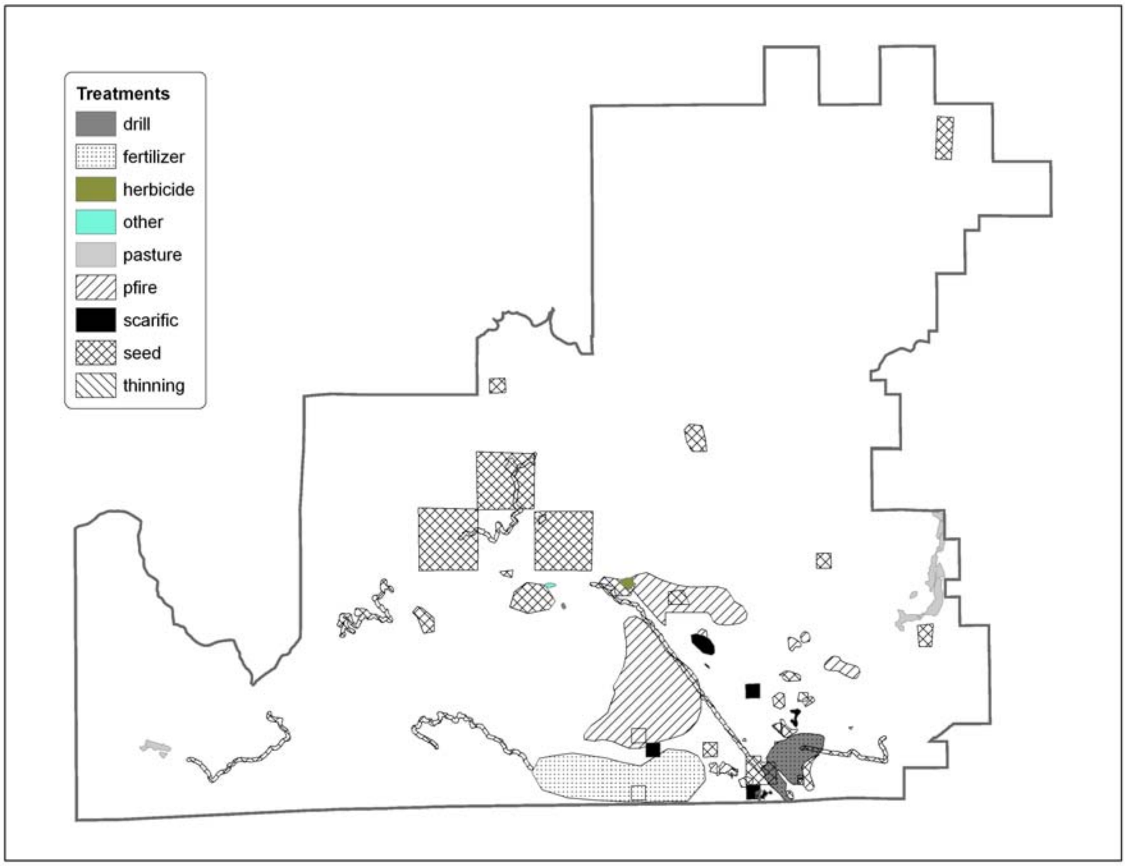


Figure 16. Management activities in non-conifer communities of the CSNM.

Agencies recommended aggressive seeding by cattlemen's associations on cutover lands in conjunction with deferred and rotation grazing systems to improve meadows (Thomas 1953). Seeding grass on logged areas, cat trails, and slash burnpiles was suggested as a way of increasing forage. Several seeding projects had already been undertaken by 1949 on public as well as private lands (Thomas 1953). Early records suggest that seeding was also used as a way to improve areas degraded by livestock. Records exist for four seed application trials on the CSNM (three on Agate Flat, and one on Soda Mountain). Seeding became standard practice following scarifications, road construction, and wildfire (see Figure 16). Photos indicate some prescribed fires were also followed by seeding. A total of 1,174 acres are recorded as having been seeded (Table 7).

Table 7. Acres and number of seeding projects in the CSNM.

Year	Acres	No. of projects
1949	11	1
1950	70	1
1951	120	2
1952	60	2
1954*	100	2
1955	100	7
1956	60	1
1957	80	4
1959	3	2
1960	17	2
1963	20	1
1968	2.5	4
1969	5	4
1970	20	3
1971	2	9
1972	**	5
1973	**	2
1975	412	1
1976	1	2
1977	88	1
1980	1	1
1998	1.5	1
Total:	1174	58

* two projects are listed as seeding completed along a total of 2.5 miles
** acreage not provided

Over fifty varieties of grasses, forbs, and shrubs have been seeded in the CSNM during the past sixty years, most of them non-native (Table 8). The seeding of shrubs (native bitterbrush and buckbrush) was limited to small areas in Agate Flat. Native grasses were seeded only in experimental areas until agricultural production of native grass seed made it feasible to seed larger areas. The bulk of the seed applications therefore comprise non-native grasses and forbs (Table 8).

Table 8. List of plant species included in seed mixtures used in CSNM since 1950.

Scientific Name	Common Name	Life Form	Origin
Bromus catharticus	rescuegrass	annual grass	non-native
Astragalus cicer	cicer milkvetch	forb	non-native
Astragalus sp.	astragalus	forb	non-native
Lotus corniculatus	birdsfoot trefoil (Cascade, dwarf)	forb	non-native
Lotus sp.	Douglas lotus	forb	non-native
Medicago polymorpha	burr clover	forb	non-native
Medicago sativa	alfalfa (Ladak, nomad, rhizoma)	forb	non-native
Melilotus officinalis	sweet clover (yellow, white)	forb	non-native
Onobrychis viciaefolia	onar sainfoin	forb	non-native
Sanguisorba minor	small burnet	forb	non-native
Sanguisorba sp.	burnet; mau burnet	forb	non-native
Secale cereale	cereal rye	forb	non-native
Trifolium hirtum	rose clover	forb	non-native
Trifolium repens	white Dutch clover	forb	non-native
Trifolium subterraneum	sub clover; t. baker subclover	forb	non-native
Vicia dasycarpa	lana vetch	forb	non-native
Vicia pannonica	Hungarian vetch	forb	non-native
Vicia villosa	hairy vetch	forb	non-native
Elymus trachycaulus	primar slender wheatgrass	per. grass	non-native
Agropyron cristatum	crested wheatgrass (Fairway)	per. grass	non-native
Elymus lanceolatus	thickspike wheatgrass	per. grass	non-native
Agropyron desertorum	nordan crested wheatgrass	per. grass	non-native
Thinopyrum ponticum	tall wheatgrass (Alkar, Largo)	per. grass	non-native
Pseudoroegneria spicata ssp. *inermis*	beardless wheatgrass (Whitmar)	perennial grass	non-native
Thinopyrum intermedium	intermediate wheatgrass (Greenar)	per. grass	non-native
Agropyron fragile	Siberian wheatgrass	per. grass	non-native
Pascopyrum smithii	western wheatgrass	per. grass	non-native
Thinopyrum intermedium	pubescent wheatgrass (Topar)	per. grass	non-native
Agrostis gigantea	redtop	per. grass	non-native
Alopecurus pratensis	meadow foxtail	per. grass	non-native
Arrhenatherum elatus	Tualatin oatgrass	per. grass	non-native
Bromus inermis	smooth brome (Manchar)	per. grass	non-native
Bromus marginatus	mountain brome (Bromar)	per. grass	non-native
Dactylis glomerata	orchardgrass (Potomac)	per. grass	non-native
Elymus glaucus	blue wildrye	per. grass	native
Psathyrostachys juncea	Russian wildrye	per. grass	non-native
Schedonorus arundinaceus	tall fescue (Alta, Goars)	per. grass	non-native
Festuca idahoensis	Idaho fescue	per. grass	native
Festuca trachyphylla	sheep fescue, Durar hard fescue	per. grass	non-native

Festuca rubra	creeping red fescue; red fescue	per. grass	non-native
Lolium perenne	h-1 ryegrass, perennial rye	per. grass	non-native
Muhlenbergia porteri	mesquite grass	per. grass	non-native
Phalaris arundinacea	reed canarygrass	per. grass	non-native
Phalaris aquatica	harding grass	per. grass	non-native
Phleum pratense	drummand timothy; timothy	per. grass	non-native
Poa secunda	big bluegrass (Sherman)	per. grass	non-native
Poa bulbosa	bulbous bluegrass	per. grass	non-native
Poa compressa	Canada bluegrass	per. grass	non-native
Poa pratensis	Kentucky bluegrass (Delta)	per. grass	non-native
Ceanothus cuneatus	buckbrush	shrub	native
Purshia tridentata	bitterbrush	shrub	native

Conclusions

Utilization data, including historic and contemporary stocking rates, livestock herd composition, browse and forage utilization (including seasonal patterns), individual plant species preference, and landscape-level utilization patterns reflect the literature representing the Pacific Northwest.

Livestock numbers increased rapidly with European colonization. Sheep were more numerous than cattle until 1920. Although the transition from sheep to cattle husbandry was less violent than in other parts of Oregon, the memoirs of George Wright recorded competition for grazing resources (the strategic acquisition of key pastures by the cattlemen) and his disdain for sheepmen (Wright 1968). Early Forest Service rangers noted heavy utilization by livestock and consequent degradation of the forage resource. Current stocking rates are lower than historic stocking rates by at least an order of magnitude.

Under historic season-long grazing, cattle browsed shrubs such as antelope bitterbrush and buckbrush, likely contributing to winter die-off of deer. Other contributing factors likely include high deer populations and the influence of fire suppression on the availability of palatable shrub browse (Peek et al 2001, 2002). Early exclusion studies indicated that delaying the grazing season would reduce livestock use of shrubs. This together with the proclamation of winter deer areas alleviated the winter deer die-off. Prescribed fire and scarifications were implemented in part to improve habitat for wildlife. Recent Cole-Browse transects indicate that cattle browsing of shrubs at lower elevations in the Monument is minimal. As reflected by the literature and fecal composition analysis within the CSNM (Hosten et al. 2007b), use of riparian shrubs increases towards the end of the grazing season as upland forage dries out and becomes less palatable. The use of elderberry early in the grazing season at high elevations, indicates that elderberry is a desirable species, and use is not based solely on availability after the herbaceous forage has cured. The ranked palatability of herbaceous species also reflects local knowledge and publications.

The seasonality and pattern of livestock movement has changed over time. Turnout dates were gradually delayed by judicial use of fencing and spring development, and areas allocated to a particular season of use. Lower elevation sites were designated for spring use, mid-elevation for summer use, and higher elevation for late summer and fall use. As with early pioneers, snowfall (mid-October) still governs the end of the grazing season despite early observations by Forest Service rangers that the forage was depleted by mid-September. In addition to seasonal restriction in pastures, lower stocking rates likely result in much lower utilization rates than historic levels, at least outside of severe use areas. The historic practice of herding and/or full utilization of the forage base closer to water must have resulted in a more equitable distribution of livestock across the landscape. Despite this more even distribution, the higher stocking rates resulted in higher utilization across the landscape as indicated by livestock trailing evident in historic photos of the Monument and southwest Oregon (Hosten et al. 2007a). The development of water sources and fences were no doubt mitigating factors to maintain cattle dispersion following the decline of active herding.

The results of modeling maximum and average utilization as response variables to environmental, biotic, and management predictors is validated by the literature. Factors such as elevation, distance from water, and distance from roads and slope play a primary role in livestock dispersal at the landscape scale. Soil factors relate to landscape features, for example, high silt content identifies a proximity to riparian areas, while shrink-swell clays relate to the role of soil texture in the expression of vegetation (Hosten et al. 2007a).

The quantification of actions (scarification, seed application, etc) ancillary to livestock management indicate the potential for multiple and synergistic management influences on the landscape. In particular, since much of the Monument is near roads and water-sources, these factors can be expected to influence landscape patterns of livestock dispersion and consequently vegetation attributes on a landscape scale. Given their small footprint, prescribed fire, herbicide application, fertilizer application and scarifications likely have little long-term direct impact across the landscape. Seeding associated with many of the projects may be an exception; although total area directly seeded is small, there is considerable potential for introducing invasive plant species, especially considering the large number of plant species purposely introduced to replace less palatable species.

Acknowledgements

Jeff Lalande and Ann Ramage both helped locate historic livestock utilization records. Steve Slavik helped design the utilization transects, and trained technicians to implement the transects throughout the Cascade-Siskiyou National Monument. Frank Lospalluto, Jherime Kellerman, Dominic Di Paolo, Kevin Glueckert, and Sherri Kies from the Klamath Bird Observatory spent many hours collecting utilization data throughout the Monument.

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