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Green Fescue Rangelands: Changes Over Time in the Wallowa Mountains

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Cover Photo

Leaving Tenderfoot Basin following 60th-year revisitation of Reid's study sites. Photo by David Jensen.

Unless otherwise noted, all photographs were taken by the author.

Abstract

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This publication documents over 90 years of plant succession on green fescue grasslands in the subalpine ecological zone of the Wallowa Mountains in northeast Oregon. It also ties together the work of four scientists over a 60-year period. Arthur Sampson initiated his study of deteriorated rangeland in 1907. Elbert H. Reid began his studies of overgrazing in 1938. Both of these individuals utilized high-elevation green fescue grasslands in different locations in the Wallowa Mountains for their study areas. Then in 1956, Gerald Strickler returned to the sites previously studied by Sampson and Reid to establish the first permanent monitoring points when he located and staked camera points they had used. He also established line transects where he photographed and sampled the vegetation to benchmark the condition of the sites. In 1998, on the 60th anniversary of the Reid camera points in Tenderfoot Basin, the author returned to document the changes in the vegetation on the Sampson and Reid sites establishing photographic comparisons and resampling the transects Strickler had established. When Sampson and Reid conducted their initial studies, domestic sheep had overgrazed the vegetation leading to severely eroded soils and weakened native vegetation. In recent years, the presence of domestic sheep had declined dramatically. As a result, vegetation trends were generally found to be static or upward on most of the sampled sites. The recent drought period (1985-92) and the high population of elk in the 1980s and 1990s contributed to the downward trend on some permanent monitoring sites. The use of repeat photography from permanent camera points and the use of permanent line transects for vegetation data acquisition provide the basis on which this comparative study and publication of findings was made possible.

Keywords: Green fescue, Wallowa Mountains, Arthur Sampson, Elbert Reid, Gerald Strickler.

Green fescue slopes with Sentinel Peak in the distance.

Introduction

The subalpine grasslands of the Wallowa Mountains provided forage to bighorn sheep and mountain goats, domestic sheep of ranchers, and domestic horses of the Nez Perce Indians through the beginning of the 20th century. Then in 1907, America's "Father of Range Management," Arthur W. Sampson, initiated one of the first rangeland research projects on national forest lands and used green fescue rangelands for his studies. His work was followed by that of Elbert H. Reid and G.D. Pickford in 1938 with their studies of utilization and plant community succession following severe overuse by domestic sheep. Gerald S. Strickler followed Reid's efforts with his 1956-57 baseline monitoring of green fescue sites in Tenderfoot Basin and Sampson's green fescue sites on the Standley and Sturgill ranges.

Wade B. Hall, long-time range staff officer of the Wallowa-Whitman National Forest, was instrumental in getting Reid — after his retirement — to return to Tenderfoot Basin. In 1956, 18 years after Reid had photographed the study sites in Tenderfoot Basin, Reid and Strickler were able to relocate 36 of 57 camera points. Hall was instrumental in initiating a revisitation every 10 years by Reid to rephotograph and note changes in the vegetation from the previous visit. Starting in 1968, Reid returned to northeast Oregon and, accompanied by Hall and Strickler, made August pilgrimages back to Tenderfoot Basin that year and again in 1978. Reid and Hall revisited the basin for one last time in 1988, marking the 50th year since the initial study and photography had been taken. Reid and Hall led the author to the camera points where photography was then retaken, locations remonumented and mapped, and ecological information recorded. That information was published in Reid and others (1991).

This publication documents the changes in green fescue communities over a 60-year period in Tenderfoot Basin. In 1998, the author documented changes and rephotographed camera points on the sites established by Reid in 1938, as well as those at Standley Spring and Sturgill Basin on sites first visited by Sampson in 1907. The author also provided findings of a comparative analysis on Strickler's vegetation transects of 1956 at Tenderfoot Basin, Standley Spring, and Sturgill Basin. Common at all sites is green fescue and the successional relation of the plant communities following ungulate disturbances and curtailment of severe grazing pressure over a long period.

Pioneering Ecologists

Sampson (fig. 1) conducted some of the first studies to test principles of range and livestock management in the United States on the Wallowa National Forest from 1907 to 1911. At this time, livestock use was at an all-time high on federal lands. Many rangelands were rapidly deteriorating with accelerated erosion resulting from overgrazing. Administrators of the "new" national forests needed sound management information to guide their management of the rangelands.

In 1907, Sampson and James T. Jardine were selected to study the rangelands in the mountains of northeast Oregon. Sampson, with a background in ecology and botany, was well trained for this research undertaking. His studies provided information on how to use forage without negatively affecting the growth requirements of the plants. These studies led to the understanding of successional relations between plants of the native vegetation, the season for grazing without deteriorating the sites, and the early concepts of deferred and rotating grazing systems. He also studied the restoration practices of seeding nonnative forage plants on degraded high-elevation rangelands (Parker and others 1967).

Because of his pioneering studies, subsequent research, prolific writings, and fundamental teachings during the infancy of rangeland management in America, Sampson is known today as the "Father of Range Management."

In the 1930s, Reid (fig. 2) was an instructor at the School of Forestry at the University of California in Berkeley when he met Sampson. He became a student in the infancy of the science of range management. In 1937, he became a range ecologist at the newly formed range research branch in Portland, Oregon, at the Pacific Northwest Forest and Range Experiment Station (now the PNW Research Station). During his 11 years with the Station, he conducted research and authorized many publications on the proper use of rangeland plants, judging range condition, competition between livestock and elk, and methods for conducting rangeland surveys. It was during this period that he chose the green fescue rangelands of the Tenderfoot Basin in the subalpine zone of the Wallowa Mountains to conduct his studies of plant succession following overgrazing by domestic sheep. As a result, the 1938 baseline data were established by using his camera points to enable future revisits and documentation of changes attributed to climatic factors. Reid would return to Tenderfoot Basin in 1956, 1968, 1978, and 1988 to revisit the 1938 plot location and continue his ongoing effort to document successional changes.

Strickler (fig. 3) was highly recognized as an authority on the ecology of forests and grasslands of northeast Oregon. He served as the research plant ecologist with the Forest and Range Experiment Station (Pacific Northwest Region) in La Grande, Oregon, throughout his 25-year career (1956 to 1981). He was an excellent botanist and was widely respected for his knowledge of inland Pacific Northwest flora. One of his passions as a professional was the successional stories waiting to be told about green fescue in the Wallowa Mountains. He was cognizant of the sites at Standley Spring and Sturgill Basin (Standley-Sturgill) where Sampson had conducted his research. He also maintained a close professional relation with Reid and was instrumental in the initial revisitation by Reid to Tenderfoot Basin in 1956. As a result, Strickler coauthored three key publications that serve as references for the studies at Tenderfoot Basin (Reid and others 1980, Strickler 1961) and Standley-Sturgill (Strickler and Hall 1980).


Figure 1—Arthur W. Sampson (1884-1967), scholar, scientist, and educator.


Figure 2—Elbert H. “Bert” Reid (1912-1992), scholar, scientist, and educator.


Figure 3—Gerald “Gerry” Strickler (1928-1982), pioneering plant ecologist.

The Study Areas

Because green fescue grasslands supported most of the sheep on the Wallowa National Forest during summer, Sampson searched for depleted green fescue sites in the Wallowa Mountains for his intensive studies. He selected the area surrounding Standley Spring (fig. 4), at the head of Cougar Ridge, and Sturgill Basin (fig. 5), south of Bald Mountain on Washboard Ridge, in the northern Wallowa Mountains. These areas had been heavily grazed by sheep and cattle prior to the establishment of the Wallowa National Forest in 1905. The practice of grazing all available herbage from snowbanks in early summer to “snowfall” in early fall produced the depleted rangelands Sampson studied.

Both areas are on broad subalpine ridgetops at 7,400 feet elevation. The green fescue-dominated grasslands are surrounded by lodgepole pine,[1] subalpine fir, and Engelmann spruce forests. Precipitation is principally in winter when snows pile up to an average depth of 8 feet. The summer is dry with surface soils desiccating from lack of moisture and warm winds. Soils are deep, fine textured, and contain loess and ash. These attributes provide a high water-holding capacity enabling the fescue to dominate in late-seral stands. When overgrazing had reduced or eliminated the fescue plants, the soil surface dried. Western needlegrass became the plant best adapted to the resultant warmer and drier sites. Also increasing in abundance as a result of overuse and depletion of green fescue grasslands were Ross’ sedge, fleabane, yarrow, alpine fleeceflower, pussytoes, and prickly sandwort.

[1] See appendixes 1 through 3 for common and scientific names of species.

Figure 4—Standley Spring.

Figure 5—Sturgill Basin.

Tenderfoot Basin (fig. 6) is the head of the North Fork Imnaha River. The study area is approximately 690 acres of mostly gentle ridgetop, benchland, and basin bottom southeast of Pete’s Point and northeast of Sentinel Peak. Study location elevations range from 7,800 to 8,000 feet. The landscape is characterized by a dominance of grasslands with interspersed stands of whitebark pine occupying rockier sites, and subalpine fir and Engelmann spruce occurring on deep soils with ash as a component.

The 1938 study centered on Tenderfoot Basin of the North Fork Imnaha River. It was selected because of its varying sites with degraded green fescue communities. This enabled the investigators to establish plots on sites having a variety of vegetation and soils representative of the successional stages resulting from overgrazing by sheep.

An area at the head of Lick Creek on Nebo Lookout Ridge (fig. 7) also was selected to represent the climax conditions (late-seral stage) of green fescue. There were no signs of accelerated erosions, green fescue was abundant and vigorous, and grazing had been light. Here the fescue stood 12 inches tall (Pickford and Reid 1942).

Figure 6—Tenderfoot Basin.

Figure 7—Nebo Lookout Ridge.

The Natural Setting

The Wallowa Mountains are in the extreme northeast corner of Oregon. The elevational base of the uplift is approximately 4,000 feet in the Wallowa Valley on the north side and approximately 3,000 feet in Pine Valley on the south side. The highest peaks rise to about 10,000 feet with 10 summits over 9,500 feet. There are many diverse plant communities covering this montane landscape. The elevational gradient, varied soil depths, and geologic formations, along with the major aspects of the uplift, all influence the flora and plant communities of the Wallowa Mountains.

Vegetation is dominated by forests where elevations and aspects dictate the plant associations that predominate. At the lowest elevations (4,000 feet), Douglas-fir plant associations are found on loessal and basaltic colluvium. These forested communities give way to vegetation where moister growing conditions prevail. Grand fir plant associations occupy the midelevations on the cool, moist and warm, moist environments. The subalpine zone begins at approximately 6,000 feet in elevation and continues to 9,500 feet. Here, two tree species—subalpine fir and whitebark pine—are capable of persisting in cold, moist and cold, dry environments.

The nonforest vegetation of the subalpine zone is dominated by green fescue on deep, moist soils and by Idaho fescue on shallow, moist soils. Shrublands that are prominent on mountain ridges are mountain snowberry, mountain big sagebrush, and mountain-mahogany.

Figure 8—Green fescue grasslands.

The two predominant fescues found in the Wallowa Mountains are Idaho fescue and green fescue. Idaho fescue has the widest ecological amplitude, occurring in deep canyon northerly aspects to subalpine ridgetops. The more restricted green fescue is most widespread in the subalpine area of the Wallowa Mountains. The cool, moist climate coupled with fine-textured soils that average 30 inches in depth (and up to 50 inches deep) provide a highly productive vegetation. Herbage production ranges from 500 to 1,300 pounds per acre (Johnson and Simon 1987). The availability of green, nutritious grasses late into the summer grazing season brought domestic sheep into the Wallowa Mountains beginning in the mid-1800s.

Green fescue vegetation (fig. 8) has been differentiated by microenvironmental factors into plant associations in the Wallowa Mountains. These are green fescue/spurred lupine occurring on deep, moist soils and green fescue/Parry's rush, which is found on stonier, drier sites (Johnson, n.d.).

Standley Allotment

At the turn of the century, and prior to establishment of the Wallowa National Forest, approximately 10,000 sheep grazed for almost 4 months on the allotment. Sheep numbers began a steady decline after World War II. There was a continued decline to about 2,000 sheep grazing for a 3-month period by 1980. In 1986, sheep grazing was terminated on the Standley allotment.

Deer and elk use also has been a factor in the successional trends of the two sample areas. There were high populations of deer in the 1930s. Elk numbers were relatively small in the 1930s but escalated in the 1980s.

Tenderfoot Basin

Tenderfoot Basin historically received heavy grazing pressure annually, which reduced standing biomass to low levels and resulted in a reduced litter layer to protect the soil surface. Tucker (n.d.) wrote "There was also prevalent, during those times, an idea among many Forest Officers that the vegetation should be grazed heavily each year as a means of fire protection on the Forests." The 18,702 cattle and horses and 251,830 sheep reported by Tucker for 1906 indicated the dominance by domestic sheep and the density of grazing animals using the Wallowa Reserve (Wallowa National Forest). Prior to 1916, the Tenderfoot Basin allotment received approximately 14,400 sheep months of use over about 3 months (Strickler 1957). In 1938 when Pickford and Reid worked on their study, approximately 1,200 sheep months of grazing fully utilized the allotment (fig. 9). From their height and weight measurements of almost 700 green fescue plants, they determined a maximum use for properly grazed subalpine rangeland to be where 50 percent or less of herbage had been used. This equated to a range where two-thirds of the plants were grazed to a 3-inch stubble height, and 15 percent of the plants remained ungrazed. These conditions would permit seed production and stand vigor to be maintained (Pickford and Reid 1942). After the results of the 1938 study, Forest Service managers gradually reduced the number of sheep months of use to allow the range to recover from its depleted condition. By 1948 (10 years later), about 1,000 ewes with lambs used the allotment for only 35 days (Strickler 1957). In the early to mid 1950s, use in the basin averaged about 300 sheep months as managers further reduced permitted numbers and began deferring use until late August or early September to enhance fescue seed production and dissemination (Reid and others 1980).

Photo by E.H. Reid.

Figure 9—Grazing history: sheep in Tenderfoot Basin (1938).

From 1949 through 1978, the upper Tenderfoot Basin averaged 0.17 sheep months per acre. This was 60 percent less than in 1938 when use of the allotment averaged 0.44 sheep months per acre (Reid and others 1980). In the 1980s, the area was lightly grazed (use varied from 5 to 38 percent) and was ungrazed by domestic sheep during three grazing seasons (Reid and others 1991).

Light grazing by sheep continued through the 1990s (1,000 head for 7 days from 1990 to 1993). From 1994 to 1997, use by domestic sheep was deferred in Tenderfoot Basin. Records indicate an average of 0.07 sheep months per acre for the period 1989-98. Domestic sheep use was terminated on the allotment in 2000. Elk use has historically occurred in mid to late summer by the Imnaha herd. The herd numbers have ranged from 900 in 1988 to 1,700 in 1998. Increases were estimated at 1,200 in 1989, 1,100 in 1993, and 1,200 in 1995 (ODFW 2001).

History of Successional Change—Standley Spring Area

In 1907, Sampson fenced a 20-acre area to protect it from livestock. Within this area was a smaller protective enclosure, which contained weather instruments. At that time, Sampson noted that total vegetation cover was nearly 15 percent, of which green fescue constituted only 5 percent (Strickler and Hall 1980). Sampson acquired no subsequent data about the vegetation and use following the 1910-11 period.

The next sampling effort was performed by Bob Harris. In 1955, he installed a single 100-foot line transect within Sampson's instrument enclosure and took one hundred ¾-inch loop readings for plant composition. The line transect was resampled by Harris, Strickler, and Hall in 1962. In 1993, the author relocated the transect and resampled it in 1998. Soil depth was 40 inches with a very fine silt loam occupying the top 25 inches (figs. 10 through 12).

The consistent decline by green fescue and the increases by deep-rooted perennial forbs represents a downward trend to a lower seral stage. There was a high density of elk beds, pellet groups, and utilization of the plants by

Photo by Bob Harris

Figure 10—1955. Green fescue dominated (50 percent) with needlegrasses strongly associated (23 percent). Forbs were only 17 percent of the community. Erosion pavement occupied 16 percent of the site, and bare soil contributed 23 percent of the surface cover.


Photo by G. Strickler

Figure 11—1962. Fescue had declined (41 percent) with needlegrasses making a slight increase (27 percent). Sedges now contributed 13 percent to the cover while forbs were near static at 19 percent. However, the bare soil had doubled on the site since the 1955 survey and now constituted over half of the surface cover (53 percent).


Photo by Bob Harris.

Figure 12—1998. Green fescue had declined again; it was now only 22 percent of the community. Forbs had dramatically increased to 47 percent cover on the deeper soils. On the areas with erosion pavement between fescue hummocks, the pioneering plants commonly found on the deflection depressions (Parry's rush and alpine pussytoes) had dramatically increased to 23 percent cover. Ross' sedge had declined to only 5 percent. Even the needlegrasses were strongly in decline (almost absent at 2 percent). Bare soil cover was now only 10 percent; down from the 53 percent of 1962. Bare soil had probably been colonized by leafy aster and Wallowa penstemon.

Table 1—Line transect at Standley instrument enclosure site

Species and ground condition	1955	1962	1998	Trend[a]
	Percentage of cover[b]			
Green fescue	50	41	22	↓↓
Needlegrass	23	27	2	↓↓
Fleabanes	9	0	0	→
Veronicas	8	12	8	↓
Sedges	4	13	5	↓
Asters	0	7	30	↑↑
Wallowa penstemon	0	0	9	↑
Parry's rush	0	0	11	↑
Alpine pussytoes	0	0	12	↑
Bare soil	23	53	10	↓↓
Pavement	16	—	0	→
Rock	3	—	2	→
Moss	0	—	8	↑
Litter	26	21	44	↑↑

— = no data.
[a] Trend arrows (1962-98):
↑↑ = significant upward trend.
↑ = upward trend.
→ = static.
↓ = downward trend.
↓↓ = significant downward trend.
[b] Total plant and ground cover may exceed 100 percent due to overlapping plant canopies.

elk at the time of the 1998 sampling. Elk made noticeable use of green fescue as well as the leafage of penstemon and aster. As a result, herbage was sampled at only 850 pounds per acre. The heavy use of this site by elk coupled with the drought conditions in the decade preceding the 1998 sampling are likely contributing factors to the declines of the grasses and sedges and resultant increases in aster and penstemon.

Sturgill Basin Area

After Sampson concluded his studies in 1910, Sturgill Basin was heavily grazed by sheep for many years afterward (Strickler and Hall 1980). Sturgill Spring provided the attraction for herders, campers, and hunters for encampments. The proximity of the spring to the fescue forage available on the adjacent slopes provided for heavy use by livestock. It continued to be overgrazed until closure to sheep use in 1941. The Minam elk herd experienced increases beginning in the mid-1970s, peaked in 1993 at an estimated 2,900 animals, and has declined to 1,700 today (ODFW 2001). Interestingly, an ecological classification plot was installed in August 1993 during the period of heightened use by elk. At the time of installation of the plot, a large herd was present making noticeable use of the site. Ross' sedge was especially relished by the elk at that time.

The transect summary and comparison over the three sampling periods shows an upward trend. Although green fescue (61 percent) and western needlegrass (24 percent) are static over the 46-year period, since 1952, indicators of progressive succession are provided by the increases in Ross' sedge and a concurrent decline by pussytoes. Bare ground (12 percent) and rock plus erosion pavement surface cover (13 percent) are in decline with a concurrent increase by litter (31 percent) and moss (9 percent). Overall, the trend in plant cover is upward (figs. 13 through 24).

Table 2—Species coverage over time and recent trends for Standley (Sturgill Basin)

Species and stand condition	1952	1962	1998	Trend[a]
		Percentage of cover[b]		
Green fescue	61	48	61	→
Western needlegrass	22	22	24	→
Phlox	4	0	0	→
Ross' sedge	0	1	6	↑
Pussytoes	0	11	6	↓
Parry's rush	0	0	1	→
Pussypaws	0	0	2	→
Bare soil	18	31	12	↓
Pavement	30	21	0	↓
Rock	5	2	13	↓
Moss	t	t	9	↑
Litter	23	23	31	↑

t = trace (less than 1 percent).
[a] Trend arrows (1962-98):
↑ = upward trend.
↓ = downward trend.
→ = static.
[b] Total plant and ground cover may exceed 100 percent due to overlapping plant canopies.

Photo by A. Sampson

Figure 13—In 1907, Sampson enclosed and reseeded a 5-acre bed ground above Sturgill Spring in the basin. The area was almost devoid of native vegetation except for relict green fescue, tufts of yarrow, sedge, and needlegrasses (Strickler and Hall 1980).

Photo by Bob Harris

Figure 14—In 1955, the seeded timothy was totally replaced by western needlegrass, sedges, pussytoes, Parry's rush, Douglas knotweed, and spike trisetum. Grass covered 48 percent of the area. By 1973, green fescue, needlegrasses, and sedges had reestablished to cover 39 percent of the area. Parry's rush and pussytoes accounted for about 3 percent cover.

Figure 15—In 1993, the site had continued to improve with over 70 percent of the area now covered by green fescue, Ross' sedge, western needlegrass, and pussytoes. Green fescue had increased dramatically over 20 years to 60 percent coverage. Bare ground, gravel, and erosion pavement totaled 28 percent coverage.

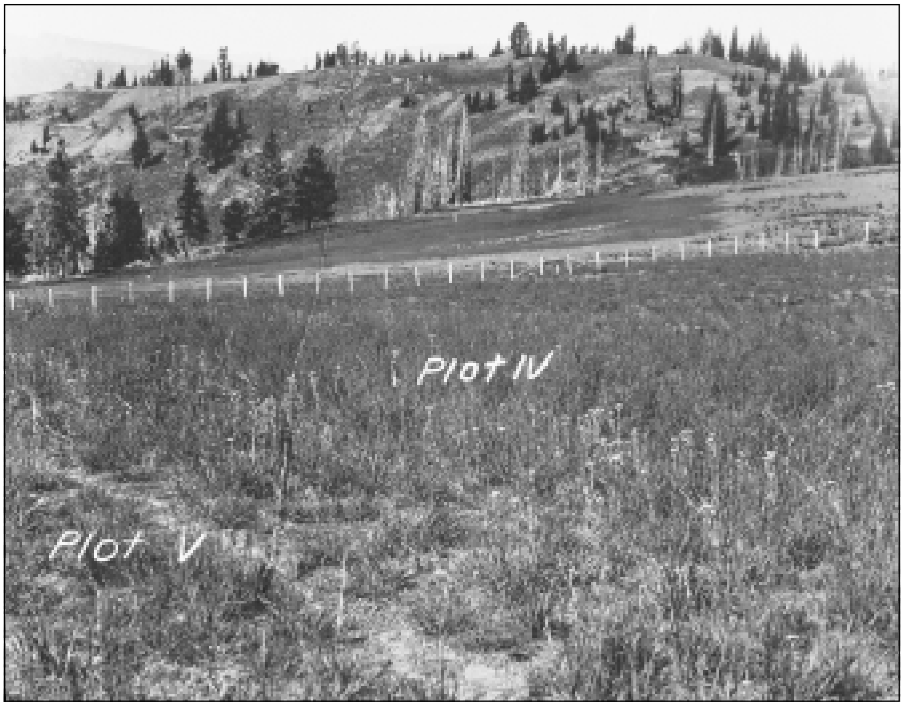

Photo by A. Sampson

Figure 16—In 1952, Hall installed three line transects on the site of Sampson's reseeding. The transects traversed the area photographed by Sampson (1909), Strickler (1966), and the author (1998) as shown. In 1909, timothy dominated from the reseeding.

Photo by G. Strickler

Figure 17—By 1966, timothy was absent. Approximately 60 percent of the ground cover consisted of green fescue, western needlegrass, and pussytoes.

Figure 18—In 1998, green fescue and western needlegrass covered 85 percent of the site. Pussytoes had declined with Ross' sedge and mosses increasing over past levels.

Photo by W.B. Hall

Figure 19—Sturgill Basin, 1952. Wade Hall established vegetation monitoring transects in 1952. Green fescue dominated the sites. Western needlegrass was associated. Together both grasses constituted 83 percent coverage.

Photo by W.B. Hall

Figure 20—Sturgill Basin, 1952. Erosion pavement, bare soil, and rock occupied 43 percent of the site.

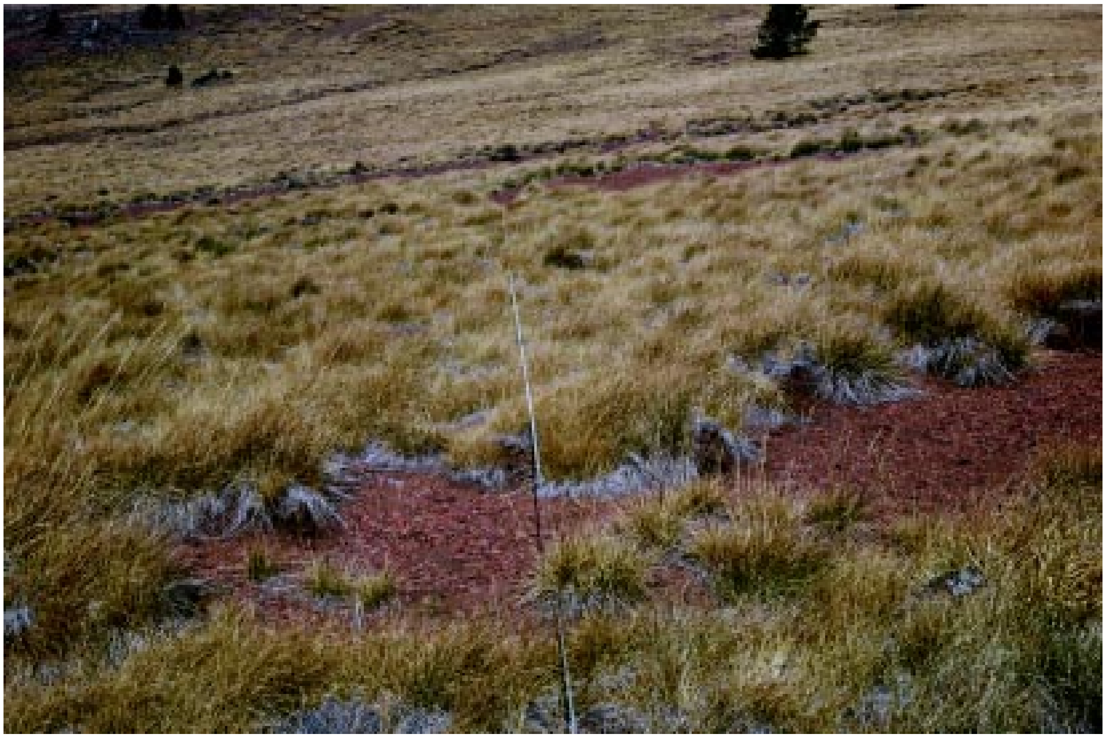

Photo by W.B. Hall

Figure 21—Sturgill Basin, 1962. Ten years after the 1952 samples, Bob Harris and Wade Hall resampled the sites. Green fescue had declined from 61 to 48 percent over the 10-year period. The foliar cover was about the same with pussytoes pioneering erosion pavement sites.

Photo by W.B. Hall

Figure 22—Sturgill Basin, 1962. The trend was downward owing to a decline in green fescue and an increase from 43 to 54 percent by erosion pavement, bare soil, and rock.

Figure 23—Sturgill Basin, 1998. The passage of 36 years with reduced ungulate use helped green fescue cover to rebound to 61 percent. The community became richer with the increase by Ross' sedge and forbs.

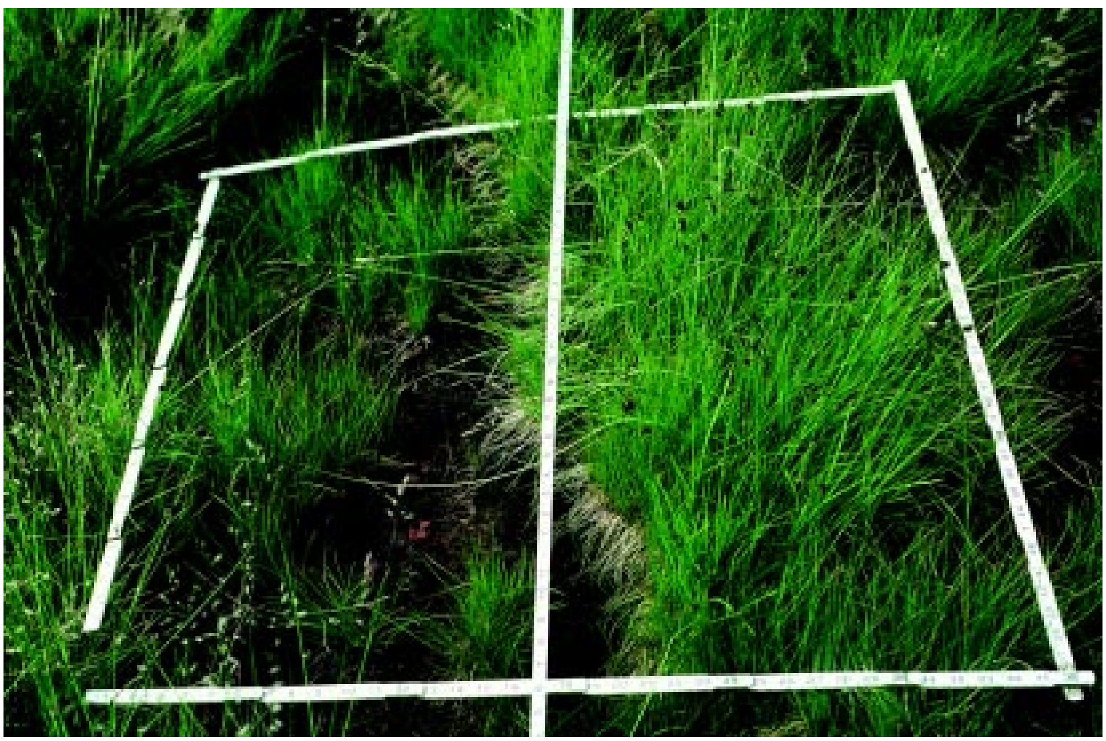

Figure 24—Sturgill Basin, 1998. Strengthening the upward trend of the site were declines in erosion pavement, rock, and bare soil (54 to 25 percent) along with a dramatic increase by moss (to 9 percent).

Tenderfoot Basin Area

Prior to 1938—The Tenderfoot allotment had a history of use by four bands of sheep for a 3-month period each year before 1916. The resultant change to the plant communities by 14,400 sheep months of use each year was a loss of vegetation and litter cover to the soil surface resulting in severe uncontrolled soil erosion. Management responded by reducing sheep numbers, reducing the grazing period, and deferring use as a result of this degeneration (Strickler 1961).

Pickford and Reid (1942) (fig. 25) determined that 73 percent of the land surface on the study area was eroded with 20 percent of the surface covered by gravelly erosion pavement. Gullies remained from accelerated soil erosion. But the most dramatic landforms were hummocks left as "islands" from the soil erosion. These were surrounded by deflation depressions containing an erosion pavement. The hummocks were as high as 20 inches above the eroded surface. The green fescue plants growing on the hummocks were either of low vigor or were dead.

Sheep continued to use Tenderfoot Basin—albeit in much reduced numbers. Strickler studied the area in 1956 and 1957 (Strickler 1957) (fig. 26). He noted that the soil hummocks were still intact and now supported a vigorous growth of vegetation. Plants were now colonizing the erosion pavement of the deflation depressions between the hummocks. The primary pioneers were pussytoes, needlegrasses, sedges, and annual forbs (see apps. 1-3 for species listed by common and scientific names).

On the deeper soils, especially on hummocky slopes, alpine fleeceflower, linanthastrum, penstemon, and buckwheats were strongly associated with the relict green fescue plants.

The overall aspect was of a grass-forb mixture on the hummocky landscape. The deflation depressions now contained dense vegetation dominated by grasses and sedges. The principal species were needlegrass, ovalhead sedge, and green fescue. There was no sign of further accelerated erosion. Some of the hummocks had begun to slough with a smoothing of slopes from the steepened terracettes of the pre-1938 era (Reid and others 1980) (fig. 27).

Reid noted on his 1978 visit that after 40 years, green fescue had increased by outcompeting needlegrasses, sedges, and perennial forbs (fig. 28). Where needlegrasses had dominated in the pioneering stage of early succession, they were now being replaced by vigorous, young, green fescue plants. However, some forbs were persistent with fleeceflower, linanthastrum, penstemon, and buckwheats continuing to occupy niches in the grassland community. The hummocks were still there but were less conspicuous owing to the masking by the vegetation. On slopes, the terracettes had sloughed and were much less abrupt. Litter now covered the interstitial areas between the grasses (Reid and others 1980).

Reid's visit in 1988 was during a drought (fig. 29). He noted unusually dry soils and ungrazed green fescue with leaf lengths of only 3 to 5 inches (normally 6 to 8 inches). He noticed little compositional change for the first time. Soil surfaces and hummocks appeared the same as 10 years previously (Reid and others 1981).

In 1998, the author along with photographer David Jensen visited the area (fig. 30). The 21 camera points revisited by Reid and the author in 1988 were again photographed. Large format photos were taken with black and white print film to conform to the original 1938 images. Notes were taken at the camera points of vegetation composition, density, and surface conditions.

In 1996, prior to the anniversary revisit, the transects installed by Strickler were resampled. These transects had been installed on key sites adjacent to some of Reid's camera points by Strickler in 1956. The Parker 3-Step Condition and Trend system had recently been devised by Ken Parker and was beginning to be installed throughout the Western rangelands administered by the Forest Service. Strickler used the ¾-inch loop to sample 100 points along the 100-foot transect. For comparison, the author resampled the same transects by using the ¾-inch loop. This was the only resample since the installation of 1956. Seven sites were resampled.

Photo by E.H. Reid

Figure 25—The basin in 1938.

Photo by E.H. Reid

Figure 26—1956, 18 years after the Pickford and Reid study.

Photo by G. Strickler

Figure 27—1968, 30 years after the 1938 study.

Photo by E.H. Reid

Figure 28—1978; Tenderfoot Basin 40 years after the 1938 study.

Figure 29—1988; Tenderfoot Basin 50 years after the 1983 study.

Photo by David Jensen

Figure 30—1998; Tenderfoot Basin 60 years after the 1938 study.

Comparative Analysis (1956 and 1996)—40 Years of Change

Strickler established 100-foot line transects on seven sites in Tenderfoot Basin in 1956. Green fescue was a component of all seven communities at these sites. All the sites were associated with one of Reid's 1938 study sites.

Four plant community types are represented as follows: mountain big sagebrush/green fescue (mid-seral stage); green fescue/western needlegrass (early- and mid-seral stages); green fescue/globe penstemon (early-seral stages); and green fescue/Hood's sedge (early-seral stage). Collectively (excluding the mountain big sagebrush/ green fescue site), the green fescue sites have exhibited no major changes over the 40-year period. The following are notable exceptions:

- Western needlegrass has declined in cover from 34 to 16 percent.
- Ballhead sedges (small-winged sedge; Liddon's sedge) increased from 4 to 12 percent.

The increase in green fescue from 31 to 33 percent and the increase in bare ground from 20 to 23 percent are relatively static trends. These data tend to support Reid's 1988 observations of static trend at the same locations.

Four of the seven sites are highlighted in the pages that follow in the photographic images taken in 1938, key subsequent years, and the most recent 1998 image. Captions are included of observations made by Reid prior to 1998 and my notes for the 60th year (1998).

Green fescue/western needlegrass (FEVI-STOC)
Mid-seral stage
Strickler (area 5), Reid (CP9), Johnson (ecoplot 6081)

The site is located at 7,980 feet elevation on a southwest aspect with the slope averaging 30 percent. The soils are deep silt loams (greater than 60 inches deep with 24 inches of ash/loess), which overlie limestone. In 1996, when transects were resampled, the factors contributing to the downward trend appeared to be a combination of prior domestic use, elk use, and drought. Elk droppings were uniformly scattered across the site, domestic sheep had continued to use the area, and the drought period of 1985 to 1992 had probably weakened the fescue plants. Burrowing animals (especially pocket gophers) had caused upwellings in the interstitial areas resulting in

Photo by E.H. Reid

Figure 31—1938. Green fescue dominant and vigorous with other grasses, sedges, and forbs subordinate to occasional (late-seral successional stage).

bareground coverage of 16 percent. The vigor of the fescue plants was low (leaf length only 3 to 4 inches). As a result, the productivity (clipped) was only 940 pounds per acre. In 1938, production of all plants at this site was 1,600 pounds per acre. In 1956, production was 2,400 pounds per acre (figs. 31 through 36).

Photo by E.H. Reid

Figure 32—1978. Green fescue dominant (90 percent cover) with forbs, sedges, and grasses subordinate (late-seral successional stage).

Photo by David Jensen

Figure 33—1998. Green fescue dominant (47 percent cover) with increases in the forb composition owing to elk use and drought (mid-seral successional stage).

Photo by E.H. Reid

Figure 34—1938. Late-seral community dominated by green fescue: (85 percent green fescue, 5 percent western needlegrass,5 percent sedge, 5 percent yarrow).

Photo by E.H. Reid

Figure 35—1956. The area was used as a bed ground for 2 years after 1978. As a result, green fescue declined in cover (to 62 percent), western needlegrass increased (to 18 percent), and fleabane invaded (15 percent).

Figure 36—1998. Because of increases in levels of disturbance, green fescue had declined further to a coverage of 47 percent, and western needlegrass had declined to 14 percent. Capitalizing on the increased bare ground (10 to 16 percent) were increases by yarrow (4 to 9 percent) and invasion by Cusick's bluegrass (5 percent), and thick-stemmed aster (0 to 19 percent). The fleabane of 1956 was not encountered.

Green fescue/globe penstemon (FEVI-PEGL4)

Early-seral stage

Strickler (area 7), Reid (CP8), Johnson (ecoplot 6267)

The site is located at 7,960 feet elevation on a south aspect. The slope is gentle at 20 percent. Soils are moderately deep overlying limestone. The apparent upward trend from 1938 to 1993 is based on the capability of the soils to retain moisture favoring germination and establishment of green fescue to the detriment of needlegrasses and linanthastrum. Ross' sedge occupied the pedestal sides where enough soil moisture allowed it to persist. It could not compete with the fescue on pedestaled tops nor the drier interpedestal sites where needlegrasses, linanthastrums, and penstemon dominated. Vigor of the fescue plants was good (6 to 8 inches in stature). Productivity was 620 pounds per acre. This was roughly equivalent to the 1938 productivity (672 pounds per acre). The 1956 productivity of 3,380 pounds per acre was strongly influenced by linanthastrum plants (2,600 pounds per acre) (figs. 37 through 39).

Photo by E.H. Reic

Figure 37—1938. A deteriorated green fescue site where green fescue cover was only 6 percent and linanthastrum constituted 78 percent of the cover. Western needlegrass cover was 6 percent; Hood's sedge cover was 5 percent.

Photo by E.H. Reic

Figure 38—1956. The site improved in ecologic condition. Green fescue now covered 41 percent and linanthastrum decreased to 33 percent. The sedges increased to 16 percent. Western needlegrass was static at 6 percent.

Photo by David Jensen

Figure 39—1998. The major change has been the decline in linanthastrum from 41 to 19 percent with a replacement in the community by globe penstemon (21 percent cover). Green fescue, western needlegrass, and sedges remained at 1956 levels.

Green fescue/globe penstemon (FEVI/PEGL4)

Early-seral stage

Strickler (area 10), Reid (CP 10), Johnson (ecoplot 6268)

The site is located at 7,790 feet elevation on a steep 42 percent slope facing southwesterly. This community has remained forb-rich over 40 years. It continues to receive disturbance from elk and burrowing rodents (figs. 40 through 42).

Photo by E.H. Reid

Figure 40—1938. A degenerated green fescue site dominated by forbs and needlegrasses. Alpine fleeceflower, or pokeweed, was prominent.

Photo by E.H. Reid

Figure 41—1956. The fleeceflower, cinquefoil, and penstemon are still present with the same plants or colonies visible. Green fescue, sedges, and lupine are now growing on the 1938 fescue-deteriorated remnant sites noted in 1938.

Photo by David Jensen

Figure 42—1998. Fleeceflower, ballhead sedges, and green fescue remain at the same coverage. Western needlegrass declined markedly (16 to only 1 percent) as did globe penstemon (32 to 17 percent). Increasing were cinquefoil and mountain brome.

Green fescue/Hood's sedge (FEVI-CAHO)

Mid-seral stage

Strickler (area 3), Reid (CP 3, 4), Johnson (ecoplot 6084)

The site is on a west-facing slope (25 percent) at 7,860 feet elevation. Soils are 35 inches deep with 9 inches of ash/loess over a limestone parent material. This site has shown the greatest upward successional movement of all sampled green fescue sites in Tenderfoot Basin. It is dominated by grasses (62 percent) and sedges (36 percent) with only trace amounts of forbs. Use by domestic sheep and elk has been as high as on other basin fescue sites. The difference here is the favorable slope position with adequate vernal moisture retained by the deep soils (figs. 43 through 45).

Photo by E.H. Reid

Figure 43—1938. This site is near Twin Springs where livestock trailing and bedding use resulted in terracettes and high pedestals (hummocks). The result was a high loss of topsoil and mortality to green fescue clumps. Relict fescue plants were low in vigor. Erosion pavement formed in the depressions.

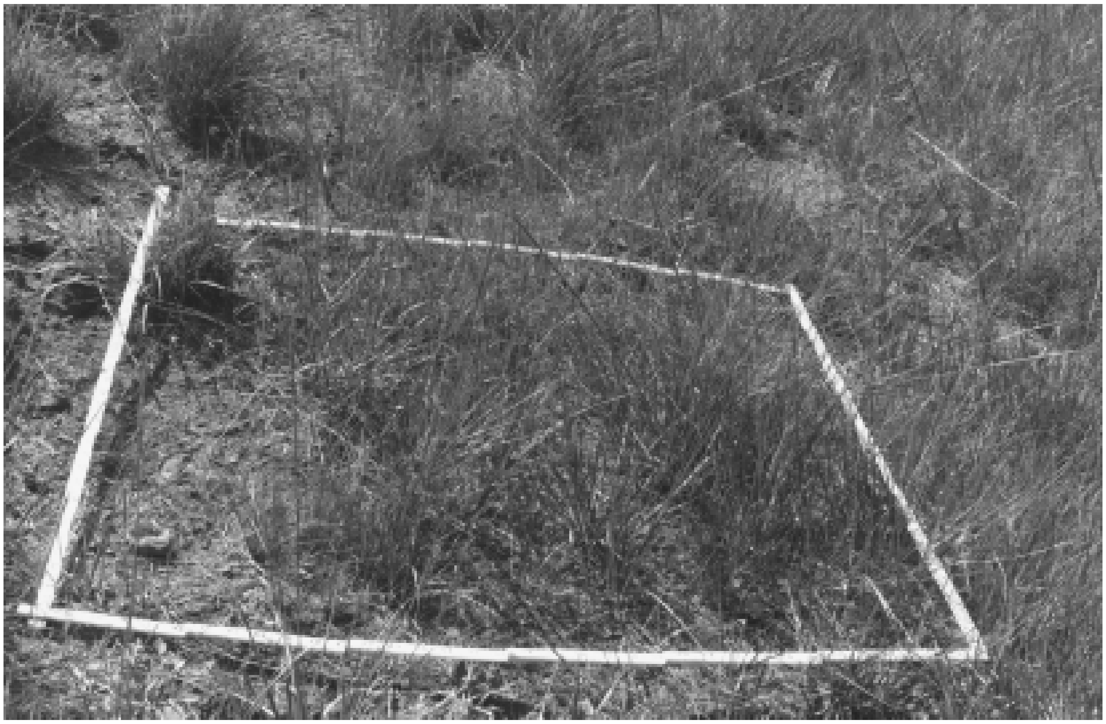

Photo by E.H. Reid

Figure 44—1956. Needlegrasses have stabilized the soil between the hummocks. Some recolonization by green fescue was noted in the depressions because of the stabilization afforded by the needlegrasses coupled with the cessation of active erosion.

Photo by David Jensen

Figure 45—1998. The needlegrasses have declined significantly (66 to 17 percent) since 1956. This is related to the reestablishment of green fescue in the depressions. Green fescue has increased since 1956 from 28 to 44 percent. Sedges have increased owing to added moisture retention on the site (7 percent in 1956 to 36 percent in 1996). This may be the result of increased organic buildup owing to increased litter. Litter increased from 5 to 31 percent between 1981 and 1996.

Nebo Lookout Ridge Area

Subsequent to the 1938 study year, grazing became more prominent on Nebo Lookout Ridge. By 1953, according to data from a Parker Condition and Trend cluster of transects, features attributed to accelerated erosion were now present. The green fescue was pedestalled with deflation depressions overlain by an erosion pavement. In 1938, the composition of the sampled site showed green fescue at 68 percent. The only other plant species present was hoary velvet lupine at 32 percent coverage. By 1953, the lupine was gone, green fescue had declined to 53 percent, and western needlegrass had invaded. Western needlegrass cover was 46 percent. Samples at the Nebo Lookout transects in 1959 provided data which, when compared to 1953 data, showed the site to be static, or unchanged. Forty years later in 1999, the site was resampled. The data showed that a significant change had occurred. Green fescue had surpassed the 1938 coverage of 68 percent and was now covering 82 percent of the site. Western needlegrass had declined sharply from 43 to 18 percent in the 40-year period. The only other plant present was Ross' sedge in trace amounts. Bare ground and erosion pavement had declined from 32 percent in 1959 to 17 percent in 1999.

Photo by G. Strickler

Figure 46—Nebo transect 3 (1959).

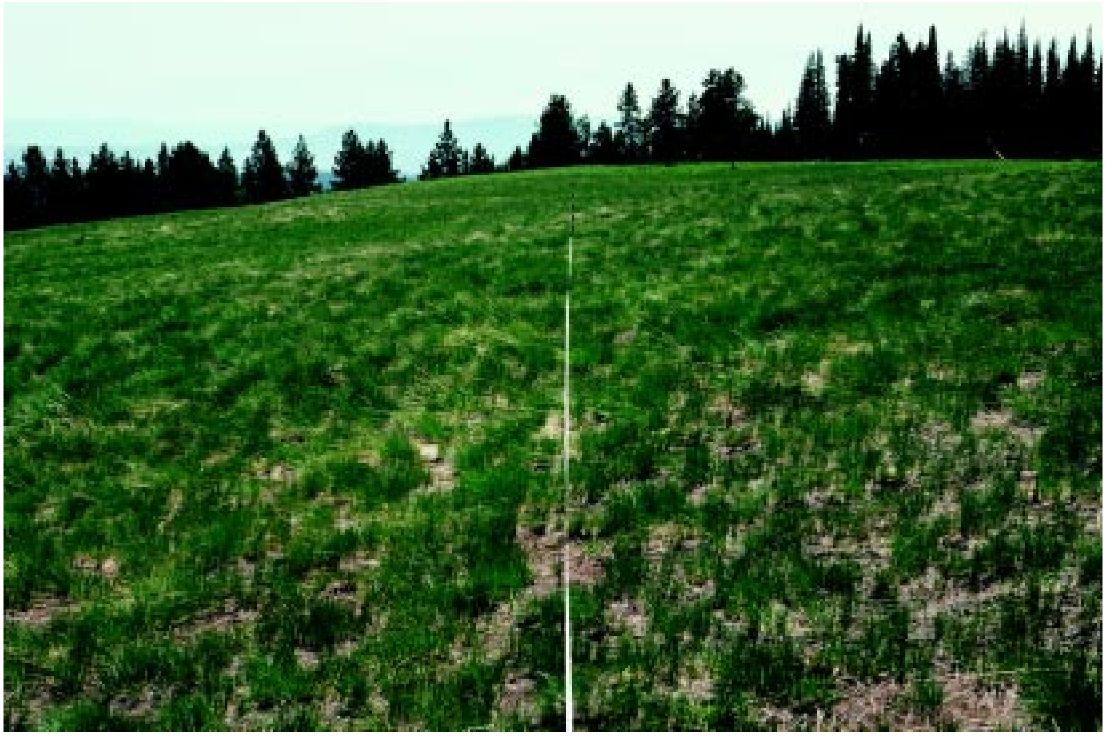

Figure 47—Nebo transect 3 (1999).

Table 3—Species coverage over time and trends for Nebo

Species and ground condition	1938	1953	1959	1999	Trend[a]
			Percentage of cover[b]		
Green fescue	68	53	56	82	↑
Western needlegrass	0	46	43	18	↓
Ross' sedge	0	0	0	1	→
Bare ground	—	17	24	10	↓
Erosion pavement	—	9	8	7	→

— = no data.
[a] Trend arrows (1959-99):
↑ = upward trend.
↓ = downward trend.
→ = static.
[b] Total plant and ground cover may exceed 100 percent owing to overlapping.

Conclusions

The current green fescue landscape has changed dramatically from that of the early 1900s. No longer are grazing animals allowed to overuse vegetation to promote increases in forbs or invasion by aliens, or to provide for accelerated erosion. The grasslands of Tenderfoot Basin, Nebo Lookout Ridge, Standley Spring, and Sturgill Basin have had a total cessation of annual grazing by permitted domestic livestock. The use is currently light from recreational stock. The period where natural successional processes can effect a change has essentially been ongoing since the 1950s. Trends in the resampled sites were static or upward on five of the seven areas. Only two sites, one in Tenderfoot Basin and the other at Standley Spring, showed strong evidence of a downward successional trend. In those two cases, elk use coupled with droughty climatic conditions probably contributed strongly to the declines in cover of green fescue and concurrent increases in perennial forbs. Elk populations in the Minam herd increased during the decade 1988-98. Elk numbers were growing steadily from 1,800 in 1998, peaked at 2,900 in 1993, and decreased to 1,950 animals in 1998. During the same period, the estimated deer population declined from 4,750 in 1988 to 3,250 estimated in 1998 (ODFW 2001).

With another 50 years, and with natural disturbances operating at a low level, the green fescue grasslands should continue to succeed progressively toward late-seral stages.

Sampson, Reid, Hall, and Strickler each left a wonderful legacy. The subalpine grasslands of the Wallowa Mountains, once so vigorous and dense with herbage on deep loessal soils, had been desecrated by years of extreme overgrazing. It was the notoriety of the degraded subalpine that brought first Sampson and then Pickford and Reid to initiate their studies of succession and restoration. It was then Hall who recognized the importance of repeat photography and periodic resampling of site-specific areas to assist in the evaluation of the impacts being made from management activities. Wade was instrumental in the installation of steel stakes for line transects and the performance of the first three-step method as devised by Parker (1951). Strickler next entered the study areas and provided the first scientific reassessment since the initial work by Sampson at Standley-Sturgill. He joined with Reid to reevaluate the Tenderfoot sites. The combined visions of Reid, Hall, and Strickler initiated the 10-year cycle of resampling and retake photography at Tenderfoot Basin. The author is continuing this work of retaking the photographic images, resampling the line transects, and doing comparative data analysis. This is the fifth technical publication following 60 years of change in Tenderfoot Basin and the second technical publication following Sampson's work at Standley-Sturgill.

Since the beginning of the 21st century, these subalpine grasslands have been devoid of domestic livestock under permit. Recreational horse and mule use is sporadic and light. The impacts by elk and deer ebb and flow as population numbers change. Elk are currently in decline after high populations in the mid-1980s. Deer populations continue to decline in the Snake River and Minam Units while the Imnaha Unit has exhibited a slight increase (ODFW 2001). The management emphasis has now shifted from utilization of the subalpine grasslands for commodities to restoration of the ecosystem with natural processes dictating the successional trend of the vegetation. The continuation of cyclic monitoring (i.e., sampling and photography) by rangeland scientists and specialists will enable future generations of land managers to learn from the long-term scientific undertakings and findings for continued best decisions regarding the vigor and vitality of the green fescue grassland communities.

Metric Equivalents

When you know:	Multiply by:	To get:
Inches	2.54	Centimeters
Feet	.305	Meters
Acres	.40	Hectares
Pounds	.453	Kilograms

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Appendix 1: Common and Scientific Names[1] of plants

Scientific name	Common name
Trees:	
Douglas-fir	*Pseudotsuga menziesii* (Beissn.) Franco
Engelmann spruce	*Picea engelmannii* Parry
Grand fir	*Abies grandis* (Dougl.) Forbes
Lodgepole pine	*Pinus contorta* Dougl.
Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
Whitebark pine	*Pinus albicaulis* Engelm.
Grasses:	
Green fescue	*Festuca viridula* Vasey
Idaho fescue	*Festuca idahoensis* Elmer
Little western needlegrass	*Stipa occidentalis* var. *minor* (Vasey) Hitchc.
Mountain brome	*Bromus carinatus* H. & A.
Needlegrass	*Stipa* spp.
Spike trisetum	*Trisetum spicatum* Richter
Timothy	*Phleum pratense* L.
Western needlegrass	*Stipa occidentalis* Thurb.
Sedges and rushes:	
Hood's sedge	*Carex hoodii* Boott
Liddon's sedge	*Carex petasata* Dewey
Parry's rush	*Juncus parryi* Engelm.
Ross' sedge	*Carex rossii* Boott
Sedge	*Carex* spp.
Small-winged sedge	*Carex microptera* Mack.
Thick-headed sedge	*Carex pachystachya* Cham.
Forbs:	
Alpine fleeceflower	*Polygonum phytolaccaefolium* Meisn.
Alpine pussytoes	*Antennaria alpina* Gaertn.
Buckwheat	*Eriogonum* spp.
Cinquefoil	*Potentilla* spp.
Douglas' knotweed	*Polygonum douglasii* Greene
Fleabane	*Erigeron* spp.
Globe penstemon	*Penstemon globosus* Pennell & Keck
Hoary velvet lupine	*Lupinus leucophyllus* var. *canescens* Dougl.
Leafy aster	*Aster foliaceous* Lindl.
Linanthastrum	*Linanthastrum* spp.
Lupine	*Lupinus* spp.
Penstemon	*Penstemon* spp.
Phlox	*Phlox* spp.

Pokeweed	*Polygonum phytolaccaefolium* Meisn.
Prickly sandwort	*Arenaria aculeata* Wats.
Pussypaws	*Spraguea umbellata* Torr.
Pussytoes	*Antennaria* spp.
Veronica	*Veronica* spp.
Wallowa penstemon	*Penstemon spatulatus* Pennell
Yarrow	*Achillea millefolium* L.

[1] Scientific names are from Hitchcock and others 1977.

Appendix 2: Plant Species Alphabetically by Common Name

Scientific name	Common name
Alpine fleeceflower	*Polygonum phytolaccaefolium* Meisn.
Alpine pussytoes	*Antennaria alpina* Gaertn.
Buckwheat	*Eriogonum* spp.
Cinquefoil	*Potentilla* spp.
Douglas’ knotweed	*Polygonum douglasii* Greene
Douglas-fir	*Pseudotsuga menziesii* (Beissn.) Franco
Engelmann spruce	*Picea engelmannii* Parry
Fleabane	*Erigeron* spp.
Globe penstemon	*Penstemon globosus* Pennell & Keck
Grand fir	*Abies grandis* (Dougl.) Forbes
Green fescue	*Festuca viridula* Vasey
Hoary velvet lupine	*Lupinus leucophyllus* var. *canescens* Dougl.
Hood’s sedge	*Carex hoodii* Boott
Idaho fescue	*Festuca idahoensis* Elmer
Leafy aster	*Aster foliaceous* Lindl.
Liddon’s sedge	*Carex petasata* Dewey
Linanthastrum	*Linanthastrum* spp.
Little western needlegrass	*Stipa occidentalis* var. *minor* (Vasey) Hitchc.
Lodgepole pine	*Pinus contorta* Dougl.
Lupine	*Lupinus* spp.
Mountain brome	*Bromus carinatus* H.& A.
Needlegrass	*Stipa* spp.
Parry’s rush	*Juncus parryi* Engelm.
Penstemon	*Penstemon* spp.
Phlox	*Phlox* spp.
Pokeweed	*Polygonum phytolaccaefolium* Meisn.
Prickly sandwort	*Arenaria aculeata* Wats.
Pussypaws	*Spraguea umbellata* Torr.
Pussytoes	*Antennaria* spp.
Ross’ sedge	*Carex rossii* Boott
Sedge	*Carex* spp.
Small-winged sedge	*Carex microptera* Mack.
Spike trisetum	*Trisetum spicatum* Richter
Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
Thick-headed sedge	*Carex pachystachya* Cham.
Timothy	*Phleum pratense* L.
Veronica	*Veronica* spp.
Wallowa penstemon	*Penstemon spatulatus* Pennell
Western needlegrass	*Stipa occidentalis* Thurb.
Whitebark pine	*Pinus albicaulis* Engelm.
Whitebark pine	*Pinus albicaulis* Engelm.
Yarrow	*Achillea millefolium* L.

[1] Scientific names are from Hitchcock and others 1977.

Appendix 3: Plant Species Alphabetically by Scientific Name

Scientific name	Common name
Abies grandis (Dougl.) Forbes	Grand fir
Abies lasiocarpa (Hook.) Nutt.	Subalpine fir
Achillea millefolium L.	Yarrow
Antennaria alpina Gaertn.	Alpine pussytoes
Antennaria spp.	Pussytoes
Arenaria aculeata Wats.	Prickly sandwort
Aster foliaceous Lindl.	Leafy aster
Bromus carinatus H. & A.	Mountain brome
Carex hoodii Boott	Hood's sedge
Carex microptera Mack.	Small-winged sedge
Carex pachystachya Cham.	Thick-headed sedge
Carex petasata Dewey	Liddon's sedge
Carex rossii Boott	Ross' sedge
Carex spp.	Sedge
Erigeron spp.	Fleabane
Eriogonum spp.	Buckwheat
Festuca idahoensis Elmer	Idaho fescue
Festuca viridula Vasey	Green fescue
Juncus parryi Engelm.	Parry's rush
Linanthastrum spp.	Linanthastrum
Lupinus leucophyllus var. *canescens* Dougl.	Hoary velvet lupine
Lupinus spp.	Lupine
Penstemon globosus Pennell & Keck	Globe penstemon
Penstemon spatulatus Pennell	Wallowa penstemon
Penstemon spp.	Penstemon
Phleum pratense L.	Timothy
Phlox spp.	Phlox
Picea engelmannii Parry	Engelmann spruce
Pinus albicaulis Engelm.	Whitebark pine
Pinus contorta Dougl.	Lodgepole pine
Polygonum douglasii Greene	Douglas' knotweed
Polygonum phytolaccaefolium Meisn.	Pokeweed
Polygonum phytolaccaefolium Meisn.	Alpine fleeceflower
Potentilla spp.	Cinquefoil
Pseudotsuga menziesii (Beissn.) Franco	Douglas-fir
Spraguea umbellata Torr.	Pussypaws
Stipa occidentalis Thurb.	Western needlegrass
Stipa occidentalis var. minor (Vasey) Hitchc.	Little western needlegrass
Stipa spp.	Needlegrass
Trisetum spicatum Richter	Spike trisetum
Veronica spp.	Veronica

[1] Scientific names are from Hitchcock and others 1977.

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