

RANGELANDS

AN INTRODUCTION TO WILD OPEN SPACES

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The University of Idaho Rangeland Center and the Idaho Rangeland Resource Commission are mutually dedicated to fostering the understanding and sustainable stewardship of Idaho's vast rangeland landscapes by providing scientifically-based educational resources about rangeland ecology and management.

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Rangelands are incredibly dynamic ecosystems. Drastic changes can be observed among seasons within a year and among years and decades. There are five major factors that cause rangelands to change over time – **grazing, fire, invasive plants, weather and climate**, and **fragmentation** due to human influences. These factors change the plants and animals that inhabit rangeland sometimes in ways that land managers and users find desirable and other times in ways that are considered adverse.

Grazing

The grasses, forbs, and shrubs that grow on rangelands are important sources of forage for grazing animals. Rangeland plants photosynthesize and use energy from the sun to turn carbon dioxide, water, and nutrients into organic compounds such as carbohydrates and proteins. When herbivores consume plant material, these compounds are digested and provide energy and nutrients for herbivores. Grazing is a natural ecological process that occurs on all rangelands.

Impacts of Grazing on Ecosystems

Grazing animals have several direct and indirect impacts that can improve or degrade rangelands depending on the timing and intensity of grazing. Foraging animals affect rangelands by removing vegetation, roughing up and compacting soil through hoof action, and depositing minerals and nutrients in the form of urine, feces, or the animal's carcass. Appropriate and well-managed grazing can favor

desirable plants, improve habitat for wildlife, reduce weed invasion, reseed areas for restoration, reduce mulch accumulation, increase soil organic matter, and reduce fuel loads that promote wildfire. Overgrazing and prolonged poorly managed grazing can remove desirable plants, decrease water infiltration into soil, increase soil erosion, reduce water quality, increase weed invasion, and alter the plant community composition to a less desirable state. Therefore, the impacts of grazing depend on when and how it occurs.

Plant Response to Grazing

Plants live in ecosystems full of herbivores that range from small insects to large grazing animals. Losing leaves or stems to herbivores is a common event in the life of a rangeland plant. For rangeland plants to remain healthy and productive, enough vegetation must remain after grazing so that plants can photosynthesize and manufacture energy to produce more leaves, stems, and seeds. Plants also need to produce and store a little energy as starches and sugars in roots and crowns to successfully start the next season of growth. Only when too much of the plant is removed does the plant suffer in a way that yields lasting detrimental effects. Substantial damage to rangeland plants generally only occurs under repeated and heavy grazing.

The impact of grazing on plant growth depends greatly on when the grazing occurs during the growing season and at what stage of the plant's life cycle. Plants are generally less damaged by grazing early in the season when time, soil moisture, and nutrients needed for regrowth are abundant. Plants are most likely to be damaged by grazing when the plant is beginning to produce flowers and seeds. At this time, the plant has high energy demands to produce seeds, complete growth for the season, and store energy to get through the dormant season. Plus, this generally occurs at the peak of summer when the environment is hot and dry and not favorable for regrowth. Once the plant produces seeds and turns brown (i.e., begin to senesce and becomes dormant), it is no longer sensitive to grazing. At this time, the leaves are not photosynthesizing and are no longer being used by the plant.

Because plants evolved with grazing animals, it is not surprising that plants have attributes and processes to reduce the potential of being eaten and to recover from the loss of plant material after grazing. One way that plants can reduce the impacts of grazing is to have characteristics that reduce the likelihood that herbivores will even take a bite. These characteristics that reduce the probability or severity of grazing are called mechanisms for **grazing avoidance**. These include physical characteristics like thorns, prickles, and spines that make plants less likely to be grazed by large herbivores such as cattle or elk. Similarly, a hairy or waxy leaf surface may be avoided by insect herbivores. The size, shape, or arrangement of leaves may also make it difficult for animals to access and graze the plant.

The buds or growing points (**meristems**) of a plant are especially important to protect from grazing because they will be the source of new stems and leaves for continued growth after grazing. Grasses have a unique strategy of protecting meristems – they are kept near the ground surface (within the crown of the plant) while the leaves and sheaths grow upwards. Some forbs also adapt this tactic by forming a basal rosette of leaves that photosynthesize right near the ground surface – out of the reach of grazing animals. The meristems of these rosette forming plants are kept in the center of the rosette and are not elevated and made accessible to grazing animals until later in the growing season.

Some plants also contain compounds that are harmful to the grazing animal. These compounds, called **secondary compounds**, can cause illness, neurological disorders, birth defects, or even death.

Secondary compounds such as alkaloids, tannins, and essential oils are common in plants. Most often these compounds don't kill the animal but, simply make it feel sick or nauseated so that the plant becomes distasteful and undesirable to the herbivore. Some plants, however contain toxic compounds that are very powerful even in small amounts. For example, tall larkspur contains a mixture of alkaloids that if eaten can cause muscular paralysis, leading to respiratory failure, bloat and often death.

Plants also have attributes that facilitate their regrowth and recovery after grazing. The morphological and physiological characteristics that promote rapid plant growth are termed mechanisms of **grazing tolerance**. For instance, some plants have a higher potential to mobilize stored energy sources and replace leaves after defoliation.

Plants vary in how well they can tolerate and avoid grazing. In fact, many plants can benefit from the effects of grazing. For example, grazing animals can remove the older and less efficient leaves making space and resources for younger more efficient leaves. Grazing can also stimulate the plant to produce more seeds and stems than if they had never been grazed. So, the effects of grazing can be detrimental or beneficial depending on the: 1) plant species, 2) season when grazing occurs, and 3) intensity of grazing (how many leaves remain after grazing).

How Does Grazing Change Plant Communities?

Many fence-line contrasts exist where a difference in plant community across the fence is caused by animals preferring some plants over others. When herbivores focus their grazing attention on one plant, or group of plants, the ungrazed plants can express themselves – sometime creating dramatic contrasts.



Sheep grazing in Montana (on the right-side of this fence) preferred the yellow forbs in this mountain meadow and almost completely removed them from where they grazed.



Goats grazing in Idaho (on the right-side of this fence) ate most of the leafy spurge (a noxious weed) out of their pasture.



Sheep grazing in a spring pasture in Idaho (on the left-side of the fence) reduced the abundance of yellow-flowering forbs (mostly taper-tip hawksbeard). Whereas, fall sheep grazing (on the right-side of the fence) reduced the cover of sagebrush.



Elk grazing in Yellowstone National Park (on the right-side of this fence) preferred these willow species and removed them from the plant community.

What is Overgrazing?

Many people are concerned that excessive grazing by livestock or wildlife creates rangelands that are “overgrazed.” Overgrazing is defined as repeated heavy grazing that results in deterioration of the plant community. Caution must be taken when declaring a range as “overgrazed” because it is difficult of truly assessing whether land is “overgrazed.” Pastures can be heavily grazed but that may not lead to land degradation. In fact, some grazing systems designed to improve and restore rangelands are accomplished by grazing a pasture very heavily once and then giving the pasture several years of rest (e.g., Rest-Rotation or Management-Intensive Grazing). True overgrazing is when continued grazing exceeds the recovery capacity of the plant community and causes a shift in plant composition and soil condition away from a desired community. Overgrazing normally can be attributed to heavy, repeated grazing over several years.

It can be difficult to recognize overgrazing because not all rangelands are equally productive. Differences in soils and the presences of rocky subsurface layers can create large differences in kind and amounts of plants. The differences can create visible contrasts on the landscape. Therefore, a low amount of plant biomass or large proportion of bare soil does not necessarily indicate overgrazing. The “bare spaces” are, in fact, an important characteristic of many healthy plant communities. These open spaces usually have roots from adjacent plants under the soil to harvest precipitation and support plant growth.

Example of differences in soil creating different plant communities.



Loamy Ecological Site dominated by Big Sagebrush and Bitterbrush
750 to 1,100 lb/ac depending on precipitation

Shallow Stony Ecological Site dominated by Low Sagebrush
350 to 440 lb/ac depending on precipitation.

Overgrazed rangeland is often characterized by an increase in less palatable plants, increased soil erosion, increase in weedy species that thrive under disturbance, and decreased production of important forage plants. Rangeland deterioration results from animals continually and closely eating the most palatable plants until those plants are stressed so much they fail to reproduce and/or die. Overgrazing can also correspond with soil compaction or disruption of soil crusts resulting in decreased water infiltration and increased erosion. Due to the complex nature of animal preferences, highly desirable areas in a pasture may experience overgrazing while other regions experience little or no use.

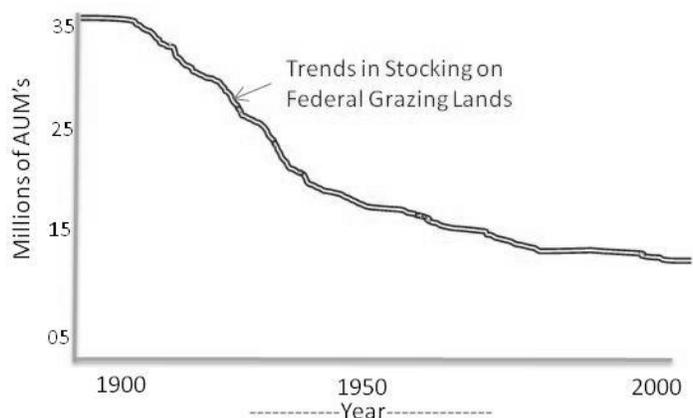
Range plants evolved to withstand grazing and can withstand a heavy grazing event if done in the right season and if plants are given enough time to recover after grazing. Most rangeland grasses and forbs can have 40-50% of their leaves and stems removed every year and still remain healthy and productive. In general, light use is considered less than 40%, moderate 40-65%, and heavy greater than 65% of biomass removed. The season during which the grazing occurs is very important. As described above, plants are most sensitive to grazing when they are flowering and forming seeds. After plants go dormant they are affected little by grazing. When considering effects of grazing on shrub species, one must look at the amount of usage of current year's growth – these include the leaves and young stems



Hedging of Curl-leaf Mountain Mahogany

that are important for photosynthesis. The current year's growth of shrubs is the most digestible part of the plant and is the portion generally removed by browsing animals such as deer and goats. In winter, shrubs survive by using energy compounds (i.e., starches and sugars) stored in the stems. Thus, though the shrub is dormant, it is important to watch browsing of these stems. An indicator of overgrazing of shrubs is moderate or heavy hedging (i.e., growth of lateral stems just below a grazed point) and a lack of new or juvenile plants.

Many of the signs of overgrazing seen on Idaho rangelands today occurred 75 to 125 years ago when much of Idaho was "open range" and livestock numbers were not controlled. The era of controlled and managed grazing was signified by the passing of the Taylor Grazing Act in 1934. This act was passed to "stop injury to public grazing lands and provide for their orderly use, improvement and development." Idaho rangelands are in better condition today than in a century because they are now managed and monitored. A skilled rangeland manager can recognize overgrazing and take steps to correct it.



Invasive Plants

One of the most serious threats to the health and sustainability of rangeland ecosystems in Idaho is exotic invasive plants. As white settlers explored, homesteaded, and developed the West, they brought with them many plants that have colonized and taken up residence on Idaho rangelands. Some of these plants were introduced on purpose as ornamental plants, like leafy spurge and purple loosestrife.

Others, like cheatgrass, came in accidentally in grains and feed. Some of the plants the people brought to Idaho have a malicious attribute of invading native rangelands, forests, and croplands, choking out the desirable native plants or crops.

Invasive Plant Terminology

The term “**weed**” can mean different things to different people. But, basically a weed is a plant in a place where it is not wanted or a plant of little value. Others describe weeds as plants that compete with crops and native plants or as troublesome pests that reduce the health of land and its value for livestock or wildlife. Ross & Lembi, in their book *Applied Weed Science* (1999), define weeds as “*plants that interfere with the growth of desirable plants and that are unusually persistent and pernicious. They negatively impact human activities and as such are undesirable.*”

Exotic, alien, or nonindigenous plants are not native to a region and have been brought into the region either by accident or for a specific purpose. These exotic species often have an advantage over native plants because they lack the natural predators and diseases that kept them in check in their native environment. For example, spotted knapweed seldom dominates native communities in its homelands in Eurasia. In its native habitats, knapweed is naturally suppressed by insects predators that feed on the roots and seeds. When the plant made the trip across the ocean, these native insects were left behind. However, not all exotic plants are invasive or bad. Many plants were introduced as forages for livestock, like crested wheatgrass, or as agricultural commodities such as the plants we eat. These are exotic species but they seldom take over native rangelands and become weeds.

Invasive plants are those that exhibit “weedy” or aggressive growth characteristics. Once established, invasive species will out-compete native species and often spread and dominate wildland plant communities. Invasive species are not typically one particular plant life form and can be grasses, forbs, shrubs, or trees. Common examples of invasive plants in western North America include: cheatgrass, leafy spurge, spotted knapweed, and salt cedar. Invasive plants may persist at relatively insignificant densities for a period of time until ideal conditions occur and then the plant will spread and dominate a site. Most invasive plants of concern are exotic. However, some native plants, like western juniper, can become invasive and start to dominate plant communities.

“**Noxious weed**” is a specific term held for particularly problematic plants that are recognized by a county, state, or federal governments as so serious that they need to be controlled or contained. **Noxious** is therefore a legal definition used to describe weeds that have been recognized by the government as injurious to public health, agriculture, recreation, wildlife, or property. Idaho state law has recognized 57 noxious weeds and requires that landowners attempt to control or contain these weeds when they occur on their property. If a landowner chooses not to take action, counties can treat the infestation, and bill the landowner for incurred expenses.

Why Are Weeds Bad?

Exotic invasive plants can have many detrimental effects on healthy rangeland ecosystems. The negative ecological effects can include:

- Reducing the abundance of native plants and animals – even rare plants can be displaced
- Replacing diverse communities containing many species with a monoculture where only one species dominates.

- Reducing water infiltration and changing the hydrologic characteristics of the land
- Altering soil characteristics and increasing soil erosion and runoff
- Altering fire intensity and frequency

Weeds can also have serious impacts on human activities and economic profitability. Some weeds such as Scotch thistle and yellow starthistle can form dense, nearly impenetrable stands which reduce the value of land and inhibit recreation such as hiking and hunting. Weeds can also reduce the abundance of forage plants on rangelands thereby reducing their value for grazing. And, the cost and time spent controlling weeds and keeping them in check can seriously reduce the profitability of ranchlands.

Wildland Fire

Wildfires are a natural part of rangelands and have helped shape the plant and animal communities that we recognize today. Fire naturally served a role in maintaining rangeland health, plant composition and diversity in many communities. Plants, animals, and insects in fire-adapted ecosystems have evolved mechanisms to tolerate or even benefit from fire. Adaptations include: long lived seeds that are activated by fire, quick germination and regrowth after fire, thick bark resilient to fire, and seed production activated by fire. For example, plants in the *Ceanothus* genus (a rangeland shrub) contain a waxy coating on the seed surface that is dependent on heat treatment from fire to break seed dormancy and promote germination. Antelope bitterbrush, rabbitbrush, and several other rangeland shrubs have adapted to sprout quickly after a fire, utilizing the increase of minerals and nutrients that are present in the ash. Grasses often come to dominate shrublands and woodlands after fire because the woody plants are removed and the grasses are better adapted to fire.

Fire is one of nature's tools for consuming the dead and decadent biomass that can accumulate in rangeland plant communities. Most rangelands are characterized by dry climates which can slow biological decomposition – the rate at which plant material is incorporated into organic matter in the soil. Fire rapidly converts that dead and decadent plant growth into inorganic ash that frees nutrients and minerals for new plant growth. However, if fires are too frequent or intense, plant cover and organic matter at the soil surface can be reduced. Fire almost always results in a loss of nutrients through volatilization, oxidation, ash transport, and erosion. However, fires can also convert nutrients to inorganic forms that are more available to plants for growth. Fire also increases soil nutrient turnover rates and affects the distribution of nutrients in the soil horizons. Of course, the potential damage to plants and amount of dead plant material that is converted to bio-available nutrients depends on how hot the fire burned. Generally, low intensity burns increase plant productivity, while high intensity burns result in decreased productivity and plant diversity.

Wildfire versus Prescribed Burning

All fires need heat or a source of ignition, oxygen, and fuel. However, fires can occur under two scenarios: wildfire or prescribed burning. The main difference between a wildfire and a prescribed burn lies in how and when they are ignited. Wildfires could be naturally caused through lightning, or man-made through foolish actions such as improperly attended or extinguished campfires, lit cigarettes that are discarded, and arson activity. Prescribed burns are set for specific reasons, at a certain time of year when the environmental conditions will accomplish desired management goals and allow containment.

Prescribed burns avoid hot, dry, and windy conditions that can cause the rapid and unmanageable spread of fire which poses a serious threat to life and property.



Effects of Fire on Plants

The effect of fire on rangeland plants depends largely on the growth form (i.e., bunchgrasses, forbs, shrubs), plant adaptations, and season of burning. Many native rangeland plants are well adapted to fire, thus plants that return quickly after fire are termed “fire resistant.” These plants will often have their meristems (i.e., plant growing points) located just below the soil surface so that they are not damaged by the heat of fire. This adaptation allows the plants to resprout from the base unlike less fire resistant plants that have elevated meristems which can be removed and damaged by the heat of the fire. Burning during the hot, dry, summer months is the most harmful to plants because of the high intensity fires, while late summer and fall burns are the least harmful because of increased moisture and cooler temperatures.

Fire Return Intervals

A change of fire interval (i.e., the time between fires) or improper timing of fire during the season can deplete native plant communities of desirable perennial plants. Over time, repeated burning can result in severe impacts, including loss of perennial plants, an increase in frequency of weedy plants, increased erosion, and a change in nutrient cycling. Many weedy plant species are able to take advantage of the available soil nutrients, water, and growing conditions after a fire and outcompete more desirable plants. In Idaho and many other western states, land managers are concerned about cheatgrass invasion and its ability to shorten the interval between fire events. When cheatgrass goes dormant it creates a bed of fine fuels that are easily ignited and can burn rapidly and frequently across the landscape. Perennial grasses and shrubs find it difficult to recover and grow when wildfires occur every few years which can happen on cheatgrass-dominated rangelands.



Fire suppression or the exclusion of fire can also impact landscapes over time. Fire suppression policies and actions over the past century were aimed at controlling fires when they occurred on

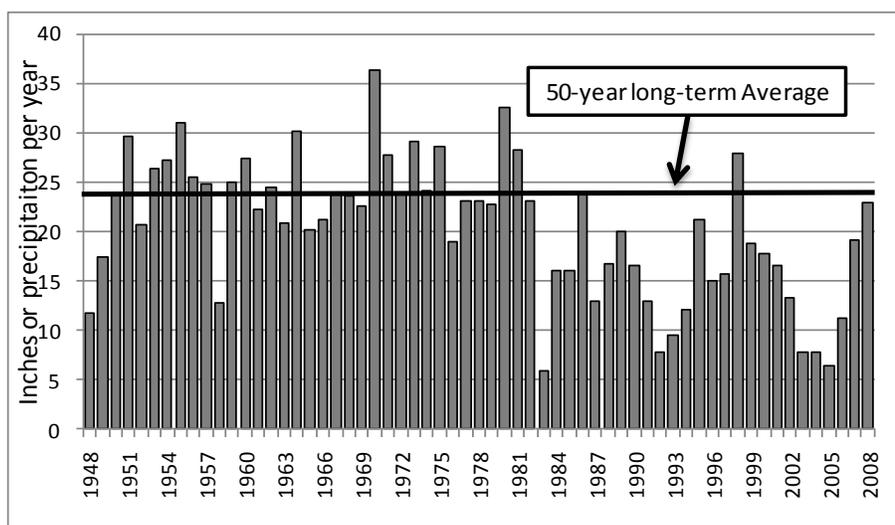
rangelands. Fire suppression can result in an unnatural accumulation of fuels that may increase the probability of large, high-intensity wildfires and pose a threat to the long-term sustainability of the ecosystem. Fire suppression has also led to an increase in woody species, and problems with the invasion of juniper and other evergreen trees onto rangelands naturally dominated by shrubs and grasses. Thus, a lack of fire can upset the balance between shrubs, grasses, and trees giving the trees a competitive edge to dominate landscapes.

Positive Aspects of Wildfire

Fire can have some positive impacts on range livestock and wildlife management. The flush of nutritious and digestible green plant growth following fire creates patches of nutrient-rich habitat that draw domestic and wild animals. Wildfires and prescribed burns can also create patchy landscapes of grasslands, shrublands, and woodlands that provide a diversity of habitats for wildlife.

Weather and Climate

Weather and climate are highly influential factors determining how rangelands change over time. Water is the primary limiting resource on rangelands, and vegetation production depends heavily on water availability and suitable growing temperatures. Idaho's rangelands, while for the most part very dry and cool, can experience



great variation in moisture and temperature depending on region, slope, and aspect. Idaho landscapes vary greatly depending on their aspect and elevation which affects the amount of solar radiation and moisture loss. Precipitation that is received on a landscape can vary substantially from year to year. For example, on this site near New Meadows Idaho, the long-term precipitation average is about 24 inches per year. However, that annual amount can vary from 6 to 36 inches per year. In other words, there can be a 6-fold increase or decrease in the precipitation that occurs from year to year.

These vast swings in the precipitation that a site receives each year, results in massive variation in the amount of biomass that the site can produce annually. For example, biomass of grass varied from 140 to 1,090 pounds/acre on a site where crested wheatgrass biomass was measured yearly for 35 years near Malta, Idaho.



1969 –
Annual grass production = 262 pounds/acre
Annual precipitation = 10 inches



1971 –
Annual grass production = 1,090 pounds/acre
Annual precipitation = 16.5 inches

The role of global climate change on rangelands has been a topic of debate and consternation. It is clear that climate is changing. But, the specific role that climate changes will have on any specific rangeland ecosystem is uncertain. Concerns include the role that warmer winters might play on reduced snow pack or enhanced growth of winter annuals like cheatgrass. There is also concern over whether climate change will lead to more frequent droughts or hotter drier summers that will encourage wildfires. Still other climate models call for areas of greater precipitation and cooler temperatures in some rangeland regions. All of these changes in climate are of great concern to land managers and those who live on rangelands because it will change the type of plants and animals that will dominate an area and how invasive plants or fire might affect these sites. Unfortunately, it is almost impossible to control or predict climate and weather. Land managers are stuck with finding strategies to accomplish sustainable management in dynamic ecosystems.

Fragmentation of Rangelands

The western United States is experiencing rapid population growth, with many people drawn by the appeal of open space, dry climates, and an abundance of public rangelands and forests on which to recreate. The dream of many westerners is a house and a few acres of land on which to enjoy western landscapes and wildlands. “Ranchette” is a term used to describe a small parcel of land created by the splitting up larger ranches. An increase in rural subdivision has resulted in a drastic fragmentation of rangelands in many areas. The same geographic features that make the land appealing to wildlife such as proximity to streams, gentle slopes, and timbered draws also makes the land appealing to developers and people wanting to build.

The increase in roads, buildings, and human activity has had several major impacts. Rural subdivision and fragmentation usually lead to an increase in weeds, a loss of biodiversity, and degradation of pasture lands. Wildlife still inhabit fragmented landscapes, but the species present change from specialists like moose, mountain lions, and buntings to more generalist species like deer, coyotes, and robins. Roads also become more dangerous and aversive to wildlife as the number of vehicles increases. Houses built on wildlife winter habitat prevent animals from moving down in winter months, or result in increased stress from interactions with humans and their pets. Loss of key areas

such as migration corridors, wintering habitat, or nesting and breeding areas can have drastic impacts upon animals and humans.

The effects of rural subdivision on plant communities can also be devastating. Ranchettes have a higher frequency and density of exotic invasive species in comparison to adjacent ranches. Roadways and paths are areas of disturbance for invasive species to establish. Small horse pastures are frequently overgrazed and highly degraded resulting in loss of habitat, and increased soil erosion. Many rare and sensitive species who are specific to certain ecological sites may find themselves in danger.

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