2018 Current Issue

www.nysenvirothon.net/current-topic/

The 2018 Current Topic is Western Rangeland Management: Balancing Diverse Views

Western rangelands include prairies and grasslands, sagebrush steppes, and woodland areas. Rangelands comprise more than 40% of the total productive land base in the western U.S. Rangelands sustain an abundance of forage for both livestock and wildlife, as well as providing aesthetic beauty enjoyed by many. Rangeland resources are a critically important ecosystem component of the western US landscape and are a vital economic factor for many agricultural producers.

Western rangeland management objectives include grazing, timber harvest,recreational uses (including hiking, camping, fishing, hunting, etc.) and mining. Western rangelands are diverse and rich in natural resources and provide an essential fresh water source for all of the western U.S. Public land managers and agriculturalists work to protect these resources to ensure their sustainability for generations to come.

Resources:

- **Rangeland Study Guide**
- **Rangeland Glossary**

Other Resources

- Bureau of Land Management (BLM) Rangeland Management site https://www.blm.gov/programs/natural-resources/rangelands-and-grazing
- BLM Weeds and Invasives https://www.blm.gov/weeds

Be familiar with what “Noxious Weeds” are, and the State and Federal Laws that govern how they are enforced.

- https://legislature.idaho.gov/statutesrules/idstat/Title22/T22CH24/
    - .

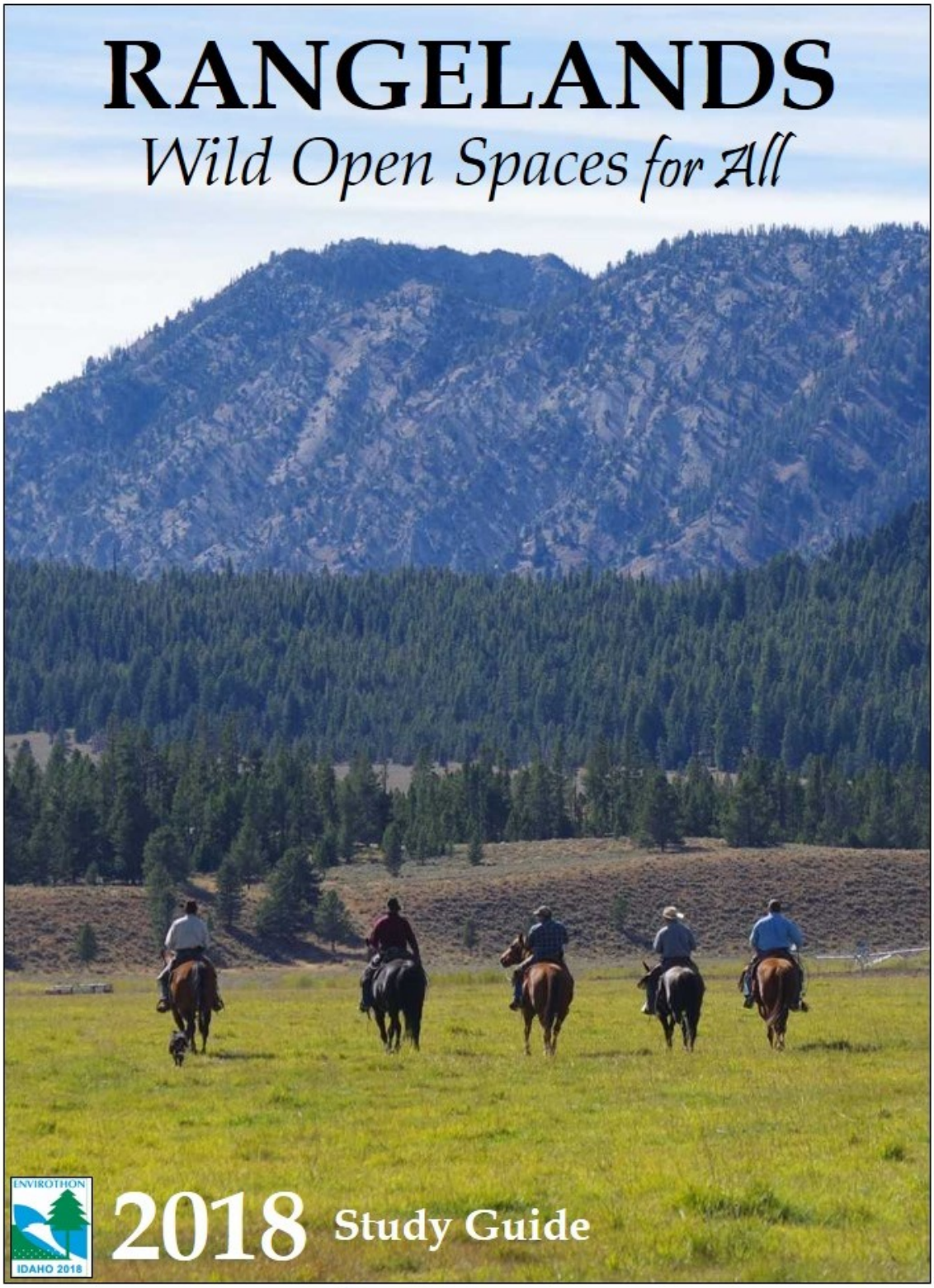
The difference between “Noxious Weeds” and Invasives, We in New York do not have “Noxious Weed Laws” and this will be a new concept to understand.

Prescribed Burning:

- https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_011175.pdf
- http://fireecology.okstate.edu/patch-burning/what-is-patch-burning

RANGELANDS

Wild Open Spaces for All



2018 Study Guide

This Study Guide is to be used to help Envirothon teams prepare for the 2018 Envirothon Program

IDAHO RANGELAND RESOURCE COMMISSION

University of Idaho

This 2018 Envirothon Rangeland Study Guide draws on numerous documents and other sources, most notably *Wild Open Spaces* and the high school curriculum created by the University of Idaho (UI) and the Idaho Rangeland Resource Commission (IRRC), plus course materials for REM151: Rangeland Principles (UI). We thank the many talented and dedicated UI faculty and staff, past and present, who contributed to these materials.

We have set up a central clearinghouse of references for students at idrange.org/Envirothon-rangeland-resources. There you will find links to a host of resources, including videos, websites, information packets and more, to help students and their instructors prepare for the 2018 Envirothon in Pocatello, Idaho.

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1. Rangeland Management: Wild Open Spaces for All

1.1. Key Topics

- What Are Rangelands?
- History of Rangelands
- Multiple Uses of Rangelands (Social, Economic and Ecological Values)
- Rangeland Management (Principles, Strategies and Tools)
- Becoming a Range Professional

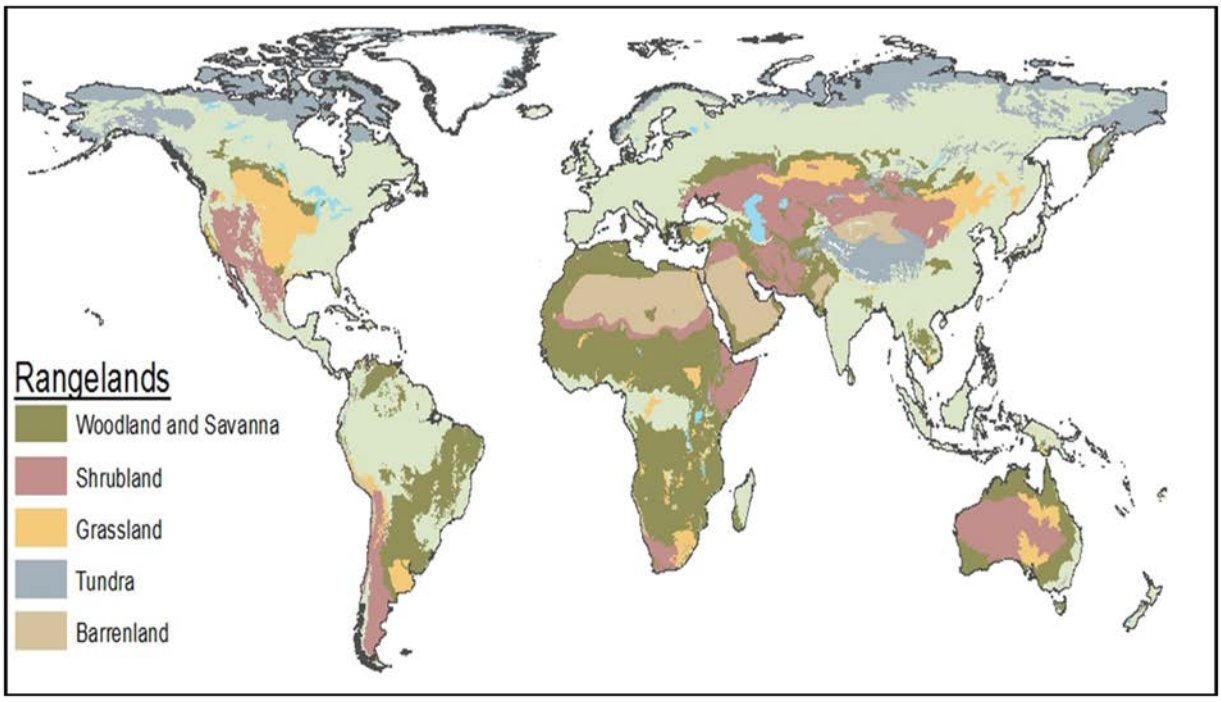
1.2. Learning Objectives

- Describe the biotic and abiotic characteristics of rangeland biomes.
- Discuss rangeland history and how it influences decisions today.
- Describe the various entities responsible for managing rangeland—private, state and federal agencies, and non-governmental organizations (NGOs).
- Demonstrate an understanding of multiple use on rangeland (social, economic and ecological values).
- Demonstrate knowledge of rangeland plants (including identification, growth form, life span, season of growth, origin, and forage value).
- Demonstrate knowledge of grazing systems.
- Demonstrate knowledge of how abiotic and biotic factors affect range conditions/health and strategies and tools that promote sustainable rangelands.
- Demonstrate awareness of career opportunities in rangeland ecology and management.

1.3. Get to Know Rangelands

What Are Rangelands?

Understanding what rangelands are begins with knowing what they are not. Rangelands *are not* lands that are farmed, densely forested, entirely barren, or covered with solid rock, ice or pavement. Rangelands *are* grasslands, shrublands, woodlands, and deserts. Rangelands are usually characterized by limited precipitation, often sparse vegetation, sharp climatic extremes, highly variable soils, frequent salinity, and diverse topography. From the wide open spaces of western North America, to the Asian steppe, to the Australian deserts, to the vast plains of Africa and the pampas of South America, rangelands are found all over the world and encompass almost half of the earth's land surface. Because rangeland landscapes are diverse and complex, you will hear them called by various names around the world, including prairies, plains, grasslands, swards, steppes, pampas, shrublands, scrublands, woodlands, savannas, deserts, semi-deserts, and arid lands.



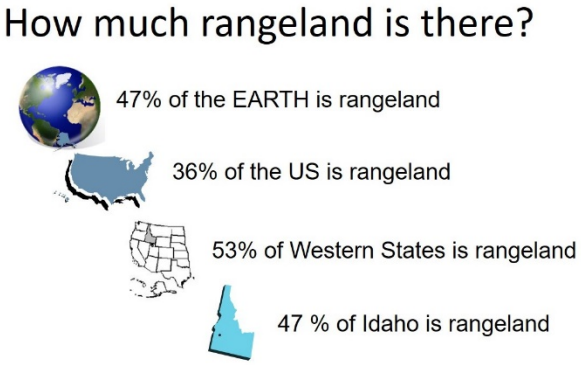
Rangelands of the World. Map created by Eva Strand, Karen Launchbaugh, and Christopher Bernau of the University of Idaho based on a global database created by the World Wildlife Fund
http://www.worldwildlife.org/science/ecoregions/item1847.html

Rangelands are a type of land, not a specific land use.

- Rangelands are non-cultivated land. Rangelands typically cannot sustain farming because of low precipitation, shallow soils, and rugged topography.
- Rangelands may have scattered trees, such as juniper or aspen, but they do not include dense forests. Rangelands are typically dominated by low-growing, diverse plant communities of grasses and shrubs intermixed with flowering plants (forbs).
- Rangelands provide essential habitat for livestock and wildlife. Their rich ecological diversity provides food, cover and rearing-ground necessary for healthy fish, birds, wildlife, and livestock.

How Much Rangeland Is There?

Of the Earth's total land surface, 47% is rangeland. In the U.S., 36% of the land area (nearly 1 billion acres) is rangeland. A total of 53% of the 19 states west of the Mississippi is rangeland. The state of Idaho encompasses about 53 million acres. Of that, nearly 26 million acres, or 47%, is classified as rangeland.



Not All Rangelands Look Alike

Grasslands**,** as the name implies, are ecosystems that are dominated by grasses. Throughout the world, grasslands go by names like prairie, steppe, pampas, sward, meadow and veld. In North America, grassland biomes include the tallgrass prairie, shortgrass, prairie, alpine meadows, California annual grasslands, palouse prairie, southern mixed prairie, marshes, wet meadows, tundra grasslands, and desert grasslands.

Shrublands are lands with abundant stands of shrubs with an understory of grasses and forbs—but shrubs dominate these ecosystems. Shrublands across the world are called chaparral, cerrados, shrub-steppe, maquis, and scrublands. In North America, shrubland biomes include chaparral, sagebrush-steppe, salt-desert shrublands, tundra shrublands, and mountain browse.

Woodlands and Savannas are dominated by widely-spaced trees including juniper, oak, mesquite and pine, with an understory of grasses and forbs. Woodland ecosystems across the world take the names of the trees that dominate the landscape. In North America, the largest woodland biome is the pinyon-juniper woodland. Other woodland and savanna ecosystems include oak woodlands, aspen savannas, and mesquite woodlands.

Deserts are the driest rangelands; they experience extreme water shortage and unpredictable precipitation. These ecosystems are dominated by shrubs and succulent cactus plants. Deserts and arid lands cover massive areas and include the Saharan, Namib, Arabian, Atacama, Australian, and Kalahari deserts. The hot desert biomes in North America are found in the southwestern United States and northern Mexico, including the Mojave, Sonoran, and Chihuahuan deserts.

Rangeland Regions of North America

The rangelands of the continental United States occur in roughly five geographic zones that vary in topography, climate, and soil type. On the southwest coast, along the Pacific Ocean, lies the ***Mediterranean Region***, with a climate similar to the lands that surround the Mediterranean Sea between southern Europe and northern Africa. A Mediterranean climate is characterized by hot, dry summers and mild, wet winters. More than 90% of the annual precipitation in this region occurs during the winter months.

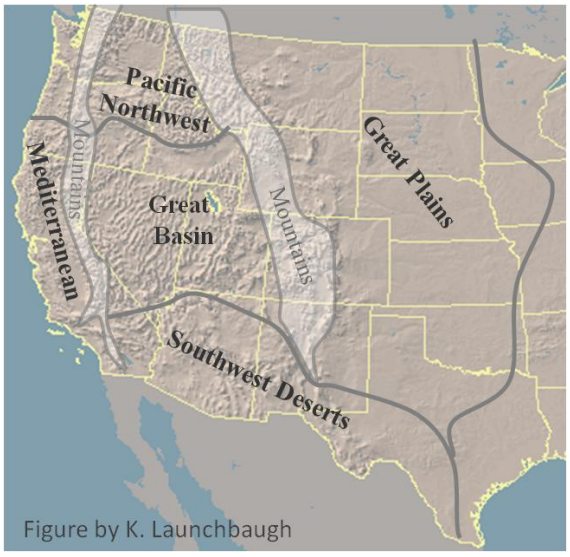


Figure by K. Launchbaugh

In the northwest corner of the United States is a region also heavily influenced by the Pacific Ocean. Known as the ***Pacific Northwest***, it is characterized by cool, dry summers and cool, wet winters. The Pacific climate is very similar to the Mediterranean region but with greater precipitation and slightly wetter summers.

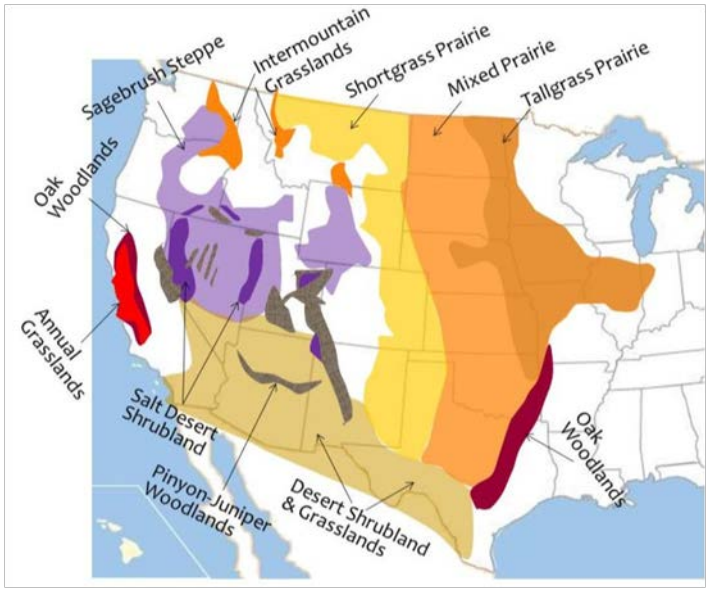
The Great Basin Region, as its name suggests, is a large dish or basin. It is bounded by two mountain ranges: the Rockies on the east and the Sierra Nevada on the west. Nearly all the moisture that falls in the region does not flow to an ocean; rather, it settles in lowlands throughout the basin. As water accumulates in the lower flat valleys, the moisture evaporates, leaving areas with salty (and often alkaline) soils. For example, the Great Salt Lake is a large lake that accumulates water and soil salts that never flow to the ocean. The climate of this region is strongly influenced by the Pacific Ocean, so it shares the cool, wet winters and dry summers of the Mediterranean and Pacific Climates. However, the Sierra Nevada Mountains form an orographic barrier, intercepting moisture heading east from the Pacific Ocean and creating a dry area on the east or leeward side of the mountains. This effect is known as a "rain shadow." Because the Great Basin is set in this rain shadow, it receives very limited precipitation—just 8 to 20 inches a year in most areas.

The Southwestern Desert Region includes the Mojave, Sonoran, and Chihuahuan deserts. These deserts are collectively known as the "hot deserts" because they are characterized by hot, dry summers and warm winters. Most areas of the region receive less than 15 inches of rain per year; some areas receive rain only once every few years. The Southwest Desert Region experiences a monsoon season of rains from July through September. After a dry spring and early summer, the prevailing winds change from westerly to southerly, bringing moisture in from the Pacific Ocean and Gulf of Mexico. This leads to almost daily thundershowers that may occur in one location while an area a short distance away remains dry.

East of the Rocky Mountains lies the ***Great Plains***: vast flat or rolling landscapes that fall away from the mountains and stretch to the Mississippi River. The Rocky Mountains intercept moisture from the Pacific Ocean and create a strong rain shadow such that the driest part of the Great Plains is directly east of the Rockies. The amount of annual precipitation increases from west to east across the Great Plains so that areas receiving the most annual precipitation are near the Mississippi River. Moisture in the Great Plains falls mainly during the spring and summer.

Rangeland Vegetation Types of North America

The grasslands, shrublands, woodlands, and deserts that dominate North American landscapes take many different forms. Each of the five rangeland regions in North America has characteristic vegetation adapted to its unique combination of climate and soils. A.W. Kuchler, an American geographer and naturalist, is recognized as having produced one of the first reliable maps of vegetation in the continental United States.



Simplified map of major rangeland vegetation types based on A.W. Kuchler's Potential Natural Vegetation (K. Launchbaugh).

Kuchler produced his map by looking at existing maps and photos and by visiting many sites across the country. His work is still widely used today. However, most modern vegetation maps are created by remote sensing technology that takes pictures and collects light waves (spectral characteristics) using cameras mounted on satellites orbiting the earth. Different vegetation types have unique spectral characteristics that can be classified using geographic information systems (GIS) and mapped.

Mediterranean Region

Annual Grasslands

Before European settlement, the annual grassland region in California was a bunchgrass prairie dominated by needlegrasses. Exotic annual plants such as cheatgrass and medusahead were introduced at a time when heavy grazing was occurring in an effort to produce meat to feed miners of the gold rush and homestead era. These plants from Eurasia were well-adapted to California's Mediterranean climate. The region quickly transitioned from native perennial bunchgrasses to annual plants. Nearly all of the range plants in unfarmed areas of this region today are annuals and exotics.

The region is characterized by mild, wet winters and long, dry summers. Annual precipitation varies greatly from 30 or more inches near the ocean to as little as 8 inches in the foothills of the Sierra Nevada Mountains. Soils range from prairie soils (called mollisols) to desert soils (called aridisols). Many of these soils are excellent for farming. More than half of the region today is farmed and is important for truck crops such as tomatoes, grapes, strawberries, apricots, and asparagus.

Oak Woodlands and Savannas

Several plant communities across western North America are dominated by oak trees or shrubs. These include the oak savannas in California and Texas, oak woodlands in southern California and central Texas, and oak shrublands in northern Texas and New Mexico and at the lower elevations of the Rocky Mountains in New Mexico and Colorado. These oak-dominated vegetation types vary significantly, depending on the species of oak present. All oak communities share mesic, or mild, climates with 20 to 31 inches of precipitation each year.

The oak savanna type is a true savanna with an overstory of oak trees and an understory of grasses and low-growing shrubs. The mid-elevation savannas surrounding the California central valley are composed of Blue Oak. In southern California, the major oak species is interior live oak, and the plant communities take a more woodland form with shrubs in the understory. Texas also has several important oak types, including the post oak savanna of east-central Texas and the live oak woodlands of central Texas.

Pacific Northwest

Intermountain Grassland

This region includes a diversity of grasslands dominated by bunchgrasses including the Palouse Prairie and Canyon Grasslands of Idaho, Washington, Oregon and Montana. Major grasses include bunchgrasses such as bluebunch wheatgrass and Idaho fescue. These grasslands receive from 12 to 25 inches of precipitation annually, mostly as spring rain. Late summer rains are uncommon in this region and therefore lightning-ignited wildfires historically were also uncommon. Long, dry summers limited the invasion of trees and shrubs into the grasslands.

The Palouse is a unique grassland type within the Intermountain Grasslands. The soils of the Palouse are mostly windblown soils, called loess, that are excellent for farming. Consequently, only about 1% of the original Palouse prairie exists today. Nearly all of the land was plowed to create the most productive non-irrigated cropland in the world for growing dry-land wheat, lentils, and dry peas.

Great Basin

Sagebrush Steppe

The sagebrush steppe is one of the most extensive range types in western North America. The term "steppe" refers to dry grasslands and treeless regions. Therefore, the sagebrush steppe is a region with an overstory of shrubs, mostly sagebrush and rabbit-brush, and abundant stands of bunchgrasses, mostly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass, between shrubs. There are about 20 different species of sagebrush found in the sagebrush steppe, though big sagebrush (*Artemisia tridentata*) is by far the most common.

The sagebrush steppe has a semiarid climate, with 8 to 20 inches of precipitation per year, characterized by wet springs and long, dry summers. Fires were historically patchy: small areas of shrubs would burn and perennial grasses would grow for several years in the burned areas until shrubs became reestablished. At lower elevations in the sagebrush steppe regions, invasive annual grasses like cheatgrass have created a fine fuel, leading to more frequent and more damaging fires. Where wildfires historically occurred once in several decades, fires may now return every few years in areas where annual grasses have taken over because annual grasses senesce early in the summer, increasing ignition risk and creating continuous fuel beds. A shortened fire regime has created a situation where native grasses and shrubs have difficulty becoming reestablished between fires, and exotic annual grasses now dominate some areas. Sagebrush steppe areas at higher elevations have a different relationship with fire. On these colder, high elevation sites, annual grasses do not grow as well and are less invasive than at lower, warmer elevations. However, juniper and other evergreen plants can invade sagebrush communities. In these regions, prescribed fire is an important tool to reduce evergreen encroachment and allow sagebrush and grasses to grow and dominate, as they have historically.

Salt Desert Shrublands

In the Great Basin at level areas in the lower elevations of the landscape, salt accumulates and supports salt desert shrublands that are well adapted to dry, salty soils. This region has a very dry climate with only 3 to 10 inches of precipitation each year. Dominant shrubs include shadscale, saltbrush, and winterfat. Like most shrubs, these plants are nutritious in the winter and provide important forage for wildlife, sheep and cattle. Invasive annual plants pose the greatest threat to this vegetation type.

Pinyon-Juniper Woodlands

Woodland communities made up of pinyon (*Pinus* ssp.) and juniper (*Juniperus* ssp.) are widely spread across the mid-elevation lands west of the Rocky Mountains and are collectively called the Pinyon-Juniper (or P-J) woodlands. This woodland type takes many forms, from nearly solid stands of Pinyon pine to stands of Western, Utah, or Rocky Mountain juniper. Precipitation averages 12 to 20 inches

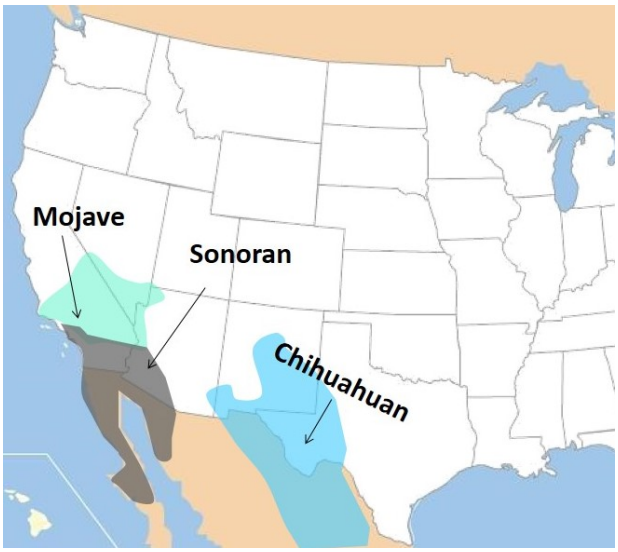
annually in these communities. This vegetation type is important because it provides good cover and forage for wildlife and livestock.

However, expansion of P-J woodlands in recent decades has caused concern because sagebrush steppe plant communities can be diminished and eventually replaced by encroaching pinyon and juniper trees. Why is that important? Approximately 90 bird species and 85 kinds of mammals use sagebrush lands for food and cover. Additionally, P-J encroachment leads to increased erosion, loss of native understory plants and seedbank. That in turn opens the way for increasing weed dominance and a buildup of fuels that leads to catastrophic wildfires. People generally suppress wildfires to protect human lives and property, and this suppression inadvertently allows pinyon and junipers to spread. Using prescribed fire intentionally ignited and carefully timed and controlled could restore fire at a frequency such as occurred historically across these landscapes and reduce pinyon and juniper encroachment.

Southwest Desert

Desert Shrublands and Grasslands

The Desert Southwest includes three major desert types, aligning with three major deserts: Mojave, Sonoran, and Chihuahuan. The three deserts are collectively called the "hot desert" or, for our purposes, desert shrublands and grasslands. The regional temperatures are indeed hot, with several weeks or months of daily high temperatures exceeding 100° F. The amount of precipitation ranges from 5 to 20 inches per year, and this varies from year to year and from place to place.



The plant communities in the Mojave are dominated by creosote bush and a mix of other shrubs and warm-season grasses. Large succulent plants such as the saguaro and other upright cactus plants are the iconic species of the Sonoran Desert. The Chihuahuan Desert is a mix of shrubs, such as mesquite and creosote bush, with stretches of grasslands common on deeper soils. A few centuries ago, more of this area was dominated by warm season grasses such as black grama. Heavy grazing and severe drought converted much of the area from grasslands to shrublands.

Great Plains

Tallgrass Prairie

This productive prairie is dominated by tall grasses, including big bluestem and Indian grass. The growth of these large grasses during the early formation of this region created very productive soil, in the mollisol soil order, that was easily plowed and converted to croplands. Consequently, most of the original tallgrass prairie region is now cropland and only about 5% of the tallgrass prairie remains today. The Konza Prairie in Kansas is one of the largest remnants of the tallgrass prairie.

This region receives 20 to 30 inches of precipitation each year, occurring mostly as spring and summer rains. The tallgrass prairie region is one of the most mesic, or moist, grassland types. Without fire and drought periods, these grasslands are quickly taken over by shrubs and trees. Grasses are well adapted to fire, while woody plants in this region are generally killed by fire. Therefore, occasional fires reduce invasion by woody plants, leading to the use of prescribed fire as an important management tool for tallgrass prairies. Drought or unusually dry summers reduce survival of shrub and tree seedlings and thus slow invasion by woody plants. Grazing by large ungulates, such as bison, was also an important ecological force during the development of this prairie, and its major grasses are adapted to grazing.

Mixed Prairie

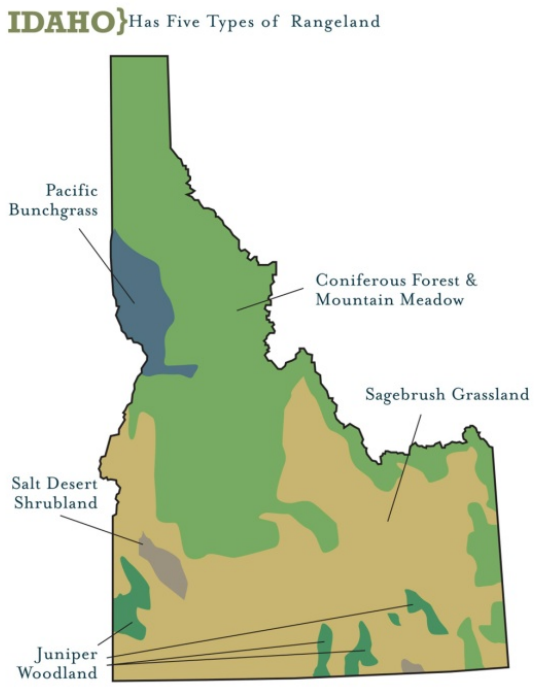
As the name suggests, this is a mix of grasses: tallgrasses and mid-grasses, and cool-season and warm-season grasses. The landscapes in the mixed prairie can also appear quite patchy, as a variety of plant communities exist across the rolling plains. Plants here evolved with grazing bison, so most are well adapted to grazing. Wildland fires were also common on the mixed prairie, and prescribed fire is often used as a management tool to reduce shrub invasion and improve the forage value of grasses.
In the Mixed Prairie, precipitation ranges from 14 to 20 inches per year and falls mainly as spring and summer rains. The soils are mostly mollisols but are not as fertile or productive as the tallgrass prairie. Therefore, much of this region was not plowed into farmlands and exists as native prairie today. This region also includes many shallow wetlands that are important for migratory waterfowl, including ducks and geese. For example, the Prairie Pothole region is found within this mixed prairie.

Shortgrass Prairie

The shortgrass prairie is dominated by low-growing, wide-spreading grasses that are adapted to low precipitation. In the rain shadow of the Rocky Mountains, this region receives only 12 to 20 inches of precipitation each year. The shortgrass prairie also received heavy grazing by bison as it formed on the plains. Native grasses in this region, such as blue grama and buffalograss, are well-adapted to drought and heavy grazing. Fire is not common in the shortgrass prairie because plant biomass is not sufficient to carry extensive fires.

Types of Rangeland in Idaho

Rangelands in Idaho include canyon grasslands, palouse prairie, sagebrush-steppe, cold desert shrublands, juniper woodlands, aspen savannas, mountain meadows, and streamside riparian communities. Idaho's climate and geography vary significantly across the state, creating distinct plant communities adapted to these particular conditions. Some of Idaho's rangelands receive as little as 10 inches of precipitation per year, so plants have adapted to survive long, hot, dry summers. For example, rangeland plants tend to have extensive root systems that effectively gather soil moisture even in the driest conditions.



In Idaho, the vegetation communities can be grouped into five ecoregions that share similar types of soils, climate, geology, and ecological processes: sagebrush grasslands, juniper woodlands, salt-desert shrublands, Pacific bunchgrass, and coniferous forests and mountain meadows.

Sagebrush Grasslands

When people think of "the West," they often envision miles and miles of sagebrush. This classic western rangeland type is a mix of sagebrush and bunchgrass that dominates about 18.5 million acres in southern Idaho. These rangelands stretch across the plains, plateaus, and valleys south of the Salmon River. Lower elevations support stands of shorter and smaller shrubs compared to taller "savanna-like" stands at higher elevations. Precipitation ranges from about 10 to 18 inches per year.

Big sagebrush is the main type of sagebrush in Idaho, but a keen observer may notice that there are about a dozen different species of sagebrush. The shrub-grass mix provides good spring and fall grazing for livestock and wildlife. Sage grouse, pronghorn, deer, and black-tailed jackrabbits call sagebrush grasslands home and rely on this type of ecoregion for survival. Therefore, they are often referred to as sagebrush obligate or sagebrush dependent species.

Common plants in the sagebrush grasslands region include sagebrush, primarily big sagebrush, and other shrubs such as rabbit-brush and bitterbrush. Perennial grasses found here include native and introduced grasses such as bluebunch wheatgrass. Common forbs include arrowleaf balsamroot, mules ear and tapertip hawksbeard that paint the landscape with their bright yellow flowers.

Juniper Woodlands

In southern Idaho, two kinds of small evergreen trees, Western juniper and Utah juniper, create a kind of "pygmy forest" that covers about 1.6 million acres. Juniper woodlands usually occur on the rougher terrain and can be dense or open, depending on soils and topography. These woodlands usually occur in scattered patches rather than dense stands. Annual precipitation in this area ranges from 12 to 30 inches a year.

Juniper woodlands are important watersheds that yield water for agriculture and other human uses. The woodlands are also important winter range for wildlife, especially deer and songbirds. Plus, the juniper trees are often harvested for fence posts, firewood and other wood products.

Western and Utah juniper both are common types of juniper found on these rangelands. Big sagebrush is usually found growing in the understory. Grasses typically found on sagebrush grassland, including

bluebunch wheatgrass, bottlebrush squirreltail, and Sandberg bluegrass, are also present on juniper-woodland landscapes.

Salt-Desert Shrublands

"Desert" usually brings to mind hot, dry places with lots of blowing sand. In southern Idaho, equally dry deserts are created by salty soils and cold temperatures. Shrubs that are able to live in these salty soils dominate this "cold desert" that covers 1.5 million acres. As the name suggests, soil salinity is a characteristic feature of this rangeland area. These shrublands get very little annual precipitation, usually 10 inches or less. Shrubs are generally better suited for these harsh conditions than grasses or forbs because of their deep root systems. Because these shrubs have high nutritive value in winter, salt deserts are excellent winter range for pronghorn and are considered some of the world's best range for winter sheep grazing.

Some shrub species that dominate this region are shadscale and fourwing saltbush, low sagebrush, and greasewood. You are likely to see some native grasses like bottlebrush squirreltail or Indian ricegrass, and half-shrubs (sub-shrubs) such as winterfat or the non-native forb, Russian thistle.

Pacific Bunchgrass

When settlers arrived in northern Idaho in the 1880s, they found mostly forest with a few rolling prairies of bunchgrass that dominated 1.2 million acres. These exploring farmers found the deep rich soils and moist climate of the Palouse and Camas prairies favorable for growing wheat and other crops. Precipitation in this area ranges from 12 to 30 inches per year.

Today most of the prairies have been converted to farmland, and very little of the native bunchgrass remains. The existing canyon and foothill grasslands continue to provide high quality spring forage for sheep and cattle and good winter habitat for deer and quail.

Predominant native grasses in the Pacific bunchgrass region are bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. Snowberry, a shrub of the honeysuckle family, is also found in this type of environment, along with wild rose. Forbs found here include arrowleaf balsamroot, biscuitroot, lupine and wild geranium. The camas that gave the prairie its name served as an important food source and trade good for the Nez Perce and other Native Americans, who dug the flowers' bulbs and roasted them in pits.

Coniferous Forest and Meadow

Most of northern and central Idaho is dominated by evergreen coniferous forest totaling about 22 million acres. The forested ecosystems are much more moist than the shrublands and grasslands of southern Idaho, receiving 40 or more inches of snow and rain each year. Most of this area is dominated by dense forest interspersed with natural openings called meadows. In between the trees are grasses, forbs and shrubs (rangeland plants) that provide valuable habitat for a variety of grazing animals. Shrubby vegetation near the forest edge is especially important for deer and elk, and the meadows are important summer range for both wildlife and livestock.

Ponderosa pine and Douglas fir are common tree species dominating Idaho's forests. On the forest floor or open meadows, you can typically find elk sedge and pinegrass, which are similar in appearance in that they have fine leaves and are often found together. Other grasses such as mountain brome and tufted hairgrass can also be found. It is common to see woody plants such as antelope bitterbrush, ninebark, chokecherry, or wood's rose. Wild geranium and fireweed are among the many types of bright wildflowers that grow in this environment.

1.4. History of Western Rangelands

When you think about the history of the West, you may think first of Native Americans, early explorers, pioneers, miners and stockmen. But using the sciences of paleontology and geology, we can learn about the evolution of these rangeland ecosystems before humans arrived. The fossil record tells us that large ungulates roamed western North America for several million years, up until about 10,500 to 7000 years ago. The Pleistocene megafauna included woolly mammoths, musk oxen and brush oxen, and species of bison, horses, burros and camels. These large grazing and browsing animals began to appear at about the same time as the flora of the region transitioned from a wetter, forest type to the grasses and shrubs typical of today's rangelands. The mountain-building processes that lifted the Cascade and Sierra Nevada ranges (10 to 2.5 million years ago) increased the rain shadow effect, creating a more xeric climate on the leeward side of the mountains. Thus, as the landscape of western North America evolved to resemble what we see today, animal species coevolved to take advantage of the ecological niche, grazing and browsing on the rangeland vegetation.

George Catlin, *Prairie Meadows Burning*, 1861/1869

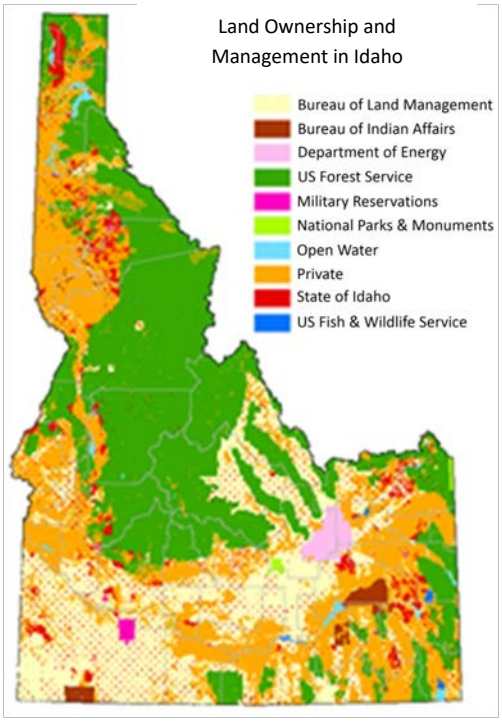
When the first people came to this part of the world about 12,000 years ago, some of those woolly mammoths, giant bison and other grazers still roamed the range. Archaeological evidence indicates that Native Americans hunted the large ungulates, as well as the saber tooth cat and other carnivores that preyed on the herbivores. These hunter-gatherers of the Clovis culture learned to use fire to drive animals, from bison to rabbits, as part of their hunting technique. They also discovered that the use of fire on rangelands increased the availability of desirable plants and maintained habitat for game animals. After Spanish explorers Cortez and Coronado brought domesticated horses to the southwest in the 1500s, Native Americans obtained and bred horses, built up their herds, and once again, equines joined the ranks of animals grazing western rangelands.

American explorers Meriwether Lewis and William Clark first documented western rangelands and the Native Americans living here. On their epic journey from St. Louis to the Pacific Ocean and back from 1804-06, Lewis and Clark reported on many different grasses, forbs, and woody plants on the range. In

fact, Lewis described prairie dogs, sage grouse and other animals still common today on rangelands. Lewis's woodpecker, Clark's nutcracker and several plant species bear the names of the intrepid explorers.

Lewis and Clark's reports of their discoveries sparked increased interest in these uncharted lands. The idea of making dreams come true in the boundless west appealed to many easterners. As a result, the first wagon-traveled road, called the Oregon Trail, crossed the country in the 1840s. Over the next twenty years, an estimated 400,000 pioneers traveled the Oregon Trail and other trails in a mass western migration. The discovery of gold in California in 1849 helped to spur thousands of people to head west to seek their fortunes. Gold was first discovered in Idaho on the Clearwater River in 1860, but the bigger strike came a year later in the Boise River Basin of southwestern Idaho. In just five years, miners took nearly $24 million in gold from the Boise Basin around what is now Idaho City. All those miners flooding into the western territories meant there were lots of mouths to feed, creating a booming market for livestock. Entrepreneuring livestockmen responded, driving cattle herds to the West and grazing them on the unclaimed open range.

In 1862, the Homestead Act helped to motivate major settlement on rangelands by offering 160 acres to any U.S. citizen over the age of 21 who would "prove up" on the land for at least five years. Most of these homesteads were located near rivers, creeks and springs where water was available for drinking and household use, to irrigate crops, and to provide for livestock. Geologist and explorer John Wesley Powell was among the first to recognize that, in the semiarid regions west of the 100th meridian that bisects the Great Plains, 160 acres was not enough land to support a family. He foresaw that settlers would fight over water rights, much as miners would squabble over mining claims. Powell's predictions proved accurate and, in 1909, the Enlarged Homestead Act increased the size of a homestead to 320 acres. The Stockraisers Act of 1916 doubled it again, allowing 640 acres to anyone with at least 50 head of cattle.



In the same year that Congress passed the Homestead Act, it enacted another piece of legislation that further began to segment the vast public lands. The Morrill Act of 1862 granted a portion of land in every state to the states to fund colleges that would foster the teaching of agricultural and mechanical arts. The Morrill Act sought to make higher education available to a broader population, and the colleges established under this system are known as land grant universities. When Idaho became a state in 1890, it received approximately 3.6 million acres of land to be used to generate money for higher education and other specific purposes. Idaho set aside two sections of each township, or 1/18th of the state's land base, to fund public schools. This contributed to the checkerboard pattern of land ownership across much of Idaho that is visible on this map. The Idaho

Constitution stipulates that these lands must be managed in a way that best secures the maximum long-term financial return for the beneficiaries. That means the lands can be sold, or they can be used for timber harvest, grazing, mining or other purposes that raise money for Idaho's schools and other institutions. The University of Idaho, Lewis-Clark State College, and Idaho State University all receive funds from the endowment.

Between 1870 and 1900, rangelands were seen primarily as land well-suited for livestock production. The wide open spaces of western rangelands provided forage and habitat for sheep, cattle, and wildlife. By the late 1880s, when the western livestock production industry peaked, more than 26 million cattle grazed in what are now the 17 western states. During this era, large ranches running thousands of cattle and sheep dominated the business sector of western North America. Unfortunately, the notion of land stewardship did not exist. It was "every man for himself," as stockmen simply wanted to be the first to get their animals out on the open range. This free-for-all resulted in range wars—cattlemen vs. sheepmen and cows vs. crops—as operators competed for grass and water.

http://www.waymarking.com/waymarks/WMJNZN_Rang...

In addition, in the years following the Civil War, cattle were sold by the head, not by the pound, as the beef was merely a by-product; the hides were more valuable for the production of leather goods. This market provided an incentive for ranchers to maximize the number of cattle on the range, rather than concerning themselves with the condition of their animals or the common rangelands. You can imagine what these massive numbers of cattle did to the range: The severe degradation came to be known as the Tragedy of the Commons. By 1886, several years of drought, bad winters and depressed cattle markets finally brought an end to unmanaged open range. Eventually, the market shifted to selling cattle by the pound rather than by the head. Today, cattle must be in good condition to bring a good price on the market. And raising healthy cattle goes hand-in-hand with sustaining healthy rangelands.

Burned timber on Rainey Creek in Lolo National Forest, Montana following 1910 fires. http://www.foresthistory.org/ASPNET/Policy/Fire/FamousFires/1910Fires.aspx

The Forest Reserve Act of 1891 set aside about 47 million acres of National Forest to preserve forests and grazing lands. This act served as the basis for the U.S. Forest Service, created in 1905, to provide for management of rangelands and grazing practices. Then, a firestorm in 1910 became one of the most influential events in the history of the Forest Service. (https://vimeo.com/135837489). In just two days, a raging wildfire burned 3 million acres and claimed 85 lives in northern Idaho and western Montana. The Big

Burn of 1910 shaped public opinion and land management policies for nearly a century, including the effort to suppress all fires, as Smokey Bear educated generations of Americans that "Only you can prevent forest fires." Only in recent decades have we recognized the ecological benefits of fire, including the use of prescribed burning to manage fuel loads.

In 1934, the Taylor Grazing Act recognized the importance of controlling use on public grazing lands and providing for their improvement. This led to the formation of the Grazing Service, which eventually was combined with the General Land Office to form the Bureau of Land Management in 1946. The Dust Bowl, sometimes called "The Dirty Thirties," gave rise to the Soil Conservation Act of 1935, aimed at reducing soil erosion. This Act created the Soil Erosion Service, later renamed the Soil Conservation Service that became what is now the Natural Resources Conservation Service (NRCS). Part of the U.S. Department of Agriculture, NRCS helps private landowners reduce soil erosion through technical assistance and financial incentives or cost-share for the implementation of best management practices (BMPs).

The 1960s saw the birth of the Environmental Policies Era that continues today. During this time, Congress has passed numerous pieces of legislation aimed at managing public lands and resources in a sustainable manner for today and for future generations. Here are some key environmental laws enacted in the last sixty years that affect the use, management and stewardship of rangelands:

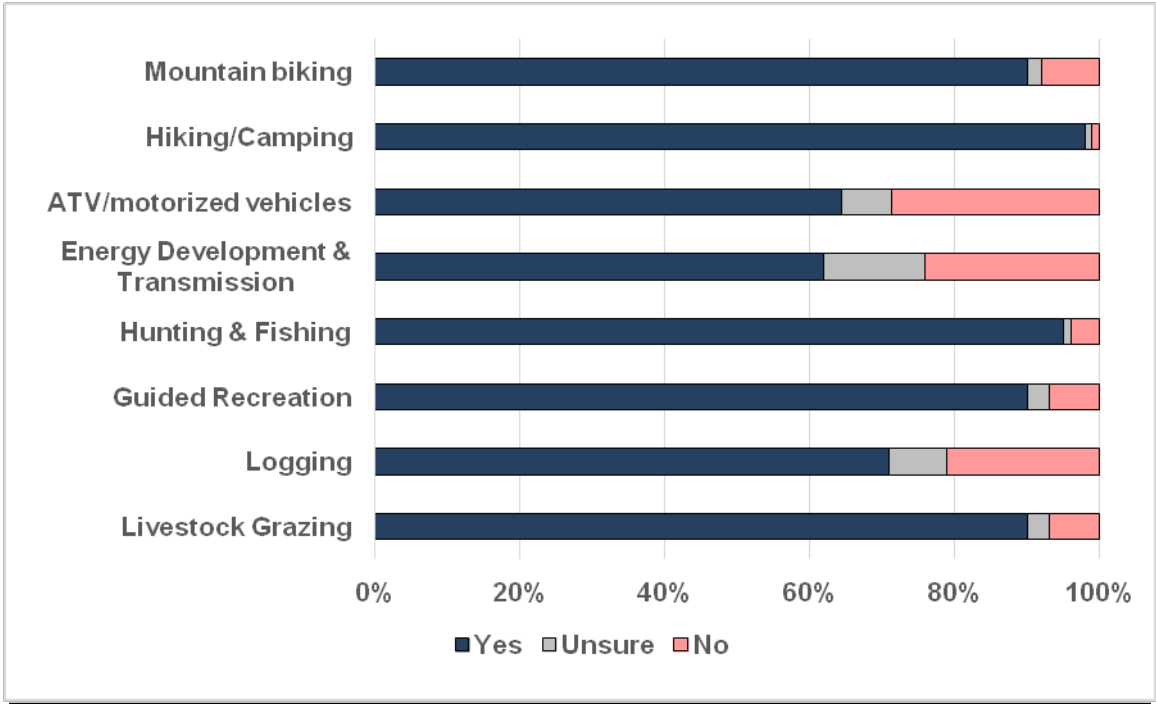
- Multiple Use and Sustained Yield Act of 1960: Defined multiple use as the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people.
- Wilderness Act of 1964: Created a way for Congress and Americans to designate "wilderness areas" that represent the nation's highest form of land protection. No roads, vehicles or permanent structures are allowed in designated wilderness. A wilderness designation also prohibits activities like logging or mining.
- National Environmental Policy Act of 1969: NEPA requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions. Using the NEPA process, agencies evaluate the environmental and related social and economic effects of their proposed actions. Agencies also provide opportunities for public review and comment on those proposals.
- Wild Free-Roaming Horse and Burros Act of 1971: Protects wild horses and burros from capture, branding, harassment, or death, and considers wild horses and burros in the area where they are presently found as an integral part of the natural system of the public lands.
- Endangered Species Act of 1973: The purpose of the ESA is to protect and recover imperiled species and the ecosystems upon which they depend. The Interior Department's U.S. Fish and Wildlife Service (FWS) and the Commerce Department's National Marine Fisheries Service (NMFS) administer the ESA.
- Federal Land Management and Policy Act of 1976: Requires BLM to establish a planning process and to accommodate multiple uses of the land and its resources to achieve sustained yields of natural resources.
- Clean Water Act of 1977: Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

Since the late 1800s, livestock grazing has been the predominant economic use of public rangelands, while hunting and fishing remained the main recreational uses until the mid-1900s. The 1990s brought ever more people to western landscapes. This increasing western population, greater individual wealth, leisure time and a high degree of mobility has created demands for other forms of recreation on public lands beyond the traditional ones. Since 1960, considerable conflict has occurred over the use of and access to public lands.

1.5. Why Rangelands Matter: The Multiple Use Paradigm

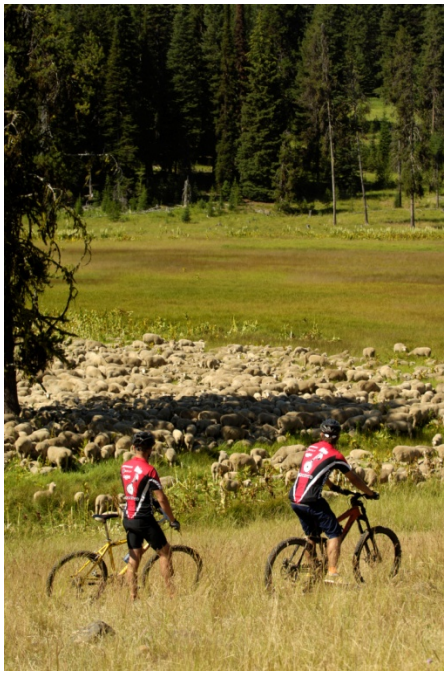
Rangelands provide a number of social, ecological and economic values. Many people appreciate rangelands for their natural beauty, diversity of wildlife, and recreational opportunities like hunting, hiking, bicycling and camping. Rangelands also contribute important economic values, including ranching, mining, and energy production. Historically, the primary function of rangeland has been as forage for livestock and wildlife. However, the importance of rangeland for recreation and water production is growing. The soils, vegetation, and water of rangelands are important to the ecological and economic health of all regions in which they dominate. Therefore, most rangelands today are managed under principles of multiple use, which means that several uses or values of rangeland are managed simultaneously, with care taken to avoid overuse or destruction of natural resources.

In a study conducted by the Social Science Research Unit (SSRU) at the University of Idaho, Idaho residents were asked whether they approve or disapprove a series of specific uses that occur on public lands. Results suggest that the public values multiple uses and is interested in a balanced management approach.



Approval of Specific Activities on Public Lands
SOURCE: UI SOCIAL SCIENCE RESEARCH UNIT TECHNICAL REPORT 14-02-05

Access to such a wide variety of activities on a single landscape is possible because much of America's rangeland is managed by the federal government on behalf of the American people. Federal public land is to be managed for multiple use and for the greatest good of all Americans. Individual states manage grazing lands to protect and enhance their value so they can achieve financial returns that benefit education and various state institutions. This is quite a change from a century ago, when most citizens considered rangelands "wasteland" and thought that meat production was the best use for rangelands. Currently, more and more people are enjoying rangelands for recreation and aesthetics. What might the next generations want from rangelands?



Multiple Use: Recreation

Have you ever gone hiking or camping on rangeland? How about mountain biking, rock climbing, or fishing in a rangeland stream? If so, you're not alone. Nearly half of all Americans over the age of six participated in outdoor recreation in 2016, according to the Outdoor Industry Association. That's more than 144 million people looking for places to get outdoors and have fun. And many of those folks are finding their playground on America's rangelands.

Expect the number of recreationists to continue to rise, based on data collected by the USDA National Survey on Recreation and the Environment. Between 1982-83 and 2005-09, day hiking in the U.S. increased by 210% (24.3 to 75.3 million participants); driving off-road increased by 142% (19.1 to 46.2 million participants); fishing and hunting grew by 30% (79.8 million to 104.6 million participants); and the number of people viewing or photographing birds soared by an astounding 287% (20.8 to 80.5 million participants). Just like other uses of public land, recreation has an impact on rangelands. The degree of impact varies by activity, of course; some pursuits can be relatively benign, while others have more lasting impacts. And even activities that leave a light footprint, when repeated by increasing numbers of people over time on the same ground, can have cumulative effects on a given landscape.

Outdoor recreation brings with it both positive and negative effects on rangelands and surrounding communities. On the plus side, recreation can provide an economic boost to rural economies when people spend money in the areas they visit. That revenue adds up, in the form of hunting and fishing license sales, camping and access fees, and the cost of guided adventures, plus the sales tax collected on money spent in local shops and restaurants. In addition to helping rural businesses, some of those funds may get channeled into restoration and improvements to rangeland recreation facilities or wildlife habitat. The increase in business activity, in turn, creates local jobs. It's harder to measure the psychological and health benefits that people enjoy from engaging in physical activity and getting back to nature. Some might say it's priceless.

On the flip side, recreational activities can disturb or displace wildlife, cause compacted soils and erosion, and trample sensitive vegetation. Conflicts can arise among users seeking different kinds of recreation experiences within the same area, such as motorized vs. non-motorized activities, or hunting vs. wildlife viewing, or large family gatherings vs. quiet, solitary outings. Conflicts can also arise between recreationists and livestock. For example, hikers with dogs may not know what to do when they encounter sheepherding guard dogs. Not everyone is conscientious about packing out whatever they pack in, so cleanup can cost money. Furthermore, users may see their own pursuits as harmless and fail to recognize the cumulative effect of all the users who are recreating on the range. There's also a cost to users, taxpayers or both to maintain facilities such as roads, trails, trailheads, campgrounds and other amenities. And a moment of carelessness can burn up everyone's playground: More than half the wildfires that occur each year are human caused.

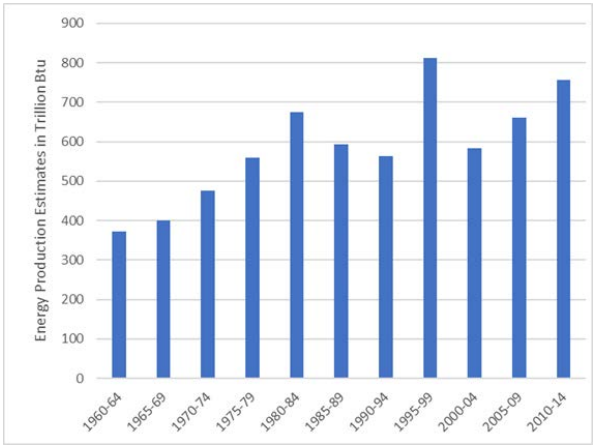
Rangeland managers have to take all the pros and cons into account when managing rangelands for multiple use. One of the best tools at their disposal is education—teaching recreationists to care for the resource and share it respectfully with others. Managers may also consider restricting access to certain areas during critical times for wildlife, such as deer fawning season or winter, when animals can't afford to expend energy avoiding people. Another option is to designate specific areas for particular kinds of recreation, such as off-road vehicle trails. Signage and maps can help users get off the beaten path but still stay on designated trails to minimize damage to resources. At some point, it may be necessary to

provide more facilities to accommodate growing demand. As our population continues to grow and more and more people want to take to the hills, it will be incumbent on managers and recreationists alike to tread lightly to sustain rangeland health.

Multiple Use: Energy Development

Rangelands can also prove to be a significant source of energy and other natural resources. Rangelands are home to hard rock mining for gold, copper, silver, and zinc that are used in manufacturing the products we use in our everyday lives. Mining benefits the economy of surrounding communities. Water coming from rangelands generates hydroelectric power. Mining and extraction of coal, oil, and natural gas are important energy resources accessed from rangelands. Woody plants are also used for fuel, while grasses and other plants on rangelands can be harvested for ethanol and biodiesel production. Rangelands can serve as suitable sites for establishing solar power facilities and wind power farms. The graph below illustrates how the amount of energy produced in Idaho from renewable sources—biofuels, solar, wind, water and geothermal—has continually increased over the last 64 years. The multiple-use character of rangelands will become more valuable and appreciated as the demand for energy increases, especially clean renewable energy.

Wind farm in Power County, ID. U.S. Dept. of Energy.



US Energy Information Administration

Multiple Use: Wildlife Habitat

A diversity of wildlife thrive in rangeland habitats. Mammals, birds, amphibians, reptiles, fish, and insects make their home in these complex ecosystems. Plants, water, and soils on rangelands provide unique environments for wild animals and plants, including threatened and endangered species. Some rangelands are designated as special protection areas for wildlife or rare plants. Learn more about wildlife habitat under the "Habitat Needs of Rangeland Animals" section.

Multiple Use: Livestock Grazing

Rangelands provide important grazing habitat for domestic livestock, including cattle, sheep, goats, and horses. Most of the world's livestock live on rangelands and serve as a highly significant and necessary source of food and livelihood for people all over the globe. Ranching is an important endeavor that uses livestock to convert the nutritious and renewable grasses and other plants on rangelands into food, fiber, and other animal-based products for humans. Livestock have been grazing on North American rangelands since the mid-1800s, and they still exist today in familiar scenes on range landscapes.

Rangelands are the primary source of our meat supply:

- Most calves and lambs fattened in feedlots are born and raised on range and pastureland.
- Nationwide, range and pasture provide 83% of nutrients consumed by beef cattle, 91% of nutrients for sheep and goats, and 72% of nutrients for horses and mules.
- Rangeland and pastureland in the 19 western states are home to 58% of all beef cattle in the U.S.
- Western rangelands harbor 79% of sheep and 88% of goats in the U.S.
- Range livestock production is economically vital to western states in terms of land used and cash receipts.

Considerable progress has been made since the Taylor Grazing Act concerning the management and sustainability of grazing practices. Today, ranchers are allowed to graze livestock on public lands under a permit system. First, land management agencies—BLM, USFS, and states—determine through their land use planning process which lands are suitable for grazing. The BLM administers approximately 18,000 grazing permits, while the USFS administers about 6500 leases nationwide. Each permit stipulates the area to be grazed, called an allotment. Additionally, the permit states the number of livestock that can graze on the allotment, or the stocking rate, as well as the timing or season of use. Permits generally cover a 10-year period and can be renewed if permit requirements are being met and the land is in acceptable condition. Ranchers and agency range conservationists monitor the range to ensure the resources are not being degraded. Ranchers pay a fee per animal unit month (AUM) for using public lands, and that fee is set by the government using a formula established by Congress, based on economic conditions and the price of raising livestock.

Even with these controls in place, however, livestock grazing on federal lands has been controversial for many years. Still, livestock production on rangeland remains a vital element in today's food supply chain, producing meat for American and world populations.

Multiple Use: Water Supply

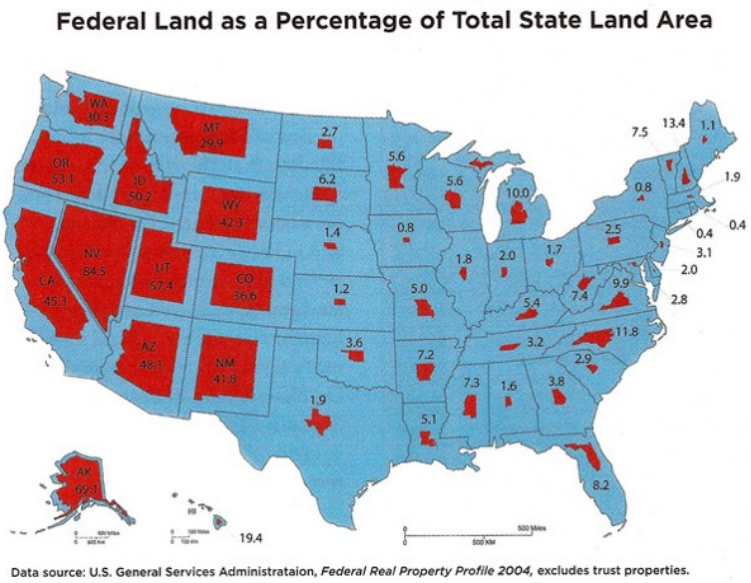
Though rangelands might appear to be dry, unyielding landscapes, in different seasons they provide important contributions of water to the streams, lakes, and aquifers that they contain. In the western states, forested and alpine rangelands are the primary source of water for agricultural, industrial, and

domestic use. Because rangelands are located mostly in arid climates with relatively low precipitation, water is doubly precious. The many miles of streams, lakes, and reservoirs scattered throughout rangelands become a water source for irrigation and urban areas. As human populations grow, and water consumption increases, the high-quality water produced by healthy rangeland ecosystems is becoming increasingly important. You may not think of the collection, storage, and release of water as a "use" of rangelands, but the multiple uses of rangelands must be compatible with continuing to provide a source of clean water. And without water, no other uses of rangeland would be possible.

1.6. Who Manages Rangelands?

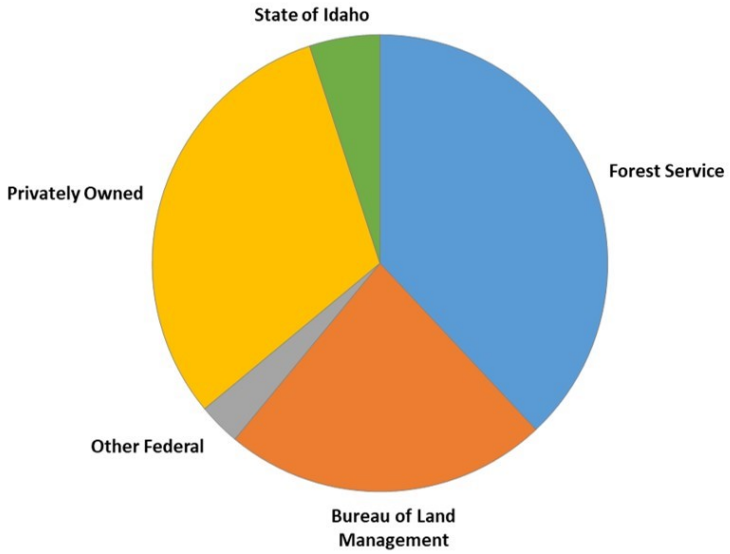
The question of who owns and manages land can be examined in three categories: Federal, State and Private. Public lands include both federal and state lands; private lands include those owned by individuals, corporations, tribes, or non-governmental organizations (NGOs).

Federal lands are those managed by federal agencies such as the Bureau of Land Management (BLM), U.S. Forest Service (USFS), National Park Service (NPS), National Wildlife Refuge System managed by the U.S. Fish and Wildlife Service (FWS), Army Corp of Engineers, and U.S. Military bases. Federal lands are 26.0% (about one-quarter) of U.S. lands. However, it is clear from this figure entitled "Federal Land as a Percentage of Total State Land Area" that almost half (48.6%) of the thirteen western states are federal lands.



These federal lands belong to all U.S. citizens and they are managed and cared for on our behalf by various federal agencies. The BLM manages the greatest area, overseeing 31.4% of all federal land, or more than one in every 10 acres of land in the U.S. The USFS manages 24.5% of federal land (8.5% of the U.S.). The NPS oversees 22.2% of federal lands (7.7% of the U.S.) and National Wildlife Refuges account for 11.3% federal land (3.9% of the U.S.).

State-owned lands include state wildlife refuges, state parks, state school lands, and other land parcels owned and managed by the individual states. Lands managed by states account for 8.7% of all land in the U.S. These lands are managed by land-care professionals in agencies such as Fish and Game agencies, State Departments of Land, and State Parks and Recreation.



Private lands are those to which individuals, tribes, companies or NGOs hold legal title, just as people own their homes and yards in the city. But on the range, it is not always easy to tell where public land ends and private land begins. Often, there are no fences, gates or signs dividing public land from private land. Ranchers may graze livestock on the private rangeland they own in combination with federal or state land for which they hold a permit and pay annual grazing fees.

Land ownership and management in Idaho is similar to the U.S. land numbers above. In Idaho, the U.S. Forest Service manages 38% of the land. The Bureau of Land Management manages about 23% of Idaho lands. Private ownership makes up 31% of Idaho. Other federal agencies (3%) and the State of Idaho (5%) round out the land management in Idaho.

1.7. Rangeland Management

Rangeland management is the careful use and stewardship of rangelands to meet the diverse needs and desires of those who live on and care about these lands. Rangeland management is different from agricultural management because rangeland plants and animals are not managed in isolation or solely for production purposes. Management decisions about rangelands are made with ecological properties in mind, such as soil health, vegetation, wildlife, invasive plants, and water quality. Range managers also need to consider the multiple uses of rangelands including things such as livestock production, open space, recreation opportunities, wildlife habitat or energy production.

Rangeland management presents challenges because many land resources and ecological forces that affect rangelands do not respect fences or property boundaries: think fire, invasive plants, wildlife, and water resources. Furthermore, even a single pasture used to manage livestock can include land owned by a rancher, the U.S. Forest Service, Bureau of Land Management and a state's Department of Lands. This can often be the case when land parcels are not productive or sizeable enough to be managed on

their own; they are more productive when managed in conjunction with adjoining ownerships and/or management agencies. Many people do not realize that one pasture may include public land and privately owned land. This creates a challenge in rangeland management because different agencies and individuals may have different goals and regulatory requirements for what they want to, or can, achieve on the land.

Because manipulating these intricate ecosystems requires a mix of science-based knowledge, practical experiences and common sense, rangeland management is described as both a science and an art. Although management decisions stand on scientific principles, there is no "silver bullet," nor are there pre-determined "correct" solutions that can apply to *all* rangeland management situations. This is why rangeland management is an art: it includes becoming familiar with various land elements, weather situations, plants and animals depending on the land, and having the knack for administering land management decisions based on what is known or understood about that rangeland. A successful range manager embraces learning through experience built upon a solid foundation of scientific knowledge.

Land Ownership Distinctions

It is easy to categorize lands simply as private or public. But this distinction can hide the important reality that private and public lands are inextricably tied. For example, many ranchers in western states graze their herds and flocks on their private land and also hold permits for grazing on state, BLM or USFS land. Thus, an individual ranch (the amount of land *used* to care for the livestock) often includes both private and public lands. In addition, wild animals use both public and private lands for habitat. Weeds, wild fires, and streams don't stop at the border between private and public land. In fact, there often is not even a fence or boundary marker between public and private lands. Thus, it is important to be aware of land ownership and management boundaries when recreating or working on rangelands. It is also important to realize that many aspects of rangeland management will require that public land managers and private land owners work together for the good of the land, water, and animals as well as the people who inhabit these spaces.

Rangeland Principles

The planning process for sustaining healthy rangelands that support multiple use is based upon six concepts:

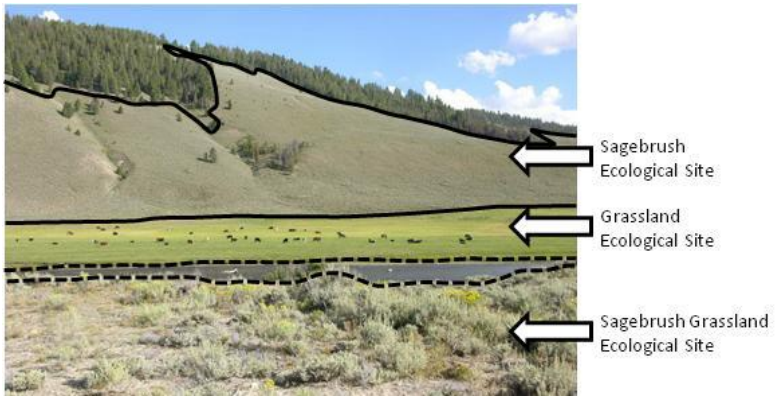
1. Rangelands are renewable resources; they can produce on a sustained yield basis if properly managed.
2. Rangelands supply man with food and fiber at very low energy costs compared to those of cultivated land.
3. Energy from the sun can be captured by green plants, which can be harvested most efficiently by grazing animals.
4. Rangeland production is determined by abiotic factors including soil, topography, and climatic.
5. Rangelands produce a variety of products (I.e. forage, recreation, water); therefore, principles of multiple use are important in range management.
6. Rangeland must be managed to maintain soil and water quality.

1.8. Rangeland Ecology

Rangelands are vast landscapes that are composed of differing abiotic and biotic components. Abiotic elements are the non-living chemical and physical parts of the environment, such as slope, aspect, minerals, precipitation and temperature. Biotic components include the living or once-living plants, animals, bacteria, and fungi species. Biotic components also include human activities (e.g., recreation, urbanization, energy development). Rangeland ecosystems change subtly or dramatically from month to month and year to year, primarily due to abiotic factors that cannot be managed. Hence, one of the great challenges for scientists and rangeland managers is to understand the interactions between abiotic and biotic factors and determine how to manage biotic factors to compliment variable climatic (precipitation and temperature) patterns. Being good land stewards requires sound methods for describing rangeland conditions and monitoring their change over time in order to make wise management decisions that will sustain rangeland health for the multiple uses rangelands provide.

Ecological Sites

For the purposes of inventory, evaluation, and management, rangeland landscapes can be divided into ecological sites. An ecological site is a distinctive kind of land with specific landscape and soil and plant characteristics that differ from other kinds of land. The classification of ecological sites allows a land manager to map large areas into units with similar potential to grow specific kinds and amounts of plants and to respond similarly to disturbances and management activities. This might involve viewing shrublands differently than grasslands, such as illustrated in the figure to the right.



An ecological site is the product of all the environmental factors responsible for its development. These include differences in soil, slope, aspect, and place on the watershed. Each ecological site has a set of key attributes that are included in the ecological site description. These include site characteristics (physiographic, climate, soil, and water features), plant communities (plant species, vegetation states, and ecological dynamics), and site interpretations (management alternatives for the site). Site descriptions are available through the Natural Resource Conservation Service.

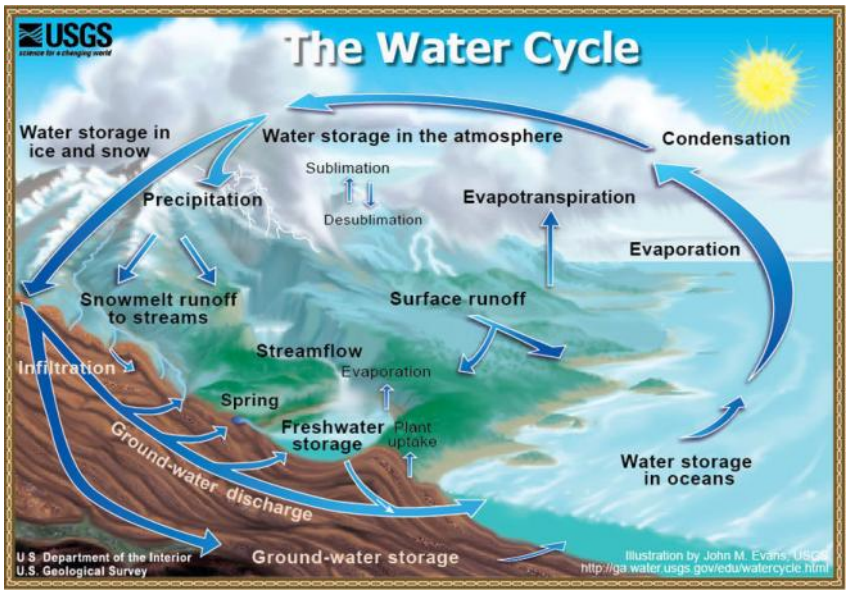
Topography and Watersheds

What is a Watershed?

A watershed is an area of land that drains water to the same endpoint. Watersheds can be defined at almost any scale, as small as a single hill or as large as the Mississippi River and all its tributaries. Watershed boundaries are determined by topography of the landscape. The highest features on the land, like ridgetops, form the perimeter of the drainage area or basin through which water travels as it makes its way to the lowest point. All the water within a region, including lakes, rivers, streams, and subsurface water flows, are part of the watershed classification.

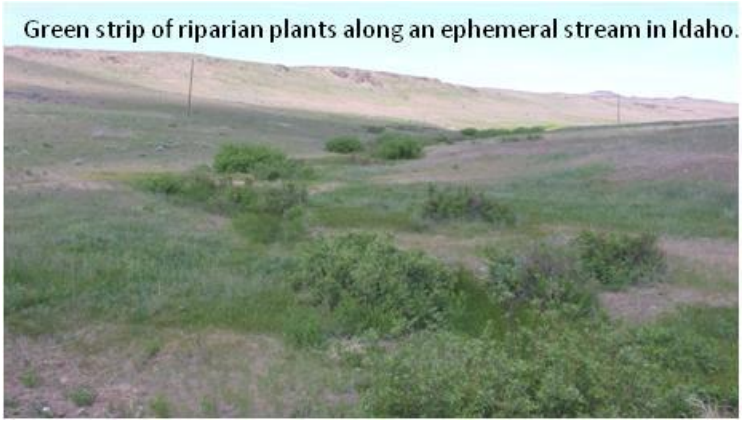
Satellite image of the Pashimeroi River watershed boundary and the local rivers and streams.

Watersheds serve three primary functions in the hydrologic cycle: the *capture*, *storage*, and *release* of water. Capture refers to how water from the atmosphere gets into the soil. The amount of water that is captured and infiltrates into the soil is related to the amount of both vegetated and non-vegetated ground cover (i.e., organic debris, rock), and the soil type. For example, in dense grasslands, infiltration rates are high because of the amount of plant cover and leaf litter that shelters the soil from the impacts of falling precipitation. However, many rangeland types include bare ground and exposed soils that can have low infiltration rates and result in the movement of soil and water across the ground surface as overland flow**.** Unhealthy or degraded sites can have elevated erosion rates that reduce the hydrologic function of a site. Land managers can indirectly manage infiltration and erosion by managing the structure and density of vegetation.



Water that is captured by the soil is stored between the soil particles. The amount of water stored in the soil depends on the soil depth, texture, and structure. Soil moisture is lost through surface evaporation, plant uptake, or percolation through the soil where it continues to move through the watershed as subsurface flows. Mesic soils have more moisture present closer to the surface than those areas that have drier or more xeric soils. The amount and kind of plants growing on a rangeland site can greatly influence the amount of water stored in the soil. For example, an infestation of leafy spurge, a noxious weed, can have a high density of plant roots deep into the soil profile that will extract soil moisture, resulting in the loss of soil water from a rangeland site. Another example is cheatgrass, an invasive annual grass with shallow rooting systems that uptake moisture near the soil surface before it can reach the deeper roots of other plants such as native grasses and sagebrush seedlings.

Once moisture enters the soil it can move deep into the rocky substrate below the soil where it is held in aquifers that can be tapped into with wells. Moisture can also move horizontally within the soil profile as subsurface flow, ultimately flowing into springs, streams, rivers or lakes. Vegetation management at the transition zones where subsurface groundwater flows meet surface waters is important to maintaining good water quality. These transition zones are also where overland flows meet surface waters, and managing for adequate ground cover provides a filter to prevent excess sediment from entering surface waters.


Green strip of riparian plants along an ephemeral stream in Idaho.

Uplands vs. Riparian

Rangelands are generally classified into three types of areas (*upland*, *riparian*, and *wetlands*), each having a distinct hydrologic regime and plant community. Uplands are drier and only wet for short periods after precipitation events, resulting in water restricted systems. A riparian zone is adjacent to surface waters, such as stream banks and shorelines. Riparian vegetation can be either associated with channels that have flowing water (lotic systems) or standing water (lentic systems). Wetlands are areas with hydric

soils that are permanently or seasonally saturated by water. Wetland and riparian areas naturally function as water filters, removing sediment and pollutants from water. Riparian areas and wetlands stay green much longer into the season and produce more biomass than adjacent uplands.

Plant species that occur in wetlands and riparian areas require frequent water and are not killed when inundated by water (as in a flood). These species include cottonwoods, willows, alders, rushes, and sedges. Species found in the floodplain – an area above the stream channel that experiences periodic flooding – require less water and are less tolerant to inundation than species found growing close to or in the channel. Willows, maples, oaks, ash, snowberries, currants, ninebark, elderberries and many other species are frequently found in floodplains. Healthy riparian vegetation is important to sustain the function of streams, as the plants shade the water to maintain the cooler temperatures required by some fish and other aquatic species, while the plants' roots help hold soil in place and reduce erosion.

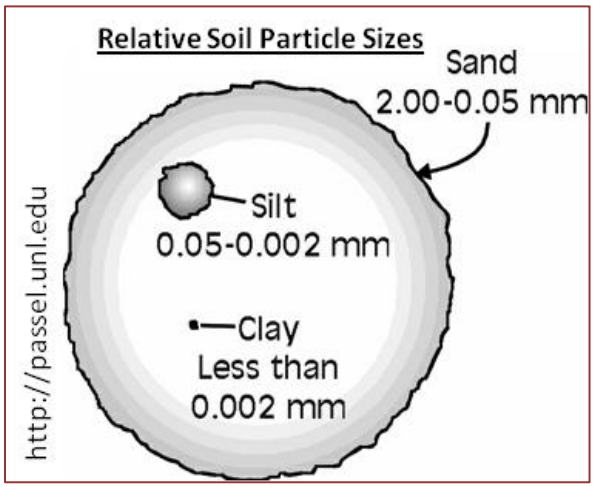
Upland sites are composed of species that have adapted to survive with minimal water in line with the average precipitation of the region. Depending on location, moisture levels can fluctuate from fewer than 10 inches a year in some arid rangelands, to greater than 30 inches on mountain meadows and the tall grass prairie. Moisture levels can vary greatly from year to year, and precipitation is often received only during a single period of the year. Many rangeland plants have evolved strategies to maximize extraction of available soil water, such as the very deep root systems found in desert shrubs or the abundance of small roots of grasses found near the surface which capture rainfall as it soaks into the soil. Upland plants also have strategies to conserve moisture once it is absorbed, such as waxy layers on the stems and leaves, narrow leaves, and the ability to go dormant during the hottest and driest season of the year.

Rangeland Soils

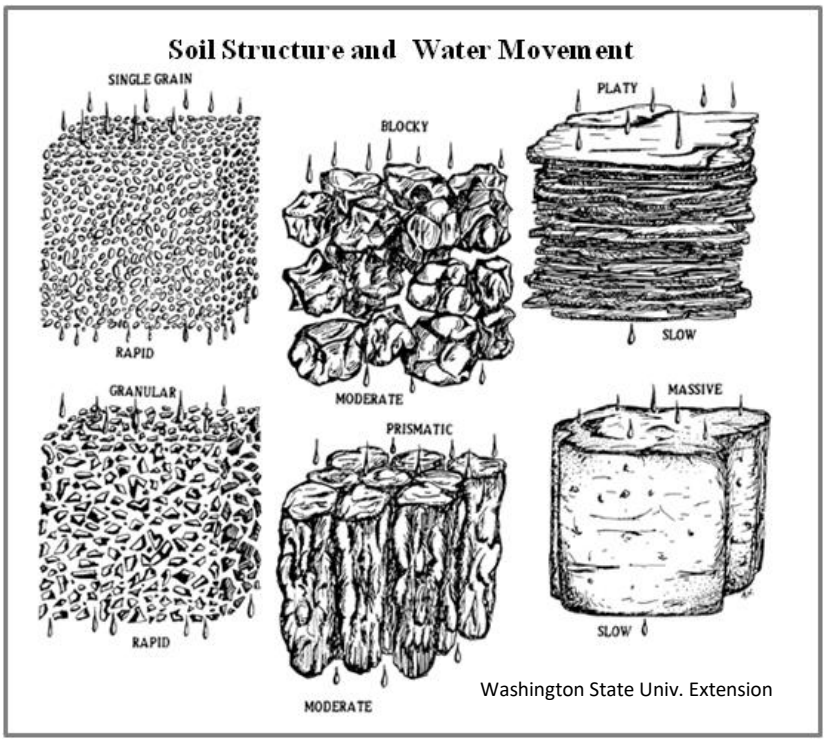
Soil is defined as a complex mix of ingredients: minerals, air, water, and organic matter—countless organisms and the decaying remains of once-living things (Soil Science Society of America). Soil is such an important aspect of rangeland communities that you will receive an entire study guide devoted to soil formation and function. But let's take a few minutes to introduce you to the subject of soil.

Ecological sites have characteristic soils that have developed over time. Factors affecting soil development are: climate, living organisms, topographic relief or landscape position, parent material, and time. These factors lead to soil development or degradation through the processes of loss, addition, translocation, and transformation. Soil forming processes create horizons in the soil that are layers distinguishable from other layers by a change in composition of abiotic and biotic components. Two key physical characteristics of soil, texture and structure, strongly influence the vegetation type that occurs at a particular rangeland site, and have a strong influence on plant water availability.

Texture class is an important aspect of soils, and is related to weathering and parent material. The differences in horizons are due, in part, to the differences in texture of their respective parent materials. The texture of a soil depends upon the relative proportions of each type of soil particle within the soil. The three basic soil particles are *sand*, *silt*, and *clay*. Sand particles are the largest of the three particles. They are between 0.05 and 2.00 mm in diameter and are coarse and gritty. When they are moist, individual grains can be seen. The presence of sand particles within a soil decreases the capacity of soil to hold both water and nutrients. Silt particles are medium in size and range between 0.002 and 0.05 mm in diameter. Silt particles feel smooth and velvety. The presence of silt particles in soils increases water-holding capacity and nutrient capacity. Clay particles are the smallest of the soil particles and have a diameter of less than .002 mm. Clay particles have the greatest ability to hold both water and nutrients. Sometimes, however, clay can bond very strongly with nutrients, making it difficult for plants to extract nutrients from the soil. Clay particles can also form very strong aggregates, decreasing the ability of water to penetrate and drain from the soil.



Soil particles seldom occur as separate units in the soil; rather, they often combine to form larger aggregates that are primarily held together by the binding forces of clay and organic matter. Soil structure is a term which describes the arrangement of soil particles. The five major structural classes of soil are *blocky*, *platy*, *granular*, *prismatic* or *columnar*, and *massive*.



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The texture and structure of soil directly influence the amount of air (pore) spaces found within the soil. These are important conveyors of water, nutrients, and air, as well as providing spaces for roots to grow. In some locations, the soil will form impenetrable barriers that may substantially impede water infiltration and root penetration. These restrictive layers may be

inherent (natural) or induced by land management practices. For example, a soil may become compacted due to excessive traffic on the land which in turn may alter the hydrologic function of that site.

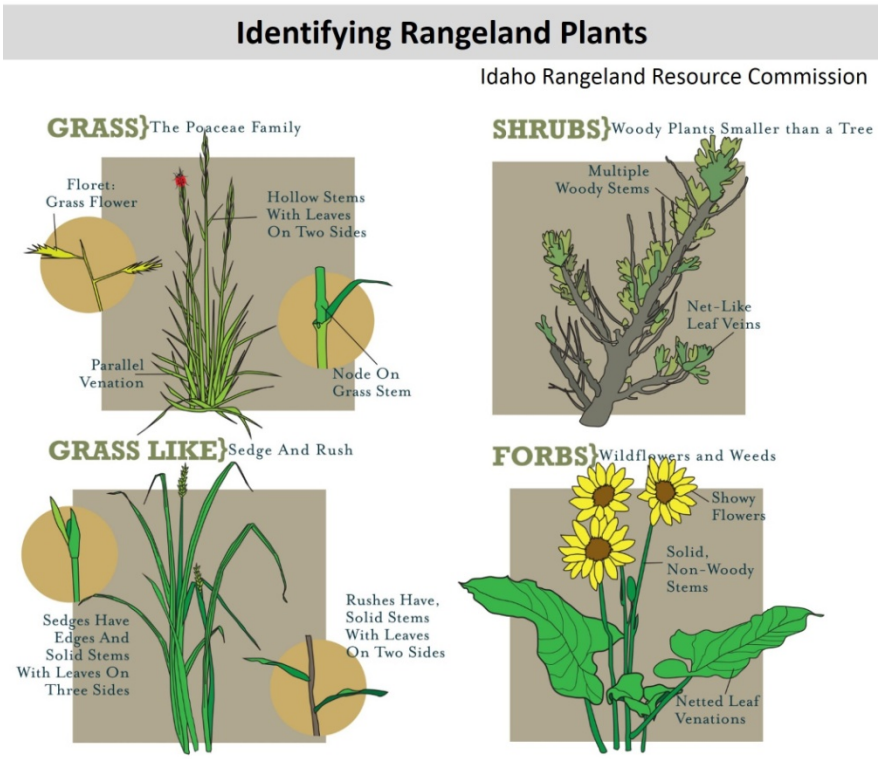
It is normal for wind and water to move soil around a landscape. This soil loss is called erosion**.** Some natural erosion can be expected; however, erosion can become excessive if vegetation is removed from the soil surface by overgrazing or other impacts such as high off-road vehicle use. It is important to manage vegetation so as to keep soil in place.

Rangeland Plants

Most management decisions on rangelands are made by first knowing the various plants inhabiting rangelands and knowing their growth habits. Correctly identifying rangeland plants requires knowledge of plant characteristics and plant types. One of the most important identifying characteristics of plants is the shape of a plant's leaf. Other important distinguishing characteristics include the margins (edges) and venation (pattern of veins) of leaves.

Range plants can be classified and grouped in many different ways, including growth form, life span, season of growth, origin, and forage value.

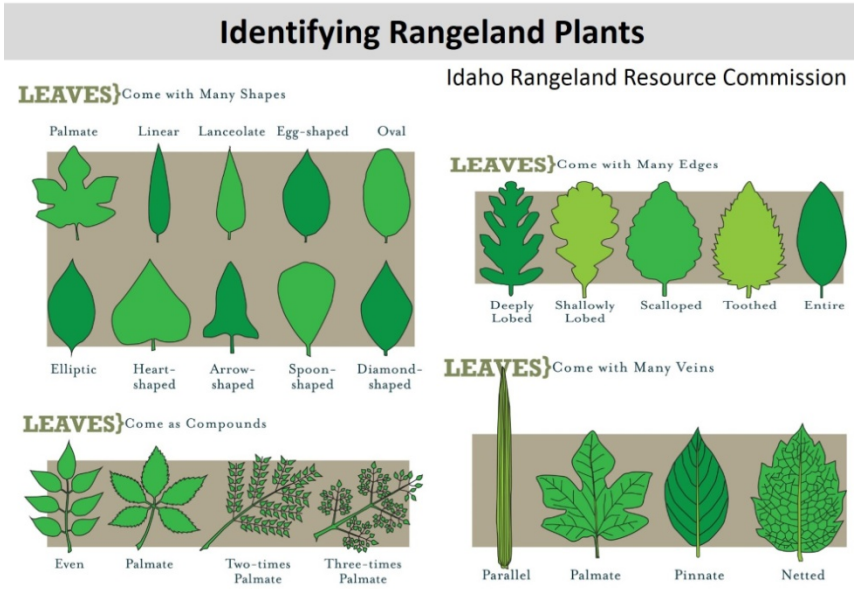
Plant Type or Growth Form



Grasses are plants with long narrow leaves and hollow, jointed stems. Leaves on grasses are in two rows on the stem with veins that are parallel. Grasses do not have colored flowers and they produce grain-like seeds. Ecosystems dominated by grasses are called grasslands and cover more than one-fifth of the earth's land surface.

Grass-like plants look like grasses but have solid stems (not hollow) without joints. Stems are often triangular. Veins in the leaves are parallel. Sedges and rushes are in this group of plants.

Forbs are herbaceous (non-woody) plants that usually have broad leaves and showy flowers. Forbs have leaves and stems that die back to the ground each year. Most forbs have pinnate, palmate, or netted veins in the leaves, but a few have parallel veins. Most of the plants commonly called wildflowers and range weeds are forbs.



Shrubs are woody plants that usually have broad leaves. Shrubs are different from trees because they do not have a main trunk; instead, they have several main stems. Some plants can take both a tree and a shrub form, but most shrubs never grow up to be trees. The term browse is used to describe the small stems and leaves of shrubs used for forage by wildlife and livestock. The term mast is used to describe the seeds and berries that shrubs produce and is especially important as wildlife forage.

Life Span

The life span of a plant refers to the length of time from the germination and sprouting of the plant to the natural death of the plant. In other words, this is how long it takes the plant to grow, flower, produce seeds, and die. Rangeland plants can be classified as annuals, biennials, or perennials.

Annual plants live only one growing season. There are two types of annuals, depending on when they begin growth. Winter annuals germinate in the fall and form a small rosette of leaves through the winter. The following growing season, the plant continues to grow, flowers, produces seeds in the summer, and then dies. Summer annuals germinate in the spring, complete all growth by the end of the summer, and then die.

Biennial plants live for two growing seasons. During the first growing season, these plants normally form a basal cluster or rosette of leaves. During the second year, they send up a seed stalk that flowers before the plant dies back to the ground at the end of the growing season.

Perennial plants live for several years, and some live up to hundreds of years. The plants produce leaves and stems from the same crown for more than two years. Most range plants are perennials.

Growth Season

The season of growth refers to when plants make their principle growth. Rangeland plants are categorized as cool season species or warm season species.

Cool season plants make their principle growth during cool weather. These plants are sometimes called "C3 plants" because they have a specific photosynthetic pathway that first yields a 3-carbon sugar. At lower elevations, these plants grow in the spring, set seed in late spring or early summer and new growth appears in the fall if moisture is adequate. Plants that grow at high elevations are usually cool season plants because of cool temperatures throughout the growing season. Evergreen plants are woody plants that retain leaves throughout the year. They are cool season plants (photosynthesizing in winter) and are important forage in drought and winter.

Warm season plants make most of their growth during late spring and summer. These plants are also called "C4 plants" because a 4-carbon sugar is the first compound produced from the specific type of photosynthesis of these plants. Seeds in warm-season plants develop in mid-summer and early fall. Southern states such as Texas and New Mexico have nearly all warm season plants. There is another pathway for photosynthesis called CAM (Crassulacean Acid Metabolism) that is common in plants such as cacti which grow in warm desert regions.

Origin

The "origin" of a rangeland plant is the area where it developed and evolved. Knowing the origin of a plant is important because it can affect the way the plant responds to the environment or help predict spread of species. Rangeland plants can be characterized as either native or exotic.

Native plants are those that originated and evolved in North America.

Exotic or introduced plants are those that were brought to North America from another continent, either on purpose or by accident. Several plants were intentionally introduced to rangelands because they have good forage value. Others were accidentally introduced, usually as contaminants in crop seeds, packing materials or other imported items. Some weedy introduced plants were brought to this continent for their ornamental value, but then escaped into rangelands. When these become widespread and problematic, they are known as invasive species. We will talk more about invasive species later in this study guide.

Woody or Herbaceous

Rangeland plants can also be described in terms of how much woody tissue they contain. This is important because it affects forage value, watershed characteristics of the landscape, habitat characteristics, and fire fuel loads.

Herbaceous plants include grasses, grass-like plants, and forbs. These plants contain little or no wood and they die back to the ground each year.

Woody plants are shrubs, trees, and woody vines that have woody stems. Wood is created by the binding of plant fiber (i.e., cellulose) with lignin, a strong and indigestible compound.

Trees are different from shrubs because they generally have a single main stem or trunk. Shrubs generally have several main stems. Woody plants can be deciduous**,** which means they lose their leaves every fall, or evergreen because they maintain some live leaves throughout the year, even winter.

Forage Value

The forage value of a plant refers to how well it provides nutrients to grazing animals. The forage value of a plant varies depending on which animal is eating it because nutritional needs and dietary preferences of grazing animals differ by species. For example, a plant could have excellent forage value for cattle and poor forage value for deer. Range plants can be classified as having high, medium, or low forage value or be poisonous.

High forage value designates plants that are nutritious, palatable, and produce abundant forage. High forage value plants are high in crude protein, low in crude fiber, and are non-toxic.

Medium forage value plants will provide adequate nutrients if eaten, but are not preferred by animals because they are not high in nutrients, are not highly digestible, or are relatively small plants and do not produce an abundant amount of forage.

Low forage value describes plants that simply do not provide adequate nutrients to the grazing animal. Low forage value plants are high in crude fiber, low in nutrients (including crude protein, minerals, etc.), have limited digestibility, and may be somewhat toxic.

Poisonous plants are rangeland plants that contain natural plant compounds that are toxic or poisonous to herbivores. These compounds include alkaloids, essential oils, tannins, and glycosides. When grazing animals eat excessive amounts of poisonous plants, they suffer ill effects that can include bloat, nausea, low intake, muscle tremors, skin sensitivity, birth defects, or death. Each year 3 to 5% of livestock grazing on rangelands suffer illness, reproductive problems, or death from toxic plants.

Rangeland Animals

Rangelands provide habitat for countless mammals, birds, amphibians, reptiles, fishes, and insects. A great majority (84%) of mammals found in North America spend at least a portion of their life in rangeland ecosystems. Large hoofed animals, called ungulates**,** are perhaps the most iconic rangeland animals. Wild grazing animals such as bison, elk, pronghorn, and deer, as well as livestock species including cattle, sheep, goats, and horses, all inhabit rangeland landscapes. Other mammals commonly found on rangelands include rodents and rabbits.

A variety of birds make their home on the range, either seasonally or year-round. Large game birds such as grouse, quail, pheasants, and turkeys call rangelands home. Migratory songbirds including meadowlarks, buntings, sparrows, and doves fill the grasslands, shrublands, and woodlands with color and song. Raptors such as hawks and falcons can often be found in the rangeland skies. Some birds are

so attached to rangelands that vegetation types are in their name: prairie falcon, meadow lark, sage thrasher, and scrub jay.

Insects are productive inhabitants of rangelands, as diverse as the grasses, forbs, and shrubs on which they live. Insects play many ecological roles on rangelands, which can be either beneficial or detrimental. Periodic large outbreaks of certain insects, such as grasshoppers or Mormon crickets, can cause great devastation to rangeland ecosystems when they eat rangeland plants and adjacent croplands. Even in unremarkable years, many insects eat plants that could be used as forage by wildlife and livestock. However, because of their small size and inconspicuous nature, they are often overlooked in both stocking rate estimates and forage assessments. Insects also play a vital role in decomposing dead plant material by incorporating it into the soil and improving soil aeration. In addition, insects pollinate plants, thus sustaining genetic diversity among flowering rangeland plants. Of course, insects make up an important part of the diet of many birds, reptiles, and mammals.

Many insects are completely dependent on a single plant species for their survival; these insects are called “host-specific.” If an exotic plant is invading into rangelands and becoming a pest, it is sometimes possible to identify host-specific insects in its country of origin that can be introduced here to bring the weed under control. Introducing a host-specific insect to control a weed is a process known as biocontrol.

Diet Selection: Plants, Animals or Both

Animals that live on rangeland can be categorized based on their foraging habits. Classification is first based on whether the animals eat plants, other animals, or both.

Herbivores are animals that eat only plants. They can be classified further:

- **Grazers,** such as cattle, elk and bison, eat mostly grasses.

Browsers include deer and goats that eat some grasses, but mostly shrubs. The leaves and small stems of woody plants are called "browse" so these animals are called browsers.

Intermediate feeders eat a mix of grasses, forbs and shrubs depending on which is most nutritious at the time. Sheep and pronghorn are examples of these opportunistic feeders that eat grasses and forbs in the spring and summer and then switch to shrubs in the winter.

Carnivores eat other animals. Their diet can include insects, birds, reptiles, and/or mammals.

Omnivores are animals such as humans or bears that eat a combination of animals and plants**.**

Digestion Strategies of Herbivores

Herbivores can be further classified based on how they digest the grasses and forbs that dominate rangelands. These plants have large amounts of cellulose-containing fiber. Cellulose is a type of carbohydrate that cannot be digested by mammals. However, most grazing and browsing mammals have both a specialized fermentation organ and a symbiotic relationship with bacteria, protozoa, and fungi that can break down cellulose and turn it into nutritional compounds that can be used by the grazing animal.

Ruminants include cows, sheep, goats, deer, elk, and moose. These animals have specialized digestive systems, including a rumen to ferment the cellulose abundant in the cell walls of rangeland plants.

Hind-gut fermenters include rodents, rabbits, and horses. These animals have an enlarged cecum or colon that houses microbes that ferment forage particles and release energy compounds that can be absorbed and used by the animal. The cecum and colon are located past the true stomach in the digestive track (i.e., behind the gut) –these animals are therefore called "hind-gut fermenters."

Concentrate-selectors are animals that do not have a way to digest fiber and so must avoid cellulose by foraging carefully, selecting berries, seeds, or roots that are low in cellulose. These animals include birds and bears that find an adequate diet on rangeland by carefully selecting plants and plant parts low in cellulose.

Wild, Domestic, and Feral Animals

Humans have developed varying levels of relationships with animals over time. Our influence over animals can vary from strong and close to weak and distant.

Wild animals or **wildlife** are animals whose behavior, physiology, and genetics are largely not influenced by humans. There is a huge variety of wildlife species that inhabit rangelands including elk, deer, rabbits, insects, reptiles, and birds.

Domestic animals are those that have been strongly influenced by their relationship with humans. The behavior and breeding of these animals has been modified by humans, creating new species from their wild ancestors. Domestic animals include cattle, sheep, goats, horses, pigs, geese, chickens, dogs, cats, and honey bees.

Feral animals are those that were once domesticated but have severed their ties with humans and gone back to a "wild" lifestyle. Wild horses and burros are examples of feral animals on rangeland.

Habitat Needs of Rangeland Animals

All wildlife and livestock require four basic habitat elements in order to survive, thrive and reproduce: food, water, cover, and space. The specific combination of food, water, cover, and space required by a given species, called its niche, is unique to every species that lives on rangelands. Because of these specific and varied requirements, any time the habitat is altered, it improves for some species but worsens for others. Additionally, because each species' niche is different, it is impossible to maximize the habitat quality of all wildlife at the same time. Therefore, trade-offs must be considered when managing habitat quality for wildlife and livestock.

Certain wildlife species depend solely on rangeland habitats, such as sagebrush obligates**.** These animals cannot exist without the habitat elements found only in sagebrush steppe communities. The sage grouse, Brewer's sparrow, and pygmy rabbit are examples of sagebrush obligate species.

A habitat is basically the home of a species, including all biotic, climatic, topographic, and edaphic (soil) factors that affect life

Food requirements for all animals, including those on rangelands, include energy, nutrients, and minerals**.** Energy in plants comes from starches, sugars, fats, and cellulose. Nutrients needed include mostly protein and vitamins. Mineral requirements include phosphorus and potassium. The types of vegetation present, the diet preferences of animals, and the spatial arrangement of available food plants must be assessed to determine the food or forage value of rangeland habitat.

Different types of animals require different amounts of food each day. As a general rule, ruminants like bison, deer, cattle, and sheep will eat about 2.5% of their body weight per day (in dry weight of forage); hind-gut fermenters such as horses and rabbits will eat about 3.0% of their body weight each day; and concentrate selectors such as birds, bears, and mice will eat about 0.25% of their body weight daily.

Water requirements vary depending on the animal species and weather conditions. In general, sheep and goats require 1-1½ gallons of water once every two days; donkeys require 3-4 gallons of water every day; horses require 5-8 gallons of water each day; and cattle and bison require 8-10 gallons of water every day or two. Rangeland animals meet their water requirement by drinking fresh water and obtaining water from forage. Plants can contain significant amounts of water. For example, immature grasses may be up to 75% water by weight. If an animal eats 28 pounds of immature forage, it will consume about 2.5 gallons of water.

Cover is required for shelter from weather conditions and from predators. Plants provide thermal protection by shading animals in the summer and sheltering them from cold in the winter. Thermal cover for rangeland animals is provided mostly by trees and shrubs. Plants can also offer hiding cover for animals to protect them from predators. Many animals use large plants to hide under or to gain protection through visual obstruction. However, other animals, like pronghorn and prairie dogs, gain protection from predators by a lack of visual obstruction. These animals prefer to be out in the open where they can see predators coming and escape by running away or retreating underground.

Space is an important consideration for breeding and nesting, home range, social intolerance, and disease transmission. An animal's home range is the area in which an individual animal conducts its normal daily and yearly activities. This area can be shared with members of its own species, or with other species. The home range of an animal is directly related to its body weight: larger animals generally have a larger home range. Home ranges also vary by foraging habits: carnivores have very large home ranges, while the home ranges of herbivores are comparatively smaller.

Factors Limiting Habitat

Limiting factors such as water, food, climate, and topography determine the size and location of home ranges and habitats. These factors are basic requirements that restrict the size, growth, and/or vigor of an animal population. Rangeland habitats can be influenced by human activities that either add or remove limiting factors. For example, when ranchers add water tanks to pastures, they may remove a habitat-limiting factor (i.e., access to water) for wild and domestic animals. On the other hand, building roads and housing subdivisions may create factors that limit access to food and cover. However, habitat modification does not always affect a wildlife species' ability to survive, thrive, and reproduce.

Think of habitat as resources that are held in a wooden barrel, as in this figure. The limiting factor is determined by the height of the lowest plank in the barrel: in this example, food is limiting the animal's ability to survive, thrive, and reproduce. If improvements to water, cover, or space occur, the species' population will not be affected. Similarly, degradation to water, cover, or space will not affect the population unless the degradations are so severe that one of these habitat essentials replaces food as the limiting factor. Habitat changes only affect a population when the species' limiting factor is enhanced or degraded. Therefore, if food is degraded in this example, the species

will be negatively impacted and if improvements to food occur, the species will benefit.

Stocking Rates and Carrying Capacity

The number of animals a piece of land can support on a long-term basis without causing damage to the range resource is the carrying capacity (or grazing capacity) of the land. Stocking rate**,** on the other hand, is the number of animals a land manager places or maintains on a piece of land over a specified period of time. Thus, carrying capacity is set by Mother Nature, through soil and climate characteristics, while stocking rate is set by humans, through livestock or wildlife management.

The currency of stocking rates is the animal unit (AU). An AU is 1,000 pounds of grazing animal. In other words, a 1,000 pound cow equals 1 AU, a 1,200 pound bison is 1.2 AUs, and a 150 pound mule deer equals 0.15 of an AU. An animal unit month (AUM) is the amount of forage an AU can eat in a month. Recall that a ruminant animal eats about 2.5% of its body weight each day. Therefore AUM equals 750 pounds of forage (1,000 pounds of animal × 2.5% × 30 days = 750 pounds).

The terms AU and AUM are widely used in rangeland management, but there is not universal agreement on the quantities each term expresses. Usually, 1,000 pounds of grazing animal equals an AU and an AUM is generally about 750 pounds. Some range managers use estimates of 780 or 800 pounds for an AUM. Stocking rate is often stated as the number of AUMs/acre or acres/AUM. For example, if the stocking rate of a pasture is 4 acres per AU per month (i.e., 4 ac/AUM) then it requires 4 acres to provide enough forage for 1 AU, such as a 1,000 pound cow, for a month.

Rangeland Animal Interactions

Rangelands are very diverse habitats with a wide variety of plants and geographic features. Livestock and wildlife often occupy the same area of rangeland. Interactions among livestock and wildlife on rangelands can be somewhat or mostly harmful, somewhat or mostly beneficial, or benign (no effect on either).

Any of the following relationships can exist depending on the animal and its habitat requirements:

- **Mutualism** (or Protocooperation): a relationship between two animals in which both benefit from the association. *For example: Cattle egrets (a type of bird) often perch on the backs of cattle or bison and eat insects and grubs. The insects benefit the birds as a food source. The cows and bison get the benefit of getting rid of the bothersome insect pests.*
- **Commensalism**: a relationship between two individuals in which one derives some benefit while the other is unaffected. *For example: Dung beetles eat the feces of ruminant animals like cows or elk. The dung is a food source for the beetles (a benefit), but this activity has no effect on the ruminant animals.*
- **Antagonism**: one species benefits at the expense of another (i.e., predation/parasitism). *For example: When a coyote eats a rabbit or lamb, the coyote gets the benefit of a food source, but the rabbit or lamb is harmed (i.e., killed).*
- **Amensalism**: a relationship between two animals in which one is adversely affected and the other is unaffected by the association. *For example: Bison can carry brucellosis (a bacterial disease) with no apparent symptoms. When bison interact with domestic cattle they can infect*

the cattle with brucellosis which can cause spontaneous abortion. The cattle are therefore harmed and bison are unaffected.

- **Competition**: if two animals use the same resource (such as food or water) and if that resource is in limited supply, this may cause harm to both animals because neither will have enough to meet its requirement. *For example: When elk and cattle eat the same forage and it becomes limited, both the elk and cattle may be harmed: they may not have enough to eat and may become thin. Animals are "competing" for a resource only if there is not enough for both of them to meet their requirements. Just because animals are using the same resource doesn't mean that they are in competition with one another. If the resource is abundant, competition is not occurring.*
- **Neutralism**: a relationship between two species that interact or share the same habitat but do not affect each other. *For example: Meadow larks or bluebirds have no effect on cattle or elk, and cattle and elk have no real effect on meadow larks or bluebirds.*

Livestock and Wildlife Interactions

Ranch management and subsequent grazing management strategies can negatively or positively impact wildlife that inhabit landscapes also used by livestock. Livestock can be also an important management tool for improving wildlife habitat. In other words, livestock grazing can be used to purposefully manipulate forage to improve wildlife habitat for a chosen wildlife species. Livestock managers can alter the timing, frequency, intensity, and type of livestock grazing to achieve wildlife habitat management goals. For example, spring grazing by cattle on the mountain benches, such as those above Boise or Salt Lake City, encourages the growth of shrubs that are important winter forage for deer and elk. This process is referred to as prescribed or targeted livestock grazing and is the strategic use of livestock grazing to achieve specific landscape goals.

In other situations, livestock grazing can damage habitat value if it is not carefully applied and purposefully planned with wildlife habitat in mind. Potentially negative impacts of livestock and wildlife interaction include parasite/disease transmission, reduction of cover, or changes of the types of plants available as forage. Several aspects of ranching such as fences and roads can also be detrimental to wildlife species.

Good land stewardship and conscientious grazing management strategies that account for wildlife can be used to limit negative interactions, enhance habitat quality, and promote complementary relationships between wildlife and livestock on rangelands.

Measuring and Monitoring Plant Communities

Assessment and Monitoring

Rangeland ecosystems are dynamic and change constantly as a result of nature's driving forces, including climate, fire, insect outbreaks, flooding, wildlife foraging, and weed invasion. Human induced disturbances—including urban expansion, domestic livestock grazing, recreational use, energy development, mining, road building, and landscape manipulations (e.g., disking, chaining, seeding) also impact soil, plant composition, and wildlife habitats on rangelands. Rangeland monitoring is a systematic

approach to document vegetation changes over time. Data derived from monitoring can help land managers determine the effectiveness of their management practices and help them select appropriate future management strategies based on objectives.

Monitoring objectives are defined for individual sites, habitats or pastures, each with a focus on specific attributes. For example, a rancher may plant willows or sedges along a stream to improve the stability of the stream banks. The rancher may then implement a monitoring protocol to determine if a new grazing system is affecting establishment of the sedges or willows. If the grazing system is not leading to the desired condition, the grazing plan could be changed, or the stream could be fenced to exclude grazing. Monitoring can also quantify how natural forces are affecting rangeland plant communities over time. For example, a land manager may implement a monitoring program to determine if and when a burned area recovers to the level of a similar plant community in an unburned area.

The first step to an effective monitoring plan is to establish a baseline of data – a point of reference from which managers can base decisions about the land use. This is accomplished through a rangeland assessment, providing a "snapshot in time" of the current conditions of the soil, plant community, site productivity, and wildlife habitat uses. Rangeland site assessments include specific attribute data and capture specific information about the site such as elevation, map coordinates (e.g., latitude and longitude or UTM), slope, aspect, soil texture and structure, watershed unit, and land ownership. It is also important to document evidence of wildlife, livestock, and human use (e.g., scat, ORV tracks, hoof prints, etc.) and hydrologic characteristics (e.g., rilling, gullying, soil pedestals, etc.).

Attributes

Though there are many ways to measure plants, there are only six basic attributes that are commonly measured for rangeland monitoring. Vegetation attributes are characteristics of vegetation that can be measured or quantified according to how many, how much, or what types of plant species are present. These six most commonly used attributes are:

- **Plant Species or Type** - What kind of plant was it?
- **Frequency** - Was the plant present in a sampled area?
- **Density** - How many plants were there in a specified area?
- **Biomass** - How much did the plants weigh?
- **Cover** - How much space did the plants cover?
- **Structure** - How tall were the plants and how were branches and leaves arranged?

The most valuable skill that rangeland managers possess is the ability to differentiate between different plant species. Therefore, plant identification is essential to effective monitoring on rangelands. Remember that plant species found on rangelands fall into five major types, or **life form** categories: grasses, grass-likes, forbs, shrubs and trees.

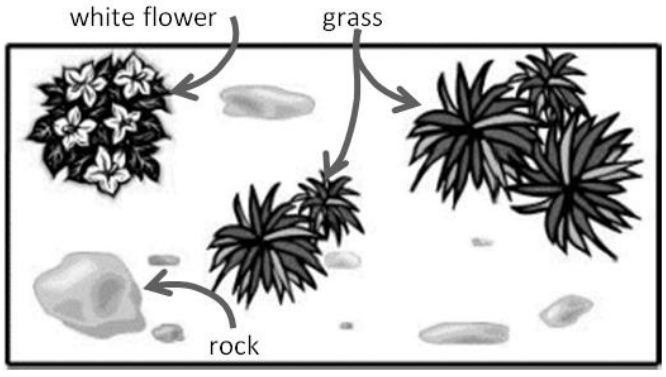
Frequency describes how often a plant occurs within a sampled area. For example, if a grid were laid out over a sample area, the frequency of a target species would be expressed as the percentage of the cells where the species was present out of the total number of cells possible. Because large plots are more likely than small plots to capture the presence of a species, frequency measurements are dependent on

plot size and shape. Therefore, frequency values between different sites or years are not comparable unless identical plot sizes are used. Frequency is most often used to compare plant communities and to detect changes in vegetation composition over time. In this way frequency can be used to assess vegetation trend.

Density is the number of individual plants per unit area (i.e., plants/ft^2 or plants/m^2). From a management perspective, density measures can be used to detect the response of plants to a given management action. In particular, density measurements provide evidence of plant mortality or recruitment on rangeland sites over time. For example, the density of a particular weed could be monitored over time to determine if an integrated weed management strategy is working. Because density is a count of plants per unit area, it is not affected by plot size and can be a useful measurement to compare different sites.

Determining the biomass of plants on a site is important for setting proper stocking rates, determining hydrological characteristics, and monitoring the effects of climate variation on a site. Biomass, or vegetative production, is expressed as weight per unit area (i.e., pounds/acre or kg/hectare). Total annual production is the production (growth) of all plants, whereas total forage production is the total amount of plants that could be used as forage by grazing animals. Biomass can be determined by clipping grasses, forbs, and browse to determine composition and weights. Or, if the ecological site is known, site guides can be consulted to obtain estimates of production in years of favorable, normal, or unfavorable precipitation. Experienced range managers can also accurately estimate the weight of forage on a site just as a good livestock manager can skillfully estimate the weight of a cow. Being able to estimate biomass is a useful skill, and can be honed through experience.

Cover is a description of the amount of ground surface covered by vegetation or other objects, including rocks, litter (dead plant matter), moss, or bare ground. Cover measurements are most often used to assess which plants dominate the solar, water, soil and nutrient resources on a site. Vegetative cover also influences the hydrologic function of a site and cover measurements may be used to interpret how well a rangeland site is able to capture, store, and safely release water from rainfall and snow. Cover is also an important management indicator, providing a variety of interpretations of direct concern to rangeland management, including erosion potential, the value of wildlife habitat, availability of forage, and trends in range condition.



Cover is expressed as a percentage. For example, if you look directly over this illustration of a plot of vegetation, you might estimate that the area is covered by 35% grass, 12% white flower, and 15% rock. Subtracting the totals from 100% yields the amount of bare ground, 38%. Cover can be measured for the entire sample area (i.e., “total vegetative cover was 47%”), or can be applied to individual species (i.e., “grass cover was 35%”).

Vegetation **structure** describes the three-dimensional arrangement of a plant community. Structure measurements are primarily used to evaluate wildlife habitat elements (i.e., nesting cover, screen or hiding cover). Techniques used to quantify vegetative structure are generally applicable in a wide variety of vegetation types and are useful in evaluating changes over time. For example, the same method used to determine vegetation structure for sage grouse brooding habitat may also be used to quantify the amount of hiding cover for mule deer.

In addition to measuring vegetation attributes to determine the effectiveness of management strategies, rangeland monitoring also helps managers make observations about the health or vigor of plants and communities. In assessing and defining sites, we can combine the above attributes to create variables such as *species composition*, *biodiversity* of the site, or *similarity* with historic measurements.

Rangeland **plant composition** is the proportion (%) of various plant species (or life forms) in relation to the total plant species (or life forms) in a given area. Plant composition is important to measure in range management because traditional range ecological site descriptions are based on plant composition. Measurement of composition over time can be used to determine if range condition is improving or declining in relation to potential composition as outlined in an ecological site description. Finally, assessing composition helps to estimate the forage available for herbivores with differing feeding habits. Range managers commonly calculate composition from biomass or cover data.

Biodiversity refers to the total amount of different organisms found within a certain area. Benefits of diverse rangeland plant communities are that they contain a variety of forages that are available to insect and vertebrate species, they contain more species that are capable of surviving disturbance, and they are theoretically less likely to be invaded by noxious or opportunistic species. Measures of diversity can be derived from cover and/or density data.

The measure of similarity between communities based on species composition, or calculating a similarity index, is useful for comparing communities under different management or comparing communities over time. Similarity can be calculated from cover and/or density data.

Forces of Ecological Change

Rangelands are incredibly dynamic ecosystems. Drastic changes can be observed among seasons within a year and across 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.

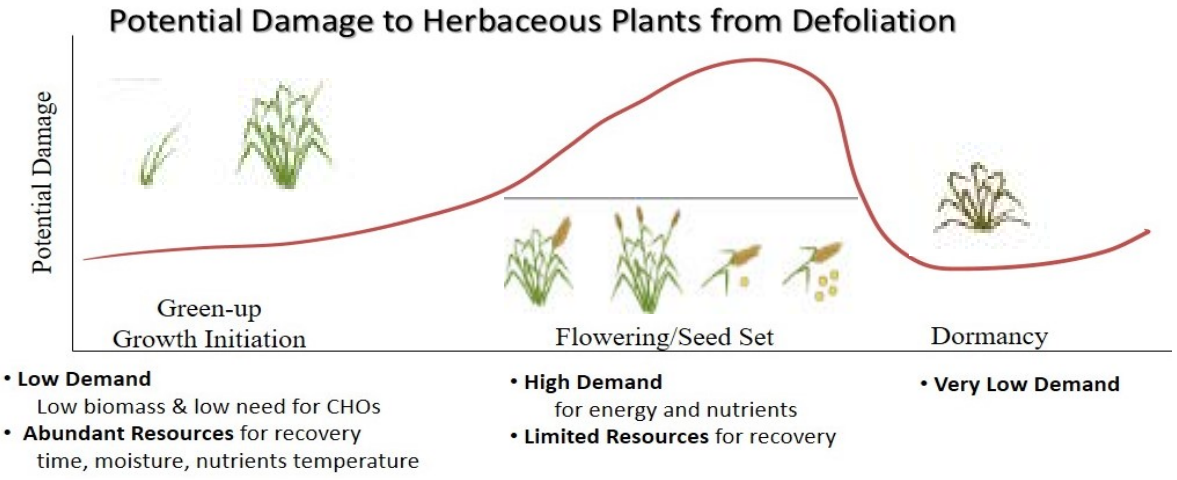
Grazing

The grasses, forbs, and shrubs that grow on rangelands are important sources of forage for grazing animals. Rangeland plants photosynthesize, using 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, providing energy and nutrients for herbivores. Grazing is a natural ecological process that occurs on all rangelands.

Plant Response to Grazing

Rangeland 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 these plants to remain healthy and productive, enough vegetation must remain after grazing so 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. When too much of the plant is removed, the plant suffers 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, or very late in the season once necessary growth has taken place. Plants are most likely to be damaged by grazing when the plant is beginning to produce flowers and seeds. This is when 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., begins to senesce and becomes dormant), the leaves are not photosynthesizing and are no longer being used by the plant. At this time, it is no longer sensitive to grazing.



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 features 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 toxic 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 do not 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 re-growth 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 it 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).

Impacts of Grazing on Ecosystems

Just as they can impact individual plants, grazing animals' direct and indirect impacts can also 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.

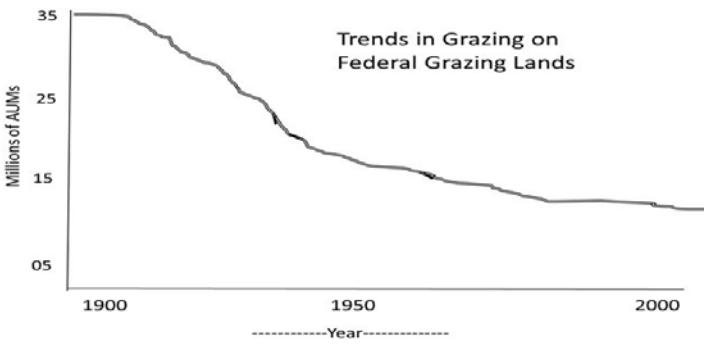
What is Overgrazing?

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. We need to be careful about declaring a range overgrazed because this is a very difficult assessment to make. Pastures can be heavily grazed without leading 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 condition. Overgrazing normally can be attributed to heavy, repeated grazing over several years. Overgrazing can be difficult to recognize because not all rangelands are equally productive. Differences in soils and the presence of rocky subsurface layers can create significant differences in the kinds and quantities 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. Bare spaces are, in fact, an important characteristic of many healthy plant communities. Such open spaces usually have roots from adjacent plants under the soil to capture precipitation and support plant growth.

Truly overgrazed rangeland is often characterized by an increase in less palatable plants, increased soil erosion, an 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 die or fail to reproduce. 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.

Nearly all range plants evolved to withstand grazing and can endure a heavy grazing event if it occurs 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 also 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 of leaves and young stems 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 still important to monitor 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 a century ago 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 European 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 deliberately as ornamental plants, such as 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. 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 keep 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 insect 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:

- Abundant seed producers
- Long-term survival of seeds
- Rapid population establishment
- Occupy disturbed sites
- Competitive
- Lack of natural enemies

Once established, invasive species will out-compete native species, and often spread throughout and dominate wildland plant communities. Invasive species are not limited to any 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 when climatic or fire conditions change.

Scientists have identified three phases of pinyon/juniper encroachment. In phase one, trees begin to establish, with seedlings and saplings scattered among the sagebrush, grasses and forbs. In phase two, the number and size of trees increases until pinyon/juniper codominate with shrubs and herbs. In phase three, trees dominate the landscape and the canopy closes. At this latter stage, the frequency of shrubs, grasses and forbs plummets, as the trees outcompete for sunlight, space, water and nutrients.

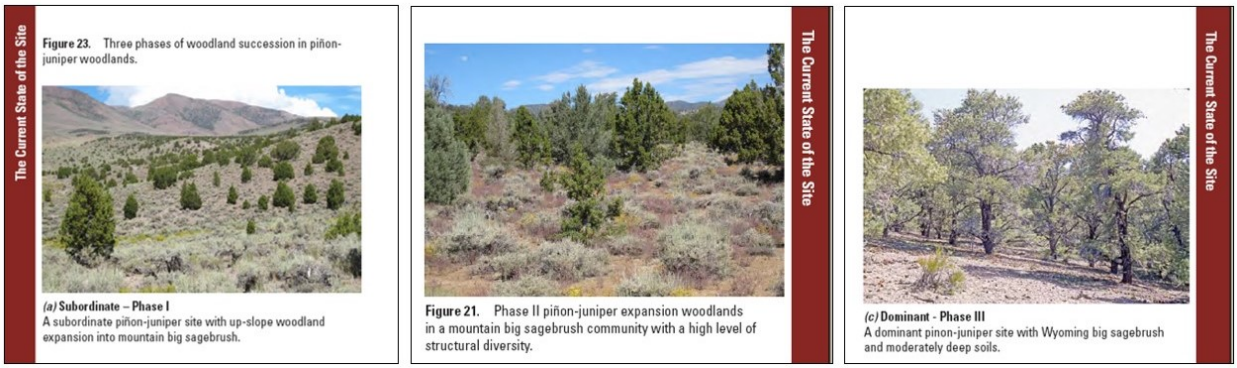


Figure modified from: Tausch, R.J., Miller, R.F., Roundy, B.A., and Chambers, J.C. 2009. Pinon and juniper field guide: Asking the right questions to select appropriate management actions: U.S. Geological Survey Circular 1335, 96p. https://pubs.usgs.gov/circ/1335/circ1335.pdf

Noxious weed is a specific term for particularly problematic plants that are recognized by the county, state, or federal government 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, and/or property. Idaho state law has recognized 67 noxious weeds (as of Sept. 2017), 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.

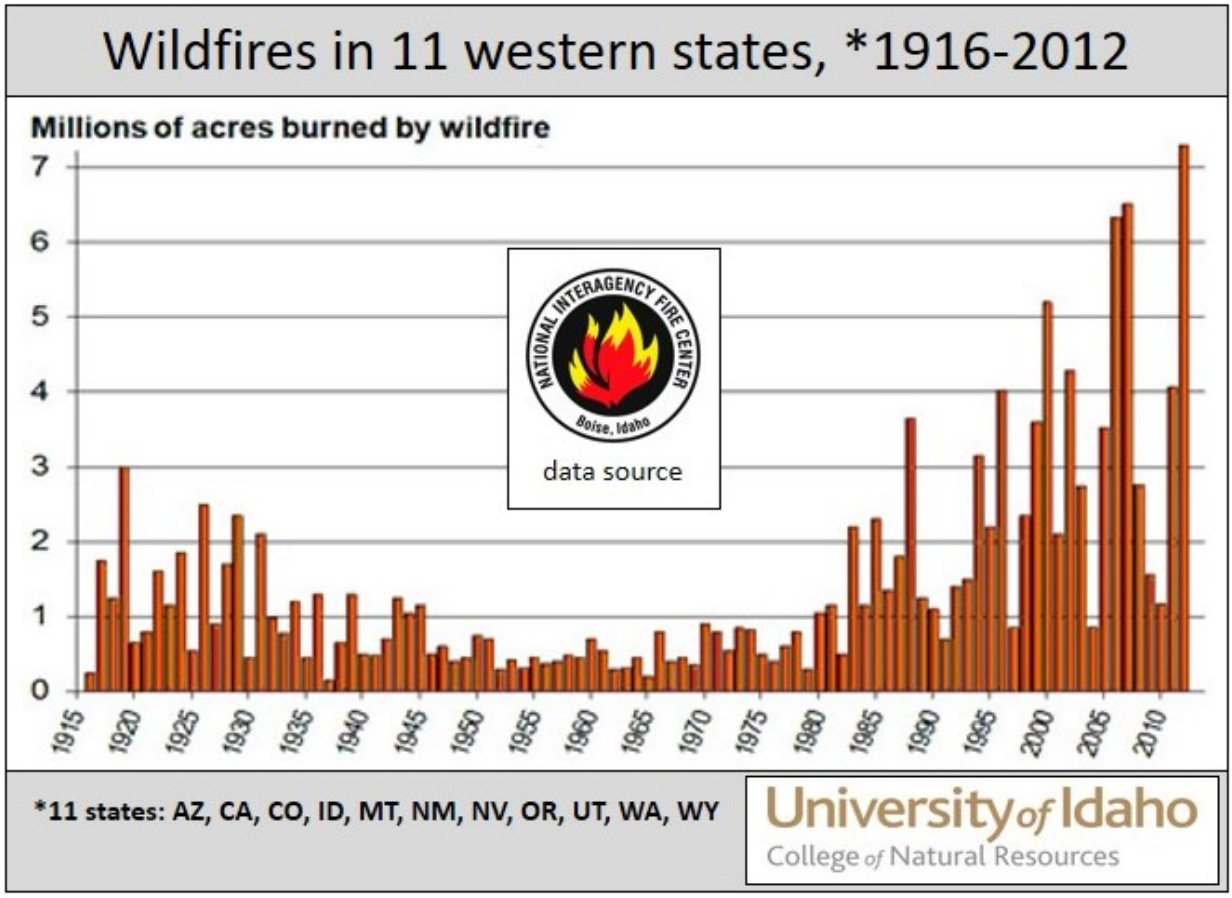
Weeds can also have serious impacts on human activities and economic profitability. Some weeds such as Scotch thistle and yellow starthistle can form dense, nearly impenetrable stands which reduce the value of land and inhibit recreation such as hiking and hunting. Weeds can also reduce the abundance of forage plants on rangelands, thereby reducing their value for grazing. Additionally, 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 occurrence on 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 some rangeland biomes. 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, rabbit-brush, 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 also 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 vs. Prescribed Burning

All fires need heat or a source of ignition, oxygen, and fuel. However, fires can occur under two scenarios: a 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 unattended or improperly extinguished campfires, lit cigarettes that are discarded, and arson. 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, windy conditions that can cause the rapid and unmanageable spread of fire which poses a serious threat to life and property.

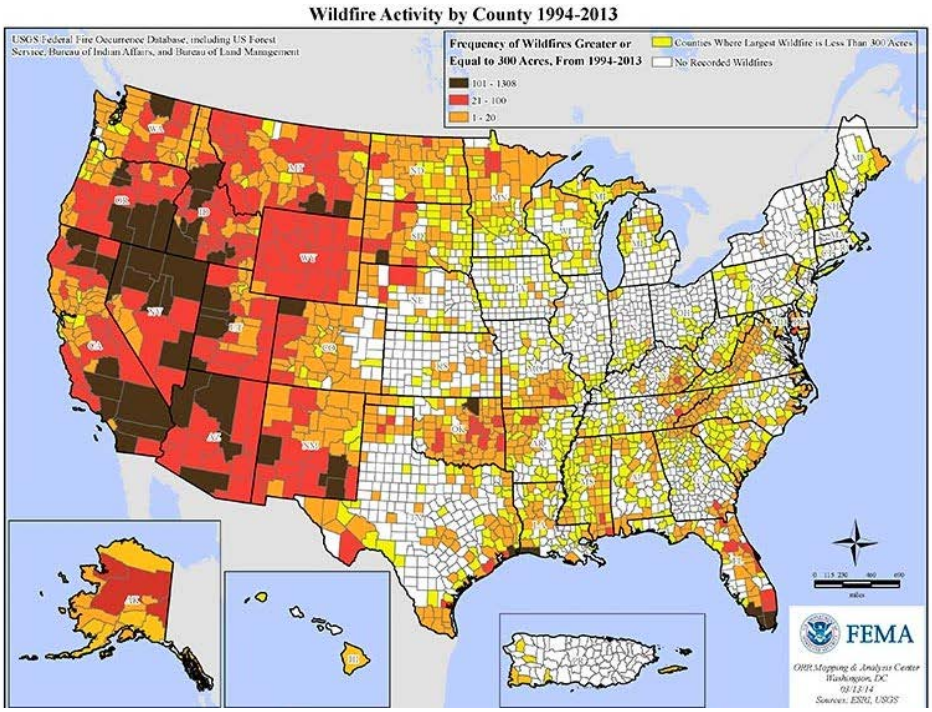
Effects of Fire on Plants

The effect of fire on rangeland plants depends largely on the growth form (i.e., bunchgrasses, forbs, and 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 re-sprout from the base, unlike less fire resistant plants that have elevated meristems which can be removed or 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 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 burn rapidly and frequently across the landscape. Perennial grasses and shrubs find it difficult to recover and grow when wildfires occur every few years, as 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 increases the probability of large, high-intensity wildfires that 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.

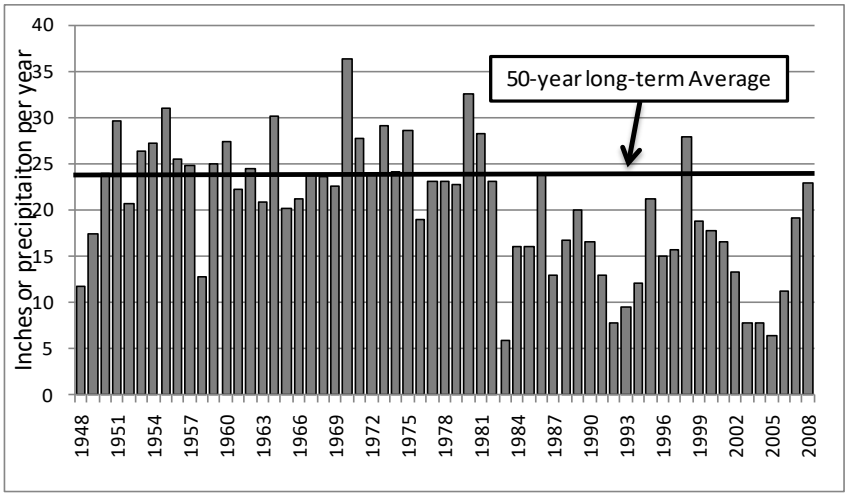
Positive Aspects of Wildfire

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, allowing for both feeding and secure cover in a relatively small area.

West Cinder prescribed burn, Twin Falls, ID.
National Interagency Fire Center

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 both 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 in turn 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, ID (see chart), 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 result in massive variation in the amount of biomass that the site can produce annually.



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 change 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 they will change the type

of plants and animals that will dominate an area and alter how invasive plants or fire might affect these sites. Unfortunately, it is almost impossible to control or predict climate and weather. Land managers are tasked with finding strategies to accomplish sustainable management in dynamic ecosystems by anticipating change and thinking through possible responses.

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 of 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 make the land appealing to developers and people wanting to live here.

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 to wildlife as the number and speed 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 that are specific to certain ecological sites may find themselves in danger. However, more resources are being made available by university Extension agents, conservation districts, NRCS, and other entities to help small land owners learn about land management and how best to conserve their meadows and pastures.

1.9. Grazing Management

America’s rangelands are in much better condition today than they were one hundred years ago, when uncontrolled, first-come-first-served access to open range led to overgrazing. Since the passage of the Taylor Grazing Act in 1934, ranchers, land managers, researchers and rangeland specialists have worked together to develop grazing practices that sustain healthy ecosystems while supporting livestock production.

In order to design a sustainable grazing plan for a given landscape, managers need to answer some fundamental questions:

- Which animals?
- How many animals?
- When to graze? For how long? When to rest?
- Where to graze?

Remember that different species of herbivores have different dietary needs and preferences. Consequently, the type of forage available will help determine which species is best suited to a given range. Besides choosing the appropriate livestock species—cows, sheep, goats, or horses—a manager will want to consider the class of animal: pregnant or unbred, young or mature, lactating or dry, as well as the size of the individual animals. Breed is a factor, too. Black Angus cattle, for example, are known for their winter hardiness, while Brahman cattle can survive harsh weather and inadequate food supplies.

Once you've determined the best species of grazers for your rangeland, you need to determine the stocking rate, as discussed earlier: How many animals will the forage support over a given period of time? Then you're ready to design a grazing system (a planned effort to leave some grazing areas unused for at least part of the year) that will be best suited for the kinds of plants present and the soil conditions of your range.

Stocking Rate: Balance forage supply with forage demand

A grazing system is a set of management practices that systematically control periods of grazing, deferment, or rest. A good grazing system should account for plant physiology and life history. It should be adapted to soil conditions, and improve range conditions and forage production by favoring desired plants. This is often accomplished through good grazing distribution. Animals typically graze in a patchy manner; herbivores select areas with vegetation that best meets their nutritional needs. However, we can entice animals to use different areas or forages; for example we can improve water distribution across the landscape, provide supplemental feed/mineral licks, and utilize fences. No matter the grazing system chosen, it needs to be practical to implement in a ranching operation and not be detrimental to animal gains. Hence, the objectives for good grazing systems include:

- Restoration of forage plant vigor
- Allowing plants to produce seeds
- Increasing animal production

There are several different types of grazing systems that are strongly dependent on grazing season (or season of use) which is based on climate factors (precipitation and temperatures). Yearlong grazing, or continuous grazing for the whole calendar year, is used primarily in tropical and sub-tropical climates. Seasonal grazing, or grazing during the growing season, typically occurs in temperate to cold climates, where grazing in dormant season is restricted by snow. Deferred grazing refers to a delay of grazing (or period of non-grazing) in a pasture until the key forage species set seed and seeds mature. A rest grazing system means a period of non-grazing for a full year.

There are pros and cons to each grazing system. Continuous grazing systems are simple and require low input. Animals get maximum choice of forage and have high animal performance. However, continuous use can have negative effects on plants, and areas that livestock prefer can be excessively used and become degraded. Deferred rotation means that grazing does not occur on at least one pasture until after it has set seed. In subsequent years, the deferred pasture is rotated among the other pastures so they all have a chance to produce seed. This type of grazing system can reduce animal performance a little because animal opportunity to choose among plants and places is restricted. This system does allow rangeland conditions to improve because pastures are occasionally not grazed when they are most sensitive to grazing. Rest rotation means that you do not graze at least one pasture for a whole year. In subsequent years, the pasture rested is rotated among all the pastures. This system can also reduce animal performance because stocking rate is increased on grazed pastures (since at least one pasture is not grazed), and animals are always moved into pastures that were not recently grazed and have dormant stems mixed with green growth (less nutritious and palatable). Rangeland condition can improve under this system because pastures are allowed to be rested and set seed every few years.

Other grazing systems include short-duration, where each pasture in the unit is grazed for a short time and animals are rotated through all available pastures so that each pasture is grazed at least two times per year. Another grazing system is seasonal suitability that requires you to move livestock to different areas of range depending on growth patterns of different vegetation types. This is often referred to as "following the green." In the spring/summer, livestock are gradually moved up in elevation and then moved back down in the fall/winter. Finally, there is the decisional or management intensive grazing system. In this system, management decisions are based on available forage, available water, and cover for calving and lambing. This type of system is probably the most common in the world; however, the success depends on the experience and timely decisions of the manager.

So which grazing system is the best? There is no "silver bullet" system that will work everywhere, and there are thousands of variations on the systems described above. At the end of the day, all systems need to be flexible to manage for unexpected disturbance such as fire or weed invasion. The success of the grazing system will depend on the type of forage, terrain, weather patterns, and the skill of the manager.

No matter the system, remember that stocking rate, species of grazing animal, and distribution patterns are important in determining how the systems affect vegetation communities.

1.10. Careers in Range

Who works on the range? If you said ranchers, cowboys and sheepherders, you're right, of course. But that's just a small sample of the numerous career opportunities available to people who want to work outdoors, like to hike and ride horses or off-road vehicles, enjoy studying and interacting with nature, and want to have a positive influence on range stewardship. The world needs botanists, wildlife biologists, hydrologists, soil scientists, livestock managers, rangeland ecologists, and recreation specialists, just to name a few. A career in range can take you as far as you want to go, from the Curlew National Grasslands of southern Idaho, to the Australian Outback, to the pampas of Argentina, to the

plains of Africa. Remember, rangelands cover nearly 47% of the earth's land surface. Talk about a world of opportunity!

Who hires range professionals? Perhaps the first employers who come to mind are the federal land management agencies such as the BLM, FWS, USFS and the Park Service, along with the Natural Resources Conservation Service (NRCS) that helps landowners implement best management practices on private property. It's true; they do need lots of trained rangeland specialists. But so do state agencies like departments of lands, agriculture, fish and wildlife, environmental protection, and parks and recreation. Some local soil and water conservation districts hire conservationists. The government isn't the only outfit that's hiring: Think about environmental consulting firms, energy companies, and tribal agencies. Non-governmental organizations (NGOs) employ rangeland professionals, too—groups such as The Nature Conservancy, Rocky Mountain Elk Foundation, Pheasants Forever, and local and national land trusts.

What does it take to become a range professional? Most rangeland management positions require a four-year college degree with a strong foundation in natural and physical sciences. To become a range technician requires at least one year of study in animal or natural sciences, engineering or mathematics. You can hear from recent college graduates regarding careers in range and find colleges and universities that offer range-related degrees by visiting https://rangelandswest.org/careersandeducation/.

Images courtesy of https://rangelandswest.org/careersandeducation/

1.11. Glossary

ANIMAL UNIT – Considered to be one mature (1,000lb.) cow or the equivalent based upon average daily forage consumption of 26 lbs. dry matter per day. Abbr., A.U. cf. *animal-unit conversion factor*.

ANIMAL-UNIT MONTH – (1) The amount of feed or forage required by an animal-unit for one month. (2) Tenure of one *animal-unit* for period of one month. Not synonymous with *animal-month.* Abbr., A.U.M.

ANNUAL PLANT – A plant that completes its life cycle and dies in one year or less.

ARID – A term applied to regions or climates where lack of sufficient moisture severely limits growth and production of vegetation. The limits of precipitation vary considerably according to temperature conditions, with an upper annual limit for cool regions of 10 inches or less and for tropical regions as much as 15 to 20 inches. cf. *semi-arid*.

ASPECT- The direction in which a slope faces.

BROWSE – (n) That part of leaf and twig growth of shrubs, woody vines and trees available for animal consumption. (v) To consume, browse. cf. of *graze*.

BUNCHGRASS – A grass that grows in tufts, or bunches. Its roots extend downward and outward from the base of the bunch, but do not sprout laterally like sodgrasses.

CARRYING CAPACITY – The maximum *stocking* rate possible without inducing damage to vegetation or related resources. It may vary from year to year on the same area due to fluctuating forage production. Syn. *grazing capacity*.

CLIMATE – The average weather conditions of a place over a period of years.

CONSERVATION – The use and management of a natural resources according to principles that assure their sustained, highest economic and/or social benefits without impairment of environmental quality.

CONTINUOUS GRAZING – The grazing of a specific unit by livestock throughout a year or for that part of the year during which grazing is feasible. The term is not necessarily synonymous with *yearlong grazing.*

COOL-SEASON PLANT – A plant which generally makes the major portion of its growth during the winter and early spring, because it is adapted to climates with winter precipitation and summer drought. *cf. warm-season plant*.

DECREASER – Plant species of the original or climax vegetation that will decrease in relative amount with continued *overuse*.

DEFERMENT – Delay or discontinuance of livestock grazing on an area for an adequate period of time to provide for plant reproduction, establishment of new plants, or restoration of vigor of existing plants. cf. *deferred grazing*.

DEFERRED GRAZING – The use of *deferment in grazing management of a management unit*, but not in a systematic rotation including other units. Cf. *grazing system*.

DESERT – Land that experiences extreme water shortage and unpredictable precipitation, dominated by shrubs and succulent plants such as cacti.

DROUGHT – Prolonged dry weather, generally when precipitation is less than the average annual amount.

ECOLOGY – The study of the interrelationships of organisms with their environment.

ENVIRONMENT – The sum of all external conditions that affect an organism or community to influence its development or existence.

EROSION – (v) Detachment and movement of soil or rock fragments by water, wind, ice or gravity. (n) The land surface worn away by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

FINE FUEL – Light, thin plant material with high surface area, typically grasses, that fire can easily ignite and consume quickly.

FIRE REGIME – The frequency, intensity, and severity that fire burns.

FIRE RETURN INTERVAL – The time interval between wildfire occurrences.

FORAGE – (n) All browse and herbaceous foods that are available to grazing animals. It may be grazed or harvested for feeding. Cf. *concentrating feed* and *cured* and *range forage*. (v) Act of consuming forage. Syn., *graze*.

FORAGE PRODUCTION – The weight of forage that is produced within a designated period of time on a given area. The weight may be expressed as either green, air-dry or oven-dry. The term may also be modified as to time of production, such as annual, current year's or seasonal forage production.
FREQUENCY OF GRAZING – The recurrence of grazing—how soon animals are put back in a pasture after grazing it previously. Or, how soon an animal takes a second or third bite from the same plant during a grazing period.

FORB – "Weeds and wildflowers." A broad-leaved flowering plant that is not a *grass* or *grass-like plant*, often having netted leaf venation and solid non-woody stems. These plants die back to the ground every year.

FREQUENCY OF GRAZING – How often or the number of times animals return to the pasture or allotment in one year or growing season.

FUEL – Living or dead plant material, which provides organic matter for fire to consume.

FUEL LOAD – The amount of fuel present on a specified land area.

GRASS – A member of the plant family *Poaceae (Gramineae*). Grass has round, hollow stems with leaves that connect to stems (jointed).

GRASS-LIKE PLANT – Herbaceous plants that look similar to grasses; members of the sedge or rush family. They typically grow in moist environments like forest floors or riparian areas.

GRASSLAND – Land on which grasses are the dominant plant cover. Syn., *grassveld*.

GRAZE – (1) The consumption of standing forage by livestock or wildlife. (2) To put livestock to feed on standing forage.

GRAZING PERIOD – The length of time that livestock are grazed on a specific area.

GRAZING SEASON – On public lands, an established period for which grazing permits are issued. Also, on private land in a grazing management plan.

GRAZING SYSTEM – A specialization of grazing management which defines systematically recurring periods of grazing and deferment for two or more pastures or management units. Descriptive common names of different grazing systems such as "Merrill," "Hormay," "South African switchback," etc., may be used. Cf. *deferred grazing*, *intermittent grazing*, *deferred-rotation grazing*, and *short duration grazing*.

GROWTH FORM – The characteristic shape or appearance of an organism.

HABITAT – An area that provides forage, water, cover, and space; the "home" of a species

HEAVY GRAZING – A comparative term which indicates that the stocking rate of a pasture is relatively greater than that of other pastures. Often erroneously used to mean overuse. cf*. light and moderate grazing*.

HERBACEOUS PLANT – A non-woody plant (cultivated or non-cultivated) that has leaves and stems, such as grasses and forbs.

INCREASER – Plant species of the original vegetation that increase in relative amount, at least for a time, under *overuse*.

INTENSITY OF GRAZING – The level of grazing a pasture experiences. This takes into account stocking rate, and frequency and duration of grazing.

INTRODUCED SPECIES – A species not part of the original fauna or flora of the area in question. cf. *native* and *resident species*.

INVADER – Plant species that were absent or present in very small amounts in undisturbed portions of the original vegetation of a specific range site and will invade following disturbance or continued *overuse*.

LIGHT GRAZING – A comparative term which indicates that the stocking rate of one pasture in relatively less than that of other pastures. Often erroneously used to mean *underuse*. cf. *heavy* and *moderate grazing*.

NATIVE SPECIES – A species which is part of the original fauna or flora of the area in question. cf. introduced and resident species. Syn., *indigenous*.

NOXIOUS WEEDS – A subset of invasive plants that are recognized and designated by local, state, and federal governments as requiring control or attention.

OPEN RANGE – (1) Range which has not been forced into management units. (2) All suitable range of an area upon which grazing is permitted. (3) Untimbered rangeland. (4) Range on which the livestock owner is not required to confine his livestock.

OVERGRAZING – Continued overuse creating a deteriorated range.

OVERSTOCKING – Placing a number of animals on a given area that will result in overuse if continued to the end of the planned grazing period. Not to be confused with *overgrazing* because an area may be

overstocked for a short period, but the animals may be removed before the area is overused. However, continued *overstocking* will lead to *overgrazing*.

OVERUSE – Utilize an excessive amount of the current year's growth, which, if continued, will result in *overgrazing* and range deterioration. Syn., *overutilization*.
PASTURE – (1) A grazing area enclosed and separated from other areas by fence. (2) Forage plants used as food by grazing animals.

PASTURELAND– Grazing lands, planted to primarily introduced or domesticated native forage species that receive periodic renovation and/or cultural treatments such as tillage, fertilization, mowing, weed control, and irrigation.

PERENNIAL PLANT – A plant that has a life cycle of three or more years.

POTENTIAL NATURAL COMMUNITY (PNC) – A historical term originally defined by A. W. Kuchler as the stable vegetation community which could occupy a site under current climatic conditions without further influence by people; formerly called "climax".

PRAIRIE – An extensive tract of level or rolling land that was originally treeless and grass-covered.

PRESCRIBED BURNING – The use of fire as a management tool under specified conditions for burning a predetermined area. Cf. *maintenance burning* and *reclamation burning*.

PRIMARY SUCCESSION – The process of initial plant establishment and growth upon bare rock or soil that has never had plants before—ever.

PROPER GRAZING – The act of continuously obtaining proper use.
PROPER STOCKING – Placing a number of animals on a given area that will result in proper use at the end of the planned grazing period. Continued proper stocking will lead to proper grazing.

PROPER USE – A degree and time of use of current year's growth, which, if continued, will either maintain or improve the range condition consistent with conservation of other natural resources. Syn., *proper utilization*.

RANCH – An establishment with specific boundaries, together with its lands and improvements, used for the grazing and production of domestic livestock and/or wildlife.

RANGE – Embraces *rangelands* and also many *forest lands* which support an understory or periodic cover of herbaceous or shrubby vegetation amenable to certain range management principles or practices. Syn. *veld*. cf. *grazable woodland*.

RANGE CONDITION – The current productivity of a range relative to what the range is naturally capable of producing.

RANGE CONDITION CLASS – One of a series of arbitrary categories used to classify range condition and usually expressed as either excellent, good,

RANGE IMPROVEMENT – (1) Any structure or excavation to facilitate management of range or livestock. (2) Any practice designed to improve range condition or facilitate more efficient utilization of the range. (3) An increase in the grazing capacity of range, i.e., improvement in *range condition*.

RANGE INVENTORY – An itemized list of resources of a management area, i.e., range sites, range condition classes, range condition trends, range use, estimated proper stocking rates, physical developments and natural conditions such as water, barriers, etc.
RANGE MANAGEMENT – A distinct discipline founded on ecological principles and dealing with the use of rangelands and range resources for a variety of purposes. These purposes include use as watersheds, wildlife habitat, grazing by livestock, recreation, and aesthetics, as well as other associated uses.

RANGE SCIENCE – The organized body of knowledge upon which the practice of *range management* is based.

RANGE SITE – A distinctive kind of rangeland, which in the absence of abnormal disturbance and physical site deterioration, has the potential to support a native plant community typified by an association of species different from that of other sites. This differentiation is based upon significant differences in kind or proportion of species, or total productivity. Syn., *ecological site*.
RANGE TREND – The direction of change in an attribute observed over time, and is described as up, down, or not apparent.

RANGELAND – Land on which the indigenous vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs, or shrubs and is managed as a natural ecosystem. If plants are introduced, they are managed similarly. Rangeland includes natural grasslands, savannas, shrublands, many deserts, tundras, alpine communities, marshes and meadows. cf. *range*.

REST – Absence of grazing for the entire growing season for one year, instead of just a portion of the year.

RESTORATION – The process of a rangeland being improved in health and function after it has been degraded or largely disturbed.

RETROGRESSION – The change from a more highly developed plant community to a less developed plant community due to a physiological disturbance; *succession* that recedes from the *potential natural community*.

RIPARIAN AREA – Referring to or relating to areas adjacent to water or influenced by free water associated with streams or rivers on geologic surfaces occupying the lowest position on a watershed.

ROTATIONAL GRAZING – System of pasture utilization embracing short periods of heavy stocking followed by periods of rest for herbage recovery during the same season. Generally used on *pasture* or *cropland pasture*.

RUSH – A general type of grass-like plant that has a round, solid stem and two leaves clasped around it.

SAVANNA – A grassland with scattered trees, whether as individuals or clumps; often a transitional type between true grassland and forest. Syn. *bushveld*.

SECONDARY SUCCESSION – The development of a new plant community on a site following a disturbance.

SEDGE – A general type of grass-like plant. Instead of round, hollow stems, the stem is solid and has edges or has a triangular shape when a cross-section is viewed.

SHRUB – A plant that has persistent, woody stems and a relatively low growth habitat, and that generally produces several basal shoots instead of a single bole. It differs from a tree by its low stature and non-tree form.

SHRUBLAND – Land that has shrubs as the dominant plant form.

SOIL – (1) The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. (2) The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of parent material, climate (including moisture and temperature effects), macro-and micro-organisms, and topography, all acting over a period of time and producing a product soil-that differs from the material from which it was derived in many physical, chemical, biological, and morphological properties and characteristics.

STOCKING RATE – The relationship between the number of animals and the grazing management unit utilized over a specified time period. May be expressed as animal units per unit of land area (animal units over a described time period/area of land). *cf. stocking density*.

SUCCESSION – The concept that vegetation communities change throughout time until a relatively stable plant community persists.

TARGETED GRAZING – "Prescription grazing." A special grazing system that involves the application of livestock grazing at a specified season, duration and intensity to accomplish specific vegetation management goals of reducing weeds.

TRANSFORMATION- A Chemical or biological process in which soil forming material is added to the soil profile. For example leaves falling from trees or tree roots dying beneath the soil.

TRANSLOCATION- Movement of soil forming element from the surface layer to the lower layers of the soil profile. This is done by burrowing animals, bacteria, leaching, and calcification.

UNDERSTOCKING – Placing a number of animals on a given area that will result in *underuse* at the end of the planned grazing period.

UNDERUSE – A degree of use less than desired.

USE – (1) The proportion of a current year's forage production that is consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole. Syn., *degree of use*. (2) The putting of range to a purpose such as grazing, bedding, shelter, trailing, watering, watershed, recreation, forestry, etc.

VEGETATION – Plants in general, or the sum total of the plant life above and below the ground in an area. cf. *vegetative*.

WARM-SEASON PLANT – A plant which makes most or all of its growth during the spring, summer, or fall and is usually dormant in winter.

WATERSHED – (1) A total area of land above a given point on a waterway that contributes runoff water to the flow at that point. (2) A major subdivision of a drainage basin.

WILDLIFE – Undomesticated vertebrate animals considered collectively, with the exception of fishes. cf. *game*.

WOODLAND – Land dominated by widely-spaced trees including junipers, oaks, mesquite, and pines, with an understory of grasses and forbs.

Terms from A Glossary of Terms Used in Range Management 2nd edition, Society for Range Management, 1974.

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- Central Idaho Rangelands Network: idahorangelands.org
- Ecological Site Descriptions: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/desc/
- el.e.men'tal Idaho: http://elementalidaho.org/
- Great Basin Fire Science Exchange: http://greatbasinfirescience.org/
- Idaho Rangeland Resource Commission: idrange.org
- Landscape Toolbox, Tools and Methods for Effective Land Health Monitoring: http://www.landscapetoolbox.org/
- Life on the Range: Stories from the Hitching Post: http://www.lifeontherange.org/
- National Water-Quality Assessment Project/USGS: https://water.usgs.gov/nawqa/glos.html
- NRCS Plants Database: http://plants.usda.gov
- Rangeland Assessment and Monitoring Methods Guide: http://www.rangelandmethods.org
- Rangeland Principles: rangelandprinciples.wordpress.com/topics/
- Rangeland Recruitment Webpage: https://rangelandswest.org/careersandeducation/
- Revegetation Equipment Catalog: http://reveg-catalog.tamu.edu/index.htm
- Sagebrush Steppe Treatment Evaluation Project (SageSTEP): www.sagestep.org
- Wrangle, Explore Rangelands: http://wrangle.org/

Glossary

Terms used in the Grazing Land Applications (GLA) software are identified by a (GLA) after the term name.

Abbreviations used in this glossary:

Abbr.	abbreviation
e.g.	for example
i.e.	in other words
Syn.	Synonym
n.	Noun
v.	Verb
vi.	Verb intransitive
vt.	Verb transitive

Abiotic Nonliving components of an ecosystem; basic elements and compounds of the environment.

Accelerating practices Practices that supplement vegetative management; help to achieve desired changes in the plant community more rapidly than is possible through vegetative management alone. Included are such practices as seeding, prescribed burning, brush management, and certain other practices that accelerate vegetative change. See Facilitating practices.

Accessibility The ease with which an area can be reached by people or penetrated and grazed by animals. The ease with which herbivores can reach plants or plant parts.

Acid soil A soil that has a pH below 6.6.

Adjustment (GLA) Change in animal numbers, seasons of use, kinds or classes of animals, or management practices as warranted by specific conditions.

Adjustment factor (GLA) A value used to adjust the recommended stocking rate for landscape attributes that limit capture of forage, such as distance to water, slope, barriers, terrain, or site preference.

Aftermath Crop residue and/or regrowth of forage crops, including growth of volunteer plants, used for grazing after a machine harvest.

Age-class (1) A descriptive term to indicate the relative age of plants. (2) Refers to age and class of animal.

Air-dry weight The weight of a substance, usually vegetation, after it has been allowed to dry to equilibrium with the atmosphere, usually without artificial heat.

Alkaline soil A soil that has a pH above 7.3.

Alkaloids Bitter tasting organic compounds of plant origin that have alkaline properties and a complex molecular structure containing nitrogen. They reduce dry matter intake and interfere with digestion of livestock grazing forages containing significant levels of them. Metabolic and reproductive disorders in livestock can occur from ingestion of the more toxic alkaloids. They are anti-quality chemicals.

Allelopathy Chemical inhibition of one organism by another.

Allotment An area designated for the use of a prescribed number and kind of livestock under one plan of management.

Allowable use (1) The degree of utilization considered desirable and attainable on various parts of a ranch or allotment considering the present nature and condition of the resource, management objectives, and levels of management. (2) The amount of forage planned to be used to accelerate range improvement.

Alluvium Sediment deposited by streams and rivers.

Amortizing The process of paying initial costs plus subsequent interest costs over a payment period, usually in equal periodic installments.

Anabolic stimulant (GLA) Growth hormones that affect the metabolic efficiency of an animal at the cellular level.

Anhydrous ammonia A nitrogen fertilizer that is 82 percent nitrogen. It is stored in pressurized tanks and injected into the soil to prevent loss to the air. Great care must be taken during application to avoid exposure to a vapor cloud of the ammonia. It is extremely toxic and can cause significant damage to eyes, nasal passages, and lungs.

Animal attributes (GLA) A listing of major domestic and wild animal species, major animal classes, and breed attributes.

Animal class (GLA) Age and/or sex groups of a kind of animal (e.g., cow, bull, calf, weaner steer, weaner heifer, yearling steer, yearling heifer, 2-year old heifer, 3-year old heifer, ox).

Animal-day One day's tenure upon grazing land by one animal. Most specify kind and class of animal. Not synonymous with animal unit day.

Animal-demand Energy requirement of ungulate herbivores based only on animal-related factors, such as body size, stage of life cycle, or production stage.

Animal kind (GLA) The common name of a kind or species of animal (e.g., cattle, sheep, goat, horse, white-tailed deer).

Animal-month A month's tenure upon grazing land by one animal. Must specify kind and class of animal. Not synonymous with animal-unit month.

Animal substitution ratio A numerical ratio of numbers, units or stocking levels of one animal species to another or in partitioning grazing capacity between two or more animal species.

Animal-unit An animal unit (AU) is one mature cow of approximately 1,000 pounds and a calf up to weaning, usually 6 months of age, or their equivalent.

Animal-unit-day The amount of forage required by an animal unit for 1 day. The NRCS uses 30 pounds of air dry forage or 26 pounds of oven dried forage per day as the amount of feed needed to meet this requirement. The pounds of feed needed to meet an animal's daily requirement is usually calculated by taking 2.5 to 3 percent of the animal's body weight.

Animal-unit-equivalent The amount of forage consumed by the different kind and class of animals expressed as a portion of an animal unit.

Animal-unit-month The amount of forage required by an animal unit for 1 month.

Animal-unit-year The amount of forage required by an animal unit for 1 year, equal to 12 AUM's. The NRCS uses 9,490 pounds of oven dried forage as required pounds of forage to equal an animal unit year.

Annual plant A plant that completes its life cycle and dies in 1 year or less.

Annual range Range on which the principal forage plants are self-perpetuating annual, herbaceous species.

Anti-quality chemicals Chemicals produced in some forages that reduce dry matter intake or cause negative responses in animals consuming those forages.

Apical dominance Domination and control of meristematic leaves or buds located on the lower stem, roots, or rhizomes by hormones produced by apical meristems located on the tips and upper branches of plants, particularly woody plants.

Apparent trend An interpretation of trend based on a single observation. Apparent trend is described in the same terms as measured trend except that when no trend is apparent it shall be described as not apparent.

Aquifer A geologic formation capable of transmitting water through its pores at a rate sufficient for water supply purposes. The term water-bearing is sometimes used synonymously with aquifer when a stratum furnishes water for a specific use. Aquifers are usually saturated sands, gravel, fractures, caverns, or vesicular rock.

Arid A term applied to regions or climates where lack of sufficient moisture severely limits growth and production of vegetation. The limits of precipitation vary considerably according to temperature conditions, with an upper annual limit for cool regions of 10 inches or less and for tropical regions as much as 15 to 20 inches. See Semiarid.

Arroyo A ravine in southwestern United States.

Ash (GLA) The noncombustible portion of feedstuff, generally nonvolatile minerals.

Ash The remaining residue after all the combustible material from a feed stuff has been burned off in a furnace at 500 to 600 °C. Nutritionally ash values have little importance.

Aspect The predominant direction of slope of the land.

Association Syn. Plant association.

AU Abbr. for Animal-unit. (Usually no periods)

AUM Abbr. for Animal-unit-month. (Usually no periods)

Autecology A subdivision of ecology that deals with the relationship of individuals of a species to their environment.

Autogate See cattleguard.

Autotoxicity A specific type of allelopathy where the presence of adult plants of a species interferes with the germination and development of seedlings from that species.

Auxin A plant hormone promoting or regulating growth.

AUY Abbr. for animal-unit-year. (Usually no periods)

Available forage (Animal oriented.) That portion of the forage production that is accessible for use by a specified kind or class of grazing animal. (Plant and animal oriented.) It is the consumable forage stated in digestible dry matter per land unit area that can be removed by grazing livestock without damage to the forage plants. See Usable forage; same except stated as dry matter per land unit area.

Available water The portion of water in a soil that can be absorbed by plant roots.

Available water holding capacity The volume of water available to plants when the soil including fragments is at field capacity.

Azonal soil A soil lacking a well-defined profile.

Backfiring Ignition of a fire on the leeward (downwind) side of a burn area, resulting in a slow moving ground fire that backs into the wind.

Bactericide A pesticide that kills bacteria.

Bag silo (plastic tube) Long (95 to 135 feet) plastic bags ranging from 8 to 10 feet in diameter that hold silage or haylage. They are filled with a wheeled machine that holds the open end of the bag and stuffs the bag with moist to wet forage. The machine is moved forward as the bag fills. For best forage quality, storage should be during cool weather and not exceed 5 months.

Balage Round baled, 40 to 60 percent moisture, grass or legume forage completely wrapped in plastic film or bagged. For best forage quality, storage should be during cool weather, in a shaded area, and not exceed 5 months.

Balanced operation (1) A livestock enterprise that provides sufficient feed and forage resources during each season to promote continuous satisfactory maintenance and production of its livestock and game. (2) An operation that integrates the kinds, classes, and numbers of animals (livestock or wildlife) to effectively use available forage resources to maintain continuous, sustainable production. (3) An operation that integrates various livestock, wildlife, and recreational enterprises which most effectively uses available forages and other range resources to maintain continuous, sustainable production.

Baler A machine that picks up a windrow of forage, compresses it, forms it into a rectangular or cylindrical bale, wraps it, and discharges it either onto the ground or into a trailing, convenient hauling vehicle. Bale size is highly variable among models.

Band Any number of sheep handled as a unit attended by a herder. See Flock.

Band-day Tenure by a band of sheep of a given size and class for 1 day.

Bare ground All land surface not covered by vegetation, rock, or litter. See Ground cover.

Barren (1) Any area devoid of vegetation or practically so. (2) A term to describe a mature female animal that is incapable of producing offspring.

Barrier A physical obstruction that limits movement.

Basal area The cross sectional area of the stem or stems of a plant or of all plants in a stand. Herbaceous and small woody plants are measured at or near the ground level; larger woody plants are measured at breast or other designated height. Syn. basal cover.

Bed ground An area where animals sleep and rest.

Bench mark (1) A permanent reference point. (2) In range inventory, it is used as a point where changes in vegetation through time are measured. (3) In soils, it is used to designate a major soil series that is representative of similar soils. (4) In economics, data that are used as a base for comparative purposes with similar data. (5) A surveyor's mark made on a permanent landmark that has known position and altitude.

Biennial A plant that lives for 2 years, producing vegetative growth the first year, usually blooming and fruiting in the second year, and then dying.

Biocide A chemical toxic or lethal to living organisms.

Biodegradable Capable of being decomposed by natural processes.

Biological diversity The variety and variability of the world's organisms, the ecological complexes in which they occur, and the processes and life support services they mediate.

Biomass The total amount of living plants and animals above and/or below ground in an area at a given time.

Biome A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

Biota All the species of plants and animals occurring within an area or region.

Biotype A group of individuals within a population occurring in nature, all with essentially the same tolerance ranges. A species usually consists of many biotypes. See Ecotype.

Bi-pass protein Protein that bypasses or escapes the rumen directly into the intestine, such as dehydrated alfalfa, blood meal, corn gluten meal, distillers grains, and feather meal.

Blackline A backfired area in front of the head fire used for stopping the head fire. Its area (length and width) is determined by the fuel load and risk. Can be burned in advance of prescribed fire. See Firebreak.

Blowout (1) An excavation in an area of soil, usually loose sand, produced by wind. (2) A breakthrough or rupture of a soil surface attributable to hydraulic pressure, usually associated with sand boils.

Body condition score (BCS) (GLA) A rating system used to evaluate the overall health and well being of livestock has become a widely used method of determining when supplemental feeding should be used. A BCS of 5 usually indicates an animal in average condition. BCS systems usually go from 1 to 9 or 10, with 1 being extremely poor and 9 or 10 being excessively fat.

Boot stage Growth stage when a grass seedhead is enclosed by the sheath of the uppermost (flag) leaf.

Bovine fat necrosis Several physiological disorders in cattle caused by necrotic or hard fat lesions in the abdominal cavity. Ingestion of highly fertilized endophyte fungus infected tall fescue seems to cause the disorder.

Brand (1) (v) To mark the skin or wool of an animal in a distinctive pattern by use of a hot or cold iron, chemical, paint, or other means to designate ownership or to identify individual animals for registration or management purposes. (2) (n) The mark so made.

Breeding herd The animals retained for breeding purposes to provide for the perpetuation of the herd or band. Excludes animals being prepared for market.

Breed type (GLA) Name of the breed (e.g., Hereford cattle, merino sheep).

Broadcast seeding Process of scattering seed on the surface of the soil prior to natural or artificial means of covering the seed with soil.

Browse (n) That part of leaf and twig growth of shrubs, woody vines, and trees available for animal consumption. (v) Act of consuming browse.

Browse line A well-defined height to which browse has been removed by animals.

Browseway A lane built through a dense brush thicket to provide access by herbivores and people and/or to encourage browse rejuvenation. See Sendero.

Brush Various species of shrubs or small trees usually considered undesirable for livestock or timber management. The same species may have value for browse, wildlife habitat, or watershed protection.

Brush control Reduction of unwanted woody plants through fire, chemicals, mechanical methods, or biological means to achieve desired land management goals.

Brushland An area covered primarily with brush; i.e., shrubland.

Brush management Manipulating woody plant cover to obtain desired quantities and types of woody cover and/or to reduce competition with herbaceous understory vegetation, in accordance with overall resource management objectives.

Buck pasture In certain localities, a pasture or paddock for holding rams separately from ewes.

Bucking range In certain localities, range selected for placing rams with ewes.

Buffalo wallow A small natural depression of prairie occasionally containing standing water and having vegetation different from that of the surrounding area.

Buildup or corrective fertilizer applications Nutrient additions, especially phosphorus and potassium, that bring the soil up to the desired level of availability for optimum plant growth.

Bunch grass A grass so-called because of its characteristic growth habit of forming a bunch.

Bunker or horizontal silo Above- or below-ground, lined or unlined storage facility used to store fermented forage material (silage or haylage). Forage material must be machine compacted and covered with an air tight film of plastic to get proper fermentation and reduce storage losses. Unlined ones can leak silage effluent, a pollutant with high biochemical oxygen demand.

Burn An area over which fire has recently passed.

Butte An isolated hill with relatively steep sides. See Mesa.

C-3 plant A plant employing the pentose phosphate pathway of carbon dioxide assimilation during photosynthesis; a cool-season plant.

C-4 plant A plant employing the dicarboxylic acid pathway of carbon dioxide assimilation during photosynthesis; a warm-season plant.

Cabling The use of a large cable pulled between two large tractors (usually crawler tractors) to pull down or uproot brush. See Chaining.

Cactus A spiny, succulent plant of the Cactaceae family.

Calf crop The number of calves weaned from a given number of cows exposed to breeding, usually expressed in percent; i.e., number of calves weaned divided by number of cows exposed x 100. Calves weaned.

Caliche (1) A layer in the soil horizon more or less cemented by secondary carbonates of calcium or magnesium precipitated from the soil solution. It may occur as a soft, thin soil horizon; as a hard, thick bed just beneath the solum; or as a surface layer exposed by erosion. Often used for road material or as a filler to build up areas in heavily traveled areas, such as pens or troughs. Not a geologic deposit. (2) Alluvium cemented with sodium nitrate, chloride, and/or other soluble salts.

Calorie The amount of heat required to raise the temperature of 1 gram of water 1 °C measured from 14.5 to 15.5 °C.

Cam plant A plant employing the crasulacean acid metabolism pathway of carbon dioxide assimilation during photosynthesis.

Canopy (1) The vertical projection downward of the aerial portion of vegetation, usually expressed as a percent of the ground so occupied. (2) A generic term referring to the aerial portion of vegetation.

Canopy cover The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. Syn. crown cover.

Carrier (1) Material used to dilute the active ingredient in a chemical formulation. (2) Material used to carry a pesticide to its target. (3) Plant or animal carrying an infectious disease agent internally, but showing no marked symptoms.

Carrying capacity The maximum stocking rate possible without inducing permanent or long-term damage to vegetation or related resources. The rate may vary from year to year in the same area as a result of fluctuating forage production.

Catchment basin See Guzzler.

Cation exchange capacity The amount of exchangeable cations that a soil can adsorb at pH 7.0.

Cattleguard A device or structure, at points where roads or railroads cross a fence line, that is so designed that vehicular travel is uninterrupted, but crossing by all kinds of livestock is restricted. Syn. autogate.

Cattle walkway Syn. walkway.

Cell A grazing arrangement comprised of numerous subdivision (pastures or paddocks) often formed by electrical fencing, with a central management to facilitate livestock management and movement to the various subdivisions. Normally used to facilitate a form of short duration grazing.

Certified seed Seed produced from foundation or registered seed that is available for consumer use. It carries a tag signifying it is high quality seed.

Chaining Similar practice as cabling except a large ship anchor chain with each chain link weighing 80 to 100 pounds is used. See Cabling.

Chaparral (1) A shrub community. (2) A dense thicket of stiff or thorny shrubs or dwarf trees, common to the Southwest United States.

Chiseling Breaking or loosening the soil, without inversion, with a chisel cultivator or chisel plow. A practice used for grassland or pasture renovation.

Class of animal Description of age and/or sex-group for a particular kind of animal; e.g., cow, calf, yearling, ewe, doe, or fawn.

Claypan A dense compact layer in the subsoil having a much higher clay content than the overlying material from which it is separated by a sharply defined boundary; formed by downward movement of clay or by synthesis of clay in place during soil formation. Claypans are usually hard when dry and plastic and sticky when wet. They usually impede the movement of water and air. See Hardpan.

Climax See Historic climax plant community.

Climax plant community Syn. historic climax plant community.

Clone A group of plants, growing in close association, derived by asexual reproduction from a single parent plant. Such plants are therefore of the same genetic constitution.

Closed range Any range on which livestock grazing or other specified use is prohibited. See Livestock exclusion.

Close herding Handling a herd in a closely bunched manner, restricting the natural spread of the animals when grazing. See Mob stocking.

Co-grazing Grazing the current year's forage production by more than one kind of grazing animal either at the same time or at different seasons.

Cold stratification Keeping seed in a cool, moist environment for a period of time to simulate overwintering thereby reducing dormancy and increasing seed germination.

Commercial (1) Livestock raised primarily for meat, milk, wool, or other animal-derived products. (2) The label applied to a producer of such animals. See Seedstock for contrasting term.

Common use (1) Grazing the current year's forage production by more than one kind of grazing animal either at the same time or at different seasons. (2) More than one operator running livestock on the same area at the same time.

Community (plant community) An assemblage of plants occurring together at any point in time, while denoting no particular ecological status. A unit of vegetation.

Community An assemblage of populations of plants and/or animals in a common spatial arrangement.

Community type An aggregation of all plant communities distinguished by floristic and structural similarities in both overstory and undergrowth layers. A unit of vegetation within a classification.

Companion crop A crop sown with another crop (i.e., perennial forage) that is allowed to mature and provide a return in the first year.

Competition A process of struggling between or among organisms of the same species (intraspecific) or different species (interspecific) for light, water, essential elements, or space within a trophic level, resulting in a shortage of essential needs for some individuals or groups.

Complementary pasture Short-term forage crop or perennial pasture used for special purposes, to extend grazing seasons, or to enhance productivity of the ranch.

Composition Syn. Species composition.

Concentrate (GLA) A feed or feed mixture for livestock that usually contains less than 18 percent crude fiber.

Concentrate feed Grains or their products and other processed food materials that contain a high proportion of nutrients and are low in fiber and water.

Concentrates Feeds low in crude fiber (less than 10% on a dry matter basis), low in moisture, and highly digestible. Protein concentrates are of plant or animal origin that contain > 20 percent protein.

Condition class (Term is no longer used by NRCS.) Syn. Range condition class.

Conservation The use and management of natural resources according to principles that assure their sustained productivity.

Conservation district A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries. Usually a subdivision of state government with a local governing body and always with limited authorities. Generally called a soil and water conservation district.

Conservation plan The recorded decisions of a landowner or operator, cooperating with a conservation district, on how the landowner or operator plans, within practical limits, to use his/her land according to its capability and to treat it according to its needs for maintenance or improvement of the soil, water, animal, plant, and air resources.

Consolidated band A band of sheep made up of several small bands.

Constancy The percentage occurrence of a species within a given community type.

Consumers Heterotrophic organisms, chiefly animals, that ingest other organisms or particulate organic matter.

Consumption Dietary intake based on amounts of specific forages and other feedstuffs or amounts of specific nutrients.

Contact herbicide A herbicide that kills primarily by contact with plant tissue rather than as a result of translocation.

Continuous grazing The grazing of a specific unit by livestock throughout a year or for that part of the year during which grazing is feasible. The term is not necessarily synonymous with yearlong grazing since seasonal grazing may be involved. Also referred to as continuous stocking.

Continuous set stocking Allowing a fixed number of animals unrestricted access to an area of grazing land for the whole or substantial part of a grazing season.

Contour furrow A plowed or listed strip, commonly 8 to 18 inches deep and wide, made parallel to the horizontal contour for the purpose of water retention and reduction of soil erosion.

Control (1) Manipulation and management for reduction of noxious plants, a term of many degrees ranging from slightly limiting to nearly complete replacement. (2) Untreated areas or animals used for research, comparison, or evaluation of treatment responses.

Controlled breeding (1) Controlling the time of breeding of livestock to synchronize the period of optimum growth for the animals with the period of peak quality and optimum growth of forage. (2) A planned program whereby livestock males and females are brought together for breeding purposes so that offsprings are born during a desired period.

Controlled burning Syn. Prescribed burning.

Conversion factor A factor by which stocking rates are partitioned according to the kind or class of animal based on energy requirements. See Animal-unit.

Cool-season plant A plant that generally makes the major portion of its growth late in fall, in winter, and in early spring. Cool-season species generally exhibit the C-3 photosynthetic pathway.

Coordinated resource management planning The process whereby various interest groups are involved in discussion of resource uses and collectively diagnose management problems, establish goals and objectives, and evaluate multiple use resource management.

Corral An enclosure or pen for handling livestock.

Coulee A regional term used for deep gulch or ravine.

Cover Syn. Foliar cover, see Basal area.

Cover type The existing vegetation of an area.

Creep feeding Supplemental feeding of suckling livestock in such a manner that the feed is not available to the mothers or other mature livestock.

Creep grazing The practice of allowing juvenile animals to graze areas that their dams cannot access at the same time.

Critical area An area to be treated with special consideration because of inherent site factors, size, location, condition, values, or significant potential conflicts among uses.

Cropland Land used primarily for the production of cultivated crops.

Crop residue The portion of a crop remaining after harvest of seed or other primary plant parts. It may be managed for grazing and/or ground cover and to replenish soil organic matter levels.

Crop rotation pasture Cropland pasture where livestock are stocked on forages grown in a designed crop rotation cycle with other cultivated crops. Livestock move from crop field to crop field as the stand life of the forage and crop rotation dictate. Depending on the forage stand life and length of the crop rotation, livestock entry may occur seasonally on the same field, or take several years to cycle around the crop fields being grazed in rotation.

Crude fiber Fiber made up primarily of plant structural carbohydrates, such as cellulose and hemicellulose, but it also contains some lignin.

Crude protein A calculated portion from the nitrogen content of a feedstuff, using the Kjedahl procedure. The crude protein content is made up of those compounds defined as proteins and designated true proteins, as well as nonprotein nitrogen compounds such as free amino acids, amides of amino acids, ammonium salts or urea. The protein content of feedstuffs is currently estimated only on the basis of crude protein.

Cryptogam A plant in any of the groups Thallophytes, Byophytes, Pteridiophytes - mosses, lichens, and ferns.

Culm The stem of a grass that has elongated internodes between nodes (jointed).

Culmless A vegetative tiller of some grasses that holds its growing point close to the ground by not elongating internodes until it is ready to initiate reproductive growth.

Cultivar (derived from cultivated variety) A named variety selected within a plant species. Distinguished by any morphological, physiological, cytological, or chemical characteristics. A variety of plant produced and maintained by cultivation which is genetically retained through subsequent generations.

Cultivars (1) A variety, strain, or race of plant that has originated and persisted under cultivation or was specifically developed for use as a cultivated crop. (2) For cultivated crops, the equivalent of botanical variety, in accordance with the International Code of Nomenclature of Cultivated Plants—1980.

Cultivated crops (1) Crops grown from seed, bulbs, corms, sprigs, crowns, tubers, cuttings, and graftings and cared for by humans for harvest or landscaping. (2) Crops genetically improved or developed by various agronomic or horticultural techniques.

Cultivating tools Variously designed machinery used to uproot weeds to keep them from competing with the desired crop. The class of equipment includes field and row crop cultivators, spike and spring tooth harrows, chain drags, and rotary hoes.

Cured forage Forage, either standing or harvested, that has been naturally or artificially dried and preserved for future use.

Cut (1) (v) To separate one or more animals from the herd or band. (n) The animal(s) so separated. (2) To reduce livestock grazing, particularly on a public land allotment.

Dam (GLA) The female parent of a calf.

Damping off The rapid rotting of seeds or seedlings before they emerge from the soil or the rapid rotting of the stem bases and toppling of seedlings after emergence.

DBH Abbreviation of diameter-at-breast-height of a tree.

Death loss The number of animals in a herd that die from various natural and accidental causes. Usually expressed as a percentage.

Debris Accumulated plant and animal remains.

Deciduous (plant) A plant whose parts, particularly leaves, are shed at regular intervals or at a given stage of development.

Decomposer Heterotrophic organisms, chiefly the micro-organisms, that break down the bodies of animals or parts of dead plants and absorb some of the decomposition products, releasing similar compounds usable by producers.

Decreaser Plant species of the climax vegetation that will decrease in relative amount with continued heavy defoliation (grazing).

Deferment Delay of livestock grazing in an area for an adequate period to provide for plant reproduction, establishment of new plants, or restoration of vigor of existing plants. See Deferred grazing and Rest.

Deferred grazing Postponing grazing or resting an area for a prescribed period, usually to meet a specific management objective.

Deferred-rotation Any grazing system, that provides for a systematic rotation of the deferment among pastures. The time of the rest period generally changes in succeeding years.

Defoliation The removal of plant leaves; i.e., by grazing or browsing, chemical defoliant, or natural phenomena, such as hail, fire, or frost.

Degenerated range Syn. Deteriorated range.

Degree of use The proportion of current year's forage production that is consumed and/or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole. Syn. Use.

Density (1) The number of individuals per unit area. (2) Refers to the relative closeness of individuals to one another.

Desert An arid area with insufficient available water for dense plant growth.

Desertification The process by which an area or region becomes more arid through loss of soil and vegetative cover. The process is often accelerated by excessive, continuous overstocking and drought.

Desirable plant (GLA) See Plant preference classification.

Desired plant community One of the several plant community types that may occupy an ecological site, the one or combination that meets the minimum quality criteria for the soil, water, air, plant, and animal resources, and that meets the landowner's or manager's objective.

Deteriorated range Range on which present vegetation and soil conditions represent a significant departure from natural potential. Syn. Degenerated range.

Detritus Fragmented particulate organic matter derived from the decomposition of debris.

Dietary essentials (nutrient) Nutrients that must be orally ingested, in contrast to those which can be manufactured or converted in the animal, such as through microbial symbiosis in the rumen.

Digestible dry matter (DDM) See Digestible organic matter.

Digestible energy (DE) The gross energy of food consumed minus fecal energy. Energy in the feces accounts for the greatest loss of ingested energy. In ruminants the losses are 40 to 50 percent for roughage and 20 to 30 percent for concentrates. In horses fecal losses account for 40 percent of the energy ingested.

Digestible organic matter (DOM) A percentage of energy and protein in forages expressed as organic matter intake minus fecal dry matter divided by dry matter intake times 100.

Discounting The process of determining the present value of a stream of future financial returns.

Discount rate (GLA) The rate of return that could be earned if you chose an investment other than the one being analyzed; it is the minimum acceptable rate of return from an investment.

Diurnal Active during daylight hours.

Diversity A measure of the number of species and their relative abundance in a community.

Docking v. To surgically shorten an animal's tail.

Doggie Syn. Orphan.

Domestication status (GLA) The animal ranking status used in GLA (i.e., domesticated - controllable, wild/feral - uncontrollable, or domestic wild - wild animals that are being managed in a semi-controllable situation, such as game farms).

Dominant (1) Plant species or species groups that, by means of their number, coverage, or size, have considerable influence or control upon the conditions of existence of associated species. (2) Those individual animals that, by their aggressive behavior or otherwise, determine the behavior of one or more animals resulting in the establishment of a social hierarchy.

Dormant (1) A living plant that is not actively growing aerial shoots. (2) A pesticide application made on crop plants that are not actively growing.

Drag An implement used for control of vegetation, e.g., chain drag.

Drainage class A method of classifying the natural drainage condition of the soil that refers to the frequency and duration of soil wetness.

Draw A natural watercourse, including the channel and adjacent areas on either side, which may occasionally overflow or receive extra run-in water from higher adjacent areas; generally having intermittent flows associated with higher intensity rainfall.

Drenching (v) Giving orally a forced dose of a specific solution to an animal, usually to control internal parasites.

Drift (v) (1) The movement of materials by wind or water. (2) The natural movement of animals. (n) Vegetative material moved and deposited by wind and water. See Spray drift.

Drift fence An open-ended fence used to retard or alter the natural movement of livestock; generally used in connection with natural barriers.

Drill seeding Planting seed directly into the soil with a drill in rows, usually 6 to 24 inches apart.

Dripline The area under the outermost branches of a tree or shrub.

Drip torch Portable equipment for applying flammable liquids to ignite a vegetative area to be burned. Primarily used in prescribed burning.

Drive The moving of livestock under human direction. In cowboy parlance, the term drift is often used in lieu of drive when animals are slowly urged in a certain direction.

Drop band A band of ewes that are giving birth or are expected to give birth within a few days.

Drouth (drought) (1) A prolonged chronic shortage of water. (2) A period with below normal precipitation during which the soil water content is reduced to such an extent that plants suffer from lack of water; frequently associated with excessively high temperatures and winds during spring, summer, and fall in many parts of the world.

Drouth (drought) plan The livestock operator's contingency plan to make necessary adjustments during unfavorable years of low forage production.

Dry band A band of ewes without lambs.

Dry flowable A water dispersible granule pesticide formulation rather than being suspended in a liquid carrier. See Flowable. Mixed with water and sprayed. Less inhalation hazard to the user.

Dry matter The amount of a feedstuff remaining after all the free moisture is evaporated out. The feedstuff is placed in a oven at a temperature of 100 to 105 °C.

Dry matter digestibility (DMD) The percentage of energy and protein in forages expressed as dry matter intake minus fecal dry matter divided by dry matter intake times 100.

Dry meadow A meadow dominated by grasses which is characterized by soils that become moderately dry by midsummer.

Dual use Grazing the current year's forage production by two species of grazing animals at the same time. See Co-grazing.

Dugout An artificially constructed depression that collects and stores water and differs from a reservoir in that a dam is not relied upon to impound water. See Stock pond.

Dust (1) Windblown soil. (2) A formulation that is a finely ground, dry mixture of an inert carrier and a pesticide. Danger of drift and inhalation by user during use.

Early head Flower head (seedhead) of a grass is emerging or emerged from flag leaf sheath, but not shedding pollen.

Earmarking The process of removing parts of the ears of livestock to leave a distinctive pattern for the purpose of designating ownership and identification.

Ecesis Establishment and development of a plant in the plant community.

Ecological site A distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

Ecology The study of the interrelationships of organisms with their environment.

Ecosystem Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.

Ecotone A transition area of vegetation between two communities, having characteristics of both kinds of neighboring vegetation, as well as characteristics of its own. Varies in width depending on site and climatic factors.

Ecotype A locally adapted population within a species that has certain genetically determined characteristics; interbreeding between ecotypes is not restricted. See Biotype.

Edaphic Refers to the soil.

Edge effect (1) The influence of one adjoining plant community upon the margin of another affecting the composition and density of the populations. (2) The effect executed by adjoining communities on the population structure within the margin zone.

Effective precipitation That portion of total precipitation that becomes available for plant growth. It does not include precipitation lost to deep percolation below the root zone, to surface runoff, to evaporation, or to rainfall that falls during the dormant season and is gone from the soil profile prior to the growing season.

Effluent (silage) Leachate produced by excess moisture in silage during anaerobic fermentation; often called silage juice or silo juice. If allowed to escape the silo facility, it poses a significant threat to receiving water because of its high biochemical oxygen demand.

Emergency crops Crops, not part of a planned rotation, grown either because of primary crop failure (planting delayed past time needed for maturity or failed growth after planting) or lack of grazeable forage on fields used for pasture, or both.

Emergency feeding Supplying feed to range animals when available forage is insufficient because of heavy storms, fires, or other such emergencies. See maintenance feeding and Supplemental feeding.

Emulsifiable concentrate A pesticide formulation with the active ingredient and an emulsifier suspended in a liquid. It mixes well and easy to handle, but is more easily absorbed through the skin. Can be corrosive and of greater toxicity.

Enclosure An area fenced to confine animals.

Endemic Native to or restricted to a particular area, region, or country.

Energy adjustment factor (GLA) An adjustment factor in GLA for the animal's net energy level.

Energy for maintenance Energy used to carry out service functions that are performed by the tissues and organisms for the benefit of the organism.

Ensile (1) To preserve a forage crop as silage. (2) The act of placing a forage crop in a silo.

Enterprise Any segment of the land unit's business that can be isolated by accounting procedures so revenue and expenses can be allocated to it.

Environment The sum of all external conditions that affect an organism or community to influence its development or existence.

Epinasty The bending or twisting of twigs or leaf petiole or blades; often used in diagnosis of herbicidal effects on plants.

Eradication (plant) Complete kill or removal of a noxious plant from an area, including all plant structures capable of sexual or vegetative reproduction.

Erosion (v) Detachment and movement of soil or rock fragments by water, wind, ice, or gravity. (n) The land surface worn away by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

Escarpment A steep slope or ridge, terminating high lands abruptly, which was formed by erosion or by faulting.

Esophageal-cannula A device used for maintenance and closure of an esophageal fistula.

Esophageal-fistula A permanent, surgically established opening in the esophagus of an animal used for collecting diet samples. See Esophageal-cannula.

Essential element A chemical element that is essential to the life of an organism.

Evapotranspiration The actual total loss of water by evaporation from soil, waterbodies, and transpiration from vegetation over a given area with time.

Evergreen (plant) A plant that has leaves all year round and sheds them more or less regularly through all seasons.

Exchangeable aluminum (extractable) The amount of aluminum extracted in one normal potassium chloride that was on the cation exchange sites in the soil.

Exclosure An area fenced to exclude animals.

Exotic An organism or species that is not native to the region in which it is found.

Exposure Direction of slope with respect to points of a compass.

Facilitating practices Practices that control or influence the movement and handling of grazing animals and make it easier to apply vegetative management practices. Facilitating practices include practices, such as water developments, stock trails, walkways, fencing, salting, and herding.

Fauna The animal life of a region. A listing of animal species of a region.

Fecal analysis A process of analyzing livestock manure for diet content of crude protein and digestible organic matter.

Feed (n) Any non-injurious, edible material having nutritive value when ingested. (v) The act of providing feed to animals.

Feed additive (GLA) A feed ingredient provided to animals that improves the conversion efficiency of ruminants.

Feed additives Materials other than the feeds themselves added to diets; e.g., vitamins, mineral supplements, or antibiotics.

Feed conversion (feed efficiency) (GLA) Units of feed consumed per unit of body weight gained; the production (meat, milk) per unit of feed consumed.

Feed ground A designated place on a range where livestock are fed.

Feed reserve Feed stored for future use. See Forage reserve.

Feedstuff profiles (GLA) A list of common feedstuffs and their nutritional value to cattle, sheep, goats, and horses.

Feedstuffs Any substance suitable for animal feed.

Fence A structure that acts as a barrier to livestock, wildlife, or people.

Fencing Enclosing or dividing an area of land with a suitable structure that acts as a barrier to livestock, wildlife, or people.

Feral Escaped from cultivation or domestication and existing in the wild.

Fescue foot A malady in cattle that commonly occurs during late fall and winter grazing of endophyte infected tall fescue. Symptoms range from hind quarter tenderness (slow walk with limp) to gangrene and tissue death of tail, ear, and feet. In extreme cases a tail or hoof may be lost. Constriction of blood vessels at the extremities limits blood flow to them and causes tissue death.

Fescue toxicosis A malady in cattle that commonly occurs during summer grazing of endophyte infected tall fescue. Symptoms include rough hair coat, low weight gain or milk production, rapid breathing, excess salivation, increased body temperature, depressed serum-prolactin levels, poor conception rates, and general unthrifty condition. Cattle spend an inordinate amount of time in shade or water, or wallow in the mud if accessible. This malady is directly linked to ergopeptine alkaloids.

Fibrous root system A plant root system having a large number of small, finely divided, widely spreading roots, but no large taproots. Typified by grass root system.

Firebrand A piece of burning wood or other material. A term used in prescribed burning describing a piece of burning material drifting away from the primary fire and capable of starting another fire.

Firebreak A natural or manufactured barrier used to prevent or retard the spread of fire, that is in existence or made before a fire occurs. It is usually created by the removal of vegetation. See Fireline and Fuelbreak.

Fireline A narrow line, 2 to 10 feet wide, from which all vegetation is removed by soil sterilization, yearly maintenance, treatment with chemical fire retardant, or clearing just before ignition of a prescribed burn.

First-last grazing A method of using two or more groups of animals, usually with different nutritional requirements, to graze sequentially on the same area.

Fixation A soil process that renders available plant nutrients unavailable or fixed in the soil.

Flail conditioner A machine used to abrade the waxy outer plant layer and break plant stems that have been cut for harvest. It uses steel or nylon free-swinging fingers on a revolving shaft (rotor). It was developed for use on grass hay crops only.

Flexibility Characteristics of a management plan that allow it to accommodate changing conditions.

Flock A group of sheep managed in fenced pastures. See Band.

Flooding The temporary covering of the soil surface by water that flows over it from any source, such as a stream, irrigation canal, tidal action, or runoff from adjacent or surrounding slopes.

Flora (1) The plant species of an area. (2) A simple list of plant species or a taxonomic manual.

Flowable A pesticide formulation that is a finely ground material suspended in a liquid carrier. It is easy to handle and apply.

Flushing Improving the nutrition of female breeding animals prior to and during the breeding season to stimulate ovulation.

Fluvial Pertaining to or produced by the action of a stream or river.

Foliage The green or live leaves of plants; mass leaves or leafage.

Foliar cover The percentage of ground covered by the vertical projection of the aerial portion of plants. Small openings in the canopy and intraspecific overlap are excluded. Foliar cover is always less than canopy cover; either may exceed 100 percent. Syn. cover.

Food reserves The excess carbohydrates in plants produced during photosynthesis and stored in a readily available form in various plant parts. Depending on forage species, they may be stored in the root, stem base, stolon, or rhizome. Often erroneously called root reserves.

Forage (n) All browse and herbage that is available and acceptable to grazing animals, or that may be harvested for feeding purposes. (v) Act of consuming forage. Syn. graze.

Forage allocation The planning process or act of apportioning available forage among various kinds of animals; e.g., elk and cattle.

Forage allowance Weight of forage per unit of animal demand at any instant of time. It is the inverse of grazing pressure and synonymous with herbage allowance.

Forage crops (Specific) Forage plants mechanically harvested before being fed to animals. These crops are fed to animals primarily as hay, haylage, fodder (stover), silage, or green chop. (General) A crop of cultivated plants, whose plant parts, other than separated grain, are produced to be grazed or harvested for use as feed for animals.

Forage harvest management The timely cutting and removal of forages from the field as hay, greenchop, or ensilage.

Forage harvester A machine that cuts standing forage or picks up windrowed forage and chops it to the desired length of cut for silage and blows the chopped forage into a trailing forage wagon or truck box.

Forage (herbage) on-offer (1) Total forage presented to livestock on a pasture at any moment in time. It is equal to available forage times pasture acreage. (2) A term that is synonymous with forage allowance. See Forage allowance.

Forage inventory An estimate of available forage in each pasture and for the operating unit as a whole; used to project stocking rates and feed requirements for specific time periods (i.e., annually, grazing season, rotation cycle)

Forage moisture content (GLA) The percent of plant weight that is water.

Forage production The weight of forage that is produced within a designated period in a given area. The weight may be expressed as either green, air-dry, or oven-dry. The term may also be modified as to time of production, such as annual, current year's, or seasonal forage production.

Forage reserve Standing forage specifically maintained for future or emergency use.

Forage suitability groups Soils with similar species adaptation, production potential, and management needs. A planning tool for species selection, practice selection, management options, forage production levels, and recommended initial stocking rates.

Forage utilization The percentage of available forage actually consumed by the grazing animal based on net forage accumulation that occurs prior to and while they occupy the pasture unit.

Forage value (GLA) The classification scheme for determining stocking rates in grazeable forest land based on the minimum percent of preferred species and minimum percent of preferred and desirable species in a stand. Values are very high, high, moderate, and low.

Forage value rating A utilitarian rating of forage plants on a particular area for a specific kind of herbivore. Forage ratings are based on preference, quality, nutritional value, and plant maturity. This is not an ecological rating.

Forb Any broad-leafed herbaceous plant other than those in the Gramineae (or Poaceae), Cyperaceae, and Juncacea families.

Ford A constructed or natural stream crossing for equipment, humans, or animals at a point where water is shallow, footing is firm, and banks are low or inclined for easy approach and exit. The bottom of the channel and approaches are either naturally or artificially paved to facilitate ease of crossing and to reduce muddying of the water.

Forest land (forest) Land on which the historic climax plant community is dominated by trees.

Formulation (1) A pesticide product supplied by the manufacturer for practical use composed of the active ingredient and a carrier. (2) The process of preparing pesticides for practical use carried out by manufacturers.

Frame score A score based on a subjective evaluation of height or actual measurement of hip height, related to slaughter weights at which cattle will grade choice or have comparable amounts of fat cover over the loin eye at the 12th to 13th rib. For horses, frame score is the measure of the size by height at the withers (shoulders).

Free range Range open to grazing regardless of ownership and without payment of fees. Not to be confused with open range.

Free ranging Ability to roam or forage at-will, unrestricted by fences.

Frequency (relative) The ratio between the number of sample units that contain a species and the total number of sample units.

Fresh mulch The primary layer of bulky, coarse, largely undecayed herbage residuum. See Mulch.

Fresh weight The weight of plant materials at the time of harvest. Syn., green weight.

Frontal grazing A stocking method by which ungrazed forage within a management unit is allocated by moving a portable fence ahead of a herd of livestock.

Frost action potential The rating of the susceptibility of a soil to frost heave upward or laterally by the formation of segregated ice lens wedges between soil peds.

Frost heave Soil and plants displaced by ice needles and lenses. Primary frost heave is caused by ice needles producing minor soil displacement. Secondary frost heave is caused by ice lenses producing major soil displacement. Primary frost heave tends to displace seedlings. Secondary frost heave can displace mature overwintering plants. The heaving action pushes plants upward. This causes root breakage, desiccation of exposed roots, and often death of susceptible plant species.

Fuelbreak A strategically located block or strip on which existing flammable vegetation has been replaced by vegetation of lower fuel volume and/or flammability and subsequently maintained as an aid to fire control. See Fireline.

Fumigant A volatile chemical that kills pests with a gas or vapor.

Fungicide Any chemical agent that kills or inhibits fungi that cause plant diseases.

Game (1) Wild birds, fish, and other animals hunted. (2) Wildlife species so designated by law and the harvest of which is regulated by law.

Game ranching (game farming) Maintaining game animals under semidomestication and maximum animal management to control breeding, health, nutrition, and production as a ranch based enterprise.

Game range Range that is predominantly grazed by wildlife seasonally or year around. Especially pertinent with migratory big game herds; e.g., winter elk or deer range.

Game refuge An area set aside as a sanctuary for game.

Geographic Information System (GIS) A spatial type of information management system that provides for the entry, storage, manipulation, retrieval, and display of spatially oriented data.

Global Positioning System (GPS) A computer based receiver system that uses satellite transmissions to determine precise latitude and longitude readings at any location in a field. This system is used to map crop yield, soil fertility, weed infestations, soil type, and other yield influencing differences. It then forms the basis for variable rate applications of fertilizer and pesticides. Application equipment is guided by a georeferenced program to deliver different application rates as it traverses back and forth across a field.

Grade (1) In livestock breeding, an offspring resulting from mating a purebred with a non-purebred or from mating animals not purebred, but having close purebred ancestors. (2) Livestock marketing classification. (3) To evaluate live animals in relation to a standard of quality.

Graminoid Grass or grass-like plant, such as Poa, Carex, and Juncus species.

Grams per plot to kilograms per hectare

Plot size	Multiply grams by:
0.25 M^2	40
1.0 M^2	10
10.0 M^2	1
100 M^2	0.10
400 M^2	0.025

Grams per plot to pounds per acre

Plot size	Multiply grams by:
1.92 ft^2	50
2.4 ft^2	40
4.8 ft^2	20
9.6 ft^2	10
96 ft^2	1

Granule (1) A soil aggregate. (2) A pesticide formulation of dry, ready-to-use, low-concentrate pesticide with a particle size less than 10 cubic millimeters. Drift hazard is low. Contamination hazard to the user is low. Soil applied. May be ingested by birds.

Grass A member of the family Gramineae (Poaceae).

Grassland Land on which the vegetation is dominated by grasses, grasslike plants, and/or forbs.

Grassland agriculture A land management system emphasizing cultivated forage crops, pasture, and rangelands for livestock production and natural resource protection.

Grasslike plant A plant of the Cyperaceae or Juncaceae families that vegetatively resembles a true grass of the Gramineae family.

Graze (1) (vi) The consumption of standing forage by livestock or wildlife. (2) (vt) To put livestock to feed on standing forage.

Grazeable forest land Land capable of sustaining livestock grazing by producing forage of sufficient quantity during one or more stages of secondary forest succession.

Grazed forest land Land that is currently used for forest land and livestock grazing.

Grazed rangeland Rangeland that is used primarily for the production of livestock. Grazed rangelands include native plant communities and those seeded to native or introduced species, or naturalized by introduced species, that are ecologically managed using range management principles.

Grazer A grazing animal.

Grazier A person who manages grazing animals.

Grazing (vt) To graze.

Grazing behavior The foraging response elicited from a herbivore by its interaction with its surrounding environment.

Grazing capacity The total number of animals that may be sustained in a given area based on total forage resources available, including harvested roughages and concentrates. See Carrying capacity.

Grazing distribution Dispersion of livestock grazing within a management unit or area.

Grazing district (1) An administrative unit of federally managed, public rangeland established by the Secretary of Interior under the provisions of the Taylor Grazing Act of 1934, as amended. (2) An administrative unit of state, private, or other rangelands established under certain state laws.

Grazing fee A charge, usually on a monthly basis, for grazing a given kind of animal.

Grazing land (1) Collective term used by NRCS for rangeland, pastureland, grazed forest land, native and naturalized pasture, hayland, and grazed cropland. Although grazing is generally a predominate use, the term is used independent of any use. (2) Land used primarily for production of forage plants maintained or manipulated primarily through grazing management. Includes all lands having plants harvestable by grazing without reference to land tenure, other land uses, management, or treatment practices.

Grazing land mechanical treatment Renovating, contour furrowing, pitting, or chiseling native grazing land by mechanical means. The purpose of this practice is to improve plant cover and water quality by aerating the soil, increasing infiltration and available moisture, reducing erosion, and protecting low areas or structures from siltation.

Grazing license Official written permission to graze a specific number, kind, and class of livestock for a specified period on a defined allotment or management area.

Grazing management The manipulation of grazing and browsing animals to accomplish a desired result.

Grazing management plan A program of action designed to secure the best practicable use of the forage resources by manipulation of the grazing animal.

Grazing period The length of time that animals are allowed to graze on a specific area.

Grazing permit Syn. grazing license.

Grazing preference (1) Selection of certain plants, or plant parts, over others by grazing animals. (2) In the administration of public lands, a basis upon which permits and licenses are issued for grazing use.

Grazing pressure (1) Animal-demand per unit weight of forage at any instant; i.e., AU/T; an animal/forage relationship. (2) The relationship between the amount of forage utilized by grazing animals on a given area.

Grazing privilege Permissive use of lands for grazing by livestock.

Grazing right A right to graze specified lands, permanently vested in the beneficiary as specified by the terms of the law or contract.

Grazing season (1) The time interval when animals are allowed to use a certain area. (2) On public lands, an established period for which grazing permits are issued. May be established on private land in a grazing management plan

Grazing survey The systematic collection of data pertaining to forage resources and other information pertinent to range management. May be either extensive or intensive grazing survey. See Forage inventory.

Grazing system A specialization of grazing management that defines systematically recurring periods of grazing and deferment for two or more pastures or management units. Descriptive common names, such as Merrill, Hormay, or South African switchback, may be used. However, the first usage of a grazing system name in a publication should be followed by a description using a standard format. This format shall consist of a numerical description in the following prescribed order: the number of pastures (or units), number of herds, length of grazing periods, length of deferment periods for any given unit in the system followed by an abbreviation of the unit of time used. Examples:

- Merrill system (4-3;12: 4 mo.) is a grazing system with 4 pastures, 3 herds of livestock, a 12-month grazing period, and a 4-month deferment period.
- South African switchback (2-1;3:3,6:3,3:6 mo.) is a grazing system with 2 pastures, 1 herd, and a grazing schedule of 3 months grazing, 3 months deferment, 6 months grazing, 3 months deferment, 3 months grazing, 6 months deferment.
- High intensity, low frequency (HILF) (14-1; 12:156 da.) A grazing system consisting of 14 pastures, 1 herd, a 12-day grazing period, and a 156-day deferment period for each pasture.

Grazing trespass The grazing of livestock on range without proper authority and resulting from a willful or negligent act.

Grazing unit An area of land which is grazed as an entity.

Green chop Mechanically harvested forage fed to animals while still fresh.

Green manure Any crop or plant grown and not harvested that is used to improve the soil's organic matter content and structure. It may or may not be incorporated by tillage.

Ground cover The percentage of material, other than bare ground, covering the land surface. It may include live and standing dead vegetation, litter, cobble, gravel, stones, and bedrock. Ground cover plus bare ground would total 100 percent. Syn. cover, see Foliar cover.

Ground datum A point on the earth's surface used as reference for measuring the height of aerial photography and for calculating photo scale.

Ground truth Measurements or observations made on the ground for the purpose of verifying interpretations made from aerial photography or remote sensing.

Ground water Subsurface water that is in the zone of saturation. The top surface of the ground water is the water table. Source of water for wells, seepage, and springs.

Growing season That portion of the year when temperature and moisture permit plant growth.

Growth form The characteristic shape or appearance of a plant.

Growth regulator An organic substance effective in minute amounts for controlling or modifying plant processes.

Grubbing The act of removing roots, whether woody or herbaceous, by humans or animal activity.

Gully A furrow, channel, or miniature valley, usually with steep sides, through which water commonly flows during and immediately after rains or snowmelt.

Guzzler A device for collecting and storing precipitation for use by wildlife or livestock. Consists of an impenetrable water collecting area, a storage facility, and a trough from which animals can drink. Syn. Catchment basin.

Habitat The natural abode of a plant or animal, including all biotic, climatic, and edaphic factors affecting life.

Habitat type The collective area which one plant association occupies. The habitat type is defined and described on the basis of the vegetation and its associated environment.

Half-shrub A perennial plant with a woody base whose annually produced stems die each year.

Hardiness The ability to survive exposure to adverse conditions.

Hardpan A hardened soil layer in the lower part of the horizon A or in the B horizon caused by cementation of soil particles with organic matter or with such materials as silica, sesquioxides, or calcium carbonate. The hardness does not change appreciably with changes in moisture content, and pieces of the hard layer do not crumble in water.

Harvest Removal of animal or vegetation products from an area of land.

Harvest efficiency The total percent of vegetation harvested by a machine or ingested by a grazing animal compared to the total amount of vegetation grown in the area in a given year. For continuous grazing, harvest efficiency usually averages:

Rangeland	25 percent
Pastureland	30 percent
Grazed cropland	35 percent

Harvest interval The length of time that occurs between forage cuttings.

Hay The herbage of grasses, legumes, or comparatively fine-stemmed forbs cut and cured (dried) to preserve forage for later use as livestock feed.

Hay crop Forage crops traditionally harvested for dry hay that can also be ensiled.

Haylage A fermented product resulting from ensiling forage that ranges from 40 to 55 percent moisture in the absence of oxygen.

Headfiring Ignition of a fire on the windward (upwind) side of a burn area resulting in a fairly rapid moving flame front moving with the wind.

Hedged The appearance of woody plants that have been repeatedly browsed so as to appear artificially clipped.

Hedging The persistent browsing of terminal buds of browse species causing excessive lateral branching and a reduction in main stem growth.

Heifer (GLA) A female of the cattle species less than 3 years of age that has not borne a calf.

Herb Any flowering plant except those developing persistent woody stems above ground.

Herbaceous Vegetative growth with little or no woody component. Nonwoody vegetation, such as graminoids and forbs.

Herbage (1) Total aboveground biomass of plants including shrubs regardless of grazing preference or availability. (2) Herbs taken collectively.

Herbage allowance Weight of forage available per unit animal demand at any instant.

Herbage disappearance rate The rate per unit area at which herbage leaves the standing crop by grazing, senescence, or other causes.

Herbage growth rate The rate of addition of new mass per unit area to the standing crop.

Herbage production Production of certain herbaceous plants or groups of herbaceous plants.

Herbicide A chemical used to kill or inhibit the growth of plants.

Herbivore An animal that subsists principally or entirely on plants or plant materials.

Herd An assemblage of animals usually of the same species.

Herder One who tends livestock on a range. Usually applied to the man herding a band of sheep or goats.

Herding The handling or tending of a herd.

Hide factor (GLA) Indicates the thickness of the animal's hide. This factor is used in GLA to compute the insulating value of the animal's hide relative to energy requirements for the thermal environment of the animal (e.g., Holstein-thin, Hereford-thick, Angus-moderate).

High intensity, low frequency Usually a single herd multipasture grazing system, that normally includes a slow rotation for range improvement (usually characterized by relatively long grazing periods and substantially longer rest periods).

Highlining Syn. browse line.

Historic climax plant community The plant community that was best adapted to the unique combination of factors associated with the ecological site. It was in a natural dynamic equilibrium with the historic biotic, abiotic, climatic factors on its ecological site in North America at the time of European immigration and settlement.

Holding ground An area where livestock are often held during roundups.

Home range The area over which an animal normally travels in search of food.

Humus The organic fraction of soil in which decomposition is so far advanced that its original form is not distinguishable.

Hybrid Offspring of a cross between genetically dissimilar individuals.

Hybrid vigor The increased performance (rate of gain) associated with F1 crossbreeding.

Hydrocyanic acid A poisonous compound, HCN, produced when forages containing antiquality chemicals called cyanogenic glycosides and the proper enzymes are eaten by a grazing animal. Plants developed cyanogenic compounds as a defense mechanism against herbivore feeding. It is the scientific term for prussic acid.

Ice-cream species A slang term used to indicate obvious grazing preference by livestock and game animals. Such species are the first plants grazed by livestock and are often overutilized under excessive grazing.

Improved pasture Grazing land permanently producing introduced or domesticated native forage species that receives varying degrees of periodic cultural treatment to enhance forage quality and yields and is primarily harvested by grazing animals.

Increaser The climax native plants in a community of different plants that, under excessive continuous grazing by livestock, are not selected initially, and increase in abundance. If the heavy grazing continues, livestock will reduce the more palatable plants and shift to the increaser species causing them to decrease in abundance.

Indicator species (1) Species that indicate the presence of certain environmental conditions, range condition, previous treatment, or soil type. (2) One or more plant species selected to indicate a certain level of grazing use. See Key species.

Indigenous Born, growing, or produced naturally (native) in an area, region, or country.

Infestation Invasion by large numbers of parasites or pests.

Infiltration The intake of water into the soil profile. It connotes flow into a substance in contradistinction to the word percolation.

Infiltration rate Maximum rate at which soil under specified conditions can absorb rain or shallow impounded water, expressed in quantity of water absorbed by the soil per unit of time; e.g., inches per hour.

Infiltration velocity The actual rate at which water is entering the soil at any given time. It may be less than infiltration rate because of limited supply of water. Expressed in same units as infiltration rate.

Ingest Nutritive materials consumed by the animal.

Initial stocking rate A safe starting stocking rate assumed to ensure against excessive grazing utilization. It is intended as a guide until experienced yields can be determined and realistic stocking rates established for a given area.

Insecticide A pesticide used to control or prevent damage by insects.

Intake adjustment (GLA) A percent of feed consumed either above or below the average Animal Unit Equivalent intake by specific breed types of cattle. Used to calculate feed and nutritional demands in GLA.

Integrated pest management Controlling pest populations using a combination of proven methods that achieve the proper level of control of them while minimizing harm to other organisms in the ecosystem. Control methods include natural suppression, biological control, resistance breeding, cultural control, and direct control.

Internal rate of return (GLA) An estimate of the average annual rate of return that an investment will produce over a given period. It is the discount rate that results in a Net Present Value of zero.

International feed number (INF) (GLA) A number that applies to a feedstuff and animal kind. This number is used for identification and computer manipulation. It is particularly useful as a tag to recall nutrient data for calculation of diets. Numbers are assigned to individual feed samples by the National Research Council.

Interseeding Planting seed in the center of narrow seedbed strips, commonly 6 inches to 6 feet wide and prepared by mechanical or chemical methods.

Introduced species A species not a part of the original fauna or flora of the area in question.

Invader Plants that are not a part of the original plant community that invade an area as a result of disturbance, or plant community deterioration, or both.

Invasion The migration of organisms from one area to another area and their establishment in the latter.

Invert emulsion A water soluble pesticide dispersed in an oil carrier. Forms large droplets that do not drift easily.

Inverter A swathing machine that lifts a swath of cut forage and turns it over to speed drying and avoid weather damage to a hay crop.

Jointed A grass stem that has distinct, elongated internodes between nodes.

Key grazing area A relatively small portion of a pasture or management unit selected because of its location, use, or grazing value as a monitoring point for grazing use. It is assumed that key areas, if properly selected, will reflect the current grazing management over the pasture or management unit as a whole.

Key species A single plant species (or in some situations two or three similar species) chosen to serve as a guide to the grazing use of the entire plant community. If the key species on the key grazing area is properly grazed, the entire plant community will not be excessively grazed.

Kid crop The number of kids produced by a given number of does, usually expressed in percent kids weaned of does bred.

Kid house A small structure designed to give shelter to a newborn kid. The doe or the kid is staked so that both remain in or near the shelter.

Kind of animal An animal species or species group, such as sheep, cattle, goats, deer, horses, elk, antelope.

Lamb crop The number of lambs produced by a given number of ewes, usually expressed in percent of lambs weaned of ewes bred.

Lambing ground Range reserved for grazing during lambing period.

Land capability Land capability, as originally used in the United States, is an expression of the effect of physical land conditions, including climate, on the total suitability for use without damage for crops that require regular tillage.

Land use class (GLA) The classification of land based on the primary use and associated management practices (i.e., rangeland, pastureland, hayland, native pastureland).

LD50 The relative degree of toxicity of pesticides to warmblooded animals. Defined as the single lethal dosage by mouth that kills 50 percent of test animals, expressed as mg/kg of body weight.

Leaf area index (LAI) Sum of leaf area expressed as a percentage of ground surface. Leaf area index may exceed 100 percent.

Lessee One who has specified rights or privileges under lease. Syn. permittee.

Lessor One who leases specified rights or privileges.

License See Grazing license or Permit.

Life-form Characteristic form or appearance of a species at maturity, e.g., tree, shrub, herb.

Lime (1) Calcium oxide. (2) All limestone-derived materials applied to neutralize acid soils.

Limiting factor Any environmental factor that exists at suboptimal level and thereby prevents an organism from reaching its full biotic potential.

Linear extensibility percent The unit of measurement that determines soil shrink-swell classes. It is the linear expression of the volume difference of natural soil fabric at one-third bar or one-tenth bar water content and oven dryness. It equals the moist length minus the dry length value sum divided by the dry length times 100.

Litter The uppermost layer of organic debris on the soil surface; essentially the freshly fallen or slightly decomposed vegetal material.

Livestock Domestic animals used for the production of goods and services.

Livestock exclusion Land closed to grazing by domestic livestock.

Livestock flexibility The ability to alter the number, kind, or class of animals within a livestock enterprise as warranted by variability in forage, economic, weather, or other conditions.

Livestock management Application of technical principles and business methods to livestock production.

Livestock operation (Farm) See Ranch.

Livestock production (1) The weight, number of animals, etc., that a rangeland area, seeded pasture, or management system produces. (2) The business of producing livestock.

Local plant code (GLA) A four character code system for identifying the plant common name in GLA

Common Name	Local
Single name	SING
Double Name	DONA
Some Triple Name	STNA

Maintenance Condition in which a nonproductive animal neither gains nor loses body energy reserves.

Maintenance burning The use of prescribed burning to maintain vegetation in a desired condition or to maintain the desired composition. Most often used to reduce woody species.

Maintenance feeding Supplying feed to range animals when available forage does not meet their minimum daily requirement. This may be necessitated by excessive grazing, inclement weather, or the inability of the site to produce the desired quality forage.

Maintenance fertilizer applications Nutrient additions that replace losses by one or more of the following: crop removal, erosion, leaching, denitrification, fixation, and volatilization.

Major Land Resource Area (MLRA) Broad geographic areas that are characterized by a particular pattern of soils, climate, water resources, vegetation, and land use. Each MLRA in which rangeland and forest land occur is further broken into range sites.

Management area An area for which a single management plan is developed and applied.

Management plan A program of action designed to reach a given set of objectives.

Management site potential The kinds of levels of productivity or values of a range site that can be achieved under various management prescriptions.

Management unit (GLA) In GLA this is synonymous with pasture or field number.

Management unit A subdivision of a management area.

Marginal land Land of questionable physical or economic capabilities for sustaining a specific use.

Marker (1) A colored or otherwise marked sheep in a range band. (2) Dye, foam, or paper strips to indicate area covered in earlier pass of sprayer. (3) An infertile (vasectomized) male animal, often equipped with a dye marker, used to identify ovulating females for artificial insemination.

Marking Any method, other than branding, of placing a sign on an animal for the purpose of identification. For example: ear slits, tags, wattles. See Brand, Earmarking, and Tagging.

Marsh Flat, wet, treeless areas usually covered by standing water and supporting a native growth of grasses and grasslike plants.

Mast Nuts, acorns, fruit, and similar plant products that may be consumed by animals.

Mature soil A soil with well developed characteristics produced by the natural processes of soil formation and in equilibrium with its environment. See Soil.

Maximum coat length (GLA) The maximum length of the animal's hair coat in the coldest period of the year. GLA uses this value to determine body nutritional needs.

Maximum economic yield The yield reached where the last increment of an input, such as fertilizer, just pays for itself by producing a yield increment of equal value.

Meadow An area of perennial herbaceous vegetation, usually grass or grasslike, used primarily for hay production.

Mesa A flat-topped mountain, or other elevation bounded on at least one side by a steep cliff. Local in Southwest.

Metabolizable energy (ME) The gross energy of feed minus energy in feces, urine, and gaseous products of digestion.

Metric units

To Convert:	To:	Multiply by:
Kilograms per hectare	Pounds per acre	0.891
Kilograms	Pounds	2.2046
Hectares	Acres	2.471
Pounds per acre	Kilograms per hectare	1.12
Pounds	Kilograms	0.4536
Acres	Hectares	0.4047

Microencapsulate A formulation where particles of a pesticide, either dry or liquid, are surrounded by a plastic coating. Can be used as a slow release product. Safer to the user since active ingredient is not exposed. Hazard to bees if picked up by a worker and taken back to hive. Can settle to bottom of spray tank unless agitated.

Migrant One that moves from place to place.

Miticide A pesticide used to control mites and ticks. Also called acaricide.

Molluscides Poisons used to kill terrestrial mollusks, such as slugs.

Morphology The form and structure of an organism, with special emphasis on external features.

Mott A group of trees and/or shrubs.

Mottling Variation of coloration in soils as represented by localized spots, patches, or blotches of contrasting color. Commonly develops under alternating wet and dry periods with associated reduction and oxidation environments. Mottling generally indicates poor aeration and impeded drainage.

Mower-conditioner A pull-type or self-propelled machine that has a mower unit mounted in front of a conditioner unit for one pass mowing and conditioning of forages being prepared for harvest. Both units are enclosed in the same housing.

Mulch (n) (1) A layer of dead plant material on the soil surface. (2) An artificial layer of material, such as paper or plastic, on the soil surface. (v) Cultural practice of placing rock, straw, asphalt, plastic, or other material on the soil's surface as a mulch.

Multiple use Use of land for more than one purpose; i.e., grazing of livestock, wildlife production, recreation, watershed, and timber production. Not necessarily the combination of uses that will yield the highest economic return or greatest unit output.

National plant symbol (GLA) A unique plant code assigned to each scientific plant name in the National List of Scientific Plant Names.

Native pasture See Naturalized pasture.

Native species A species which is a part of the original fauna or flora of the area in question. See Indigenous.

Naturalized pasture Forest land that is used primarily for the production of forage for grazing by livestock rather than for the production of wood products. Overstory trees are removed or managed to promote the native and introduced understory vegetation occurring on the site. This vegetation is managed for its forage value through the use of grazing management principles.

Naturalized species An introduced species that has become adapted to a new climate, different ecological site, or a different environment and can perpetuate itself in the community without cultural treatment.

Nematicide A pesticide used to control nematodes.

Nematodes Tiny, tubular, unsegmented, eel-like, soil-borne worms that feed on plant roots or parasitize grazing animals.

Net energy (NE) Energy available to the animal for the maintenance or various productive purposes.

Net present value (GLA) Today's worth of a sum of money that is to be available sometime in the future.

Net primary production The net increase in plant biomass within a specified area and time interval; i.e., primary production less that used in metabolic processes.

Niche The ecological role of a species in a community.

Nonconsumed plant (GLA) See Plant preference classification.

Nonprotein nitrogen Sources other than natural protein, such as urea, biuret, and ammonia hydroxide.

Nonjointed See Culmless.

Nonuse (1) Absence of grazing use on current year's forage production. (2) Lack of exercise, temporarily, of a grazing privilege on grazing lands. (3) An authorization to temporarily refrain from placing livestock on public ranges without loss of preference for future consideration.

Nose pump A livestock watering device that operates a plunger by the action of the watering animal pushing on a nose plate. The animal pushes the nose plate forward while drinking water from the cup below it. When it drinks all the water, the nose plate is fully forward. Once realizing the water is gone, the animal raises it head, the nose plate is released, and the plunger it is connected to forces more water into the cup.

Noxious species A plant species that is undesirable because it conflicts, restricts, or otherwise causes problems under management objectives. Not to be confused with species declared noxious by laws concerned with plants that are weedy in cultivated crops and on range.

Noxious weed An unwanted plant specified by Federal or State laws as being especially undesirable, troublesome, and difficult to control. It grows and spreads in places where it interferes with the growth and production of the desired crop.

NPK (GLA) Letters used to designate the elements of nitrogen, phosphorous, and potassium in that order; usually expressed as a percentage by weight of fertilizer.

Nurse crop A temporary crop seeded at or near the time primary plant species are seeded to provide protection and otherwise ensure establishment of the latter. Syn. companion crop.

Nutrient Any food constituent or ingredient that is required for or aids in the support of life.

Nutrient management Managing the amount, form, placement, and timing of plant nutrient applications to optimize plant growth, provide safe nutritious food, and minimize environmental degradation.

Nutrition Ingestion, digestion, and/or assimilation of food by plants and animals.

Nutritive value Relative capacity of a given forage or other feedstuff to furnish nutrition for animals. In range management, the term is usually prefixed by high, low, or moderate.

On-off stocker operation A grazing system where the grazing is dictated by moving livestock on and off the ranch, such as early intensive stocking.

Open (GLA) A term commonly used to describe a nonpregnant female animal.

Open range (1) Rangeland that has not been fenced into management units. (2) All suitable rangeland of an area upon which grazing is permitted. (3) Untimbered rangeland. (4) Rangeland on which the livestock owner has unlimited access without benefit of land ownership or leasing.

Operating unit Syn. Ranch

Opportunistic species A species adapted for utilizing variable, unpredictable, or transient environments; characteristic of ephemeral plants.

Opportunity cost The financial returns given up by not putting a factor of production, particularly capital, to a different use.

Organism Any living entity: plant, animal, fungus.

Orphan An offspring whose mother has died.

Outcrop The exposure of bedrock or strata projecting through the overlying cover of detritus and soil.

Oven-dry weight The weight of a substance after it has been dried in an oven at 60 degrees for 48 hours.

Overgrazed range Rangeland that has experienced loss of plant cover and accelerated erosion because of heavy grazing or browsing pressure.

Overgrazing Grazing that exceeds the recovery capacity of the individual species or the plant community.

Overland flow Surface runoff of water following a precipitation event. See Runoff.

Overstocking Placing a number of animals in a given area that will result in overuse if continued to the end of the planned grazing period.

Overstory The upper canopy or canopies of plants. Usually refers to trees, tall shrubs, and vines.

Overuse Utilizing an excessive amount of the current year's plant growth which, if continued, will result in deterioration.

Paddock (1) One of the subdivisions or subunits of the entire pasture unit. (2) A relatively small enclosure used as an exercise and saddling area for horses, generally adjacent to stalls or a stable. Syn. pasture.

Palatability The relish with which a particular species or plant part is consumed by an animal.

Pan (soils) Horizon or layer in soils that is strongly compacted, indurated, or very high in clay content.

Partial budgeting A limited budgeting procedure used to evaluate a proposed investment in an existing earning enterprise requiring only that additional costs and returns associated with the investment be considered. Results are often expressed in terms of an internal rate of return.

Pasture (1) Grazing lands comprised of introduced or domesticated native forage species that are used primarily for the production of livestock. They receive periodic renovation and/or cultural treatments such as tillage, fertilization, mowing, weed control, and may be irrigated. They are not in rotation with crops. (2) A grazing area enclosed and separated from other areas by fencing or other barriers; the management unit for grazing land. (3) Forage plants used as food for grazing animals. (4) Any area devoted to the production of forage, native or introduced, and harvested by grazing.

Pasture budget A plan developed to allocate forage to one or more groups of livestock over the grazing season. It is used to identify shortfalls and excesses in forage production, and to evaluate alternatives to either meet or reduce forage demand. It indicates when and how much excess forage to harvest and conserve.

Pastureland See Pasture.

Pasture planting Establishing adapted herbaceous species on land to be treated and grazed as pasture.

Peak milk yield (GLA) The maximum daily milk yield from a lactating cow. Usually occurs 60 to 90 days after calf birth.

Pedestaled A condition where the soil has eroded from around individual plants or other objects, such as small rocks, leaving them on small pedestals of soil. Sometimes the result of frost heaving.

Pellets A pesticide formulation similar to granules except pellets are usually more uniform, of a specific weight or shape, and greater than 10 cubic millimeters in size. Often used as rodenticide and slug baits.

Percent use Grazing use of current growth, usually expressed as a percent of the current growth (by weight) that has been removed. See Degree of use.

Percentage allowable (GLA) The percentage that is specified in the relative percentage list of range site descriptions for individual plant species or groups of species. This percentage represents the maximum amount of these species, individually or collectively, that can be counted when determining range condition.

Percolation The flow of a liquid through a porous substance.

Perennial plant A plant that has a life span of 3 or more years.

Permanent water A watering place that supplies water at all times throughout the year or grazing season.

Permit See Grazing license.

Permittee One who holds a permit to graze livestock on State, Federal, or certain privately-owned lands. Syn. Lessee

Pesticide Any chemical agent such as herbicide, fungicide, or insecticide, used for control of specific organisms.

Phenology The study of periodic biological phenomena that are recurrent, such as flowering, or seeding, especially as related to climate.

Phenotype The appearance of an individual as contrasted with genetic makeup or genotype.

Phenoxy herbicide Syn. Translocated herbicide

Photo interpretation The art and science of identifying objects and conditions from photographs.

Photo point An identified point from which photographs are taken at periodic intervals.

Photo sensitization A noncontagious disease resulting from the abnormal reaction of light-colored skin to sunlight after a photodynamic agent has been absorbed through the animal's system. Grazing certain kinds of vegetation or ingesting certain molds under specific conditions causes photo sensitization.

Photo toxic Toxic to plants.

Phylogeny The origin and evolution of higher taxa.

Physiological stage (GLA) A unique phase of biological functions of an animal (e.g., growth, pregnancy, lactation).

Phytomass Total amount of plants (including dead attached parts) above and below ground in an area at a given time. See Biomass.

Phytomer One modular unit of a plant; consisting of the leaf, sheath (or petiole), and internode.

Pioneer species The first species or community to colonize or recolonize a barren or disturbed area in primary or secondary succession.

Pitting Making shallow pits or basins of suitable capacity and distribution on range to reduce overland flow from rainfall and snowmelt.

Plain A broad stretch of relatively level treeless land.

Planned grazing system A system in which two or more grazing units are rested and grazed in a planned sequence over a period. Planned grazing systems are designed and applied to meet the needs of the vegetation, the animals, and the overall objectives of the operator.

Planned trend The change in plant composition within an ecological site from one plant community type to another relative to management objectives and to protecting the soil, water, air, plant, and animal resources. Planned trend is described as moving towards or away from the desired plant community or objective.

Plant association A kind of climax plant community consisting of stands with essentially the same dominant species in corresponding layers.

Plant community type Each of the existing plant communities that can occupy an ecological site. Several plant community types will typically be found on an ecological site, including the historic climax plant community for that site.

Plant growth curve (GLA) The percent growth occurring on a specific location expressed as a monthly percent of the total yearly production. GLA uses growth curves to project daily, monthly, and yearly production on various vegetative areas. Growth curves reflect differences in ecological condition, composition of warm-season and cool-season annuals, herbaceous species, and level of woody plant components.

Plant preference classification (GLA) Five plant classifications used in GLA:

Preferred plant—Composition of a plant species is greater in the diet of the target animal than found in the area being grazed by this animal.

Desirable plant—Composition of plant species is approximately the same in the diet of the target animal as that found in the area being grazed by this animal.

Undesirable plant—Composition of plant species is lower in the diet of the target animal than is found in the area being grazed by this animal.

Toxic plant—Rare occurrence in the diet of the target animal and, if consumed in any tangible amounts, will result in death or severe illness in the animal.

Nonconsumed Plant—Plant species that would not be eaten under normal extremes in forage conditions, but if no other forage is available, the target animal will attempt consumption although at greatly reduced rates.

Plant succession Syn. succession.

Plant symbol An abbreviation used to indicate the genus and species of a plant.

Plant vigor Plant health.

Plant vigor index An estimate of plant vigor based on measurement of one or a few attributes.

PLS Abbreviation for pure live seed.

Poisonous plant A plant containing or producing substances that cause sickness, death, or a deviation from the normal state of health of animals. See Toxic plant species.

Poloxalene An anti-foaming agent fed to prevent legume bloat in ruminants.

Pond A water impoundment made by constructing a dam or an embankment, or by excavating a pit or dugout usually to supply drinking water for livestock and or wildlife.

Ponding Water standing in a closed depression that is removed by percolation, transpiration, evaporation, or a combination of these processes.

Postemergence A herbicide applied after emergence of a specified weed or planted crop.

Potential ADG (GLA) The potential average daily weight gains of domestic livestock. Weight gains expressed as an average daily gain over a given time period.

Potential natural community (PNC) The biotic community that would become established on an ecological site if all successional sequences were completed without interferences by man under the present environmental conditions. Natural disturbances are inherent in its development. The PNC may include acclimatized or naturalized nonnative species.

Prairie An extensive tract of level or rolling land that was originally grass-covered and treeless.

Precipitation Rainfall; also include snow, hail, and sleet.

Precision farming Variable rate seeding and/or application of fertilizers and pesticides based on very precise mapping of soil conditions and yield variability done by a computerized global positioning system. It requires grid sampling of soils for fertility and organic matter levels. Harvesting equipment is equipped with a yield monitor linked to GPS receivers. Degree of resolution is cost and equipment driven.

Pre-emergence A herbicide applied prior to emergence of a specified weed or planted crop.

Preference See Grazing preference.

Preferred plant (GLA) See Plant preference classification.

Preferred species Species that are preferred by animals and are grazed first by choice.

Premature grazing Grazing before range readiness; may be allowable if done infrequently and followed by adequate rest.

Preparatory crop A residue-producing temporary crop used as part of seedbed preparation to provide mulch into which forage plants can be directly seeded.

Preplant A herbicide applied on the soil surface before seeding or transplanting.

Preplant incorporated A herbicide applied and tilled into the soil before seeding or transplanting.

Prescribed burning The use of fire as a tool to achieve a management objective on a predetermined area under conditions where the intensity and extent of the fire are controlled.

Prescribed grazing The controlled harvest of vegetation with grazing or browsing animals, managed with the intent to achieve a specified objective

Prescription fertilization method A procedure that accounts for nutrient inputs from different sources, primarily from soil residual fertility, manure (when available for use), and commercial fertilizer, if needed. Manure and commercial fertilizer applications are coordinated to deliver the proper ratio of nutrients for the crop.

Primary production The conversion of solar energy to chemical energy through the process of photosynthesis. It is represented by the total quantity of organic material produced within a given period by vegetation.

Primary productivity The rate of conversion of solar to chemical energy through the process of photosynthesis. It is represented by the total quantity of organic material produced within a given period by vegetation.

Problem area An area that is difficult to manage because of its shape, size, accessibility or other limiting factors.

Producer Rancher or stock farmer

Productivity The rate of production per unit area, usually expressed in terms of weight.

Propagule Any part of an organism produced sexually or asexually that is capable of giving rise to a new individual.

Proper grazing use Grazing at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation.

Proper harvest efficiency (GLA) The level of harvest efficiency that meets management objectives for range improvement, sustained current levels of production, and short term use.

Proper stocking Placing a number of animals in a given area that will result in proper use at the end of the planned grazing period.

Proper use A degree of utilization of current year's growth that, if continued, will achieve management objectives and maintain or improve the long-term productivity of the site. Proper use varies with time and systems of grazing.

Proper woodland grazing Grazing wooded areas at an intensity that will maintain adequate cover for soil protection and maintain or improve the quantity and quality of trees and forage vegetation.

Prussic acid A poison, hydrocyanic acid, released when forages containing cyanogenic glycosides and the proper enzymes are chewed by a grazing ruminant.

Pure live seed Purity and germination of seed expressed in percent; may be calculated by this formula: P.L.S. = % germination x % purity x 100. See Seed purity.

Quality criteria for native grazing lands One or several plant communities occupying an ecological site that will meet the minimum quality criteria for the soil, water, air, plant, and animal resources and the landowner's or manager's objectives.

Quiescence A temporary resting phase characterized by reduced activity, inactivity, or cessation of development.

Rain shadow The region of diminished rainfall on the lee side of a mountain range, where the rainfall is noticeably less than on the windward side.

Ranch An establishment or firm with specific boundaries, together with its lands and improvements, traditionally used for the grazing and production of domestic livestock and/or wildlife. A ranch may also have nontraditional uses and produce other goods and services as well as environmental and social benefits.

Rancher One who owns, leases, or manages a ranch.

Range Rangelands, native and naturalized pasture, forest and woodlands, and riparian areas that support an understory or periodic cover of herbaceous or shrubby vegetation useful for grazing or browsing by wildlife and/or livestock and that are amenable to range management principles or practices.

Range condition (Term is no longer used by NRCS.) The present status of vegetation of a range site in relation to the historic climax or natural potential plant community for the site. Range condition is expressed as a percentage of the climax plant community presently occurring on the range site and grouped into the following range condition classes:

Range condition class	Percentage of climax plant community present on the site
Excellent	76–100
Good	51–75
Fair	26–50
Poor	0–25

Range forage Forage produced on rangeland.

Range improvement (1) Any structure or excavation to facilitate management of rangeland or livestock. (2) Any practice designed to improve range condition or facilitate more efficient utilization of the rangeland. (3) An increase in the grazing capacity of rangeland; i.e., improvement of rangeland condition.

Range lambing Permitting females to drop their offspring on the rangeland under approximately natural conditions of shelter and forage.

Rangeland Land on which the historic climax plant community is predominantly grasses, grasslike plants, forbs, or shrubs. Includes lands revegetated naturally or artificially when routine management of that vegetation is accomplished mainly through manipulation of grazing. Rangelands include natural grasslands, savannas, shrublands, most deserts, tundra, alpine communities, coastal marshes, and wet meadows

Rangeland ecological site A distinctive kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

Rangeland health The degree to which the integrity of the soil, vegetation, water, and air as well as the ecological processes of the rangeland ecosystem is balanced and sustained. Integrity is defined as maintenance of the structure and functional attributes characteristic of a particular locale, including normal variability.

Rangeland hydrology The study of hydrological principles as applied to rangeland ecosystems.

Rangeland inventory (1) The systematic acquisition and analysis of resource information needed for planning and for management of rangeland. (2) The information acquired through rangeland inventory.

Rangeland remote sensing The detection, identification, and assessment of rangelands with a camera, or other imaging device, usually with the aid of aerial or satellite photography.

Rangeland renovation Improving rangeland by mechanical, chemical, or other means.

Rangeland trend The direction of change in an existing plant community relative to the historic climax plant community for the ecological site.

Range management The art and science of manipulating, using, and conserving native grazing land resources to benefit society.

Range plan Syn. management plan.

Range readiness The defined stage of plant growth at which grazing may begin under a specific management plan without permanent damage to vegetation or soil. Usually applied to seasonal range.

Range resources Syn. related resources.

Range seeding The process of establishing vegetation by the artificial dissemination of seed.

Range suitability The adaptability of a range to grazing by livestock and/or game animals.

Re-entry interval Time span that must pass after application of a pesticide before it is safe to enter the treated area. It applies to people and livestock.

Reclaim To make a site usable again for a particular land use or crop.

Reclamation Restoration of a site or resource to a desired condition to achieve management or stated goals. See revegetation.

Reconnaissance A general examination or survey of a region with reference to its main features, usually as a preliminary to a more detailed survey.

Recovery period The length of time occurring between grazing periods on rotationally stocked pastures. Synonymous with rest period that is animal oriented terminology. Although relieved of grazing pressure, the forages are recovering their photosynthetic area early on, and near the end of the recovery period they are replenishing food reserves and resuming root growth.

Recreation area A land area reserved and managed for developed and/or undeveloped recreation.

Rejuvenation (browse) Treatments, such as mechanical, pyric, or even chemical, applied to woody plants to encourage new growth as sprouts or seedlings available for browsing.

Related resources Those resources that bear relationship to one another because of common location and interdependency, such as range, game, recreation, watershed, soil, or timber.

Relative feed value (RFV) An index that ranks hay crops relative to the digestible dry matter intake of full bloom alfalfa (RFV = 100).

Remote sensing The measurement or acquisition of information of some property of an object or phenomenon, by a recording device that is not in physical or intimate contact with the object or phenomenon under study. Often involves aerial photography or satellite imagery. See Rangeland remote sensing.

Reseeding Syn. range seeding.

Resident species Species common to an area without distinction as to being native or introduced.

Residual stubble (grazing) height The height of the forage stand after being grazed, whether intermittently or continuously. When grazed continuously, monitoring must be done regularly as it means at any moment in time under that stocking method.

Resilience (1) The ability of a native plant community to recover to its former state after it has been altered. (2) The ability of an agroecosystem to return to some previous state or other successional alternative following disturbance, such as fire, plow out, and drought.

Resistance (1) A measure of the amount of stress a native plant community can endure before it is displaced by a given type of disturbance. (2) Site immunity to being impacted by catastrophic events that have the potential of creating long-term declines in productivity. The basic components, climate and soil, dictate the brittleness of a land-based ecological community.

Response unit (GLA) A relatively homogeneous area within a management unit in GLA. Response units are defined by soils, range sites, range condition, slope classes, distance to water, barriers, brush densities, past practices resulting in different plant communities, and/or suitability groups.

Rest The absence of grazing by livestock to benefit plants for regrowth between grazing periods, for critical periods of plant growth and development, or for critical periods of plant establishment. Syn. deferment.

Rest period A period of deferment included as part of a grazing system.

Restricted area An area on which grazing tenure is limited.

Rest-rotation See Grazing system.

Retrogression Syn. rangeland degeneration.

Revegetation Establishing or re-establishing desirable plants in areas where the plant community is not adequate to meet management objectives by management techniques alone. See Range seeding.

Rhizome A horizontal underground stem that usually sends out roots and aboveground shoots from the nodes.

Riparian Area, zone, and/or habitat adjacent to streams, lakes, or other natural free water, which have a predominant influence on associated vegetation or biotic communities.

Riparian community type A repeating, classified, defined, and recognizable assemblage of riparian plant species.

Riparian ecosystems Ecosystems that occur along watercourses or waterbodies. They are distinctly different from the surrounding lands because of unique soil and vegetation characteristics that are strongly influenced by free or unbound water in the soil.

Riparian species Plant species occurring within the riparian zone. Obligate species require the environmental conditions within the riparian zone; facultative species tolerate the environmental conditions, therefore may also occur away from the riparian zone.

Riparian vegetation Plant communities in the riparian zone comprised of riparian species.

Rock fragments The unattached pieces of rock 2 millimeters or larger in diameter contained in or lying on the soil.

Rodent Any animal of the order Rodentia, and commonly includes the order Lagomorpha, many of which influence rangeland by such habits as grazing and burrowing. Important rangeland rodents include pocket gophers, prairie dogs, ground squirrels, certain terrestrial mice, kangaroo rats, jack rabbits, and marmots.

Rodent control Measures taken to reduce or control the rodent population of a given area. This may apply to a specific species or rodents in general.

Rodenticides Poisons used to control rats, mice, and other rodents.

Roller conditioner A machine that uses intermeshing and nonintermeshing steel or rubber rollers to crush and crack stems of cut legume forages. It was developed for use on legume hay crops to speed drying without shattering leaves.

Rotary mower A power takeoff driven machine that cuts and shreds plants with a horizontal revolving blade held underneath a metal shroud.

Rotation fertilization method Some nutrients are added in higher amounts than needed for the current crop in the crop rotation. They are later drawn down by a following crop to keep all nutrient levels within acceptable soil loading levels. Often, it expedites manure spreading and utilization of its nitrogen content.

Rotation grazing A type of grazing system and involves moving grazing animals from one pasture to another to achieve a desired management objective.

Rough (1) The accumulation of mature living and dead vegetation, especially grasses and forbs on rangeland. (2) May refer to land surface with uneven terrain.

Roughage Plant materials containing a low proportion of nutrients per unit of weight. Generally bulky and coarse, high in fiber, and low in total digestible nutrients. Roughage may be classed as either dry or green.

Roundup The purposeful gathering of animals from a specific area.

Ruderal A plant inhabiting disturbed sites.

Rumen The large, first compartment of the stomach of a ruminant from which ingestion is regurgitated for re-chewing and in which digestion is aided by symbiotic action of microbes.

Ruminant Even-toed, hoofed mammals that chew the cud and have a 4-chamber stomach; i.e., ruminantia.

Runoff The movement of water from a watershed including both surface and subsurface flow, usually expressed in acre-feet of water yield.

Sacrifice area (1) A portion of the range, irrespective of site, that is unavoidably overgrazed to obtain efficient overall use of the management area. The area is generally a small area adjacent to a feed trough, water trough, gate, etc. (2) A fenced-off, small portion of a grazing management unit intentionally overgrazed and heavily trafficked to prevent lasting damage to the entire unit. This is only done for short periods during extreme weather conditions. Site is then deferred from grazing until it recovers (includes reseeding if necessary).

Saline soils Soils with an electrical conductivity greater than 4 millimhos per centimeter that have less than 15 percent of the cation exchange capacity occupied by sodium ions and a pH below 8.5. See sodic soils for a comparison.

Salt ground An area where salt is placed for use by livestock or game; often relocated periodically to achieve improved animal distribution.

Salt lick Spots containing unusually large quantities of salts in the soil where animals consume the soil to obtain salt.

Salting (1) Providing salt as a mineral supplement for animals. (2) Placing salt on the range in such a manner as to improve distribution of livestock.

Salvage value (GLA) The value remaining in a piece of equipment or other asset at the end of its intended useful life.

Sample Part of a population taken to estimate a parameter of the whole population.

Sand tank A water development constructed by placing a dam in a rock-bound channel and bonded to bedrock and by using the sand/gravel trap above the dam for water storage.

Saponins Any of the various plant glycosides that form soapy colloidal solutions when mixed and agitated with water. When present in forages, the antiquality chemical depresses growth and intake of grazers and may worsen bloat in ruminants. However, they also impart resistance in forages to disease and insect pests.

Savanna (Savannah) A grassland with scattered trees, either as individuals or clumps; often a transitional type between true grassland and true forest.

Scrub Vegetation dominated by low growing woody plants, often forming a dense thicket.

Seasonal distribution (1) The progressive grazing in a sequence of moves from one part of a range to another as vegetation develops. (2) The normal occurrence of precipitation at different periods of the year.

Seasonal distribution of growth or availability The tabular or graphical display of monthly increments of total annual forage production available for grazing. It may record growing forage production throughout its growing season or the deferment and release later in the year of accumulated grazeable forage mass to grazing animals.

Seasonal grazing Grazing restricted to a specific season.

Seasonal use (1) Synonymous with seasonal grazing. (2) Seasonal preference of certain plant species by animals.

Seasonal zone An area of rangeland that livestock and wildlife prefer at certain seasons.

Seed A fertilized ripened ovule of a flowering plant.

Seedbank Seeds stored in the soil, generally as hard seed, that are viable and will germinate given the proper conditions. This seedbank is principally built up by seed produced by plants growing on or adjacent to the site over many years. Species long gone may still be represented if their seed is especially long-lived.

Seedbed preparation Soil treatment prior to seeding to: enhance soil surface layer for seed deposition and optimum opportunity for generation and seedling growth, reduce or eliminate existing vegetation, reduce the effective supply of weed seed, modify physical soil characteristics, and enhance temperature and water characteristics of the microenvironment.

Seed certification A system whereby seed of plant cultivars is produced, harvested, and marketed under authorized regulation to ensure seed of high quality and genetic purity.

Seed, dormant Live seed in a nongerminative condition because of internal inhibitions in the seed; i.e., hard seed, or unfavorable environmental conditions.

Seed dribbler A metering device that drops seed onto the track of a crawler tractor for the purpose of being carried forward and pressed into the ground as the tractor passes.

Seed, hard Live seed in a physiological condition that prevents or delays germination, even when a favorable environment exists.

Seedhead The inflorescence (flowering part) of a grass where the seed will develop.

Seed inoculation Treatment of legume seed with rhizobium bacteria before planting to enhance subsequent nitrogen fixation.

Seed purity The percentage of the desired species in relation to the total quantity, including other species, weed seed, and foreign matter. See Pure live seed.

Seed scarification Mechanical or acid treatment of seedcoats to improve moisture absorption and enhance germination.

Seedstock (1) Livestock raised to refine the genetics of a particular breed and sold for breeding purposes primarily. (2) The label applied to a producer of such animals. See Commercial for contrasting term.

Seep Wet areas, normally not flowing, often created when the elevation of the lateral flow of underground water intersects ground level, as on a hillslope. Occasionally seeps occur from water arising from an underground source.

Selective grazing The grazing of certain plant species, individual plants, or plant parts on rangeland to the exclusion of others.

Selectivity ratio The fraction or decimal indicating the proportion of the diet contributed by a plant species, species group, or plant part; an expression of relative preference.

Semiarid A term applied to regions or climates where moisture is normally greater than under arid conditions, but still definitely limits the production of vegetation. The upper limit of average annual precipitation in the cold, semiarid regions is as low as 15 inches, whereas in warm, tropical regions it is as high as 45 to 50 inches.

Sendero A path or lane cut or dozed through brushy areas to provide access by livestock, pedestrians, or vehicles. A term commonly used in the Southwest.

Senesce The yellowing and withering of older, lower leaves of plants as they become shaded by higher, younger leaves. Nutrients in these older leaves are translocated to younger tissue.

Seral Refers to species or communities that are eventually replaced by other species or communities within a sere.

Seral stages The developmental stages of an ecological succession.

Sere All temporary communities in a successional sequence.

Sex ratio The ratio existing between the number of male and female animals within a given herd, band, or population.

Shearing pens A general term used to describe the buildings, machinery, pens, and other appurtenances of an establishment where animals are shorn.

Shed lambing Housing and feeding females during the time offspring are dropped.

Shinnery Range vegetation having dwarf oaks as dominants.

Short-duration grazing A grazing system with five or more pastures where the rest period is usually at least four times greater than the grazing period. See Grazing system.

Shrink-swell The action of soils that are high in montmorillinite clay content. When wet, the clays expand causing the soil to swell. When the soils dry, the clays shrink leaving cracks in the soil from 1 to 2 inches wide and commonly 6 to 20 inches deep. Expansion of the clays is even more pronounced in sodic soils.

Shrub A plant that has persistent, woody stems, a relatively low growth habit, and generally produces several basal shoots instead of a single bole. It differs from a tree by its low stature and non-arborescent form. Maximum height is generally 4 meters.

Silage Forage preserved in a succulent condition by organic acids (lactic acid primarily) produced by partial anaerobic fermentation of sugars in the forage.

Similarity index A similarity index is the percentage of a specific vegetation state plant community that is presently on the site.

Sire (GLA) The male parent of an animal.

Site See Ecological site.

Skylining The development of a line of uniform height of vegetation that gives an illusion of a horizon, usually associated with excessive use of browse. May refer to either top line or under line.

Slope A slant or incline of the land surface, measured in degrees from the horizontal, or in percent (defined as the number of feet or meters change in elevation per 100 of the same units of horizontal distance); may be further characterized by direction (exposure).

Slugs Terrestrial mollusks without a shell that prey on seedlings.

Snow fence A fence used to retard or alter the movement of snow by wind.

Sod Vegetation that grows to form a mat of soil and vegetation. Syn. turf.

Sod grasses Stoloniferous or rhizomatous grasses that form a sod or turf.

Sodic soil (nonsaline) A soil with an electrical conductivity of less than 4 millimhos per centimeter where exchangeable sodium occupies more than 15 percent of the total cation exchange capacity.

Sodic soil (saline) A soil with an electrical conductivity greater than 4 millimhos per centimeter where exchangeable sodium occupies more than 15 percent of the total cation exchange capacity.

Sod seeding Direct drilling of seed on sites on which no seedbed preparation had been made.

Soil (1) The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. (2) The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of parent material, climate (including moisture and temperature effects), macro- and micro-organisms, and topography, all acting over a period of time, producing soil, which differs from the material from which it was derived in many physical, chemical, biological, and morphological properties and characteristics.

Soil aggregates Granules formed from the arrangement of primary soil particles (sand, silt, and clay) by flocculation and cementation processes. Plant roots, especially fibrous root systems of grass forage crops, aid in their formation.

Soil amendments Any material, organic or inorganic, applied to the soil to make it more conducive to vigorous plant growth. Amendments may contain important fertilizer elements, but the term commonly refers to added materials other than fertilizer.

Soil map unit A map unit is a collection of soil areas or miscellaneous areas delineated in a soil survey. They may encompass one or more kinds of soil or one or more kinds of soil and a miscellaneous area, such as rock outcrop. They are identified by a unique map symbol in a survey area. There are four kinds of map units; consociations, complexes, associations, and undifferentiated groups.

Soil map unit components The components of a map unit are: (1) The named soil(s) or miscellaneous areas that are dominant and co-dominant in extent. (2) Similar soils or miscellaneous areas that may be extensive, but not as extensive as the named components. (3) Dissimilar soils or miscellaneous areas that are minor in extent. Soil map unit components are rated and assigned to forage suitability groups.

Soil reaction Numerical expression in pH units of the relative acidity or alkalinity of a soil. The range in soil pH is 1.8 to 11.0. A pH of 7.0 is neutral.

Soil test A chemical and physical analysis of a soil used to estimate its nutrient supplying power. It must use chemical extraction techniques appropriate for the elements being extracted and the soil being examined. For the results to be interpreted properly, the test procedures must also be calibrated against nutrient rate experiments in the field and in the greenhouse.

Soluble powder A dry pesticide formulation that dissolves readily in water and forms a true solution. It is not very common because few active ingredients are water soluble.

Solution A pesticide formulation where the active ingredient is very soluble in water. It is a liquid that contains the active ingredient and additives.

Species A taxon or rank species; in the hierarchy of biological classification, the category below genus.

Species allowable (GLA) The maximum percent composition by weight that an individual plant species is expected to contribute to the total composition on a particular site.

Species composition The proportions of various plant species in relation to the total on a given area. It may be expressed in terms of cover, density, weight, etc.

Spot grazing Repeated grazing of small areas while adjacent areas are less intensely grazed.

Spray drift The movement of airborne spray particles from the intended area of application; i.e., horizontal displacement.

Spreader dam Syn. water spreader.

Spring Flowing water originating from an underground source.

Spring development Improving spring and seeps by excavating, cleaning, capping, or providing collection and storage facilities.

Spring-fall range Rangeland that is grazed primarily during the spring and fall.

Stable The condition of little or no perceived change in plant communities that are in relative equilibrium with existing environmental conditions; describes persistent, but not necessarily culminating stages (climax) in plant succession. Implies a high degree of resilience to minor perturbations.

Stage of maturity (forage) The developmental status of a forage crop used to describe a point in time in its progress towards maturity and assess its readiness for harvest as an edible forage or for its seed.

Stand (1) An existing plant community with definitive bounds that is relatively uniform in composition, structural, and site conditions; thus it may serve as a local example of a community type. (2) An acceptable level of new plants following a seeding or planting operation.

Standing crop (GLA) The amount of forage available to a target grazing animal at a given time.

Standing crop The total amount of plant material, in aboveground parts, per unit of space at a given time. It may be modified by the words dead or live to more accurately define the specific type of biomass.

State A condition of an ecological site's characteristics. As characteristics change, there is a transition to a new state. See Vegetation state and Transition pathway.

Stem The culm or branch of a plant.

Stock (1) Abbreviated word for livestock. (2) To place animals on a discrete unit of grazing land. The term graze is often erroneously used in place of stock where the animal is the object of the verb, not the subject.

Stock driveway Syn. driveway.

Stocking The human placement of animals onto a management unit so they can graze or browse the plant resource. The term grazing is often erroneously used in place of stocking. Cattle have only one grazing method, while people have devised several stocking methods. Some stocking methods actually prevent livestock from grazing certain areas for a time.

Stocking density The relationship between number of animals and area of land at any instant of time. It may be expressed as animal-units per acre, animal-units per section, or AU/ha.

Stocking plan The number and kind of livestock assigned to one or more given management areas or units for a specified period.

Stocking rate The number of specific kinds and classes of animals grazing or utilizing a unit of land for a specific period of time. May be expressed as animals per acre, hectare, or section, or the reciprocal (area of land/animal). When dual use is practiced (e.g., cattle and sheep), stocking rate is often expressed as animal units per unit of land or the reciprocal.

Stockpiling Allowing standing forage to accumulate for grazing at a later period, often for fall and winter grazing after dormancy.

Stock pond A water impoundment made by constructing a dam or by excavating a dugout or both, to provide water for livestock and/or wildlife.

Stock trail A trail constructed across a natural barrier to permit movement of livestock to otherwise inaccessible areas.

Stock trails and walkways A livestock trail or walkway constructed to improve grazing distribution and access to forage and water.

Stock water development Development of a new or improved source of stock water supply, such as well, spring, or pond, together with storage and delivery system.

Stolon A horizontal stem which grows along the surface of the soil and roots at the nodes.

Strip grazing Confining grazing animals to a specified portion of a grazing area for a limited time. Strip grazing usually refers to temporarily subdividing a grazing area into subunits with temporary fences so grazing for short periods, often 4 hours or less, can be achieved.

Stubble The basal portion of herbaceous plants remaining after the top portion has been harvested either mechanically or by grazing animals.

Submarginal land Land that is either physically or economically incapable of indefinitely sustaining a certain use.

Substitution ratio Number of animals or animal-units of one kind or class that can be substituted for another kind or class to meet a specified management objective. Syn. animal-substitution ratio.

Subunit The subdivisions of a single grazing system. See Paddock and Pasture.

Succession The progressive replacement of plant communities on an ecological site that leads to the climax plant community. Primary succession entails simultaneous successions of soil from parent material and vegetation. Secondary succession occurs following disturbances on sites that previously supported vegetation, and entails plant succession on a more mature soil.

Suitability (1) The adaptability of an area to grazing by livestock or wildlife. (2) The adaptability of a particular plant or animal species to a given area.

Suitable range (1) Rangeland accessible to a specific kind of animal and which can be grazed on a sustained yield basis without damage to the resource. (2) The limits of adaptability of plant or animal species.

Summer range Rangeland, particularly in the mountainous Western States, that is grazed primarily during the summer growing season.

Supplement Nutritional additive (salt, protein, phosphorus) intended to remedy deficiencies of the range diet.

Supplemental cropland pasture An annual forage crop planted between two primary cultivated crops to provide supplemental grazing of enhanced nutritive quality during periods of low production and/or forage quality on other pastures or rangeland.

Supplemental feeding Supplying concentrates or harvested feed to correct deficiencies of the range diet. Often erroneously used to mean emergency feeding.

Surfactant (surface active agent) Materials used in herbicide formulations to bring about emulsifiability, spreading, wetting, sticking, dispersibility, solubilization, or other surface-modifying properties.

Suspension fence Nonwoven wire fence comprised of high tension wire supported by widely spaced posts to which the wire is firmly attached, but is loose against the post to allow the wire to move back-and-forth at the point of attachment.

Sustained yield Production of specified resources or commodities at a given rate for a designated unit of time.

Swale An area of low and sometimes wet land.

Swath A strip of cut herbage lying on the stubble left by the cutter bar, blade, flail, rotary drum, or disc blade setting of the mower, mower-conditioner, binder, swather, or small grain head on a combine.

Synecology A subdivision of ecology that deals with the study of groups or organisms associated as a unit; i.e., communities.

Tag (1) A label attached, usually to the animals, for identification. (2) A discolored and dirty part of a fleece.

Tagging (1) The process of attaching identifying tags to animals. See Brand and Marking. (2) Clipping manured and dirty locks from sheep.

Tagging chute A narrow enclosure (of board, pole, or steel construction) to hold animals during tagging.

Tame pasture Implies the forages growing on the land unit have been purposely cultivated by people as opposed to being wild growth of random origin. In permanent pastures it is often a combination of the two mechanisms and, therefore, a rather subjective and imprecise term. Synonymous with improved pasture.

Tank A reservoir of any construction for water storage.

Tannin An antiquality chemical consisting of a broad class of soluble polyphenols that occur naturally in many forage plants. They all condense with protein to form a leatherlike substance that is insoluble and of impaired digestibility. This can be good if it allows some protein to bypass the rumen and be digested in the lower digestive tract of ruminants. Excessive levels, however, interfere with digestion rate by reducing rumen microbial populations.

Taproot system A plant root system dominated by a large primary root, normally growing straight downward, from which most of the smaller roots spread out laterally.

Tedder A machine used in very humid areas to aid forage drying. It stirs cut forage lying on a field with metal tines that rotate on a series of horizontally spinning rotors.

Temporary license or permit A document authorizing grazing of a certain number of livestock on public lands during an emergency or for a certain period, terminable at the end of such period and with no guarantee of renewal in whole or in part. See Grazing license or Permit.

Term license or permit A document authorizing grazing on public lands for a stated number of years as contrasted with an annual or temporary license or permit. See Grazing license or Permit.

Terracing Mechanical movement of soil along the horizontal contour of a slope to produce an earthen dike to retain water and diminish the potential of soil erosion.

Theoretical length of cut The length of cut set with the shear plate on a forage harvester. Setting is critical to ensure forage pieces will be small enough to ensure good compaction in a silo while preserving effective fiber length for good rumen function.

Thermoneutral zone (comfort zone) Within a certain range of ambient temperature the heat produced by nor mal metabolism of a resting animal is minimal and is enough to cover the heat loss.

Tiller (1) An erect shoot that arises from the crown of a grass. (2) A grass that is growing tillers. (3) The asexual development of a new plant from a meristematic region of the parent plant.

Total annual production The total annual production of all plant species of a plant community.

Total digestible nutrients (TDN) The total digested energy in a feedstuff expressed in units of weight or percent.

Total digestible nutrients (TDN) (GLA) The total digested energy of a feed expressed as a caloric value.

Toxic plant species A species of plant that may accumulate or produce a substance toxic to animals. See Poisonous plant.

Toxicant The chemical ingredient(s) that may injure or cause death in either plant or animal life exposed to it.

Trace element An element essential for normal growth and development of an organism, but required only in minute quantities.

Trafficability The condition presented by the soil that influences the degree of ease of movement by livestock, humans, or machinery across its surface. This is influenced by the size and number of surface rock fragments, soil wetness, degree of plasticity, organic matter content of soils, and the climatic setting that drives those characteristics to affect ease of movement.

Trail A well-defined path created by repeated passage of animals.

Trail herding Directing and controlling the movement of a group of livestock on restricted overland routes.

Trailing (1) Controlled directional movement of livestock. (2) Natural trailing is the habit of livestock or wildlife repeatedly treading in the same line or path. See Drive.

Trampling Treading underfoot; the damage to plants or soil brought about by movements or congestion of animals.

Transition pathway Process(es) that cause a shift from one state to another on an ecological site.

Translocated herbicide A herbicide moved within the plant from the point of entry.

Trap A relatively small enclosure used as a temporary holding or catching area in the handling and management of livestock.

Tree A woody perennial, usually single stemmed plant that has a definite crown shape and reaches a mature height of at least 4 meters. The distinction between woody plants known as trees and those called shrubs is gradual. Some plants, such as oaks (Quercus spp.) may grow as either trees or shrubs.

Trend A rating of the direction of change occurring on an ecological site. See Rangeland trend and Planned trend.

Trespass Syn. grazing trespass.

Trick tank A modification of a guzzler in which the collection basin is elevated and the storage tank is located directly below.

Trophic levels The sequence of steps in a food chain or food pyramid from producer to primary, secondary, or tertiary consumer.

Trough (1) A large container with necessary controls and valves that provides drinking water for livestock and wildlife. (2) A feeding container that holds livestock feed and/or minerals for consumption by livestock and some wildlife species.

Turf Syn. sod.

Turnout Act of turning livestock out on rangeland at the beginning of the grazing season.

Type Syn. Vegetation type.

Type line The boundary line that separates two distinctive vegetation types on a map or photograph.

Unauthorized use The grazing of livestock on a range area without proper authority.

Unconsumed plant (GLA) See Plant preference classification.

Under grazing The act of continued underuse.

Under stocking Placing a number of animals in a given area that will result in underuse at the end of the planned grazing period.

Understory Plants growing beneath the canopy of other plants. Usually refers to grasses, forbs, and low shrubs under a tree or shrub canopy.

Underuse A degree of use less than the desired use.

Undesirable species (1) Species that are not readily eaten by animals. (2) Species that conflict with or do not contribute to the management objectives.

Ungulate A hoofed animal, including ruminants, but also horses, tapirs, elephants, rhinoceroses, and swine.

Unsuitable range Range that has no potential value for, or which should not be used for, a specific use because of permanent physical or biological restrictions. When unsuitable range is identified, the identification must specify what use or uses are unsuitable (e.g., unsuitable cattle range).

Upright or tower silo, conventional A cylindrical silo made of concrete staves, generally ranging from 12 to 30 feet in diameter and up to 80 feet in height. The staves are held together by steel rods that encircle them. It is usually unloaded from the top.

Upright or tower silo, oxygen-limiting A cylindrical silo made of steel with a glass fused coating on it. The steel panels are bolted together. The silos range in diameter from 20 to 27 feet and in height from 32 to 104 feet, are unloaded from the bottom, can be refilled at any time, and continue to unload oldest silage first.

Usable forage The portion of the standing forage crop that can be grazed off without damage to the forage plants. It varies by plant species, season of use, and companion plant species that need favoring to promote their continued existence in the stand. The pasture management section refers to it also as available forage.

Usable forage production (GLA) An entry method that allows you to enter an estimate of annual production that is consumable by the target livestock population.

Use (1) The proportion of current year's forage production that is consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole. Syn., degree of use. (2) Utilization of land for a purpose, such as grazing, bedding, shelter, trailing, watering, watershed, recreation, forestry, and wildlife habitat.

Utilization Syn., use.

Vapor drift The movement of pesticidal vapors from the area of application.

Variable cost (GLA) Expenses that change with the number of animals in the herd. Examples of variable costs include supplemental feed, veterinary services and supplies, and labor.

Variable rotational stocking A stocking method that adjusts the recovery period between grazing periods to the variable growth rate of the forage species being grazed. It attempts to offer a uniform forage allowance to livestock each day of the grazing season through the allocation of forage by sequential grazing of paddocks.

Variable stocking The practice of varying the stocking rate through the plant growing season with the objective of utilizing forage at a rate similar to its growth rate. This can be done by either varying the number of animals on a set acreage or varying the acreage offered to a set number of animals.

Vegetation states The various plant communities produced by an ecological site within given site characteristics.

Vegetation type A kind of existing plant community with distinguishable characteristics described in terms of the present vegetation that dominates the aspect of physiognomy of the area.

Vegetative Relating to nutritive and growth functions of plant life in contrast to sexual reproductive functions. (adj.) Of or relating to vegetation.

Vegetative management practices Practices that are directly concerned with the use and growth of plants. These include such practices as prescribed grazing and livestock exclusion.

Vegetative production Production of new plants by any asexual method.

Vegetative state Stage of maturity prior to the appearance of inflorescences. In grasses, it is prior to boot stage. In legumes, it is prior to the appearance of buds.

Veld The open temperate grassland areas of Southern Africa, typically containing scattered shrubs or trees.

Vigor Relates to the relative robustness of a plant in comparison to other individuals of the same species. It is reflected primarily by the size of a plant and its parts in relation to its age and the environment in which it is growing. Syn. plant vigor.

Volunteers Plants not purposely planted germinating from seed laid down from imported plant residue or by parent plants growing on the site at some previous time. How distant the time is dependent on the longevity of the seed. These plants are aggressive enough to fill in voids in the plant canopy or grow after dormancy or harvest of the planted crop.

Walkway An earthen embankment constructed to improve the accessibility of marsh rangeland. See Stock trails and walkways.

Warm-season plant A plant that makes most or all its growth during the spring, summer, or fall and is usually dormant in winter. (2) A plant that usually exhibits the C-4 photosynthetic pathway.

Water budget An irrigation tool that keeps track on a daily basis of the amount of plant available water in the soil over a 12 month period. It sums soil water depletion by evapotranspiration using one of the climatonomic estimators and deducts water inputs from precipitation or irrigation. This yields the amount of irrigation water needed to be applied to bring the soil back to field capacity within the root zone of the crop being irrigated. Water applications in excess of field capacity are assumed lost to percolation or runoff.

Water gap (1) A specially constructed fence across a drainage. The fence is easily moved by the forces of a flood, thus preventing damage to the permanent fence. (2) An opening or fenced area providing access to a developed or natural water supply permitting one watering facility to serve two or more pastures.

Water potential The thermodynamic state of the water in a cell, organism, or soil equal to the difference in free energy per unit volume between matrically bound, pressurized, or osmotically constrained, water and that of pure water.

Water ram A hydraulic pump that uses water power (flow rate or hydraulic head) to pump a small portion of the total water inflow through a pipe to a higher elevation.

Watershed (1) A total area of land above a given point on a waterway that contributes runoff water to the flow at that point. (2) A major subdivision of a drainage basin.

Water-soluble packet Wettable powder or soluble powder formulations of low dosage, highly toxic pesticides packaged in soluble plastic bags. Packets are dropped into a sprayer tank where they dissolve and mix with the spray liquid.

Water spreader A terrace, dike, or other structure intended to collect and distribute surface-water runoff from natural channels, gullies, streams, or broad drainage areas. The purpose is to increase the area of infiltration.

Waterway A way or channel for water.

Weed (1) Any growing unwanted plant. (2) A plant having a negative value within a given management system.

Well A water source developed by drilling vertically through soil, subsoil, and geological strata to intercept underground water storage or stream areas.

Well horizontal A water source developed by drilling horizontally into a hillside to intercept a perched water table or underground water source.

Wetland communities Plant communities that occur on sites with soils typically saturated with or covered with water most of the growing season.

Wetlands Areas characterized by soils that are usually saturated or ponded; i.e., hydric soils, and that support mostly water-loving plants; i.e., hydrophytic plants.

Wet meadow A meadow where the surface remains wet or moist throughout the growing season, usually characterized by sedges and rushes.

Wettable powder Dry, finely ground formulation where the active ingredient is combined with a dry carrier, usually mineral clay, along with other ingredients that enhance suspension of the material in water. Very widely used. It is of lower toxicity than other formulations, but can be inhaled while dispensing and needs constant, effective agitation in the spray tank to avoid uneven application.

Wildlife Undomesticated vertebrate animals considered collectively, with the exception of fish.

Wildlife refuge A land area reserved and managed for the benefit of one or more species of wildlife.

Windrow (1) Curing herbage dropped or raked into a narrow swath sized to be picked up easily by the head of a baler, combine, or forage harvester. (2) To cut or rake into windrows.

Winter range Range that is grazed during the winter months.

Wolf plant (1) An individual plant that is generally considered palatable, but is not grazed by livestock. (2) An isolated plant growing to extraordinary size, usually from lack of competition or utilization.

Woody A term used in reference to trees, shrubs or browse that characteristically contain persistent ligneous material.

Xeric Having very little moisture; tolerating or adapted to dry conditions.

Yearling An animal approximately 1 year of age. A short yearling is from 9 to 12 months of age and a long yearling is from 12 to 18 months.

Yearlong grazing Continuous grazing for a calendar year.

Yearlong range Rangeland that is, or can be, grazed yearlong.

Yield (1) The quantity of a product in a given space and/or time. (2) The harvested portion of a product.

Zoning (rural) A means by which governmental authority is used to promote a specific use of land under certain circumstances. This power traditionally resides in the state, and the power to regulate land uses by zoning is usually delegated to minor units of government, such as towns, municipalities, and counties, through an enabling act that specifies powers granted and the conditions under which these are to be exercised.

Investing in Range Improvements on Public Lands

FACTSHEET

BLM

What are range improvements? There are two kinds of range improvements: nonstructural and structural. Seedings or prescribed burns are examples of nonstructural range improvements. Fences or facilities such as wells or water pipelines are examples of structural improvements. Many structural improvements are considered permanent, as they are not easily removed from the land.

Photo courtesy of USDA NRCS

Why are range improvements needed? Such improvements enhance or improve livestock grazing management, improve watershed conditions, enhance wildlife habitat, or serve similar purposes.

Who is responsible for installing permanent structural range improvements on public lands? On public lands managed by the Bureau of Land Management (BLM), permittees or lessees (henceforth, "operators") may be required to install range improvements to meet the terms and conditions of their permits or leases. Often the BLM, operators, and other interested parties work together and jointly contribute to construction.

Photo courtesy of USDA NRCS

Why is it beneficial for operators to construct range improvements? Improvements to grazing management infrastructure can add to the management effectiveness and efficiency of a public lands livestock operation and thus can enhance the operator's income generation abilities.

How are range improvements funded? The law provides that each year, either half of the grazing fees paid by operators or $10 million (after it is appropriated through the Federal budget process), whichever is greater, will be provided to BLM to fund range improvements. The BLM also encourages contributions from operators and other parties who are interested in facilitating improved grazing management or enhancing other multiple uses. Often, lenders provide the funds that operators contribute for improvements, and the ability to obtain funds from a lender is a key factor in whether an operator can contribute to or fund an improvement.

How is a contributor's interest in a range improvement documented? A contributor's interest in public land range improvements is documented either by a Cooperative Range Improvement Agreement (CRIA) or a Range Improvement Permit (RIP). These records are maintained by the BLM and are available for review upon receipt of an appropriate request. The BLM will comply with applicable law when responding to the request.

What is a CRIA used for? A CRIA is an agreement between the operator or other cooperating parties and the United States that outlines the provisions for constructing, using, and maintaining a permanent structural improvement on public lands. It specifies how the project's material costs and construction labor are divided between the cooperator(s) and the United States. A CRIA can be used to authorize any type of improvement, but, since 1995, it must be used to authorize all new permanent water developments such as spring developments, wells, reservoirs, stock tanks, and pipelines. A CRIA documents the cooperator's (s') contribution of funds, labor, or materials used for the initial construction of the improvement. This documentation provides the basis to determine the proper credit to an operator should the BLM be precluded from issuing a livestock grazing permit to that operator for these lands, such as in the event of a grazing preference transfer to a subsequent operator or a change in purpose for the land where the improvement is located, which may include disposal. The interest of operators (or other cooperators) in an improvement authorized by a CRIA may range from 0–100 percent of the original construction cost, depending upon their initial contribution.

Who owns an improvement that is authorized by a CRIA? The United States holds title to an improvement authorized by a CRIA constructed before March 1984 and after August 1995; however, if operators' grazing permits or leases are cancelled or reduced because the BLM will no longer permit grazing in the vicinity of the improvement, the operators are entitled to compensation for their interest in the improvement as explained under **"What are the operator's rights to compensation?"**

What is a RIP used for? Before 1995, a RIP was used to construct any kind of improvement that enhanced grazing management. Since 1995, the use of a RIP is limited to authorizing the construction of a removable range improvement. The operator agrees to fund 100 percent of the construction costs. Construction costs do not include BLM overhead costs such as those incurred for environmental compliance documentation in accordance with applicable law.

When can an operator hold title to a range improvement? The operator may hold the title to authorized removable range improvements used as livestock handling facilities such as corrals, creep feeders, and loading chutes and to temporary improvements such as troughs for hauled water. Typically, these kinds of improvements are authorized by a RIP. If a range improvement is not one of these types of improvements and was constructed under a CRIA before March 1984 or after August 1995, then the title to the improvement is held by the United States. The operator holds title to any improvement constructed under a RIP between March 1984 and August 1995.

Photo courtesy of USDA NRCS

Photo courtesy of USDA NRCS

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Photo courtesy of USDA NRCS

Who decides how and when a project is built or if an existing project needs to be removed? The BLM coordinates with operators, State agencies, and the interested public in making that determination. The BLM normally requires specific standards, design, construction, and maintenance criteria. The BLM can require modification or removal of range improvements that no longer meet land use plan goals and objectives or fail to meet the original construction or maintenance criteria.

Photo courtesy of USDA NRCS

What are the operator's rights to compensation? The Federal Land Policy and Management Act of 1976, as amended, provides in section 402 (g) (43 U.S.C. 1752(g)) that "whenever a permit or lease for grazing domestic livestock is cancelled in whole or in part, in order to devote the lands covered by the permit or lease to another public purpose, including disposal, *the permittee or lessee shall receive from the United States a reasonable compensation for the adjusted value, to be determined by the Secretary concerned, of his interest in authorized permanent improvements placed or constructed by the permittee or lessee on lands covered by such permit or lease, but not to exceed the fair market value of the terminated permittee's or lessee's interest therein*" [emphasis added]. This right is stated in the BLM's grazing regulations at 43 CFR 4120.3-6(c) as well. These regulations also provide that if the improvement is authorized by a RIP, the operator may choose to salvage and remove the project rather than receive compensation.

Are operators entitled to compensation for their interest in authorized range improvements if the BLM cancels or reduces their grazing permits as a penalty for regulatory violations? No. In that case, it is likely that the lands still would be eligible for a BLM permit.

If a permit or lease is cancelled because the BLM sells the land or otherwise disposes of it, what is the process used to determine the adjusted value of the operator's interest in the improvement? If the BLM cannot reach agreement with operators regarding the value of their interest in the improvement, the BLM will determine the value, considering factors such as its current condition, anticipated remaining useful life, replacement cost, and so forth. The BLM will issue a formal decision to the operators that declares the monetary value of the operators' interest in the improvement and how it was derived. The operators have the right to dispute the BLM's determination and seek administrative and civil review of the decision.

Does the BLM need documentation from the lender of amounts loaned for a range improvement? No. In fact, if the BLM receives this information from a lender or an operator, the BLM will not retain it in its records. The BLM documents the amount contributed by the operator to the project.

Who in the BLM do I contact if I have other questions about this topic? Contact the BLM office that administers the grazing permit or lease of the BLM operator who is planning a range improvement. Visit www.blm.gov for contact information. You may find copies of CRIA and RIP forms at www.blm.gov/blmforms/. Click on "Forms Central" and search for form numbers 4120-006 (CRIA) and 4120-007 (RIP).

Source Material: 43 CFR 4120.3.

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