RANGELANDS

AN INTRODUCTION TO WILD OPEN SPACES

University of Idaho
Rangeland Center

IDAHO RANGELAND
RESOURCE COMMISSION

Rangelands

An Introduction to Idaho's Wild Open Spaces

2014

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University of Idaho Rangeland Center

IDAHO RANGELAND RESOURCE COMMISSION

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

Many people are credited with writing, editing, and developing this handbook, including: Lovina Roselle, Karen Launchbaugh, Tess Jones, Ling Babcock, Richard Ambrosek, Andrea Stebleton, Tracy Brewer, Ken Sanders, Jodie Mink, Jenifer Haley, Gretchen Hyde, and Joan Jones.

Table of Contents

Rangelands Overview

What are Rangelands?

Rangelands cover a significant portion of the earth, yet the term "rangelands" might not have a clear meaning for most people. So it's a good idea to define what parts of the earth are and are not included in this term.

Rangelands **are**:		Rangelands **are *not***:	
grasslands	woodlands	farmed	covered with ice
shrublands	deserts	dense forest	covered with concrete
		entirely barren	covered with solid rock

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 vast plains of Africa, rangelands are found all over the world, encompassing almost half of the earth's land surface. Because rangeland landscapes are diverse and complex, they are called by various names around the world, including prairies, plains, swards, steppes, grasslands, pampas, shrublands, scrublands, woodlands, savannas, deserts, semi-deserts, and arid lands.

Grasslands are ecosystems that are dominated by grasses. Globally, grasslands go by many names, including prairies, steppes, pampas, swards, meadows and velds. 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 dominated by shrubs, with an understory of grasses and herbaceous plants. Shrublands across the world are called chaparrals, cerrados, shrub-steppe, maquis, and scrublands. In North America, shrubland biomes include chaparrals, sagebrush-steppes, salt-desert shrublands, tundra shrublands, and mountain browse.

Woodlands and **Savannas** are dominated by widely-spaced trees including junipers, oaks, mesquite and pines 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.

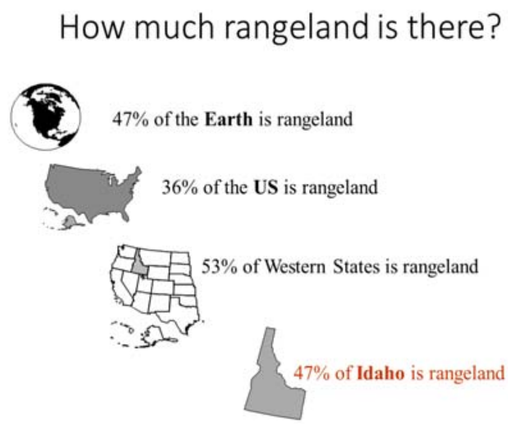
Deserts are the driest rangelands and experience extreme water shortages and unpredictable precipitation. These ecosystems are dominated by shrubs and succulent cactus plants. Deserts and arid lands in the world cover massive areas and include the Sahara, Namib, Arabian, Atacama, Australian Outback, and Kalahari deserts. The hot desert biomes in North America are found in the southwest and include the Mojave, Sonoran, and Chihuahuan deserts.

All photos on this page are courtesy of K. Launchbaugh and J. Peterson

How Much Rangeland Is There?

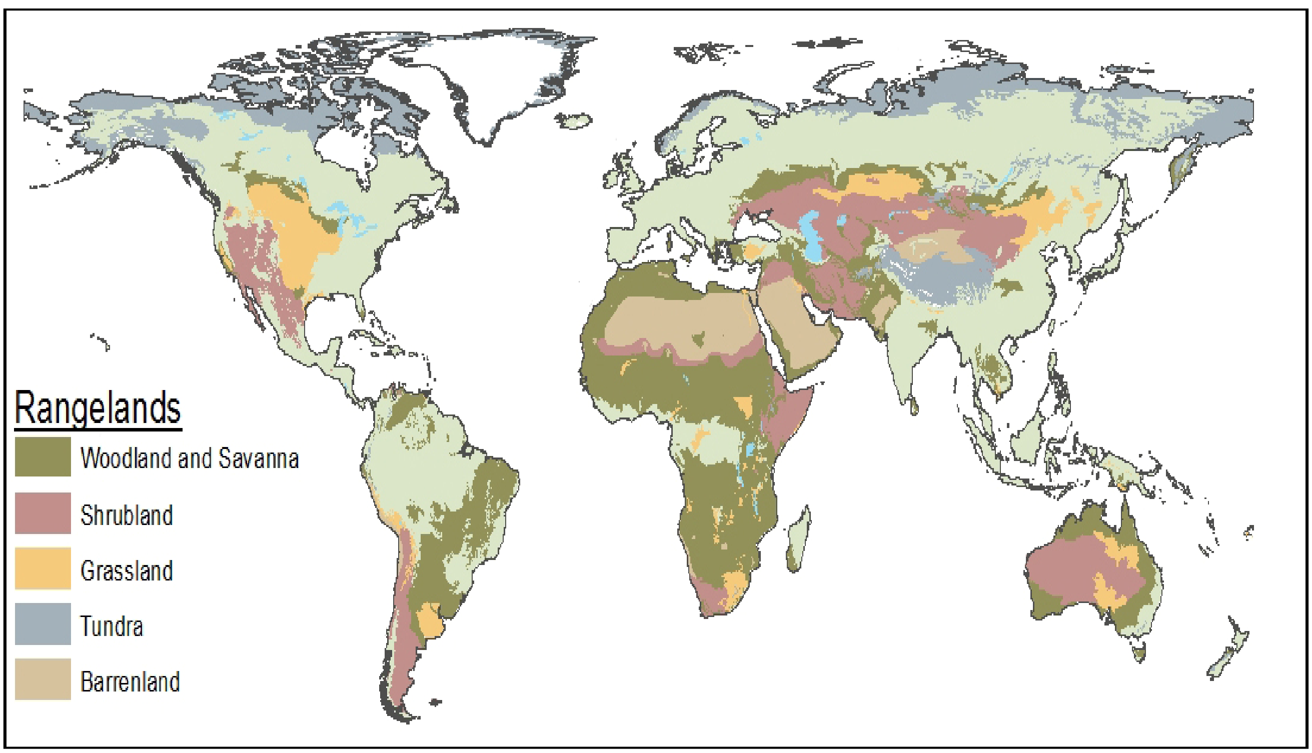
About 71% of the earth's surface is water. Of the 29% of the globe that is land, 25% is dense forest, 10% is cropland, and 15% is ice, rock, and/or barren desert. The footprint of humans in the form of roads, houses, towns, and cities is about 3%. That leaves an amazing 47% of the Earth's land surface occupied by rangelands in various forms.

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 are rangeland. Nevada is the state most dominated by rangelands: they cover about 80% of the land in that state. In Idaho, nearly 26 million acres or 48% of the land area is classified as rangeland. The geographic and climate systems of Idaho's rangelands are very diverse, creating many unique plant communities and associations.



Global Rangelands

The grassland, shrublands, woodlands, savannas and deserts that are called rangelands occur in a diverse array of forms across the globe. Rangelands occur extensively on every continent with more than 75% of the land surface in Africa and Australia characterized as rangeland.



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, is 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, cool winters. More than 90% of the annual precipitation in this region occurs during the winter months. 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 is (as its name suggests) a large dish or basin. It is bound by two mountain ranges: the Rockies on the east and the Sierra Nevadas 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 intercept moisture heading east from the Pacific Ocean, 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 per year in most areas.

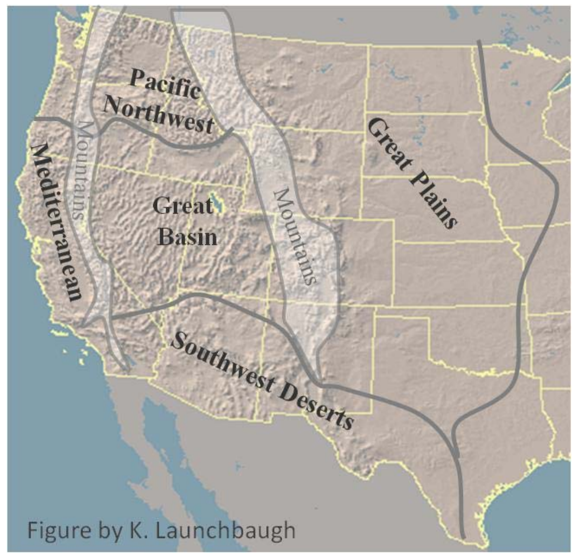


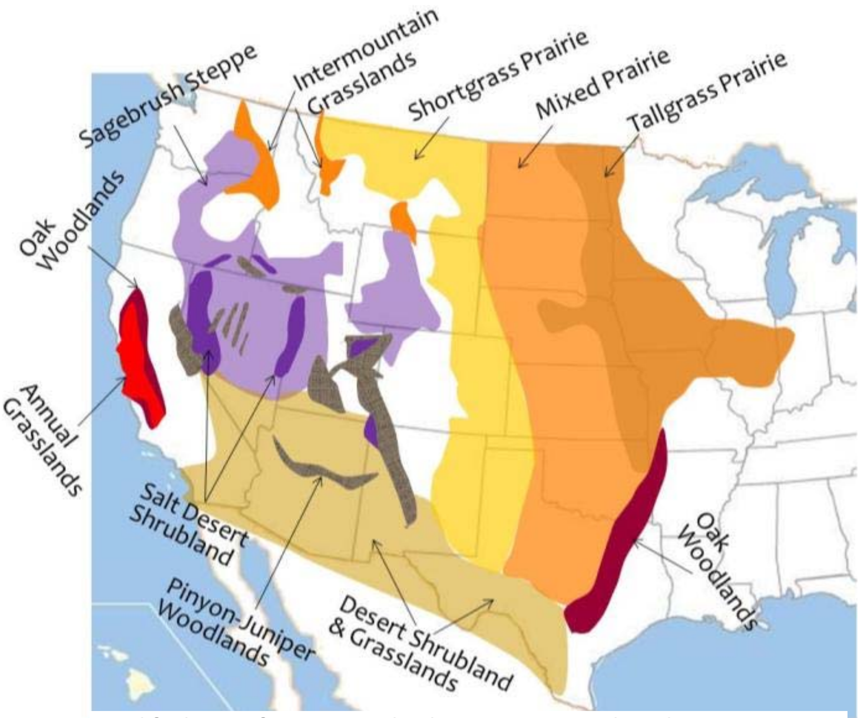
Figure by K. Launchbaugh

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 western to southerly, bringing moisture in from the Pacific Ocean and Gulf Coast. This leads to almost daily thundershowers which may occur in one location while an area a short distance away is left dry.

East of the Rocky Mountains is the Great Plains Region: 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. Moisture in the Great Plains materializes largely 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 soils and climate.



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

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. 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 using cameras mounted on satellites orbiting the earth.

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 accidentally 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 were well-adapted to California's Mediterranean climate. The region was quickly converted from 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 prairies soils (called mollisols) to desert soils (called aridisols). Many of these soils are excellent for farming. More than half of the region today is now farmed and is important for truck crops such as tomatoes, almonds, 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 Californian the major oak species is interior live oak and the plant communities take a more woodland form, with more 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 (mostly as rain) in the spring. Late summer rains are uncommon in this region and therefore lightning-ignited wildfires historically were also uncommon. Long, dry summers limited 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. Therefore, only about 1% of the original Palouse prairie exists today. Nearly all of the land was plowed to create the most productive u-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 grassland 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 the shrubs. There are about 20 different species of sagebrush found in the sagebrush steppe, though big sagebrush 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 have created a fine fuel leading to more frequent, and more damaging, fires. Fires that occurred once in several decades in the past may now occur every few years in areas where annual grasses have taken over. A fire regime with such frequent fires has created a situation where native grasses and shrubs have difficulty becoming reestablished between fires, and where the annual grasses now dominate some areas. Sagebrush steppe areas at higher elevation have a different relationship with fire. On colder, higher elevation sites, annual grasses do not grow as well and are less invasive that at lower (and warmer) elevations. However, juniper and other evergreen plants can invade sagebrush communities. In these regions, prescribed fire is very important to reduce evergreen trees and to allow sagebrush and grasses to grow and dominate the sites.

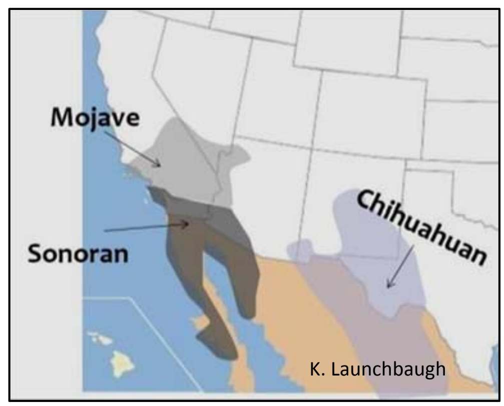
Salt Desert Shrublands In the Great Basin, at level areas in the lower elevations of the landscape, salt accumulates and supports a plant shrub community that is well adapted to dry salty soils: these are the salt desert shrublands. This region has a very dry climate with only 3 to 10 inches of precipitation each year. Dominant shrubs, such as shadscale, saltbrush, and winterfat, are mostly of the Chenopodiaceae family. Like most shrubs, these are nutritious in the winter and thus important for winter grazing by wildlife, sheep, and cattle. Invasive annual plants are the greatest threat to this vegetation type.

Pinyon-Juniper Woodlands Woodland communities made up of pine and juniper 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 for these communities is 12-20 inches annually. This vegetation type is important because it provides good cover and forage for wildlife and livestock.

Expansion of P-J woodlands in recent decades has caused concern because sagebrush steppe regions (see above) are being invaded by juniper trees. Humans generally suppress wildfires to protect human lives and property, and this suppression inadvertently allows junipers to spread. A greater fire frequency, such as occurred historically, could reduce juniper invasion.

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 varies from 5 to 20 inches per year; 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. Therefore, 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 fires as an important management tool for tallgrass prairies. Drought or unusually dry summers reduce survival of shrub and tree seedlings and thus also 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 are laid out across the rolling plains. Plants evolved with grazing from bison, and 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.

Precipitation ranges from 14 to 20 inches per year occurring as spring and summer rains. The soils are mostly mollisols but 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 the 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 for extensive fires.

Uses and Values of Rangelands

Rangelands provide natural beauty, a diversity of wildlife, recreational opportunities like hunting, hiking, and camping, and economic values, including ranching, mining, and electrical power. 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 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.

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 over range landscapes. Livestock production on rangeland a vital element in the (modern) food supply chain, producing meat for American and world populations. 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.

A diversity of **wildlife** thrive on rangeland habitats. Mammals, birds, amphibians, reptiles, fishes, and even 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.

The varied topography, scenic landscapes, and vast openness of rangelands are valuable to lots of people for recreation and tourism activities. Common recreational activities include hunting, camping, mountain biking, backpacking, hiking, horseback riding, and off-road vehicle touring. From mountains to plains, from lakes and rivers to deserts, rangeland areas are excellent places to have fun and enjoy life in these wild vistas and open spaces.

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. 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 and use increases, the high-quality water produced by healthy rangeland ecosystems is becoming increasingly important.

Riparian areas are the lush ecosystem that consists of vegetation along bodies of water. Riparian areas may surround lakes, ponds, wetlands, and fast- or slow-moving rivers, creeks, and streams. On Idaho rangelands, riparian areas surround rivers and creeks that run through grazing lands, open meadows, and uplands. These areas provide nutritious vegetation for wildlife and livestock, and important habitat for fish and other aquatic species. Without proper management, these areas can be damaged by uncontrolled livestock and wildlife grazing.

Rangelands can also prove a significant source of energy and other **natural resources**. Rangelands are home to hard rock mining, such as gold, copper, silver, or zinc, which 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 also serve as suitable sites for establishing solar power facilities, and wind power farms. The multi-use character of rangelands will become more valuable and appreciated as the demand for energy increases, especially clean renewable energy.

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?

> *"…Rangelands may be far better at producing the stuff of myth and national identity than …beef and mutton products. Yet, in the long run, the production and perpetuation of national myth may be one of the most valuable resources harvested from public rangeland."* As reported by Hart (1994) from a National Academy of Sciences Report.

What is Rangeland Management?

Rangeland management is the careful use and stewardship of rangelands to meet the needs and desires of those who live on and care about these lands. Rangeland management involves managing unforested lands with natural plant communities dominated by grasses, shrubs, and forbs. This endeavor is different from agriculture because plants and animals are not managed in isolation or solely for production purposes. Management decisions about rangelands are made with such ecological properties in mind, as soil health, vegetation, wildlife, invasive plants, and water quality. Range managers also need to consider a land owner's objectives, which might include livestock production, open space, recreation opportunities, or energy production.

Rangeland management is a challenging endeavor 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 each individual 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. Many people do not realize that one pasture may include public and privately owned land. This creates a challenge in rangeland management because different agencies and individuals have different goals and opportunities for what they want to, or can, achieve on the land.

Because manipulating these intricate ecosystems requires a mix of science-based knowledge and practical experiences, 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 every land element, every weather situation, every plant and animal 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.

History of Rangeland Use and Ownership

Western rangelands, and the Native Americans living there, were first documented by explorers Meriwether Lewis and William Clark in 1805-1806. Lewis and Clark were among the first Europeans who made the journey from St. Louis to the Pacific Ocean and they reported on many different grasses, forbs, and woody plants on the range. In fact, Lewis also described prairie dogs, sagegrouse and other animals still common today on rangelands.

Lewis and Clark's discoveries during their journey westward sparked increased interest in these uncharted lands. The idea of making dreams come true in the boundless west seemed appealing to many easterners. As a result, the first wagon-traveled road, called the Oregon Trail, crossed the country in the 1840s. In 1862, the Homestead Act helped to motivate major settlement on rangelands, followed by additional laws to allocate land for settlement and human use. Most of these settlements surrounded rivers, creeks and streams where water was available to irrigate crops and to provide for livestock. 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, the western livestock production industry peaked. During this era, large ranches running thousands of cattle and sheep dominated the business sector of western North America.

The Forest Reserve Act of 1891 set aside about 47 million acres of National Forest to preserve forests and grazing lands. This act helped to set the basis for the U.S. Forest Service, created in 1905, to provide for management of rangelands and grazing practices. In 1934, the Taylor Grazing Act recognized the importance both 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.

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 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.

Who Owns and Manages Rangelands?

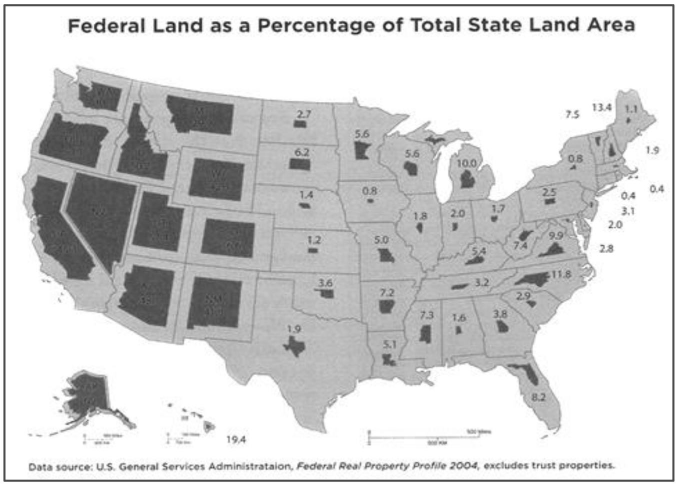
The question of who owns land can be examined in three categories: Federal, State and Private (public lands include both federal and state lands).

Federal lands are those owned and 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, 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 are owned by 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 (10.9% of all U.S. land). The USFS manages 24.5% of federal land (8.5% U.S.). The NPS oversees 22.2% of federal lands (7.7% U.S.) and National Wildlife Refuges account for 11.3% of federal land (3.9% U.S.).

	% Federal	% State	% Private
	------ 13 Western States----		
Alaska	60.2	29.0	10.8
Arizona	41.1	12.5	46.4
California	40.1	2.3	57.6
Colorado	35.5	4.4	60.1
Hawaii	12.8	0.6	86.6
Idaho	*61.4*	*5.2*	*33.5*
Montana	29.3	5.6	65.1
New Mexico	29.4	11.2	59.4
Nevada	80.9	0.2	18.9
Oregon	26.7	4.9	68.4
Utah	63.1	7.3	29.6
Washington	27.3	9.1	63.6
Wyoming	48.4	6.2	45.4
13 Western States Combined	**48.6**	**13.5**	**37.9**
	-------- 6 Plains States------		
Kansas	0.3	0.6	99.1
Nebraska	1.1	0.5	98.4
North Dakota	3.1	1.8	95.1
Oklahoma	1.3	1.0	97.7
South Dakota	7.4	0.2	92.5
Texas	1.4	0.5	98.1
6 Plains States Combined	**2.1**	**0.7**	**97.2**
	------ 31 Eastern States----		
31 Eastern States Combined	**4.7**	**5.9**	**89.4**
	------ All 50 States----		
All 50 States	**26.0**	**8.7**	**65.3**

Source: www.nrcm.org/documents/publiclandownership.pdf



State-owned lands include state wildlife refuges, state parks, state school lands, and other land parcels owned and managed by the individual states. Lands owned 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 owned and managed by individuals, corporations, and Native American tribes. An individual land owner may simply be a person or family who owns a house with a yard or small pasture. Large land owners include ranchers that cover thousands of acres and are owned by a family or a family corporation. All land owners manage their land for different personal or professional goals. Many rangeland owners are ranchers who garner income from grazing livestock or offering recreational opportunities, including hunting and guest ranches. Private lands are often called "**deeded land**" because an individual or corporation holds the deed to the land.

Federal Agencies Owning and Managing Rangelands

Agency and Website	Major Purposes
Bureau of Land Management www.blm.gov	Administers and manages land, and develops management and conservation programs.
United States Forest Service www.fs.fed.us	Manages national forests and grasslands, and provides technical and financial assistance to state and private forestry agencies.
Natural Resources Conservation Service www.nrcs.usda.gov	Provides technical assistance to private land owners, serving through Soil Conservation Districts and the Farm Services Agency.
National Park Service www.nps.gov	Preserves national parks and reserves for resource conservation and recreation.
Fish and Wildlife Service www.fws.gov/refuges/	Manages lands and waters set aside in the National Wildlife Refuge system to conserve America's fish, wildlife and plants.

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 state 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 is often not even a fence or boundary marker between public and private lands. Thus, it is important to be aware of land ownership boundaries when recreating or working on rangelands. It is also important to realize that many aspects of rangeland management will require that public and private land owners work together for the good of the land, water, and animals that inhabit these spaces.

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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 and venation (pattern of veins) of leaves.

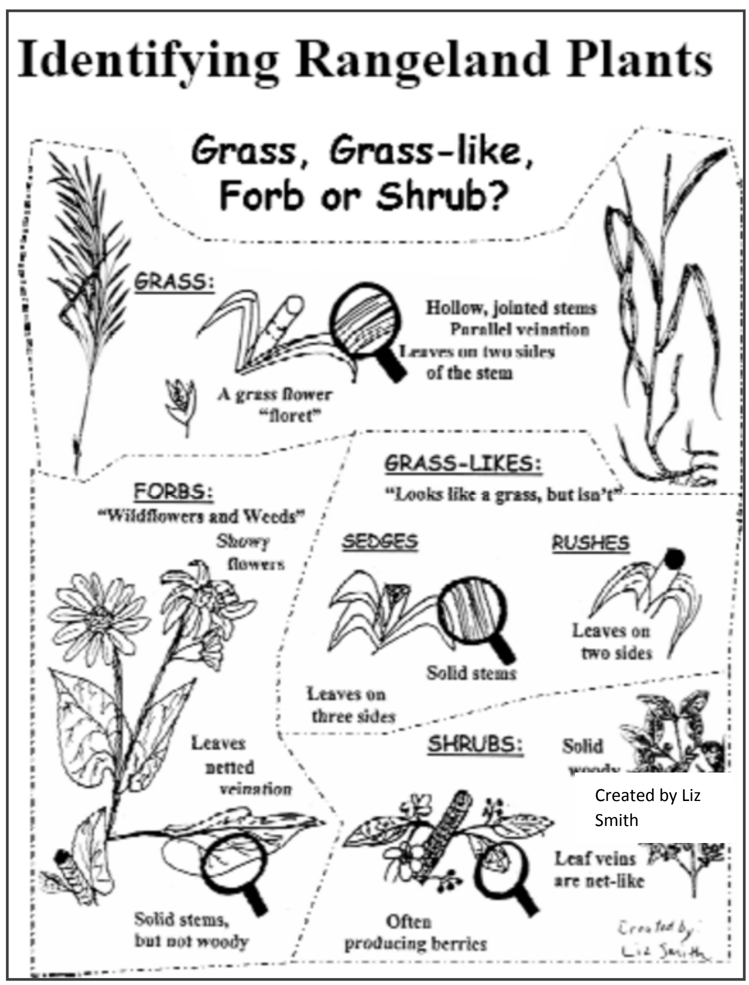
Types of Rangeland Plants

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" covering 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.



Created by Liz Smith

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.

Parallel Pinnate Palmate Netted

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 seed and berries that shrubs produce and is especially important as wildlife forage.

Lifespan

The lifespan 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 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 plants 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".

Weed Designation

A **weed** is a plant that creates a problem for humans. Weeds might reduce yield of crops, pastures, gardens, or yards. Weeds can also be spiny and cause pain, be poisonous, or have odors or pollens that make it difficult to breath. These problematic plants can affect how ecosystems function by accelerating soil erosion, changing natural fire regimes, affecting populations of grazing animals or pollinators, or decreasing water infiltration into soil. Weeds are often detrimental because they outcompete and reduce populations of native plants on land or in streams, lakes, or other aquatic ecosystems. (More information at: The Weed Center http://www.weedcenter.org/inv_plant_info/impacts.html.)

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 it is 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 which 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.

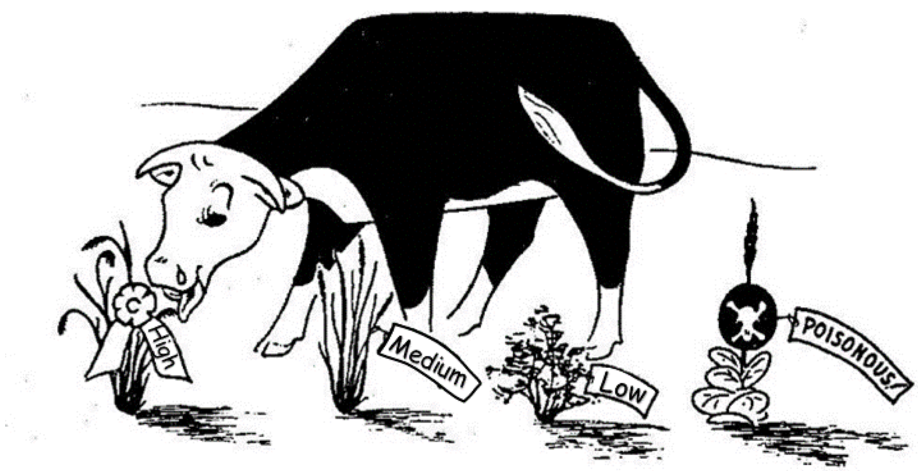


Figure from Pacific Northwest Extension Bulletin 73

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Rangeland Animals

Major Types of Animals on Rangelands

Rangelands provide habitat for countless mammals, birds, amphibians, 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.

Rangelands are also characterized by the presence a variety of birds. Large game birds such as grouse, quail, pheasants, and turkeys call rangelands home. Migratory song birds including meadowlarks, buntings, sparrows, and doves fill the grasslands, shrublands, and woodlands with color and song. Raptors including 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.

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 often possible to identify host-specific insects in their country of origin that can be introduced 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 antelope are examples of these opportunistic feeders that each eat grasses and forbs in the spring and summer and then switch to shrubs in the winter.

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

Omnivores are animals, such as humans or bears, which 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 animals such as 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 which 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

Food, water, cover, and space are the four basic habitat essentials required by all wildlife and livestock to survive, thrive, and reproduce. 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 is improved for some species but made worse 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. Rangeland habitats must provide animals four basic elements: food, water, cover and space.

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. **Thermal protection** is provided by plants when animals are shaded in the summer and sheltered 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 antelope 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 others of their 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

Location and size of home ranges and habitats are set by limiting factors such as water, food, climate, and topography. 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.

One can envision 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.

More information on animal units and how to set a stocking rate, refer to "**Forage Production and Carrying Capacity: Guidelines for Setting a Proper Stocking Rate**". The article can be found at http://rem151.files.wordpress.com/2013/10/stocking-rate-guidelines.pdf.

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).

Types of Interactions

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 their 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 are largely unaffected by 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.

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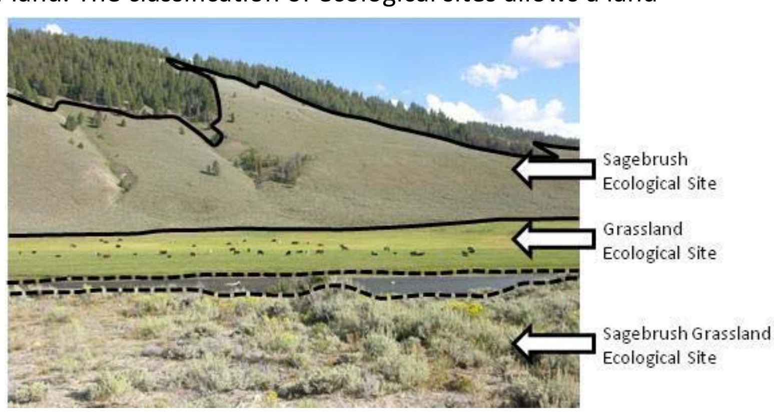
Describing and Monitoring Rangelands

Rangelands are vast landscapes that are composed of differing **abiotic** (non-living chemical and physical parts of the environment, e.g. slope, **aspect**, minerals, moisture, temperature) and **biotic** (living or once living, e.g. plants, animals, bacteria, fungi) components. Rangeland ecosystems also change dramatically from month to month and year to year. It is a great challenge for scientists and managers to describe and measure rangelands in ways that will help us understand what causes them to change or stay the same. Being good land stewards requires sound methods for describing rangeland conditions and monitoring their change over time in order to make wise management decisions.

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. This might involve viewing shrublands differently than grasslands, such as illustrated in the figure to the right.

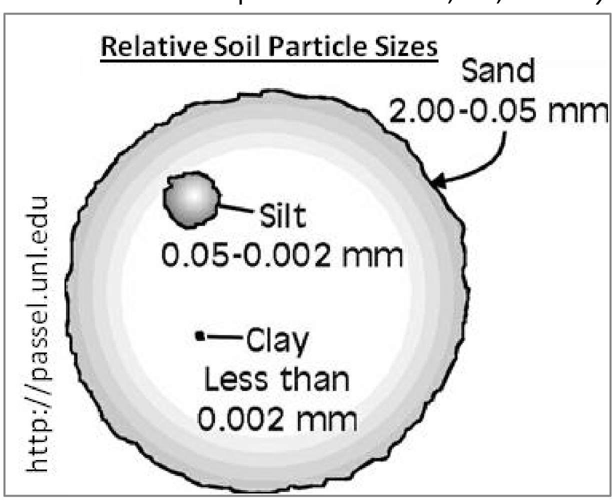


An ecological site is the product of all the environmental factors responsible for its development. Many factors lead to the different ecological sites that create landscapes. These include differences in soil, slope, aspect, and place on the watershed. Plant communities on an ecological site are characterized by a set of species that differs from other ecological sites in the kind, amount or proportion of species present. Each ecological site has a set of key characteristics that are included in the ecological site description. The site description states the physiographic factors: climate, water, soil, and plant communities the site could possibly support. Site descriptions are available through the Natural Resource Conservation Service, and are accessible online at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/desc/.

Soils

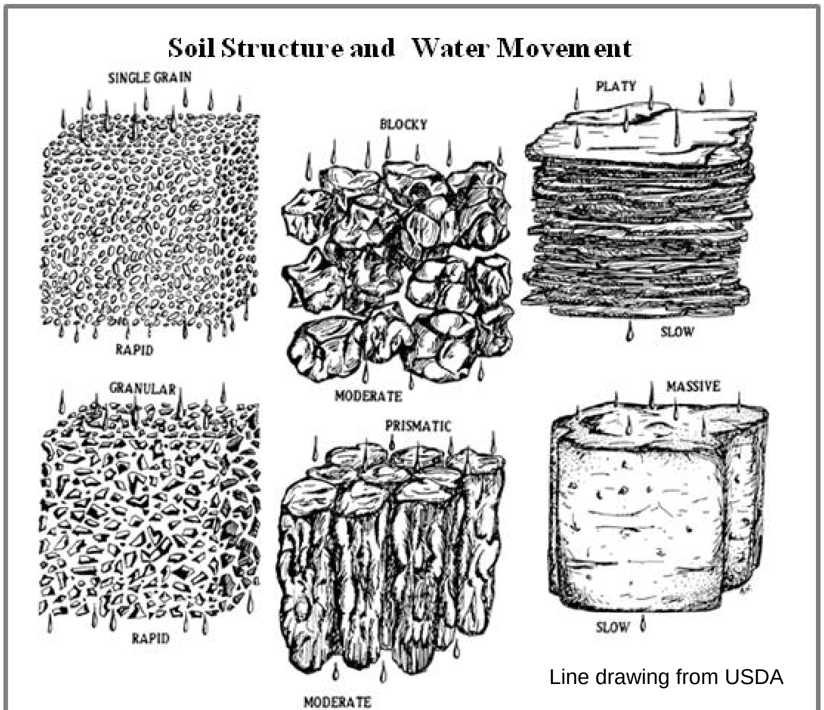
Soil is defined as a complex mix of ingredients: minerals, air, water, and organic matter—countless organisms and the decaying remains of once-living things (Soil Science Society of America). Soil is an important aspect of rangeland communities, and ecological sites have characteristic soils that have 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.

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*.

The texture and structure of soil directly influences 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.



Line drawing from USDA

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.

Topography and Watersheds

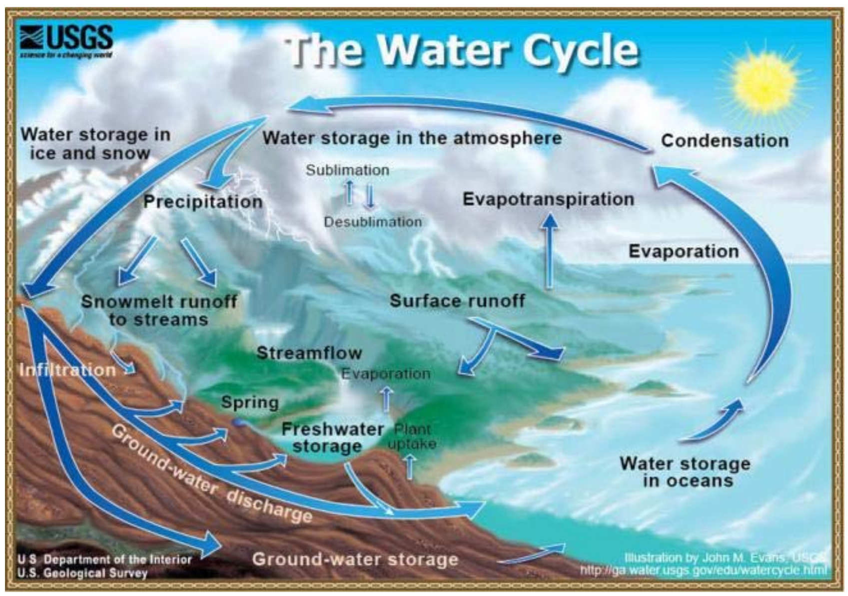
Land managers care for rangeland, forests, and croplands by managing the health of the watershed. Managing for healthy and productive soil ultimately leads to a functional watershed system. Managers accomplish this feat by managing the vegetation within the watershed.

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 which water travels through 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 are 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 meets 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.

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.

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

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. Riparian plants are characterized by strong root systems that can hold soil along the bank and protect it from the force of moving water.

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 pastures 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.

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 remove 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 referring 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?

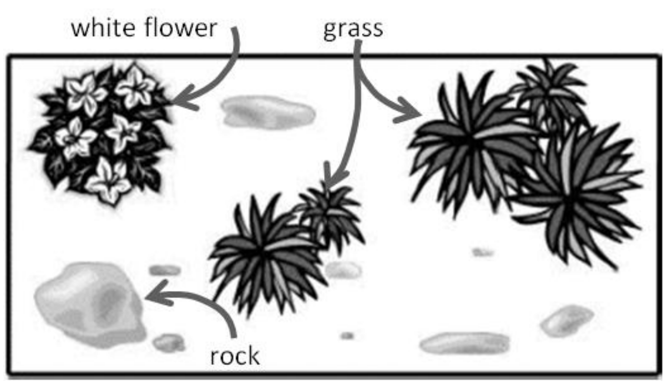
The most valuable skill that rangeland managers possess is the ability to differentiate between different **plant species**. Therefore, plant identification is essential to effective monitoring on rangelands. Plant species found on rangelands fall into five major types, or **life form** categories: grasses, 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 the plot of vegetation to the right, 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 45%"), or can be applied to individual species (i.e., "sagebrush cover was 15%").

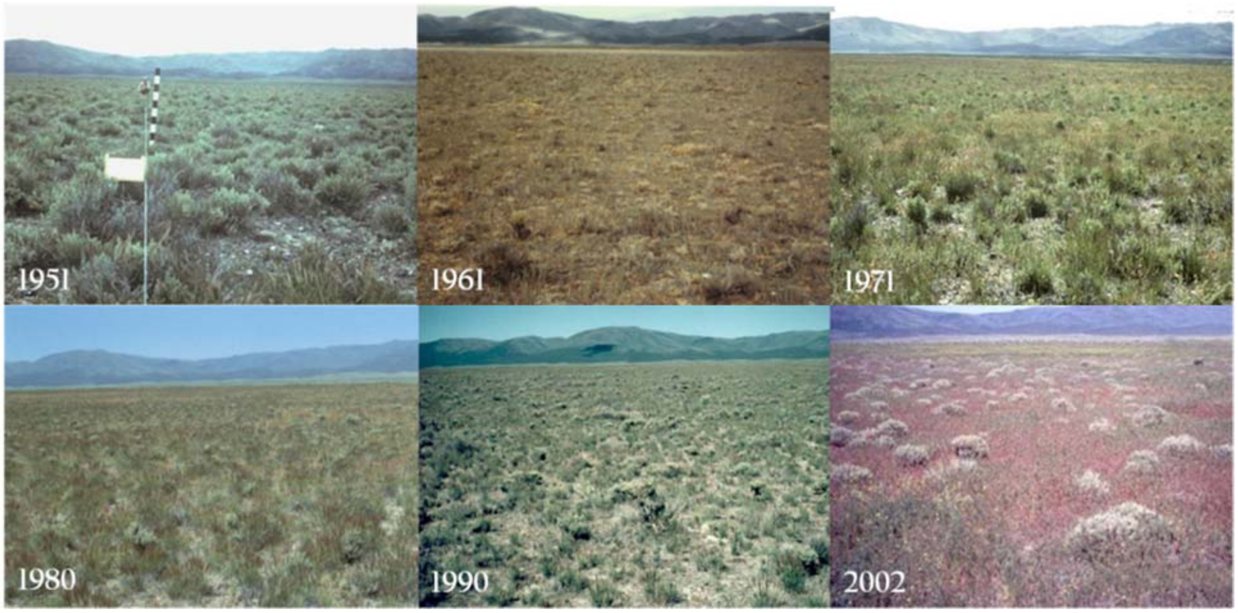
Vegetation **structure** describes the three-dimensional arrangement of a plant community. Structure measurements are primarily used to evaluate wildlife habitat elements (i.e., nesting cover, screen or hiding cover). Techniques used to quantify vegetative structure (such as the cover board in the figure to the left) 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 white-tailed 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.



Monitoring photographs of a rangeland shrub (shadscale) community in southern Idaho showing the dynamic nature of the site over time by L. Sharp and K. Sanders (1951 to 2002).

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Forces of Ecological Change

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

Grazing

The grasses, forbs, and shrubs that grow on rangelands are important sources of forage for grazing animals. Rangeland plants photosynthesize, 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., begin 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 they had never been grazed. So, the effects of grazing can be detrimental or beneficial depending on the: 1) plant species, 2) season when grazing occurs, and 3) intensity of grazing (how many leaves remain after grazing).

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.

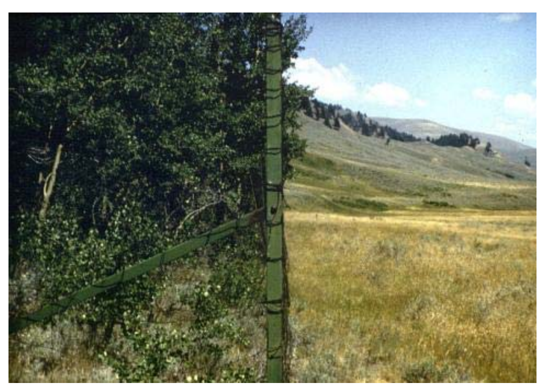
How Grazing Changes Plant Communities

Fences can provide a very clear delineation between two differently-grazed sections of otherwise identical rangeland. Many fence-line contrasts exist where a difference in plant community across the fence is caused by animals preferring some plants over others. When herbivores focus their grazing attention on one plant, or group of plants, the ungrazed plants can flourish – sometime creating dramatic contrasts.

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

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

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



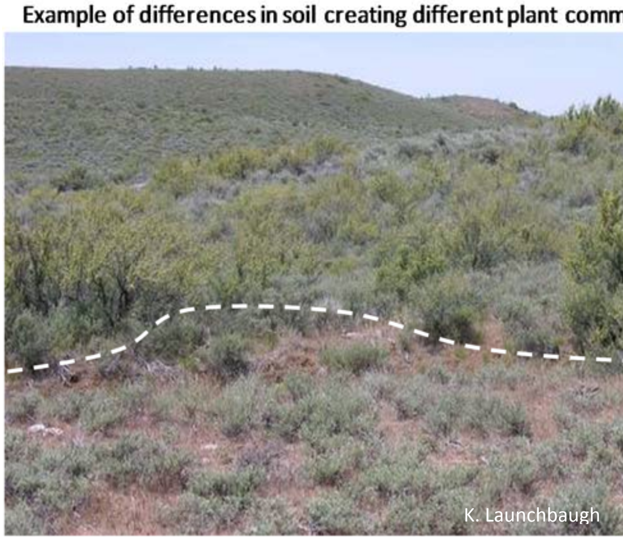
Elk grazing in Yellowstone National Park (on the right-side of this fence) preferred these willow species and removed them from the plant community.

What is Overgrazing?

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

Overgrazing can be difficult to recognize because not all rangelands are equally productive. Differences in soils and the presences 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 harvest precipitation and support plant growth.

Example of differences in soil creating different plant communities.



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

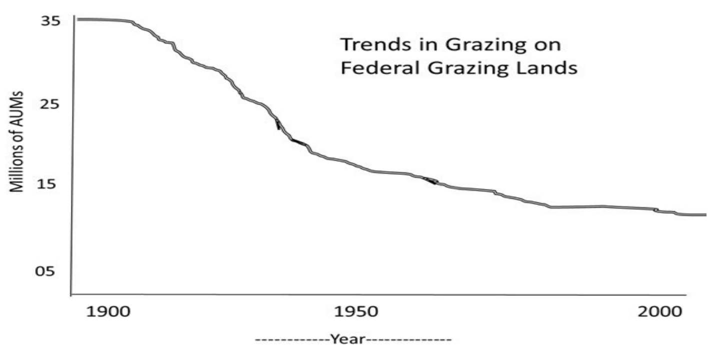
Shallow Stony Ecological Site dominated by Low Sagebrush 350 to 440 lb/ac depending on precipitation.

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 fail to reproduce and/or die. Overgrazing can also correspond with soil compaction or disruption of soil crusts, resulting in decreased water infiltration and increased erosion. Due to the complex nature of animal preferences, highly desirable areas in a pasture may experience overgrazing while other regions experience little or no use.

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 – this includes the 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 watch browsing of these stems. An indicator of overgrazing of shrubs is moderate or heavy hedging (i.e., growth of lateral stems just below a grazed point), and a lack of new or juvenile plants.


Hedging of Curl-leaf Mountain Mahogany

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. 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

Noxious weed is a specific term held 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 57 noxious weeds and requires that landowners attempt to control or contain these weeds when they occur on their property. If a landowner chooses not to take action, counties can treat the infestation, and bill the landowner for incurred expenses.

Why Are Weeds Bad?

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

- Reducing the abundance of native plants and animals – even rare plants can be displaced.
- Replacing diverse communities containing many species with a monoculture where only one species dominates.
- Reducing water infiltration and changing the hydrologic characteristics of the land.
- Altering soil characteristics and increasing soil erosion and runoff.
- Altering fire intensity and frequency.

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

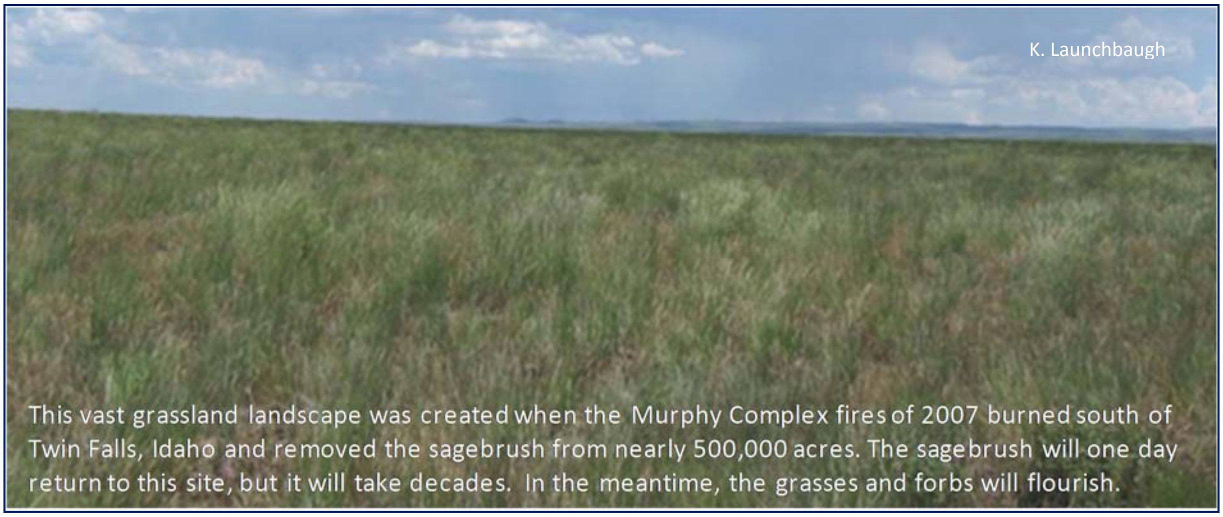
Wildland Fire

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

Fire is 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 improperly attended or 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, and windy conditions that can cause the rapid and unmanageable spread of fire which poses a serious threat to life and property.



This vast grassland landscape was created when the Murphy Complex fires of 2007 burned south of Twin Falls, Idaho and removed the sagebrush from nearly 500,000 acres. The sagebrush will one day return to this site, but it will take decades. In the meantime, the grasses and forbs will flourish.

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 and damaged by the heat of the fire. Burning during the hot, dry, summer months is the most harmful to plants because of the high intensity fires, while late summer and fall burns are the least harmful because of increased moisture and cooler temperatures.

Fire Return Intervals

A change of fire interval (i.e., the time between fires) or improper timing of fire during the season can deplete native plant communities of desirable perennial plants. Over time, repeated burning can result in severe impacts, including loss of perennial plants, an increase in frequency of weedy plants, increased erosion, and a change in nutrient cycling. Many weedy plant species are able to take advantage of the available soil nutrients, water, and growing conditions after a fire and outcompete more desirable plants. In Idaho and many other western states, land managers are concerned about cheatgrass invasion and its ability to shorten the interval between fire events. When cheatgrass goes dormant it creates a bed of fine fuels that are easily ignited and 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.


Fine fuel created by cheatgrass

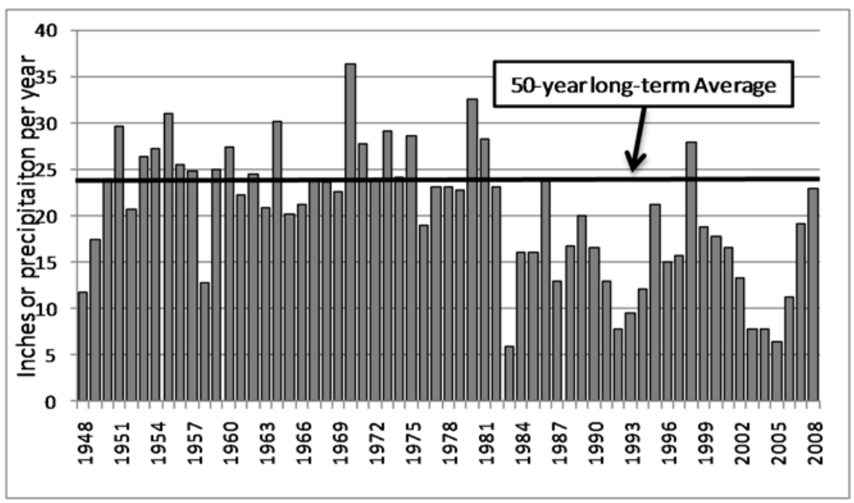
Fire suppression or the exclusion of fire can also impact landscapes over time. Fire suppression policies and actions over the past century were aimed at controlling fires when they occurred on rangelands. Fire suppression can result in an unnatural accumulation of fuels that may increase the probability of large, high-intensity wildfires that pose a threat to the long-term sustainability of the ecosystem. Fire suppression has also lead 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.

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, above), 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. For example, biomass of grass varied from 140 to 1,090 pounds/acre on a site where crested wheatgrass biomass was measured yearly for 35 years near Malta, ID (see below).

1969 –

Total grass production = 262 pounds/acre

Annual precipitation = 10 inches

1971 –

Total grass production = 1,090 pounds/acre

Annual precipitation = 16.5 inches

The role of global climate change on rangelands has been a topic of debate and consternation. It is clear that climate is changing. But the specific role that climate 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 build.

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

The effects of rural subdivision on plant communities can also be devastating. Ranchettes have a higher frequency and density of exotic invasive species in comparison to adjacent ranches. Roadways and paths are areas of disturbance for invasive species to establish. Small horse pastures are frequently overgrazed and highly degraded, resulting in loss of habitat and increased soil erosion. Many rare and sensitive species who are specific to certain ecological sites may find themselves in danger. However, more resources are being made available more frequently to help small land owners learn about land management and how best to conserve their meadows and pastures.

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Glossary of Rangeland Terms

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.

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

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.

Rangelands

An Introduction to Wild Open Spaces

2014

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