Rangelands

Chapter Goals:
After completing this chapter, volunteers should be able to:

- Define what Rangelands are.
- Tell how much Rangeland is in Idaho.
- Describe the uses and values of Rangelands.
- Define Rangeland management.
- Identify the different types of Idaho Rangelands.
- Discuss the history of land use and ownership in Idaho.
- Tell who owns and manages Rangelands in Idaho.
- Identify types of Rangeland plants including: type, lifespan, origin, weed designation, woody or herbaceous, forage value, major Rangeland plants of Idaho.
- Differentiate major types of animals on Rangelands including: diet selection: plants, animals or both, digestion strategies of herbivores, wild, domestic, and feral animals.
- Tell habitat needs of Rangeland animals including: limiting habitat factors, stocking rates and carrying capacity.
- Describe Rangeland animal interactions including: types of interactions, livestock and wildlife interactions.
- Explain Rangelands including: ecological sites, soils, topography and watersheds.
- Tell what a watershed is including: uplands vs. riparian.
- Describe measuring and monitoring plant communities including: assessment and monitoring, and attributes.
- List and discuss the major drivers of ecological change: Grazing, ecosystem impacts of grazing, plant response to grazing, grazing changing plant communities, overgrazing; Invasive Plants, invasive plant terminology, why weeds are bad; Wildland Fire, wildfire versus prescribed burning, effects of fire on plants, fire return intervals, positive aspects of wildfire; Weather and Climate; Fragmentation of Rangelands.
- Find references, agencies responsible for Rangelands, glossary of Rangeland terms.

RANGELANDS

An Introduction to Idaho's Wild Open Spaces

University of Idaho
College of Natural Resources

IDAHO RANGELAND RESOURCE COMMISSION

Rangelands

An Introduction to Idaho's Wild Open Spaces

2009

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

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

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Rangelands Overview

WHAT ARE RANGELANDS?

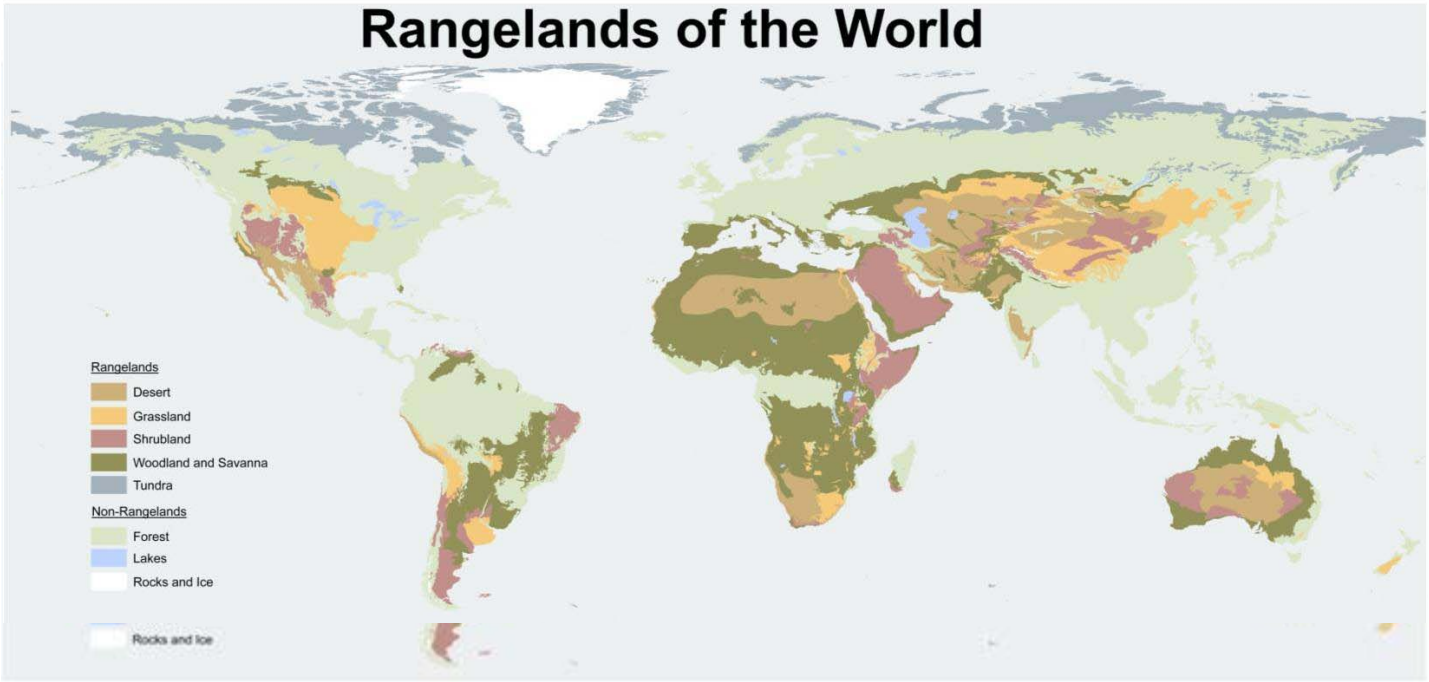
What are rangelands? Rangelands are lands that are not: farmed, dense forest, entirely barren, or covered with solid rock, concrete, or ice. Rangelands are: grasslands, shrublands, woodlands, and deserts. Rangelands are usually characterized by limited precipitation, often sparse vegetation, sharp climatic extremes, highly variable soils, frequent salinity, and diverse topography. From the wide open spaces of western North America to the 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, grasslands, swards, steppes, pampas, shrublands, scrublands, woodlands, savannahs, deserts, semi-deserts, and arid lands.

Grasslands are ecosystems that are dominated by grasses. Throughout the world, grasslands go by many names including prairie, steppe, 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 lands with abundant stands of shrubs with an understory of grasses and herbaceous plants-but shrubs dominate these ecosystems. Shrublands across the world are called chaparral, cerrados, shrub-steppe, maquis, and scrublands. In North America, shrubland biomes include chaparral, sagebrush-steppe, salt-desert shrublands, tundra shrublands, and mountain browse.

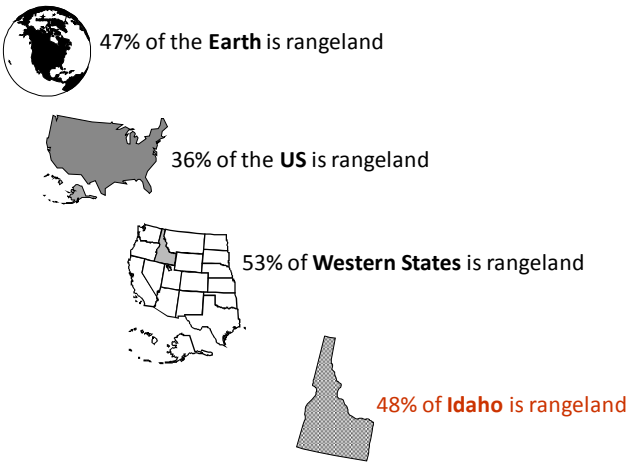
Woodlands and **Savannahs** are dominated by widely-spaced trees including junipers, oaks, mesquite and pines with an understory of grasses and forbs. Woodland ecosystems across the world take the names of the trees that dominate the landscape. In North America, the largest woodland biome is the pinyon-juniper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

Deserts are the driest rangelands and they experience extreme water shortage 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 Saharan, Namib, Arabian, Atacama, Australian Outback, and Kalahari deserts. The hot desert biomes in the North America are found in the southwest and include the Mojave, Sonoran, and Chihuahuan deserts.



HOW MUCH RANGELAND IS THERE?

Of the earth's total land surface, 47% is rangeland. In the U.S., 36% of the land area (nearly 1 billion acres) is rangeland. A total of 53% of the 19 states west of the Mississippi are rangeland. The state of Idaho encompasses 53 million acres. Nearly 26 million acres or 48% of Idaho's land area is classified as rangeland. The geographic and climate regimes of Idaho's rangelands are very diverse, which creates many unique plant communities and associations.



USES AND VALUES OF RANGELANDS

Historically, the primary use of rangeland has been to provide forage for livestock and wildlife. However, the importance of rangeland for recreation and water production is growing. Rangelands provide natural beauty, a diversity of wildlife, recreational opportunities like hunting, hiking, and camping, and economic values, including ranching, mining, and electrical power. Rangelands also serve as important watersheds for production of clean abundant water. The soils, vegetation, and water of rangelands are important to the ecological and economic health of the world, especially Idaho and everyone living it. Therefore, most rangelands are managed under principles of multiple-use which means that several uses or values of rangeland are managed simultaneously with care to avoid overuse or destruction of natural resources.

Though rangelands appear to be dry, unyielding landscapes, they provide important contributions of water to the streams, lakes, and aquifers that they contain. Because rangelands are located mostly in arid climates with 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, water consumption and use increases, and healthy rangeland ecosystems are becoming increasingly important.

Rangelands also provide important **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 the grassy landscapes. Livestock production on rangeland is very important to supply 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.
- Livestock grazing occurs on 65% of Idaho's total land area and in every county throughout the state.
- Range livestock production is one of Idaho's major agricultural activities in terms of land used and cash receipts.

A diversity of **wildlife** thrive on rangelands habitats. Mammals, birds, amphibians, reptiles, fishes, and even insects make home in these complex ecosystems. Plants, water, and soils on rangelands provide unique environments for wild animals and plants, including threatened and endangered plant and animal 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.

Rangelands can also provide a significant source of energy and other **natural resources**. Rangelands are used for 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 gained 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 attaining solar power, and wind

power from turbines. These uses of rangelands will become more valuable and common as the demand for more energy increases, especially clean renewable energy.

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. A century ago, most citizens considered rangelands "wasteland" and thought that meat production was the best use for rangelands. Recently, more and more people are enjoying rangelands for recreation and aesthetics. What will the next generations want from rangelands? Open space? Wind power? Carbon sequestration?

> *"…Rangelands may be far better at producing the stuff of myth and national identity than …beef and mutton products. Yet, it 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 and for production purposes. Management decisions on rangelands are made with ecological properties in mind such as: soil health, vegetation, wildlife, invasive plants, and water quality. Range managers also need to consider the land owner's objectives that might include livestock production, open space, recreation opportunities, or energy production.

Rangeland management is a challenging endeavor because many of land resources and ecological forces that affect rangelands do not respect fences or property boundaries such as 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 the State Department of Lands. This can often be the case when land parcels are not productive or sizeable enough to be managed on their own so they are 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 can or want to 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 and having the knack for administering land management decisions based on what one knows or understands about that rangeland. A successful range manager embraces learning through experience built upon a foundation of scientific knowledge.

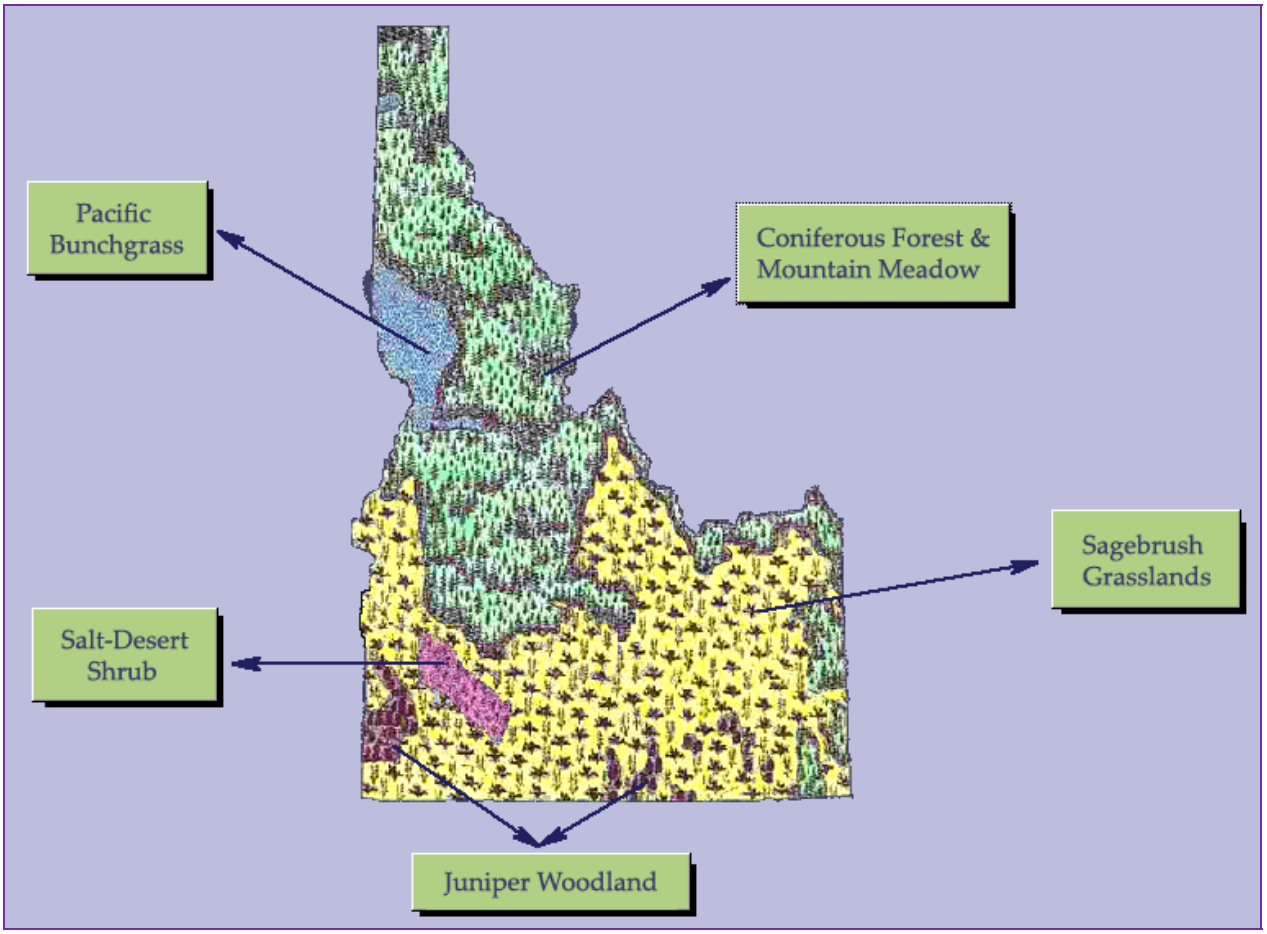
IDAHO RANGELANDS

Types of Rangeland in Idaho

Rangelands in Idaho include canyon grasslands, Palouse prairie, sagebrush-steppe, cold desert shrublands, juniper woodlands, aspen savannahs, mountain meadows, and streamside riparian communities. The geographic and climatic regimes of Idaho's rangelands are very diverse, creating many unique plant communities and habitats that are well adapted to these conditions. Low precipitation in these areas, often less than 10 inches per year, throughout most of Idaho creates plant communities, such as grasslands and shrublands, that can survive hot, dry summers. These plants have many adaptations such as extensive root systems that effectively gather soil moisture even in the driest of conditions.

Ecoregions are equivalent to small biomes within a specific geographic region. For example, in Idaho, the vegetation communities can be grouped in five "ecoregions": sagebrush grasslands, juniper woodlands region, salt-desert shrublands, pacific bunchgrass, and coniferous forests.

The following is an overview of the common ecoregions found in Idaho.



Sagebrush Grasslands

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

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

Common plants in the sagebrush grasslands region include sagebrush; primarily big sagebrush, and other shrubs such as rabbitbrush. Perennial bunchgrasses that are found in this region are typically bluebunch or crested wheatgrass. Arrowleaf balsamroot and tapertip hawksbeard are also common forbs in this region which produce bright yellow flowers that characteristically paint this landscape.

Juniper Woodlands

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

Out on the range, we humans generally try to fight wildfires. This fire suppression

benefits the juniper trees because they are usually killed by fire. Without natural wildfires, juniper expands into adjacent sagebrush-grasslands and displaces this ecoregion.

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

Western and Utah juniper are both common types of juniper found on these rangelands. Big sagebrush is usually found growing in the understory. Grasses typically found on sagebrush-grassland, including bluebunch wheatgrass, bottlebrush squirreltail, and Sandberg bluegrass, are also present on juniper-woodland landscapes.

Salt-Desert Shrublands

"Desert" usually brings to mind hot, dry places with lots of blowing sand. In southern Idaho, equally dry deserts are created by salty soils and cold temperatures. Shrubs that are able to live in these salty soils dominate this "cold desert" covering 1.5 million acres. As the name suggests, soil salinity is a characteristic feature of this rangeland area. These shrublands get very little precipitation each year, usually 10 inches or less. Shrubs are generally

better suited for these harsh conditions than grasses or forbs because of their deep root systems. Because these shrubs have high nutritive value in winter, salt deserts are excellent winter range for pronghorn antelope and are considered some of the world's best range for winter sheep grazing.

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

Pacific Bunchgrass

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

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

Predominant native grasses in the Pacific Bunchgrass region are bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. Snowberry, a shrub of the honeysuckle family, is also found on this type of environment, along with wild rose. One may also find arrowleaf balsamroot, biscuitroot, lupine and wild geranium.

Coniferous Forest and Meadow

Most of northern and central Idaho is dominated by evergreen coniferous forest totaling about 22 million acres. The forested ecosystems are much more moist than the shrublands and grasslands of southern Idaho, receiving 40 or more inches of snow and rain each year. Most of this area is dominated by dense forest interspersed with natural openings called meadows. In between the trees is vegetation

characteristic of rangeland (grasses, forbs, and shrubs) that is valuable habitat for all kinds of grazing animals. Shrubby vegetation near the forest edge is especially important for deer and elk, and the meadows are important summer range for both wildlife and livestock.

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

Riparian Areas

The lush ecosystem that consists of vegetation along bodies of water is called a **riparian area**. Riparian areas may surround lakes, ponds, wetlands, or fast or slow-moving rivers, creeks, or streams. There are riparian areas on Idaho rangelands surrounding the Snake River, 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 easily damaged by uncontrolled livestock and wildlife grazing.

Water-loving plants thrive in these moist areas of rangelands. Coyote willow, redosier dogwood, and cottonwoods typically grow along edges of the water. Otherwise, mostly sedges and rushes, such as Baltic rush, beaked sedge, and Nebraska sedge occupy the open moist soils.

History of Land Use and Ownership in Idaho

The lands in Idaho, and the Native Americans living there, were first documented by explorers Meriwether Lewis and William Clark in 1805. Lewis and Clark were among the first Europeans who made the journey through rough terrain and weather in Idaho and reported on many different grasses, forbs, and woody plants on the range. In fact, Lewis also described sage grouse and other animals still common today on Idaho rangelands.

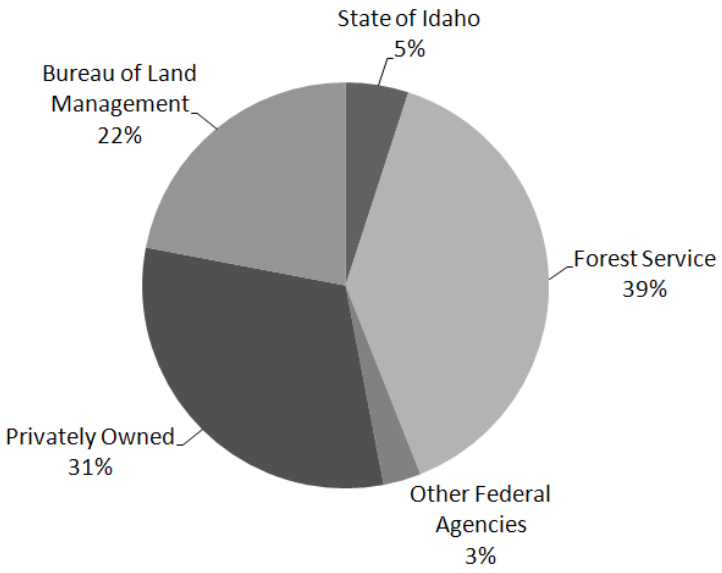
Lewis and Clark's discoveries from their journey through the Pacific Northwest were followed by increased interest in these uncharted lands. The idea of making dreams come true in the green and boundless west seemed appealing to many easterners. As a result, the first wagon traveled road was called the Oregon Trail and it crossed Idaho in 1843. In 1862, the Homestead Act helped to motivate the major settlement on rangelands, followed by additional laws to allocate land for settlement and human use. Most of these settlements surrounded water sources, such as the Snake River. Successful homesteaders in Idaho filed on land that had a natural source of water, before dams were constructed on the Snake River in the early 1900's. Between 1870 and 1900, rangelands were seen 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 1880's, the livestock production industry in Idaho peaked. Large ranches, running thousands of cattle and sheep, dominated the Idaho business sector.

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 foundation for the U.S. Forest Service, created in 1905 providing for management of rangelands and grazing practices. In 1934, the Taylor Grazing Act recognized the importance of controlling use on public grazing lands and their improvement. This led to the formation of the Grazing Service, which eventually was combined with the General Land Office to form the Bureau of Land Management in 1946.

The 1990's brought more and more people to Idaho's landscapes. Since the late 1800's, livestock grazing has been the predominant economic use of public rangelands, while hunting and fishing remained the main recreational uses until the mid-1900's. However, an increasing western population, greater individual wealth and a high degree of mobility has created demands for other forms of recreation on public lands. Since 1960, considerable conflict has occurred over the use of public lands. With an increase in population, Idaho citizens and visitors continue to find many uses of the land, such as hiking and all terrain vehicle (ATV) use. With this increased public use of rangelands, the Idaho Rangeland Resource Commission was created in 1994 with the goal of increasing the public understanding of Idaho's rangelands by providing factual information about economic and ecological aspects of rangeland management (www.idrange.org). Expanding knowledge about Idaho's precious lands helps to promote proper environmental stewardship and conservation for future generations to use and enjoy.

Who Owns and Manages Rangelands in Idaho?

In Idaho, about 68% of all land is publicly owned (33.1 million acres federal; 2.5 million acres state). Who owns or manages all this wild and vast country? These public rangelands in Idaho are primarily managed by federal agencies, which are the U.S. Forest Service, Bureau of Land Management, and National Park Service. Other public lands are also managed by the State of Idaho through the Idaho Department of Lands, Idaho Fish and Game, and Idaho Parks and Recreation. About one third of Idaho is owned by private individuals and families who manage their rangeland for economic benefit and personal enjoyment. Included in these privately owned lands are Native American Tribes, such as the Nez Perce and Shoshone-Bannock Tribes, who manage tribal lands that comprise about 464,077 acres or 1% of Idaho lands. The intermingled mosaic of land ownership across many western states creates challenges for rangeland managers because land management goals may not be the same across boundaries.



Idaho land ownership (1996) by percent of total land area (O'Laughlin et al. 1998)

Agencies Owning and Managing Idaho Rangelands	
Agency and Website	Major Purposes
Bureau of Land Management (BLM) http://www.blm.gov	Administers and manages land, and develops management and conservation programs.
United States Forest Service (USFS) http://www.fs.fed.us	Manages public lands in national forests and grasslands, and provides technical and financial assistance to state and private forestry agencies.
USDA-Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov	Provides technical assistance to private land owners, serving through Soil Conservation Districts and the Farm Services Agency.
National Park Service (NPS) http://www.nps.gov	Preserves national parks for resource conservation and recreation.
Idaho Department of Lands (IDL) www.idl.idaho.gov	Manages endowment trust lands to protect Idaho's natural resources.
Idaho Fish and Game (IDFG) http://fishandgame.idaho.gov	Manages fish, wildlife, plant resources, and habitats for public use.
Idaho Parks and Recreation http://parksandrecreation.idaho.gov	Manages state parks, run registration program for boats and recreational vehicles.

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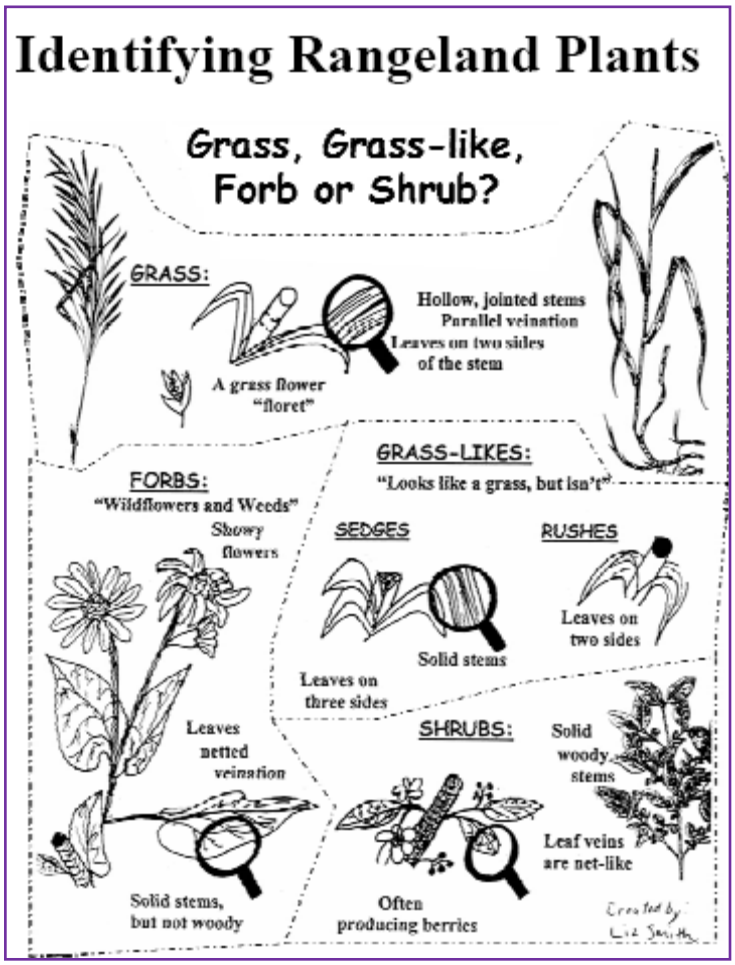
Rangeland Plants

Most management decisions on rangelands are made by first knowing the various range plants inhabiting them and knowing their growth habits. The identification of range plants is based on various plant characteristics and plant types. One of the most important identifying characteristics of plants is the shape of a plant's leaf. Other important characteristics include the margins and venation of leaves which are important when distinguishing plants.



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.

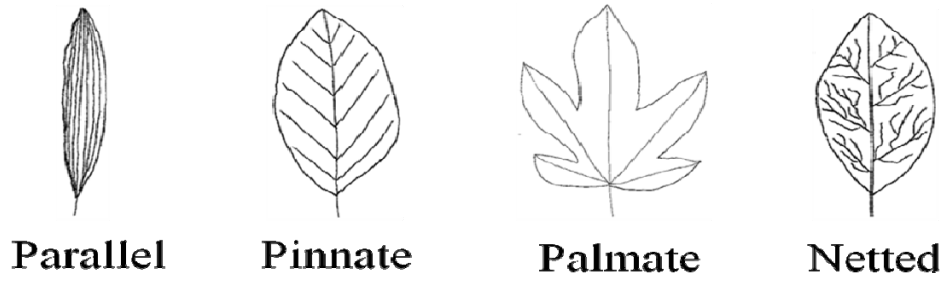
Plant Type or Life Form

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 produce grain-like seeds. Ecosystems dominated by grasses i.e. grasslands cover more than one fifth of the earth's land surface.

Grass-like plants look like grasses but have solid stems (not hollow) without

joints. Stems are often triangular. Veins in the leaves are parallel. Sedges and rushes are in this group of plants.

Forbs are herbaceous (non-woody) plants that usually have broad leaves and showy flowers. Forbs have above-ground growth that dies back each year. Most forbs have net veins in the leaves, but a few have parallel veins. Most of the plants commonly called wildflowers and range weeds are forbs.



Shrubs are woody plants that usually have broad leaves. They 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 part of a shrub plant that is 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 for wildlife.

Lifespan

The life span of a plant refers to the length of time from the beginning of the development of the plant to the death of the plant. In other words, how long it takes the plant to grow, flower, and produce seeds. Range plants can be classified as annuals, biennials, or perennials.

Annual plants live only one growing season. There are two types of annuals in the Pacific Northwest. 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 and complete all growth by the end of the growing season and then die.

Biennial plants live for two growing seasons. During the first growing season, these plants normally form a basal cluster 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 from one year to the next. 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 can appear in the fall if moisture is adequate. Plants that grow at high elevations are usually cool season plants because of the cool temperatures throughout the growing season. Most of the plants

in Idaho are cool season plants. 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 that is the first compound produced from the specific type of photosynthesis of these plants). Seed develops in mid-summer and early fall. In Idaho, warm season plants only occur at low elevations and topographic exposures where warm growing conditions are reached in the summer. Southern states such as Texas and New Mexico have nearly all warm season plants. There is also another pathway for photosynthesis called CAM (Crassulacean Acid Metabolism) that is common in plants such as cacti, found in the desert regions.

Origin

The "origin" of a range 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. Range 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 have been brought to North America from another continent, either by intentional or accidental methods. Several plants have been introduced to rangelands because they have good forage value. Others were accidentally introduced, usually as contaminants in crop seeds. Weedy introduced plants were accidentally introduced or brought in for their ornamental value, but then "escaped" into rangelands.

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 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 binding of plant fiber (i.e., cellulose) with lignin which is 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 differ by species for grazing animals. 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 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 are plants that will provide adequate nutrients if eaten, but it is not preferred by animals because they are not high in nutrient, are note highly digestible, or are relatively small plants and do not produce and 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 can 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 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.

MAJOR RANGELAND PLANTS OF IDAHO

Idaho is a state of great plant diversity. Living in these wild habitats is an amazing variety of plants that are adapted for and survive harsh natural climates. These rangeland plants convert sunlight into leaves and fruit for animals to eat, roots to hold soil and flowers to provide aesthetic beauty. For more information and pictures of common Idaho rangeland plants, visit http://www.cnr.uidaho.edu/what-is-range/. A ***Backpack Guide to Idaho Range Plants*** featuring these common range plants is available from the Rangeland Ecology and Management Department at the University of Idaho (http://www.uidaho.edu/range) and the Idaho Rangeland Resource Commission (www.idrange.org).

Major Rangeland Plants of Idaho - 50 Common Plants

Common Name (*Scientific name)*

Grasses and Grass-Like Plants

Bluebunch Wheatgrass *(Pseudoroegneria spicata)*
Bottlebrush Squirreltail *(Elymus elymoides)*
Cheatgrass or Downy Brome *(Bromus tectorum)*
Columbia Needlegrass *(Achnatherum nelsonii)*
Crested Wheatgrass *(Agropyron cristatum)*
Great Basin Wildrye *(Leymus cinereus)*
Idaho Fescue *(Festuca idahoensis)*
Indian Ricegrass *(Achnatherum hymenoides)*
Medusahead Rye *(Taeniatherum caput-medusae)*
Mountain Bromegrass *(Bromus marginatus)*
Orchardgrass *(Dactylis glomerata)*
Red Threeawn *(Aristida purpurea)*
Sandberg Bluegrass *(Poa secunda)*
Smooth Bromegrass *(Bromus inermis)*
Western Wheatgrass *(Pascopyrum smithii)*

Grass-Like Plants

Baltic Rush (*Juncus arcticus)*
Elk Sedge *(Carex geyeri)*
Nebraska Sedge *(Carex nebrascensis)*

Noxious Weeds

Dyer's Woad *(Isatis tinctoria)*
Hoary Cress or Whitetop *(Cardaria draba)*
Leafy Spurge *(Euphorbia esula)*
Poison Hemlock *(Conium maculatum)*
Rush Skeletonweed *(Chondrilla juncea)*
Spotted Knapweed *(Centaurea stoebe)*
Yellow Starthistle *(Centaurea solstitialis)*

Forbs

Arrowleaf Balsamroot *(Balsamorhiza sagittata)*
Curlycup Gumweed *(Grindelia squarrosa)*
Indian Paintbrush *(Castilleja spp.)*
Low Larkspur *(Delphinium bicolor or D. nutalliana)*
Mules Ear *(Wyethia amplexicaulis)*
Penstemon or Beardtonge *(Penstemon* spp.*)*
Russian Thistle or Tumbleweed *(Salsola kali)*
Tailcup Lupine *(Lupinus caudatus)*
Tall Larkspur *(Delphinium occidentale)*
Taper-tip Hawksbeard *(Crepis acuminata)*
Western Yarrow *(Achillea millefolium)*
Wild Geranium *(Geranium viscosissimum or G. richarsonii)*

Woody Plants

Antelope Bitterbrush *(Purshia tridentata)*
Big Sagebrush *(Artemisia tridentata)*
Chokecherry *(Prunus virginiana)*
Coyote Willow *(Salix exigua)*
Curl-leaf Mountain Mahogany *(Cercocarpus ledifolius)*
Juniper *(Juniperus utahensis or J. occidentalis)*
Quaking Aspen *(Populus tremuloides)*
Rabbitbrush *(Chrysothamnus viscidiflorus or Ericameri nauseosa)*
Redosier Dogwood *(Cornus sericea)*
Serviceberry *(Amelanchier alnifolia)*
Shadscale Saltbrush *(Atriplex confertifolia)*
Snowberry *(Symphoricarpos albus)*
Winterfat *(Krascheninnikovia lanata)*

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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 grazing animals such as bison, elk, pronghorn, and deer are perhaps the most iconic rangeland animals. Grazing livestock species including cattle, sheep, goats, and horses also inhabit rangeland landscapes. These hooved animals are called **ungulates**. Other mammals commonly found on rangelands include rodents and rabbits.

Rangelands are also characterized by 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 be often found in the rangeland skies. Some birds are so attached to rangelands that vegetation types are in their name like prairie falcon, meadow lark, sage thrasher, and scrub jay.

Insects are most prolific inhabitants of rangelands that are 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. Periodically, large outbreaks of certain insects occur, namely grasshoppers or Mormon crickets, and can cause great devastation to rangeland ecosystems by eating rangeland plants and adjacent croplands. Insect herbivory competes directly with wildlife and livestock foraging, but because of their small size and inconspicuous nature, they are often overlooked is both stocking rate estimates and forage assessments. Insects are not only powerful herbivores that forage on native plants; they also can be introduced into areas to control undesirable plants such as noxious weeds, a process known as **biocontrol**. They also play a vital role in decomposing dead plant material in the soil and improving soil aeration. Insects are also the indispensable pollinators of plants that sustain genetic diversity among rangeland plants.

Diet Selection: Plants, Animals or Both

Animals that live on rangeland can be categorized based on their foraging patterns. For example, classification is first based on whether the animals eat plants, other animals, or both:

Herbivores are animals that eat plants.

Grazers – are animals, like cattle, elk and bison that eat mostly grasses.

Browsers – include deer and goats that eat 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 basically 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 including insects, birds, reptiles, or mammals.

Omnivores are animals, including most humans, who 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 are composed mostly of fiber or cellulose, which is a type of carbohydrate that cannot be digested by the enzymes of the grazing animal's stomach. However, many herbivores have a specialized fermentation organ and a symbiotic relationship with bacteria, protozoa, and fungi that can break down cellulose into 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 that include 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, which houses fermentation of forage particles to release energy from the cellulose. The cecum is located past the true stomach (i.e., behind the gut) – therefore these animals are called "hind-gut fermenters."

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

Wild, Domestic, and Feral Animals

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

Wild animals or **wildlife** are animals whose behavior, physiological, 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 good 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 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. This natural home of an animal includes all biotic, climatic, topographic, and edaphic (soil) factors that affect life. Rangeland habitats must provide animals four basic elements:

Food requirements for rangeland animals include energy, nutrients, and minerals**. Energy** sources in plants can come from starches, sugars, fats, and cellulose. **Nutrients** come mostly from protein and vitamins. **Mineral** requirements focus on phosphorus and potassium. When determining the food available to rangeland animals, rangelands must be evaluated on the basis of food requirements (the types of vegetation present and the diet preferences of animals) and the special arrangement of available food.

Different types of animals require different amounts of food each day. As a general rule, ruminants such as 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 3.5% 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 1-1 ½ gallons of water once every two days; donkeys require 3-4 gallons of water every day; horses require 5-8 gallons of water once or twice a day; and cattle and bison require 8-10 gallons of water every one to two days. 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 it offers animals shade in the summer and shelter from cold in the winter. Thermal cover for most 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.

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 other animals. The home range of an animal is directly related to its body weight; the larger the animals the larger its home range. Home ranges also vary by foraging habits; carnivores have very large home ranges; home ranges of herbivores are comparatively smaller.

Limiting Habitat Factors

Location and size of home ranges and habitats are set by limiting factors such as water, food, climate, and topography. These limiting factors are basic requirements that limit 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. 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, 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. Stocking rate is often stated as the number of AUs/acre/year or acres/AU/year. For example, if the stocking rate of a pasture is 4 acres per AU per year (i.e., 4 ac/AUY) then it requires 4 acres to provide enough forage for 1 AU, such as a 1,000 pound cow, for a year.

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 and 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.

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://www.cnr.uidaho.edu/what-is-range/curriculum/Contents/MOD3/Stocking-rate-guidelines.pdf.

RANGELAND ANIMAL INTERACTIONS

Rangelands are very diverse habitats with a great 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 harmful, 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 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 they have 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 it gets a benefit as a food source, but the rabbit or lamb is harmed.*

- **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. Competition only occurs when the common resource is used by both animals. Animals are "competing" for a resource only if there is not enough for both of them to meet their requirements.*

- **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 affect on meadow larks or bluebirds.*

Livestock and Wildlife Interactions

Ranch management and subsequent grazing management strategies can negatively or positively impact wildlife that utilizes similar landscapes as livestock. Livestock can be an important management tool for improving wildlife habitat. In other words, livestock grazing can be used to purposely manipulate forage to improve wildlife habitat for a chosen wildlife species. Livestock managers can alter the timing, frequency, intensity, and type livestock grazing to achieve wildlife habitat management goals. For example, spring grazing by cattle on the mountain benches near Boise encourages the growth of shrubs that are important winter forages 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 and enhance habitat quality and promote complementary relationships between wildlife and livestock on rangelands.

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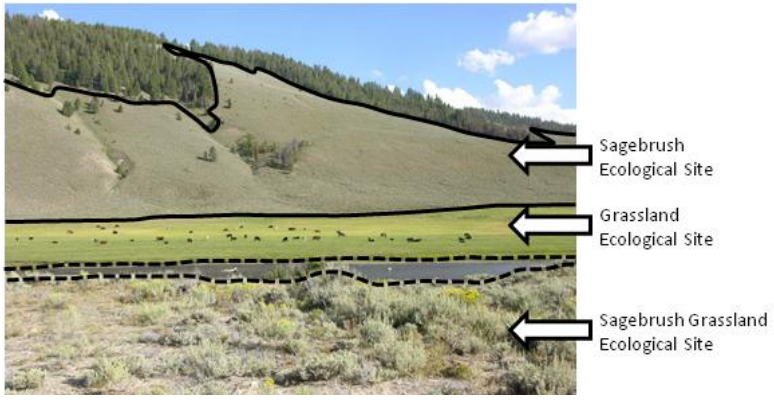
Describing and Monitoring Rangelands

DESCRIBING RANGELANDS

Rangelands are vast landscapes that are composed of differing **abiotic** (e.g. slope, aspect, minerals, moisture, temperature) and **biotic** (e.g. plants, animals, bacteria, fungi) components. Furthermore, rangeland ecosystems 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.

Ecological Sites

Rangeland landscapes can be divided into **ecological sites** for the purposes of inventory, evaluation, and management. An ecological site is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation. The classification of ecological sites allows a land manager to map large areas into units with similar potential to grow specific types of plants. This might involve viewing shrublands different than grasslands or separating grasslands dominated by wheatgrass from those dominated by fescue.



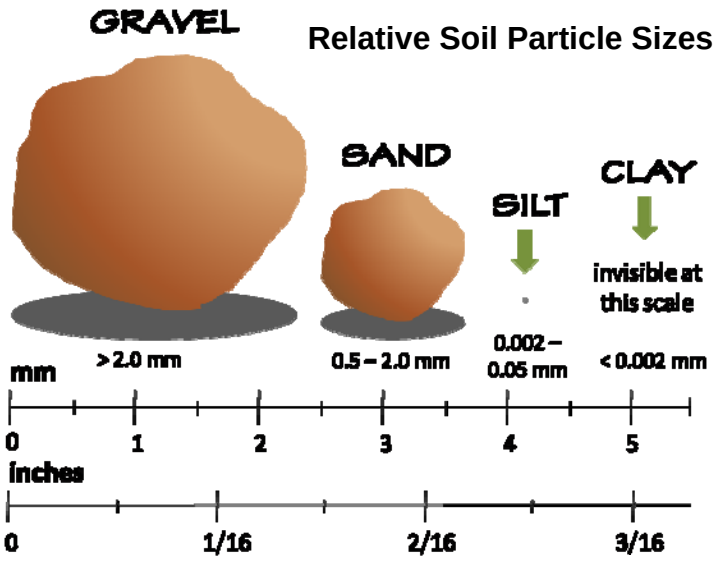
Many factors lead to the different ecological sites that create landscapes. These include differences in soil, slope, aspect, and place on the watershed. Plant communities on an ecological site

are typified by a specific group of species that differs from that of other ecological sites in the kind, amount or proportion of species present. An ecological site is the product of all the environmental factors responsible for its development, and it has a set of key characteristics that are included in the ecological site description. The site descriptions take into account physiographic factors, climate, water, soil, plant communities, and a rangeland health reference sheet. Site descriptions are available through the Natural Resource Conservation Service, and are accessible online at: http://esis.sc.egov.usda.gov/Welcome/pgESDWelcome.aspx.

Soils

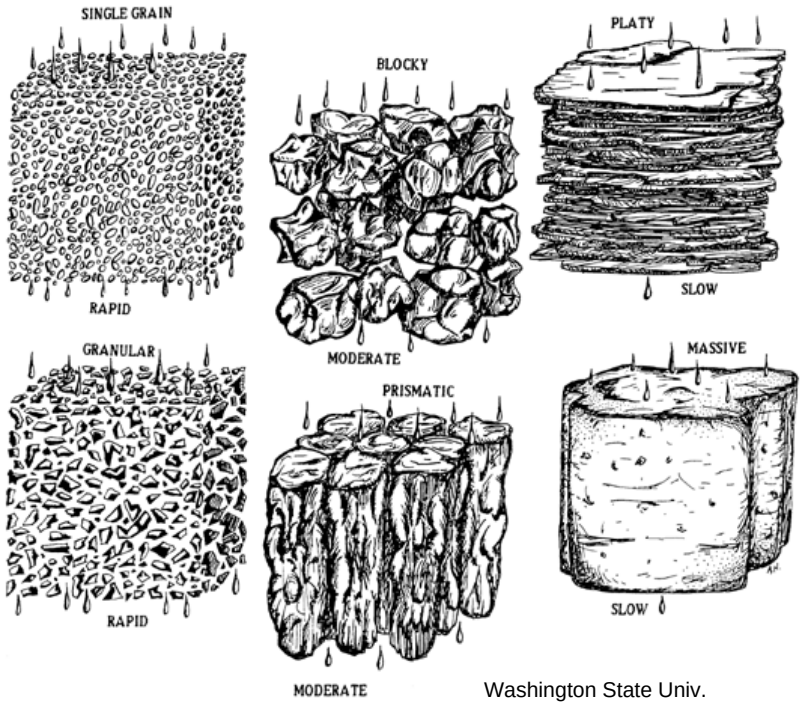
Soil is an important factor in rangeland communities and ecological sites have characteristic soils that have developed over time. Factors that affect soil development are parent material, climate, living organisms, topography or landscape position, and time. These factors lead to soil development or degradation through the processes of loss, addition, translocation, and transformation. 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 formed into horizons (layers that are distinguishable from other layers by a change in composition of abiotic and biotic components) by soil forming processes. 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 .05 and 2.00 mm in diameter and are coarse and gritty. When 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 .002 and .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, but sometimes 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 include: blocky, platy, granular, prismatic or columnar, and massive.



Washington State Univ.

Soil structure and water movement

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.

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, when 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.

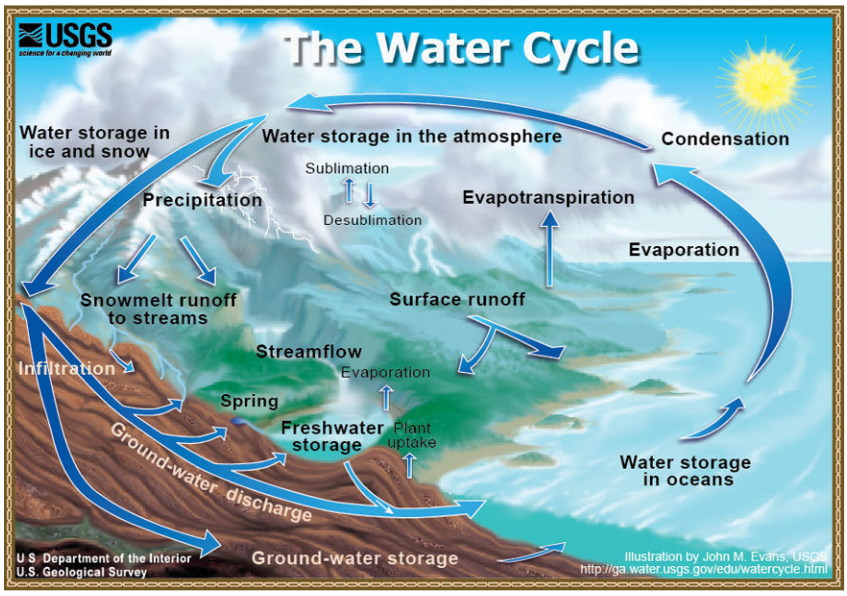
What is a Watershed?

A **watershed** is an area of land that drains water to the same endpoint. Watersheds can be defined at almost any scale, being 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 with a depiction of the Pashimeroi River watershed boundary and the local rivers and streams. All of the water within this region flows into the Salmon River (northwest corner) near Challis, Idaho.

Watersheds serve three primary functions in the **hydrologic cycle**; the capture, storage, and release of water. **Capture** refers how water from the atmosphere gets into the soil. The amount of water that is captured, or infiltrated, in 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 which 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 over 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.

Once moisture enters the soil it can move deep into to the rocky substrate below the soil and held in aquifers that can be tapped into with wells. Or moisture can move horizontally within the soil profile as **subsurface flow**, ultimately flowing into springs, streams, rivers or lakes. Vegetation management at the transition zones of subsurface groundwater flows meeting with 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) with each area having a distinct hydrologic regime, and a supporting 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 streambanks and shorelines. Riparian vegetation can 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 areas stay green much longer into the season, and generally produce more biomass than upland systems.


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 by inundation by water. 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 system that can 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, according to the average precipitation of the region. Depending upon location, moisture levels can fluctuate from less than 10 inches a year in some arid rangelands, to greater than 30 inches on mountain pastures and the tall grass prairie. Fluctuations of moisture from year to year can vary greatly, and many areas in

Idaho receive their moisture during one critical period, winter. 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 to capture precipitation. Upland plants also have strategies to conserve moisture once it absorbed such as waxy layers, narrow leaves, and the ability to go dormant or senescent during the hottest and driest season of the year. Common upland species include junipers, sagebrush, antelope bitterbrush, bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, tailcup lupine, Indian paintbrush, and scarlet globemallow.

MEASURING AND MONITORING PLANT COMMUNITIES

Assessment and Monitoring

Rangeland ecosystems are dynamic and are constantly changing as a result of natures driving forces including climate, fire, insect outbreaks, flooding, wildlife foraging and weed invasion. Human induced disturbances such as 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 on a site-specific basis, each with a focus on specific attributes. For example, a rancher may implement a monitoring protocol to determine if a new grazing system is affecting establishment of sedges or willows along a stream improving the stability of stream banks. 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 way to measure plants, but, there are only 6 basic "attributes" that are commonly measured. 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. The most commonly used attributes are:

- **Plant Species or Type** - What kind of plant was it?
- **Frequency** - Was the plant there or not?

- **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?

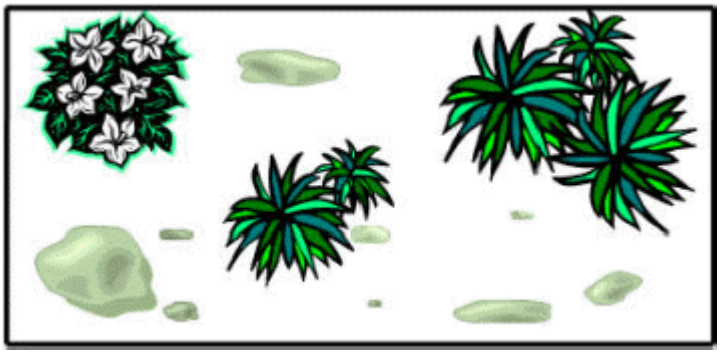
The most valuable skill that rangeland managers possess is the ability to differentiate between different **plant species**. Therefore, plant identification is essential to effective monitoring on rangelands. Plant species found on rangelands fall into five major types, or **life form** categories: grasses,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

Frequency describes how often a plant occurs within a sampled area. For example, if a grid was 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 larger plots are more likely 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**.

Determining the **biomass** of a site is important because it 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 production of plants that could be used 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 with 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.

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.

Cover is the area of the ground surface covered by vegetation or other solid objects including rocks, litter, moss, or bare round. Cover is expressed as a percentage. For example, if you look directly over the quadrat below, 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%).



Grass: 

White Flower: 

Rock: 

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.

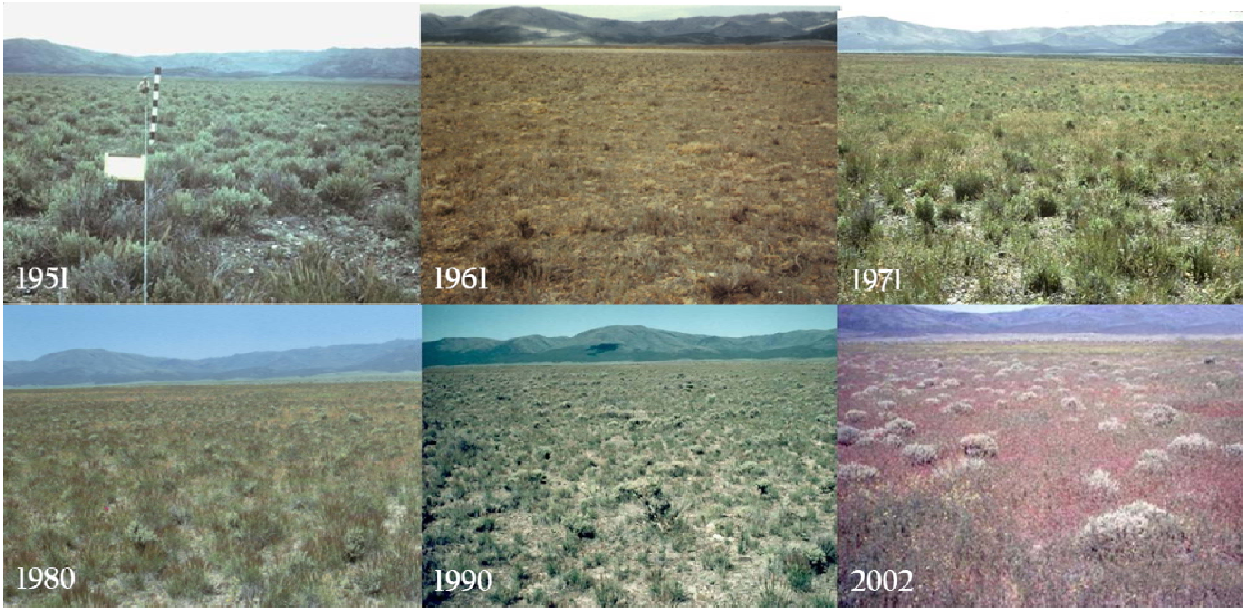
Vegetation **structure** describes the three-dimensional arrangement of a plant community. Structure measurements are primarily used to evaluate wildlife habitat elements (i.e., nesting cover, screen or hiding cover). Techniques used to quantify vegetative structure are generally applicable in a wide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

In addition to measuring vegetation attributes to determine the effectiveness of management strategies, rangeland monitoring also helps mangers 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 guides for proper stocking rates and range ecological sites 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 traditional compositions. 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 a diverse rangeland plant community are that it contains a variety of forages that are available to insect and vertebrate species, contain more species that are capable of surviving disturbance, and 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 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 (1951 to 2002).

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Forces of Ecological Change

MAJOR DRIVERS 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 and turn energy from the sun into organic compounds such as carbohydrates and proteins. When plant material is consumed, these compounds are digested and provide energy and nutrients for herbivores. Grazing is a natural ecological process that occurs on all rangelands.

Ecosystem Impacts of Grazing

Grazing animals have several direct and indirect impacts that can improve or degrade rangelands depending on the timing and intensity of grazing. Foraging animals affect rangelands by removing vegetation, roughing up and compacting soil through hoof action, and depositing minerals in the form of urine, feces, or the animal's carcass. Appropriate and well-managed grazing can favor desirable plants, improve habitat for wildlife, reduce weed invasion, reseed areas for restoration, reduce mulch accumulation, increase soil organic matter, and reduce fuel loads that promote wildfire. Overgrazing and prolonged poorly managed grazing can remove desirable plants, decrease water infiltration into soil, increase soil erosion, reduce water quality, increase weed invasion, and alter the plant community composition to a less desirable state. Therefore, the impacts of grazing depend on when and how it occurs.

Plant Response to Grazing

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

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

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

The buds or growing points (**meristems**) of a plant are especially important to protect from grazing because they will be the source of new stems and leaves for continued growth after grazing. Grasses have a unique strategy of protecting meristems – they are kept near the ground surface (within the crown of the plant) while the leaves and sheaths grow upwards. Some forbs also adapt this tactic by forming a basal rosette of leaves that photosynthesize right near the ground surface – out of the reach

of grazing animals. The meristems of these rosette forming plants are kept in the center of the rosette and are not elevated and made accessible to grazing animals until later in the growing season.

Some plants also contain compounds that are harmful to the grazing animal. These compounds, called **secondary compounds**, can cause illness, neurological disorders, birth defects, or even death. Secondary compounds such as alkaloids, tannins, and essential oils are common in plants. Most often these compounds don't kill the animal but, simply make it feel sick or nauseous so that the plant becomes distasteful and undesirable to the herbivore. However, some plants contain toxic compounds that are very powerful even in small amounts. For example, tall larkspur contains a mixture of alkaloids that if eaten can cause muscular paralysis, leading to respiratory failure, bloat and often death.

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

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

How Does Grazing Change Plant Communities?

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

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

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

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

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

What is Overgrazing?

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

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

Example of differences in soil creating different plant communities.

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

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

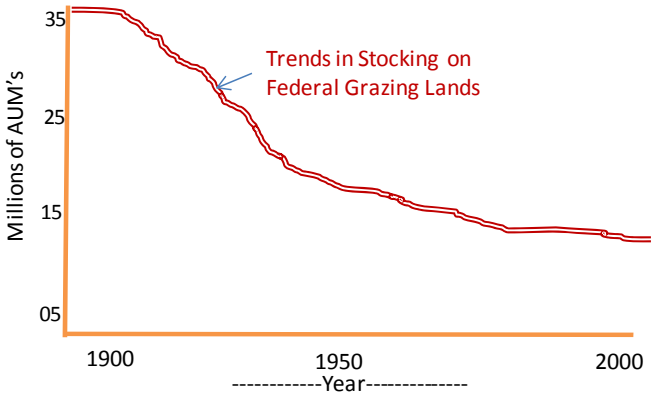
Overgrazed rangeland is often characterized by an increase in less palatable plants, increased soil erosion, increase in weedy species that thrive under disturbance, and decreased production of important forage plants. Rangeland deterioration results from animals continually and closely eating the most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

Range plants evolved to withstand grazing and can withstand a heavy grazing event if done in the right season and if plants are given enough time to recover after grazing. Most rangeland grasses and forbs can have 40-50% of their leaves and stems removed every year and still remain healthy and productive. In general, light use is considered less than 40%, moderate 40-65%, and heavy greater than 65% of biomass removed. The season during which the grazing occurs is very important. As described above, plants are most sensitive to grazing when they are flowering and forming seeds. After plants go dormant they are affected little by grazing. When considering effects of grazing on shrub species, one must look at the amount of usage of current year's growth – these include the leaves and young stems that are important for photosynthesis. The current year's growth of shrubs is the most digestible part of the plant and is the portion generally removed by browsing animals such as deer and goats. In winter, shrubs survive by using energy compounds (i.e., starches and sugars) stored in the stems. Thus, though the shrub is dormant, it is important to watch browsing of these stems. An indicator of overgrazing of shrubs is moderate or heavy hedging (i.e., growth of lateral stems just below a grazed point) and a lack of new or juvenile plants.

Hedging of Culleaf Mountainmahogany

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 ever before because they are now managed and monitored. A skilled rangeland manager can recognize overgrazing and take steps to correct it.



INVASIVE PLANTS

One of the most serious threats to the health and sustainability of rangeland ecosystems in Idaho is exotic invasive plants. As white settlers explored, homesteaded, and developed the West, they brought with them many plants that have colonized and taken up residence on Idaho rangelands. Some of these plants were introduced on purpose as ornamental plants, like leafy spurge and purple loosestrife. Others, like cheatgrass, came in accidentally in grains and feed. Some of the plants the people brought to Idaho have a malicious attribute of invading native rangelands, forests, and croplands, choking out the desirable native plants or crops.

Invasive Plant Terminology

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

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

Invasive plants are those that exhibit "weedy" or aggressive growth characteristics. Once established, invasive species will out-compete native species and often spread and dominate wildland plant communities. Invasive species are not typical of one particular life form and can be grasses, forbs,

shrubs, or trees. Common examples of invasive plants in western North America include: cheatgrass, leafy spurge, spotted knapweed, and salt cedar. Invasive plants may persist at relatively insignificant densities for a period of time until ideal conditions occur and then the plant will spread and dominate a site. Most invasive plants of concern are exotic. However, some native plants, like western juniper, can become invasive and start to dominate plant communities.

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

Why Weeds Are 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 complex communities with a monoculture
- Reducing infiltration and changing the hydrologic characteristics of the land
- Increasing soil erosion and runoff
- Altering soil characteristics
- Altering fire intensity and frequency

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

WILDLAND FIRE

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

the ash. Grasses often come to dominate shrublands and woodlands after fire because the woody plants are removed and the grasses are better adapted to fire.

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.

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

Wildfire versus Prescribed Burning

All fires need heat or a source of ignition, oxygen, and fuel. However, fires can occur under two scenarios: wildfire or prescribed burning. The main difference between a wildfire and a prescribed burn lies in how and when they are ignited. Wildfires could be naturally caused through lightning, or man-made through foolish actions such as improperly attended or extinguished campfires, lit cigarettes that are discarded, and arson activity. Prescribed burns are set for specific regions, 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 an unmanageable spread of fire which poses a serious threat to life and property.

Effects of Fire on Plants

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

Fire Return Intervals

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

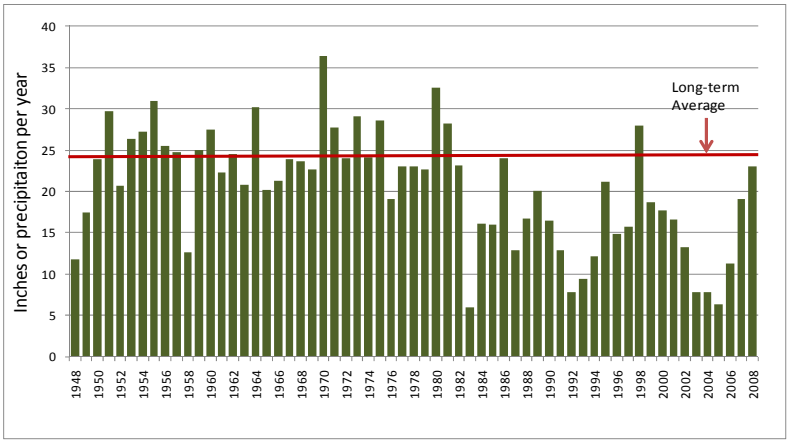
Fine fuel created by cheatgrass

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

WEATHER AND CLIMATE



Weather and climate are highly influential factors determining how rangelands change over time. Water is the primary limiting resource on rangelands, and vegetation production depends heavily on water availability and suitable growing temperatures. Idaho's rangelands, while for the most part are very dry and cool, can experience great variation in moisture and temperature depending on region, slope, and aspect. Idaho landscapes vary greatly depending on their aspect and elevation which affects the amount of solar radiation and moisture loss. Precipitation that is received on a landscape each year can vary substantially from year to year. For example, on this site near New Meadows Idaho, the long-term average is about 24 inches per year. However, that annual amount can vary from 6 to 36 inches per year. In other words, there can be a 6-fold increase or decrease in the precipitation that occurs from year to year.

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

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

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

The role of global climate change on rangelands has been a topic of debate and consternation. It is clear that climate is changing. But, the specific role that climate changes will have on any specific rangeland ecosystem in Idaho 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 weather 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 parts of Idaho. All of these changes in climate are of great concern to land managers and those who live on rangelands because it will change the type of plants and animals that will dominate an area and how invasive plants or fire might affect these sites. Unfortunately, it is almost impossible to control or predict climate and weather. Land managers are stuck with finding strategies to accomplish sustainable management in dynamic ecosystems.

FRAGMENTATION OF RANGELANDS

The western United States is experiencing rapid population growth, with many people drawn by the appeal of open space, dry climates, and an abundance of public rangelands and forests on which to recreate. The dream of many westerners is a house and a few acres of land on which to enjoy western landscapes and wildlands. "Ranchette" is a term used to describe a small parcel of land created by the splitting up 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 makes the land appealing to developers and people looking to build.

Fragmentation has had several major impacts caused by the increase in roads, buildings, and human activity. 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 cars traveling on roads increases. Houses built on wildlife winter habitat prevent animals from moving down in winter months, or result in increased stress from interactions with humans and their pets. Loss of key areas such as migration corridors, wintering habitat, or nesting and breeding areas can have drastic impacts upon animals and humans.

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

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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 1 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*.

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.

DURATION OF GRAZING – The length of time animals graze a pasture or grazing allotment.

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*.

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

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

FREQUENCY OF GRAZING – The recurrence of grazing—how soon animals are put back in a pasture after grazing it previously. Or, how soon an animal takes a second or third bite from the same plant during a grazing period.

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

FOREST LAND – Land on which the native vegetation (potential natural community) is forest.

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 CAPACITY – Syn., *carrying capacity*.

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. May be established 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.

PLAIN – A broad stretch of relatively level, treeless land.

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.

RANCHER – One who owns, leases, or manages a ranch.

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 such as 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*.

RUNOFF, SURFACE – The part of runoff that travels over the soil surface to a stream channel. Syn. *overland flow*.

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

SAVANNAH – 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 nonarborescent 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.

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.

UNDESIRABLE SPECIES – (1) Species that are not readily eaten by animals. (2) Species that conflict with or do not contribute to the management objectives.

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.

YEARLONG GRAZING – *Continuous grazing* for a calendar year.