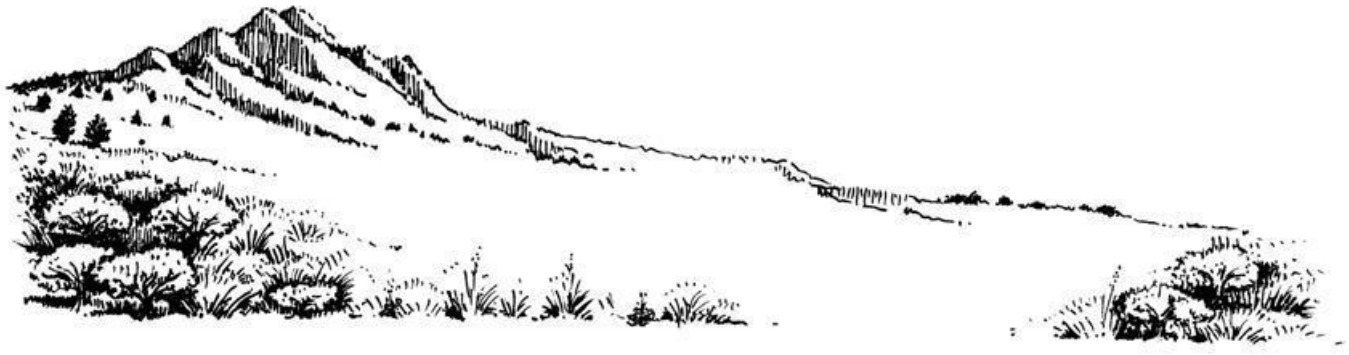
Western National Rangeland Career Development Event Manual



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Description and Background of Event Components

Rangelands are vast western landscapes including grasslands, shrublands and woodlands that are managed largely for livestock grazing and wildlife habitat. However, many other uses such as recreation, mining, and alternative energy development also occur on rangelands. The proper management of rangelands requires knowledge of ecological concepts, understanding what people want from rangelands, and how managers effectively assess rangeland ecosystems. Land management is an art and a science that requires a keen eye and attention to complicated factors such as multiple resource use, yearly climate variation, landownership patterns, and natural disturbances (i.e., weed invasions, wildland fire, insect outbreaks, drought, and floods).

Part 1 – Rangeland Management Recommendations

Part 1A: Stocking Rate and Management Recommendations

Stocking Rate

Any given area of land can only support so many animals for a given length of time – regardless of whether it is being used by livestock or wildlife or both. Land managers must be careful to balance the "supply" (forage available) with the "demand" (number of animals present and using it) if the rangeland is to be maintained or improved. The way managers accomplish this is by setting a **stocking rate**, which is simply the number of animals present on a particular area for a specific time. On the score card, a scenario will be described, and participants will calculate the usable forage "supply" and the forage "demand" and record these values. Participants will then use their knowledge of stocking rates to recommend one of the following management options:

> ***Maintain Current Stocking rate*** – means that for the given scenario, the current stocking rate reflects a balance between the plant material present and the number and kinds of animals present. If the forage "supply" and forage "demand" are within 5% of each other then stocking rate only needs to be maintained.
>
> ***Decrease Stocking Rate*** – means the current stocking rate is too high based on the supply of useable forage. In other words, the demand for forage by animals is at least 5% greater than the supply of forage.
>
> ***Increase Stocking Rate*** – means the current stocking rate is low and could be raised. In the scenarios, the demand for forage by animals is at least 5% lower than the supply of forage.
>
> To calculate stocking rates, several pieces of information must be known:
> - Size of management area to be used = total acres
> - Plant Production of area = biomass (weight) per acre
> - Kind, Weight, and Number of animals on the management area
> - Forage Requirement of animals on the management area
> - Duration of use by animals = # of days or months animals are grazing the area
> - Suggested Utilization Level = % of herbage that can be grazed each year on a sustainable basis without causing land degradation.

Animal Units (AU): In the early days of rangeland management, a system was devised to convert groups of cattle, sheep, and horses into common animal units so that herds and flocks could be easily compared in terms of how much forage they would consume. The standard unit created was the **Animal Unit (AU)** which was designated as a 1,000-pound cow and her calf. However, many grazing animals weigh more or less than 1,000

pounds and are not ruminants, so these early rangeland managers developed the concept of the Animal Unit Equivalent (AUE) to reflect such equivalencies as 5 sheep = 1 AU or 1 horse = 1.25 AU. However, modern ranchers have scales to weigh their livestock and the idea of an Animal Unit has evolved to simply mean 1,000 pounds of grazing ruminant animal.

Animal Unit Months (AUM): To express how much forage is on the land, a concept called an **Animal Unit Month (AUM)** is used based on the amount of forage that an animal unit will eat in a month. A large grazing ruminant animal, like cows or bison, eats about 2.5% of their body weight each day while foraging on rangeland. Therefore, a 1,000 lbs ruminant (i.e., an AU) would eat 25 pounds/day (i.e., 1,000-pound animal × 2.5% = 25 pounds) and in a month an AU would eat 750 pounds (i.e., 25 pounds/day for 30 days in a month). Therefore, an **AUM = 750 pounds** of dry forage.

Animal Forage Consumption: The amount a grazing animal eats depends on forage quality, physiological state of the animal, climatic conditions, and many other factors. However, in the CDE we will focus on two important factors: 1) the size of the animals, and 2) whether the animal is a ruminant (i.e., cow, bison, moose, elk, sheep, deer, pronghorn, etc.) or an equid (i.e., horse, donkey, or burrow).

Ruminant animals vary greatly in size from small deer to large bulls. Weight matters when figuring how an animal, flock, or herd will eat while grazing on a piece of land.

- Large ruminants like a beef cow or big bison or moose bull, weighing 1,000 pounds or more, would be expected to eat about 2.5% of body weight each day.
- Medium-sized ruminants weighing 500 to 1,000 pounds like growing beef steers or heifers or elk cows would eat about 3.0% of body weight each day.
- Small ruminants like sheep, goats, pronghorn, deer, or bighorn sheep weighing 100 to 500 pounds would eat 3.5% of their body weight each day.

To determine how much a ruminant eats each day first determine their average weight and multiply their weight times 2.5% if they are a large ruminant (1,000 or more), 3.0% if a medium-sized ruminant (500-1,000 lbs), or 3.5% for a small ruminant (100-500 lbs). For example, a cow weighing 1,200 pounds would eat 30 lbs/day, a bull elk weighing 700 pounds would eat 21 lbs/day, and a domestic sheep that weighs 200 pounds would eat 7 lbs/day.

Equids are a group of animals that include horses, donkeys, and burrows. Equids do not have a rumen, but they can eat rangeland grasses and forbs because their digestive system is adapted for grazing. The digestive track of equids has an enlarged cecum/colon which houses microbes and breaks down cellulose just like a rumen. This so called "hindgut" fermentation system works like a rumen, but it is less efficient, so equids eat about 25% more than ruminants on an average day. Therefore, to estimate how much a horse would eat just calculate consumption as if the horse was a ruminant, then multiply by 1.25 to estimate the greater amount the equid would eat because of its less efficient digestive system. For example, a wild horse weighing 800 pounds would eat 3% of its body weight per day (because it weighs between 500 and 1,000) or 24 lbs/day plus 25% more because it is equid or 30 lbs/day (24 × 1.25 = 30).

Setting a Stocking Rate: Determining the appropriate stocking rate involves three steps:

1. Determine supply of forage in the management unit (i.e., pasture or ranch) in pounds **and** AUMs.
2. Estimate forage demand of animals currently grazing the management unit in pounds **and** AUMs.
3. Compare forage supply and demand to determine if the management unit is under-stocked, properly stocked, or over-stocked.

For this event, if your calculation results in a decimal value, round to the nearest one unit beyond the decimal before going on to the next step in the calculation (e.g., 123.456 acres would be 123.5 acres). Whole numbers do not need to be expressed with a decimal value.

1) **Supply of Usable Forage** – The grazing scenario will describe the forage supply in acres per AUM or pounds per acre with a recommended utilization level. Calculate forage supply in the management unit (pasture or ranch) in AUMs **and** pounds.

   🔔 If forage supply is expressed as acres/AUM, divide the number of acres in the management unit or ecological site by the number of acres required to produce an AUM of forage (i.e., acres/AUM) on that unit. Acres ÷ Ac/AUM = AUMs of forage. For example, if an upland site offers a forage supply of 3.5 acres/AUM and covers 250 acres then total AUMs would = 250 acres ÷ 3.5 acres/AUM = 71.4 AUMs of supply.

   Different areas of a management unit may have different forage supply rates or estimates of acres/AUMs. Therefore, the different areas need to be summed to estimate the total forage supply on the management unit. Note that when forage supply is reported in "acres/AUM" without a recommended utilization level then consider all this biomass is "usable" and no reductions are needed to accomplish proper utilization levels.

   To convert AUMs into pounds of forage, multiply AUMs by 750 because 1 AUM = 750 pounds of forage. For example, 71.4 AUMs = 53,550 pounds of usable forage.

   ◆ If forage supply is expressed as lbs/acre, then multiply the number of acres in the unit or ecological site by the lbs/acre it produces. For example, if a meadow site offers a forage supply of 1,200 lbs/acre and covers 150 acres then total lbs produced would = 1,200 lbs × 150 acres = 180,000 lbs of total biomass.

   Different ecological sites in a management unit may produce different amounts of forage per acre. Therefore, the total pounds of forage should be calculated for each ecological site and the pounds of forage can be summed across all ecological sites on the management unit to obtain a total forage supply on the ranch or management unit.

   Proper Use Factor. When total pounds of biomass on the ranch is determined it must be adjusted by a proper use factor to estimate how much of the total biomass can be utilized as forage. Proper use factors for western rangelands are usually between 30 and 50% and the recommended proper use factor for the area described in the scenario will be given. For example, if the whole management unit produced 2,130,000 lbs of total biomass and the recommended proper use factor is 45% then the total forage supply =958,500 (i.e., 2,130,000 × 0.45 = 958,500)

   To convert pounds of forage in AUMs, divide pounds by 750 because 1 AUM = 750 pounds of forage. For example, a management unit that produces 285,000 pounds of usable forage would equal 380 AUMs (285,000 lbs ÷ 750 lbs/AUM = 380 AUMs).

2) **Forage Demand** is the second step in assessing a stocking rate to determine how many pounds of forage the current animals are consuming. The number of animals and the amount of time they are on the management unit will be listed in the scenario description.

   a) Start by estimating the average daily consumption of each type of animal grazing on the range as described above.

   b) Multiply average daily consumption by the number of days each animal is grazing on the ranch or management unit to determine how much each animal will graze during the whole grazing period. If animals are growing while they are on the ranch calculate their average weight while on the ranch.

c) Multiply the average amount each animal will eat while on the ranch by the number of animals in the herd or flock.

d) If there is more than one type of animal grazing on the ranch, total the consumption for all different animal types to get a total animal demand for the ranch.

For example, if 200 cows weighing 1,100 lbs were grazing on the ranch for 45 days the whole herd would eat 247,500 lbs of forage (i.e.,1,100 lb cow × 2.5% = 27.5 lbs/day × 200 cows × 45 days = 247,500 pounds for the whole herd while on the ranch). If the rancher also grazed 5 mules weighing 800 lbs each on the ranch from mid-May through mid-October 15 (150 days) the mules would eat 22,500 lbs (i.e., 800 lbs × 3.0% = 24lbs/day × 1.25 for equids = 30 lbs/day × 5 mules × 150 days = 22,500 pounds). All the cows plus, the mules would consume 270,000 lbs.

To convert pounds of demand to AUMs, divide pounds by 750 because 1 AUM = 750 pounds of forage. For example, 270,000 lbs ÷ 750 lbs/AUM = 360 AUMs

Details and examples on the method of determining stocking rate will be added and updated on the Rangeland CDE Web site (https://wnrcde.org/)

3) **Stocking Rate Determination** - The **last step** is to compare the current forage supply with the current forage demand. If supply is very close to demand (within 5%) then the stocking rate should be kept the same. If the supply is less than the demand, the stocking rate should be decreased. If the supply is greater than demand, the stocking rate can be increased. For example, if the current supply on the ranch is 300 AUMs and it is currently stocked with 340 AUMs, the stocking rate should be decreased.

For more information about stocking rates, visit the sites listed below. Note that different authors or agencies may have slightly different numbers for an AUM.

Management Recommendations

One of the greatest challenges of grazing management is getting animals to graze pastures relatively evenly. Even if the stocking rate is set properly, some parts of a pasture are often grazed too heavily while others may only be lightly used. Several practices can be implemented to try and improve animal distribution. It is impossible to look on a map and decide, what specific range improvement practices should be implemented. A decision cannot be made until soil characteristics and management issues are considered. However, recommendations regarding practices that should be considered can be made. Consider the following (based on the Range Judging Handbook, North Dakota Cooperative Extension Service).

Defer from spring grazing - Use this option if the site is in the Mountain, High Mountain, or Sub-alpine climatic zone. This is to protect the soils, wet from spring rainfall or snowmelt, from possible trampling damage and erosion. It also protects plants during the stem elongation time of growth.

Rest from grazing for a growing season - After brush or tree or weed control, or seeding, rest the area from grazing until desired plant species are established/re-established to the desired degree. The time required for establishment/re-establishment of desired plant species depends on existing population, weather, growing conditions, and other factors such as herbivory by insects or wildlife species.

Install a rotation grazing system - A rotation grazing system allows for periods of grazing followed by periods of non-use during the same season. Successful systems maintain high forage and livestock production. If the current grazing system consistently applies grazing to a pasture in the same seasons each year, a rotation grazing system should be considered.

Add or revise fencing – Use this option if you would like to increase uniformity of use. Livestock use land in smaller pastures more evenly than in large pastures. Fencing can include permanent or temporary structures.

Develop additional water sites – Distribution problems can often be reduced by adding a water source. Livestock need to drink water every day and it may be difficult for animals to effectively use areas of a pasture that are more than 1 mile away from water. Select this option if: 1) a need for additional water exists, and 2) water is somewhat available (within ½ mile) and useable, i.e., a spring or stream is in close proximity.

Control brush or trees – Controlling brush should be considered if shrubby species make up more of the total production of the site than is desired based on management goals. Attention needs to be paid to the type of animal grazing the area and the amount of shrubs desired for that animal. For example, if the area is used exclusively for deer habitat, the shrub component is important. If control is needed, it can be done by using mechanical means, herbicides, burning, or targeted grazing with goats. Trees should be controlled if the site is being invaded or is dominated by trees such as maple, ash, juniper and/or pinyon pine trees. Control can be done using mechanical means, herbicides, or burning. Control could also be accomplished by using a combination of these control types.

Seed or interseed with adapted species - Use this following any tree, brush or weed control option if grass and forb species produce less than 20% of the total production of the area.

Reduce human recreation activities on site - Use this option if observable erosion is resulting from various activities like trails, ATV use, or camping. Managers often post signage or problem areas are barricaded to alleviate recreational impacts.

Manage for endangered species - Use this option if there are known occurrences of rare or threatened species on the site. If a federally listed endangered species is located on a site, land managers will be required to adhere to endangered species related laws, policies, and regulations.

Add or Change Salt Location – It is important to attract livestock into areas that are seldom grazed. A commonly employed practice is to move salt into under-used areas. It is also important to move salt out of heavily used areas like riparian zones.

Part 1B: Current Rangeland Issues

Rangeland management is an ever-changing activity. Several factors can affect how management decisions are made and the potential impacts of those decisions. Factors may include but are not limited to issues such as changing fire regimes, endangered or threatened species, urban encroachment, noxious weeds, and multiple use. Participants will be asked to read and review the current issue that is posted for the host site. It can be found on the Western National Rangeland Management Career Development Event website: https://wnrcde.org. Students will then answer 5 multiple-choice questions to test their knowledge of the current issue.

Addressing any management challenge usually involves a cost. After careful examination of a ranch, a rangeland manager can suggest improvements to address the issue. A scenario will be given to improve habitat. This may include installing a fence, planting species to improve forage or cover value, installing or improving a water source, etc. Total cost of the improvement can be accomplished based on inputs and requirements.

For example, to improve habitat for a desirable species, it would be valuable to add 1.5 miles of pipeline for water from a nearby spring. This will require spring development ($,1800), above-ground black poly-pipe ($0.80/foot), holding tank ($800), float ($30), and a wildlife escape ramp ($80). It takes approximately 135 hours of labor at $15/hr. Calculate the estimated cost for this habitat improvement.

Answer = $1,800 + (1.5 miles × 5280 feet/mile × $.80/foot) + $800 + $30 +$80 + (135 hrs ×$15/hr) = $11,701

Show your work on the scorecard. Partial credit will be given for problem set up and correct calculations.

Part 2: Plant Identification

Participants will be asked the common name, growth form, life span, origin, forage value (for grazing and browsing animals), and toxicity of 20 rangeland plants. The contest specimens will be selected from a list of 60 major western rangeland plants (see Event Plant List). Each year an additional 5 species will be added by the host state to total 65 plants. Each specimen will be clearly numbered and could be a dried and mounted specimen, potted plant, or flagged plant growing on the site.

Common Name as provided on the event plant list. There are often several common names for the same plant. However, for this event, the common name as expressed on the event list should be used. The common names used in this event follow those in the national plants database (https://plants.usda.gov/). The name should be clearly written on the event scorecard (do not reference plant number from the list). A list of the 65 common western rangeland plants will be included on the scorecard.

Growth Form describes the basic structure of a range plant that can be categorized as grass or grass-like, forb, or woody.

Grasses are plants with jointed stems. The stems are hollow between the joints (i.e., nodes). Leaves are in two rows on the stem. Veins in the leaves are parallel. Grass-like plants look like grasses but have solid stems (not hollow) without joints. Sedges and rushes are in this group of plants. Leaves of grass-like plants are long and narrow and have parallel veins just like grasses. Many, but not all, species of sedges have triangular stems.

Forbs are broad-leaved plants with above-ground growth that die back to the ground each year. Most forbs have net veins in the leaves, but a few, such as wild onion, have parallel veins. Broadleaf weeds and wildflowers are kinds of forbs.

Woody plants include trees and shrubs with stems that live from one year to the next. Shrubs have stems branching from near the base. Trees have a definite trunk and are usually bigger than shrubs. Some plants can appear as a shrub or tree depending on environmental conditions. Browse is a term for the part of a woody plant which is used by range herbivores for forage. Browse includes leaves and young stems.

Life Span is a term that describes the number of years a plant grows and reproduces:

Annual plants live only one growing season. There are 2 types of annuals. *Winter annuals* germinate in the fall and form a small rosette of leaves that persist through the winter. The following growing season, the plant continues to grow, produces flowers and seeds sometime in the summer, and then dies. *Summer annuals* germinate in the spring and complete all growth, including seed production, by the end of the growing season and then die.

Perennial plants live from one year to the next, producing leaves and stems for more than two years from the same crown. Most range plants are perennial. Some plants live only two growing seasons and are properly called biennial plants. Normally, these plants form a basal cluster of leaves the first year and send up a seed stalk the second year. There are no true biennial plants on the event plant list, so this category of life span does not appear on the event scorecard.

Origin of a range plant refers to the continent on which a plant is native. It is important to know the origin of a plant because it can affect the way that a plant responds to the environment.

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

Introduced plants were brought to North America from another continent. Several of these plants were intentionally introduced to rangelands because they have good forage value or other use. Other plants were accidentally introduced as contaminants in seeds or materials brought to North America. Many weedy plants were brought in for their ornamental value, but then "escaped" into rangelands.

Forage Value of a plant refers to how well it provides nutrients to grazing animals. Plants that have low amounts of fiber and high amounts of protein, vitamins, and minerals generally have high forage value. Plants that are "stemmy" and have few nutritious leaves when they mature would have lower forage value.

The forage value of a plant varies depending on which animal is grazing it because nutritional needs and dietary preferences differ by species of grazing animals. For example, a plant could have excellent forage value for cattle and poor forage value for deer. *Grazers* are animals like cattle, domestic sheep, bighorn sheep, and elk that get most of their nutrients from grasses and therefore grasses and grass-like plants usually have relatively high forage value for these herbivores. *Browsers* are animals such as goats, mule deer, white-tailed deer, moose, and pronghorn that eat mostly woody plants and forbs. For these herbivores, woody plants generally have pretty good forage value.

Desirable (D) forage value designates plants that are nutritious, palatable, and produce abundant forage. This designation also describes plants that will provide adequate nutrients if eaten; however, the plant may not be preferred by animals or does not produce abundant forage.

Undesirable (U) forage value describes plants that simply do not provide adequate nutrients to the herbivores.

Toxic plants contain natural chemicals that are harmful to grazing animals and can even cause death if eaten in sufficient quantities. (The plants have poor forage value and should be designated with a U in the forage value column on the scorecard.)

Part 3: Site Description

Describing the soils and physical characteristics of an area of land allows managers to better determine what amount and type of vegetation may occur there and/or how the site may respond to different management practices or disturbance events. In the rangeland CDE a small uniform area of rangeland will be roped off or flagged for evaluation of site characteristics. Near the evaluation area, a soil pit at least 30 inches (64 cm) deep will be dug. Participants will view the evaluation area and determine the precipitation zone, soil depth and rockiness, soil texture, slope, and aspect.

Precipitation Zone

Climatic conditions, particularly precipitation, influence the types of plant species that grow across a region. For this CDE, participants will be required to identify the correct climatic zone based on the amount of precipitation received on the contest site. The average annual precipitation for the contest site will be provided on a placard located in the evaluation area. Participants will select from the following precipitation zones: desert, semidesert, upland, mountain, high mountain, and alpine.

Desert = less than 8" precipitation
Semidesert = 8 - 12" precipitation
Upland = 13 - 16" precipitation
Mountain = 17 - 22" precipitation
High Mountain = 23 - 35" precipitation
Alpine = greater than 35" precipitation

For example: A site receives 9 inches of precipitation, either in the form of rain or snow.
What is its climatic zone? Answer = Semidesert.

Soil Depth and Rockiness

Soil depth refers to the thickness of the surface and subsoil plus any underlying material that is readily penetrated by plant roots, water, and air. Many soils have a restrictive layer that will limit the root and impede the flow of air and water. Examples include bedrock and dense, cemented, or frozen layers. Soils are considered shallow if they are less than 20 inches (51 cm) deep. Deep soils are described as greater than 20 inches deep.

While rock at the soil surface can improve water infiltration, coarse rock within the soil, such as gravel and stone, can inhibit water infiltration. If coarse rocks are scattered throughout the soil in quantities of greater than 20%, the water infiltration rates begin to diminish. Under USDA standards, rocks up to 3" (2-76 mm) in diameter are categorized as gravel, rocks 3 to 10 inches (76-250 mm) in diameter are categorized cobble, rocks 10 to 24 inches (250-600 mm) in diameter from are categorized as stones, and rocks greater than 24 inches (600 mm) are called boulders. For this event, we will only categorize rock fragments as gravelly including gravel and cobble < 10 inches or stony including stones and boulders >10 inches.

A restrictive layer is a compacted horizon of soil that cannot be penetrated by plant roots and water. A restrictive layer is different from bedrock because it is created by cementation of soil particles and not from parent material. There are several different and specific types of restrictive layers often referred to as a hardpan. A true hardpan is formed from manmade, repeated disturbance like plowing or large equipment on logging trails. A common type of restrictive layer found on rangelands is called a duripan and are formed from a natural process where silica or carbonates accumulate creating a cemented horizon.

For this event, participants must determine if the soil is deep or shallow and make a determination of the presence of gravel/cobbles or stones/boulders in the soil based on the following categories:

Shallow (< 20 inches)
Deep Gravelly
(> 20 inches deep with>20% gravel/cobble)

Deep (> 20 inches)
Deep Stoney
(> 20 inches with >20% stones/boulders)

Soil Texture

Soils particles are broken into three size classes: sand, silt, and clay (particles >2 mm in size are considered gravel or coarse fragments and are not included in texture classes). Soil texture refers to the relative proportion of sand, silt, or clay in a specific soil mass. Texture is an important characteristic of any rangeland site because it determines opportunities for plant growth and hydrological characteristics. Soil scientists recognize 12 soil textural classes: Sand, Loamy Sand, Sandy Loam, Silt Loam, Loam, Silt, Sandy Clay Loam, Silty Clay Loam, Clay Loam, Sandy Clay, Silty Clay, or Clay.

For this event, participants will go through the steps of the "Soil Texture-by-Feel Analysis" in the field to determine the texture of the soil (Figure 1 & 2). Participants will collect a small portion of topsoil (A horizon) from a bucket located near the soil pit, wet it with water, and work it between their thumb and fingers. The "feel" of the soil will help reveal the correct texture class by estimating the different soil particle content by grittiness, flexibility, and stickiness. Participants will record the texture class on their scorecard.

Clues to the Feel of Textural Classes

Tips from the Soil and the Environment: A Land and Homesite Evaluation Handbook and Training Guide.
(University of Idaho Extension - Bulletin 795)

Sand

- Moist sample collapses after squeezing.
- Your hands don't get dirty working the sample.

Loamy Sand

- Sample has very little body.
- Moist soil barely stays together after squeezing.
- Just enough silt and clay to dirty your hands.

Sandy Loam

- Sand dominates noticeably.
- Enough silt and clay to give the sample body.
- Moist soil stays together after squeezing.
- Hardly forms any ribbon at all.

Silt Loam

- Feels smooth, like flour or corn starch.
- Tends to be nonsticky.
- Only forms short, broken ribbons.

Loam

- Sand noticeably present, but does not dominate.
- Sample works easily between thumb and fingers.
- Contains enough silt and clay to give sample good body.
- Sample only forms short, broken ribbons.

Sandy Clay Loam

- Feels gritty and sticky.
- Forms ribbon 1 to 2 inches (2.5 to 5 cm) long.

Silty Clay Loam

- Feels smooth and sticky.
- Contains very little sand.
- Forms ribbons 1 to 2.5 inches (2.5 to 6 cm) long.

Clay Loam

- Noticeably gritty, but sand doesn't dominate.
- Noticeably sticky.
- Noticeably hard to work between thumb and fingers.
- Forms ribbons 1 to 2.5 inches (2.5 to 6 cm) long.

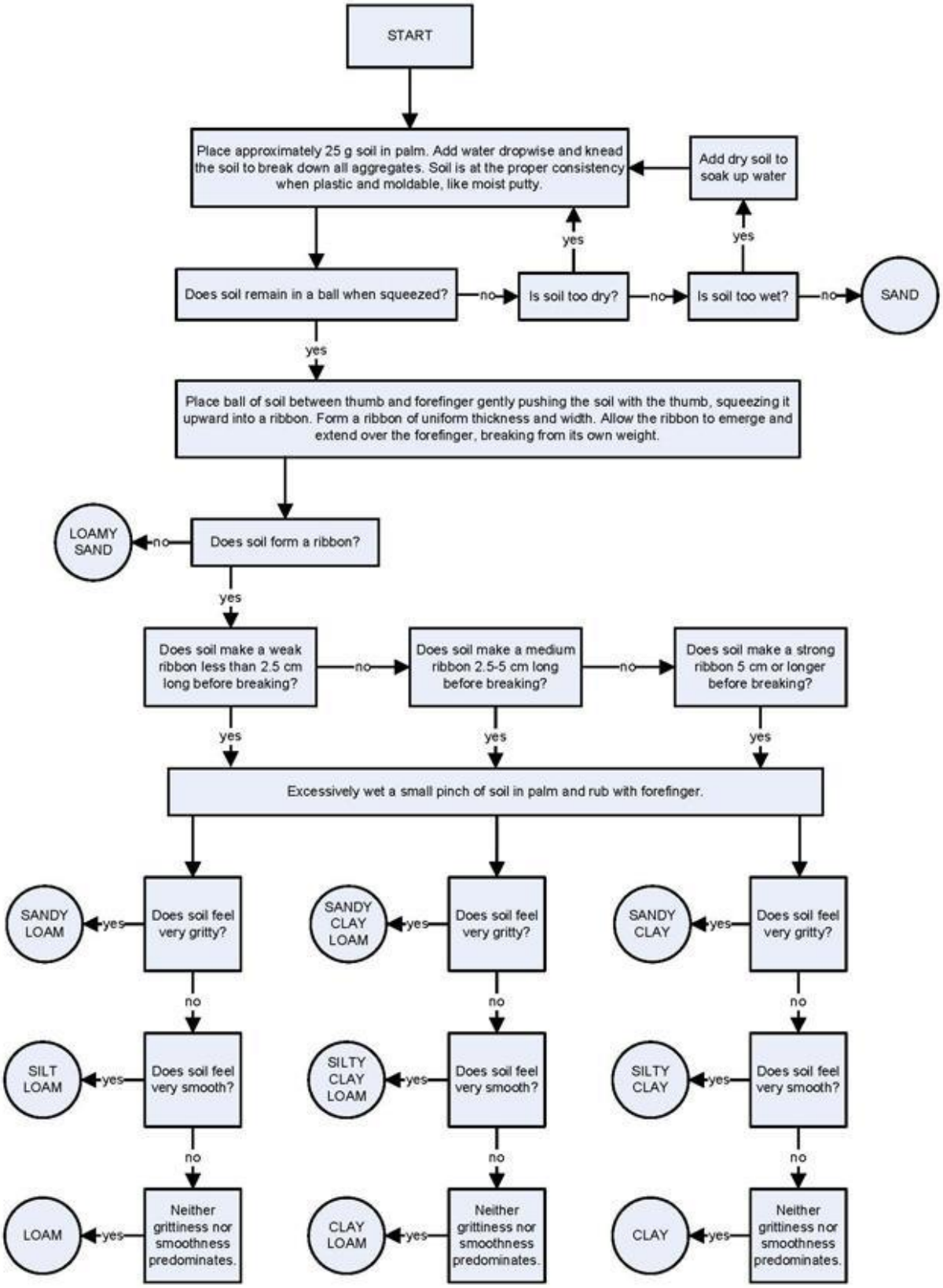
Sandy Clay

- Feels definitely sandy.
- Forms ribbon 2 to 3 inches (5 to 7.5 cm) long.

Silty Clay and Clay

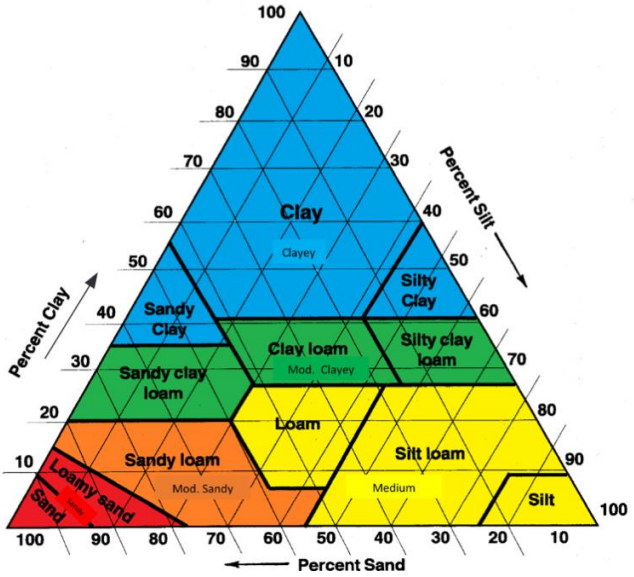
- Dry sample absorbs a lot of water before it is moist enough to work.
- Sample very hard to work between thumb and finger.
- Forms ribbon 2.5 to 4 inches (6 to 10 cm) long.

Figure 1. Tips from Soil and the Environment: A Land and Homesite Evaluation Handbook and Training Guide. (University of Idaho Extension - Bulletin 795; https://drive.google.com/file/d/18nNsRrvnXkdvQPuM2F-tVtVaQ5bxvhv-/view)


START
Place approximately 25 g soil in palm. Add water dropwise and knead the soil to break down all aggregates. Soil is at the proper consistency when plastic and moldable, like moist putty.
Add dry soil to soak up water
yes
yes
Does soil remain in a ball when squeezed?
no
Is soil too dry?
no
Is soil too wet?
no
SAND
yes
Place ball of soil between thumb and forefinger gently pushing the soil with the thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over the forefinger, breaking from its own weight.
LOAMY SAND
no
Does soil form a ribbon?
yes
Does soil make a weak ribbon less than 2.5 cm long before breaking?
no
Does soil make a medium ribbon 2.5-5 cm long before breaking?
no
Does soil make a strong ribbon 5 cm or longer before breaking?
yes
yes
yes
Excessively wet a small pinch of soil in palm and rub with forefinger.
SANDY LOAM
yes
Does soil feel very gritty?
SANDY CLAY LOAM
yes
Does soil feel very gritty?
SANDY CLAY
yes
Does soil feel very gritty?
no
no
no
SILT LOAM
yes
Does soil feel very smooth?
SILTY CLAY LOAM
yes
Does soil feel very smooth?
SILTY CLAY
yes
Does soil feel very smooth?
no
no
no
LOAM
yes
Neither grittiness nor smoothness predominates.
CLAY LOAM
yes
Neither grittiness nor smoothness predominates.
CLAY
yes
Neither grittiness nor smoothness predominates.

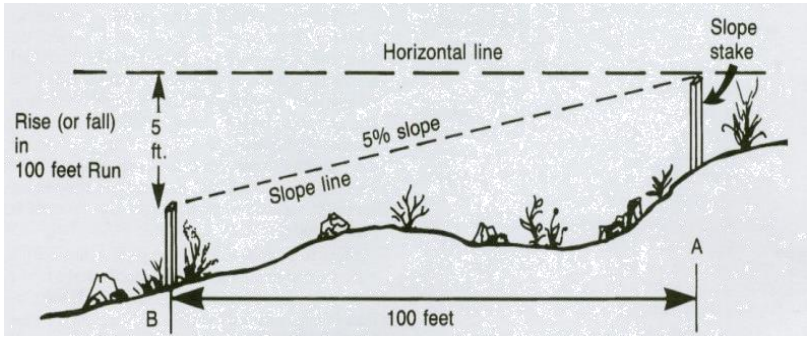
Students will receive half credit (5 points) for marking an adjacent soil texture next to the correct soil texture on the soil triangle on their scorecards (see Figure 3).

Example: If a student marks the soil as "sandy loam" on their scorecards and the correct soil texture is "loam" then the student will receive half credit (5 points).



Slope

The slope topography of rangelands affects many factors including site productivity, water runoff and infiltration, erosion potential, and animal access. Steeper ground is often less productive, has shallower soil, is less stable when saturated, and can limit use by several classes of livestock. Slope describes the steepness of a site and is defined as the ratio (%) of the altitude change or "rise or fall" divided by the horizontal distance or "run."

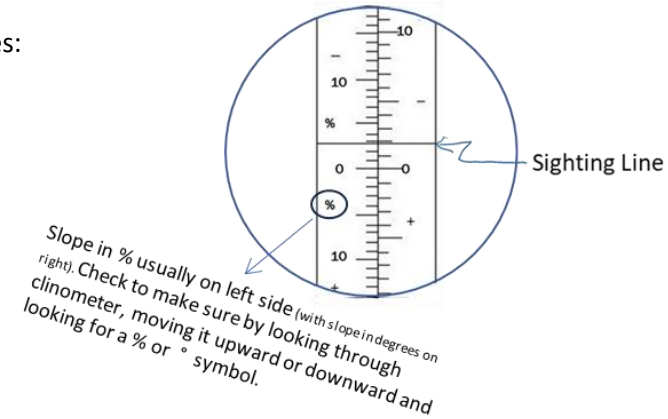


F*or example: If the vertical rise or fall between the two endpoints that are 100 feet apart is 5 feet, the slope would be 5%.*

A clinometer will be used to estimate slope. Participants may bring their own clinometer, or use one provided at the site. Two stakes will be spaced 100 feet apart on the slope of the site. Place the clinometer on the top of the lower stake and look through the clinometer to put the "sighting line" on the top of the upper stake. Read the number for % slope (not degrees).

Participants will select from the following slope categories:

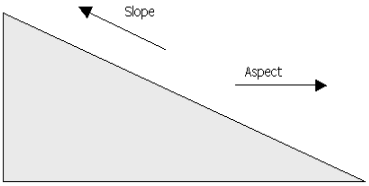
- ***0-5%*** (nearly level)
- ***6-10%*** (slight slope)
- ***11-15%*** (moderate slope)
- ***16-20%*** (moderately steep)
- ***21-45%*** (steep)
- ***>45%*** (very steep)



Aspect

Just as slope strongly influences plant productivity and animal use, the compass direction that the ground faces, or aspect, can also greatly influence the productivity of a site. For example, plants on a southern aspect are subjected to direct sunlight, which creates warmer temperatures and a drier soil environment, thereby limiting productivity. Conversely, northern exposures experience less direct sunlight, creating a cooler and wetter growing environment where plants are inherently more productive.

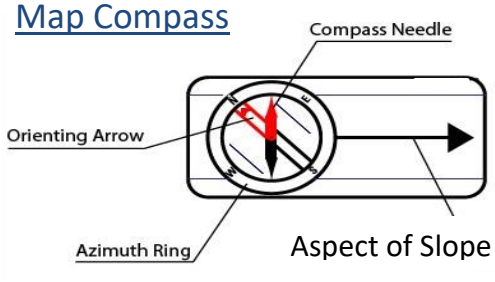
Aspect will be measured between the same points designated for the slope measurement. Aspect is opposite from the direction the slope is pointing (which is the direction you faced when you measured the slope). Aspect can be determined with a compass. Stand facing downhill --this is the direction a ball would roll if set down on the hill.



Slope is determined with a compass using the same two posts that were used for slope. Students can bring their own compass or use one provided at the site. (Note that declination should be 0°, or no declination, for this event). There are basically two types of compasses: A map compass which is clear and flat, and a sighting compass which folds in the middle and has a mirror. A sighting compass is used most often in the field by range managers and is therefore the style of compass recommended for this event. However, either style of compass can be used though the method for determining aspect varies depending on the type of compass. Stand at the top post and face the post lower on the slope.

- If using a map compass, face in the direction of the lower post and turn the center dial (i.e., azimuth ring) until the compass needle is aligned inside the north arrow (i.e., orienting arrow). The direction directly ahead is the aspect of the slope.
- If using a sighting compass, hold the compass in hand with the arrow dial facing up. Raise the compass to just in front of one's eyes and fold the mirror so the compass dial can be seen in the mirror. Hold the compass level and use the notch at the top of the mirror to sight an object that is directly above the lower post. Turn the center dial (i.e., azimuth ring) until the compass needle is aligned inside the north arrow (i.e., orienting arrow). The direction that is at the white line at the center of the folding part of the compass is the aspect of slope.

Map Compass



Sighting Compass

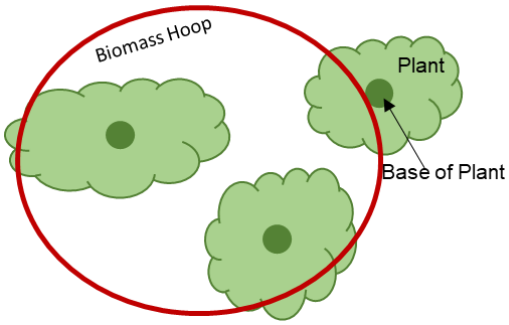
Participants will categorize aspect into one of the following categories:

North *(0° or 338°–22°)*
North West *(315° or 293°–337°)*
West *(270° or 248°–292°)*
South West *(225° or 203°–247°)*
North East *(45° or 23°–67°)*
East *(90° or 68°–112°)*
South East *(135° or 113°–157°)*
South *(180° or 158°–202°)*

Total Biomass Estimate

Knowing the total yearly biomass production of rangeland is very important to rangeland ecology and management because it is the basis for setting a proper stocking rate, determining hydrological characteristics, and monitoring the effects of climate over time. Biomass, or yearly production, is the weight of the aboveground parts of plants per unit area. Biomass can be determined by clipping grasses, grass-likes, forbs, and browse in a small area (plot of known size), drying the biomass in an oven, weighing the biomass, then calculating the weight per unit area. However, experienced range managers can quite accurately estimate the weight of yearly biomass production 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.

For this event, three 4.8 ft^2 circular plots (2'6" diameter; 7'9" circumference) will be marked and participants will estimate and average the weight of all plant production in the marked area, **including all plants in a vertical projection above the hoop** no matter whether a plant is rooted inside or outside the plot. Weight of biomass in a plot of this size is measured in grams, simply multiply by 20 to obtain an estimate in pounds per acre. Biomass in this case includes the herbaceous biomass and current year's growth of woody plants. The biomass of herbaceous plants (i.e., forbs, grasses, and grass-like plants) is all above ground plant parts including leaves, stems, flowers or seed heads, and fruits. The biomass of woody plants includes the leaves, stems produced in the current season (usually greener or hairier than old growth), flowers, and fruits.



Vegetation within a vertical projection of the plot is included when estimating biomass production. It does not matter if a plant is rotted inside or outside the plot.

For this event, we will be estimating total biomass. All biomass estimates will be based on the dry weight of the current available biomass in pounds per acre. Dry weights are used in biomass estimations to eliminate the effect of water content. Water content varies significantly by growth stage of the plant and can fluctuate quickly based on shading, aspect, and time between precipitation events. The percentage of dry matter in a plant can be determined by comparing the field weight of vegetation with the weight after it has been dried or guidelines based on plant type and growth stage can be used to convert fresh field weights to dry weights. This estimate of biomass relates well to forage available for grazing and browsing animals.

Standardized percentages of dry matter, such as these listed below, are available in the National Range and Pasture Handbook: www.nrcs.usda.gov/national-range-and-pasture-handbook

Grass:
- before heading = 30-35% dry matter
- headed out = 35-40%
- after bloom = 45-50%
- mature seeded = 55-60%
- leave dry/stem partly dry = 80-85%
- apparent dormancy = 90-95%

Forbs:
- very lush = 15-20% dry matter
- mature, seed-stage = 35-40%
- seed ripe, leaves drying = 60%
- dry and dormant = 90-100%

Shrubs/Trees (deciduous):
- lush, new leaves = 20-35% dry matter
- older, full-sized leaves = 50%

Shrubs/Trees (evergreen)
- lush, new leaves = 55%
- older, full-sized leaves = 65%

Prticipants will estimate herbaceous biomass and current-season growth of shrubs separately in the 4.8 ft^2 plot marked on the site. Biomass will be categorized as: 0-400, 400-800, 800-1200, 1200-1600, or > 1600 Pounds/Acre

When all participants have completed the event, the 4.8 ft^2 plot will be clipped and separated into herbaceous and current-season shrub components in the field. Percent dry matter will be estimated with published guidelines listed earlier in this document. The final clipped weight (pounds/acre dry matter) of the plot will serve as the reference to determine the accuracy of participant responses.

Part 4 – Rangeland Assessment

Part 4A: Similarity to Desired State

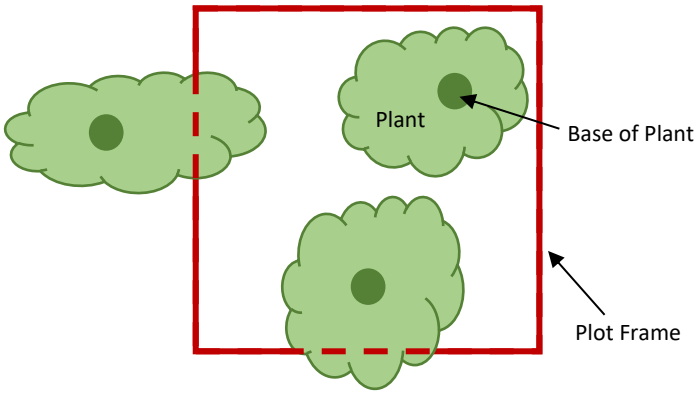
An important part of rangeland management is to examine how the land looks today compared to what is desired by the landowner. The method rangeland managers use to accomplish this task is to first describe the desired state, next determine the current state, and then calculate the similarity between the desired and current state. For this Rangeland Assessment Event, a reference area (about 15 by 30 feet) will be marked and participants will focus on estimating the current plant community.

Describe Desired State – The desired condition is set by the landowner or land manager and includes proportions of plants that sustain healthy rangelands and meet management goals. The desired condition must be clearly stated to determine how close current conditions are to this desired state. A description of a desired state usually lists the proportion of total biomass that is accounted for by specific plants or plant groups. This proportion of biomass is called **composition** of the plant community. The desired state can also include soil attributes or desired animal communities. In our example, the desired state will be given in terms of composition of perennial grass, annual grass, forbs, and browse. These values will be displayed on an event placard.

Step 1) Determine Current State – Within the reference area, 3 square plot or quadrats (50 x 50 cm) will be placed and marked with flags. Within each plot, the participant must estimate the proportion of annual biomass (dry weight) that is contributed by the following plant classes:

- Perennial Grass
- Annual Grass
- Forbs (annual and perennial)
- Shrubs

Estimate all cover within the vertical line of the plot. It does not matter if the plant is rooted inside or outside the plot (see Figure 6). An average of these three plots will create an "Average Observed Composition" which will represent the current state.



Step 2) Calculated Similarity - A similarity index was traditionally calculated to compare the current vegetation composition found on a site to the vegetation that was presumed to originally dominate a site prior to European settlement. However, the type of vegetation that exists today may be drastically altered from what the site may have looked like centuries ago and determining the departure from this "pristine" vegetation composition may not always be the best indicator for proper management. In this Rangeland Assessment Event, participants will calculate a Similarity Index to compare the Current State with the Desired Rangeland State with respect to a management goal for the site.

To calculate the Similarity Index, determine the percent composition in common (by plant class) between the current plant community (Average Observed Composition) and the desired plant community (Desired Composition). The *"percent composition in common"* is simply the lowest % composition for any plant class in the "Average Observed Composition" or the "Desired Composition" column (points will be given for transposing the correct value into the % Counted Toward Similarity column on the scoresheet).

> *For example, if the average observed composition of perennial grasses on the site is 15% and the desired composition is 20%, the amount in common would be 15% because 15 is the lower of the two values.*

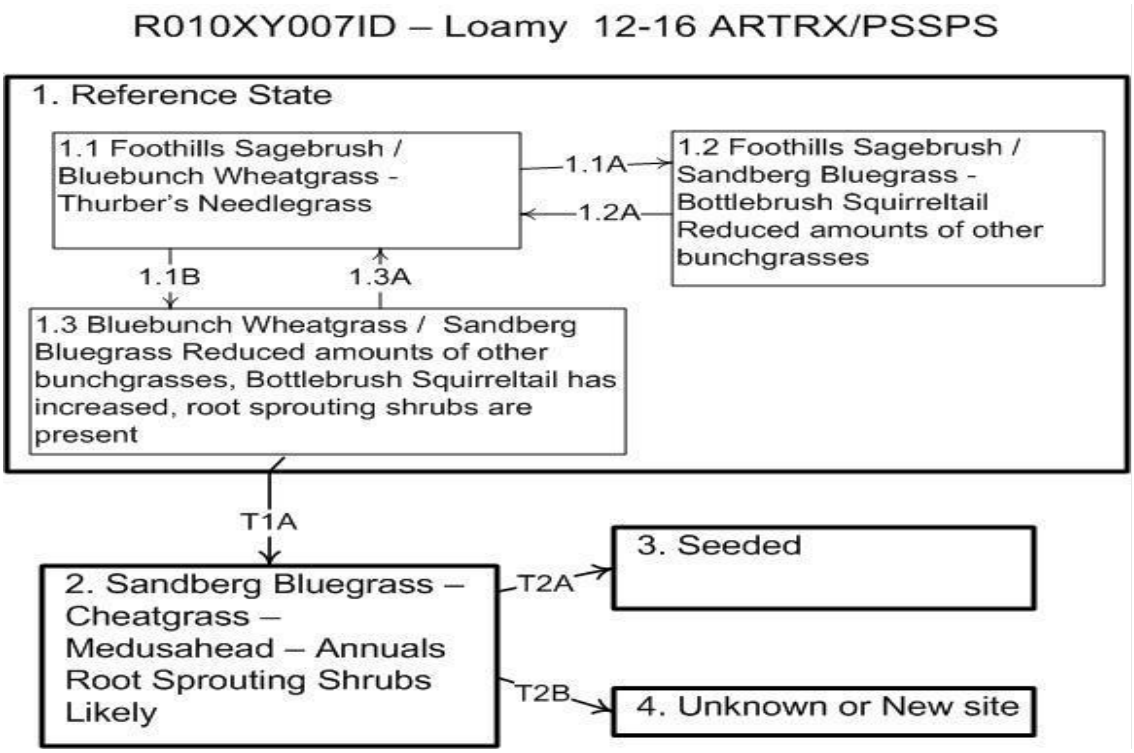
Record this percent in common as the "% Counted Toward Similarity Index." Total the values in common to obtain the final Similarity Index. This Index can range from 0 to 100%. The closer the current state is to the desired state the higher the Similarity Index will be. If the current state were exactly the same as the desired state in composition the resulting similarity would be 100%. If the current state were completely different than the desired state and the states had nothing in common, the resulting similarity index would be 0%.

Part 4B: Identify phase in simplified State and Transition Model

State-and-transition models hold great potential to aid in understanding rangeland ecosystems' response to natural and/or management induced disturbances by providing a framework for organizing understanding of potential ecosystem dynamics. State and Transition Models descriptions can be used to determine the current stage of succession of a place on a landscape. They will contain information on the impact of the primary ecological processes and the resulting change in the biotic community and system function. State and transition models identify indicators of change for ecological processes that will allow management to intervene prior to a threshold change. Once a threshold has been crossed, the focus of management should be on restoration of the damaged ecological processes, not on reestablishing a specific plant community.

In this event, a state and transition model will be provided at the site. Students will study a state and transition model and determine which stage best identifies the current state. They will make that determination by examining the landscape and use the plant community as reference. Participants will write the number that best describes the site on their scorecard. (10 pts)

Example State and Transition Model:



<u>Plant Community and Sequence:</u> Transition pathways between common vegetation states and phases:

State 1. Is the "reference state" that can vary in amount of sagebrush and grass species present depending on abundance of shrubs and the types of grass species present. Transitions between phases in this state are caused by poor or appropriate grazing, wildland fire and drought.

State 2. Develops through frequent fire or continued improper grazing management. This state has crossed the threshold. It's not economically feasible to move this state back towards the reference state.

State 3. Develops through range seeding and revegetation efforts. This revegetated state can be quite stable.

State 4. An unknown site with abundant weedy species and excessive soil loss and changes in the hydrologic cycle caused by continued improper grazing management and/or frequent fire cause this state to cross a threshold and it is not economically feasible to move this state back towards the reference state.

Part 5 – Rangeland Ecosystem Measurements

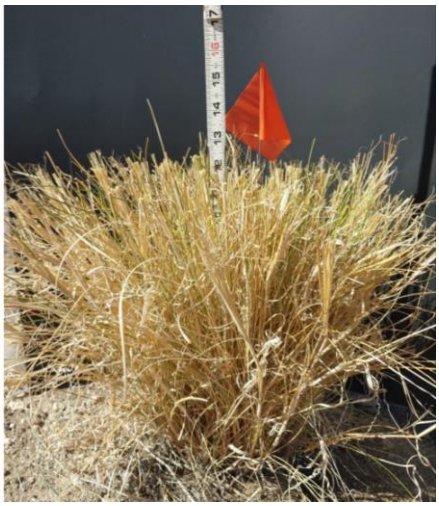
Part 5A. Height-Weight Method Utilization Estimate

Utilization is defined as "… the proportion or degree of the current year's forage production that is consumed or destroyed by animals (including insects). The term may refer either to a single plant species, a group of species, or to the vegetation community as a whole" (as stated in Utilization Studies and Residual Measurements pgs 89-101; available at: https://www.nrcs.usda.gov/sites/default/files/2022-09/stelprdb1044249.pdf

Utilization is an important attribute to measure and monitor because it determines the potential effect of grazing on individual plants and plant communities. One of the fundamental principles of rangeland management is that plants can be grazed or browsed each year without lasting damage as long as this utilization is below some critical level. The recommended level of utilization varies by plant and season. However, most rangeland plants can survive the loss of 30 to 50% of their leaves and stems when they are actively growing. The distribution of utilization levels across a pasture also gives an indication of how evenly grazing animals are using the pasture. In addition, if grazing by wildlife is heavy, levels of utilization may need to be estimated before livestock enter a pasture to make sure recommended or desired levels of utilization are not exceeded.

Utilization levels are inherently difficult to estimate because utilization describes an amount of forage production that was removed as a percent of what is remaining. It is difficult to estimate an amount of forage that is no longer there. However, several methods have been designed to get at the "removed" vegetation levels. One of these methods is the height-weight method which uses the measured height of grazed and ungrazed grasses to determine percent utilization.

For this event, 20 grass plants of the same species will be marked with a flag number 1-20. Participants will:



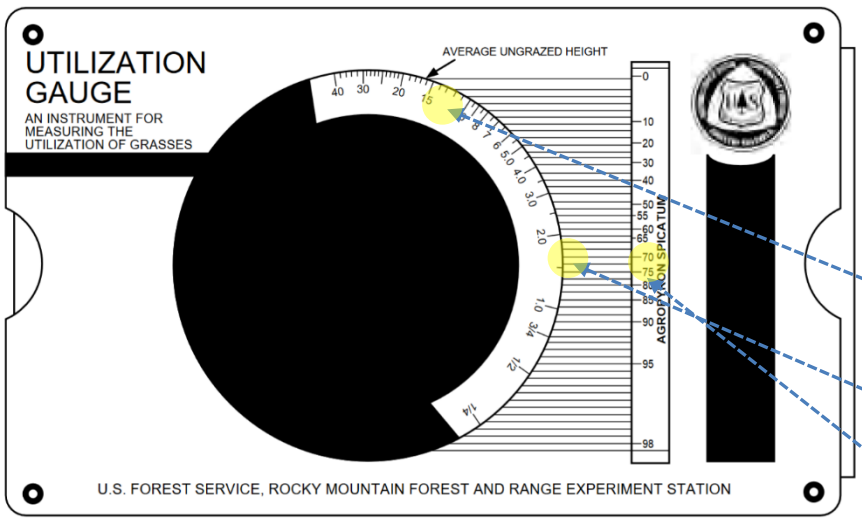
1) Determine if the plant is grazed or ungrazed

2) Place a yard stick in the middle of the grass plant, next to the flag, and measure the maximum height to the nearest ½ inch. Participants are NOT allowed to touch the plant to push drooping culms up to add to the max height, simply assess height as the grass stands.

3) Record height in the appropriate column, ungrazed or grazed. (Example scorecard below).

4) Calculate the average height of ungrazed plants. (Average height = Total height of ungrazed plants ÷ number of ungrazed plants).

5) Use a Utilization Guage to calculate the % utilization of each grazed plant. Utilization gauges can be purchased from Colorado State University Book Store or made from a template provided on page 97 of the handbook "Utilization Studies and Residual Measurements"



- Slide out of card until scale for species designated appears in window. (The species will be clearly labeled at the site)
- Turn dial until average ungrazed height appears opposite arrow for "Average Ungrazed Height" *(in this example 15").*
- On the dial, find the height recorded for each grazed plant *(e.g., 2.0")*
- Follow the line to the right to determine % utilization listed on the card *(e.g., 65%).*

Record % Utilization for each grazed plant.

6) Calculate average utilization. (Average Utilization = Total utilization of all grazed plants ÷ 20).

Example of how heights are used to estimate utilization with a Utilization Guage.

Plant Number	Height (measured in inches)		% Utilization
	Ungrazed	Grazed	
1	22		20
2		12	20
3		8	35
4		17	5
5	20		0
6		6	45
7		3	65
8		10	32
9		15	10
10	19		0
11	23		0
12		13	18
13		8	35
14	22		0
15		3	65
16		8	35
17		17	5
18		9	31
19		15	10
20		6	45

Count from ungrazed column

Number of ungrazed plants = 5 plants

Add heights of in ungrazed column

Total Height of ungrazed plants = 106"

Total height ungrazed plants ÷ by number of ungrazed plants

Average ungrazed plant height = 21"

21.2" rounded to nearest 1/2 inch

Number of all sampled plants = 20 plants

All percentages from % utilization column added

Total % utilization of all plants = 456

Total % utilization ÷ by 20 which is the number of plants sampled

Average % Utilization = 23%

22.8% rounded to nearest whole number

Part 5B. Shrub Cover Estimate

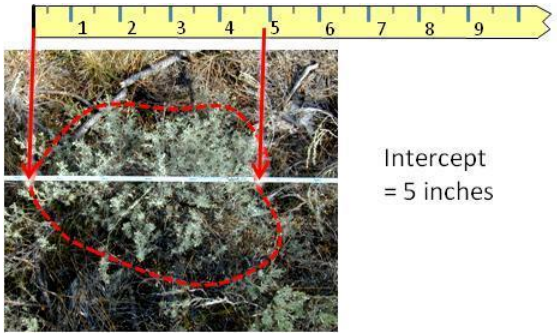
When examining cover for wildlife, it is important to focus on shrubs. Big game, upland game birds, and small mammals use shrub cover as forage or as hiding, nesting, or thermal cover. Cover is a vegetation attribute that refers to the proportion of the ground surface that is "covered" by a plant or group of plants. **Canopy cover** can be visualized as the area of the ground surface that is covered by the leaves or stems of a plant in a way the vegetation shades the ground or intercepts rain drops. For shrub canopy, it might be useful to visualize the area under the shrub that a small animal, like a rodent, might go for shelter. From an ecological standpoint, it is the area that a plant controls or influences with its leaves, stems, and roots.

There are dozens of ways to estimate cover. A common method used for estimating brush cover when evaluating habitat is the line-intercept method. By this method, the habitat manager or scientist lays down a tape measure to create a transect line. Then the area intercepted by the plant of interest is summed up. The total area covered by a specific plant divided by the total length of tape examined = % cover for the species of interest.

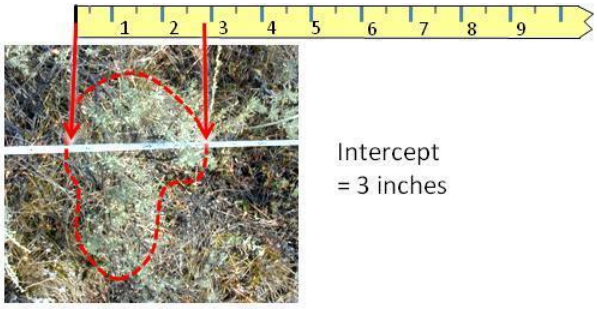
$$\frac{\text{Plant cover}}{\text{Length of tape}} \times 100 = \%\ \text{cover}$$

In this event, a transect will be placed on ground level and the total length of the transect will be displayed. Each participant will examine the transect and measure the cover of shrubs that intercepts the transect and **only the green canopy of the shrubs will be measured**, so any dead canopy is ignored. The transect length will vary based on how many shrubs are on the site. For example, in areas of sparse shrub cover, the transect may be longer than in denser stands.

1. Participants will walk from the transect start point to the end and look for instances where shrubs intercept the plane of the transect line. Breaks of less than 2.5 inches will be disregarded. This means that gaps in the **green canopy** of less than 2.5 inches are ignored and the canopy is considered as continuous. If two shrubs grow together with no gaps > 2.5" in their combined intercept, they would be a single "Plant Intercept."



Intercept
= 5 inches



Intercept
= 3 inches

2. Measure and record the distance that shrubs cover directly intercepts the transect line. Add the shrub intercepts to obtain the sum of the length of total intercept.
3. Calculate % cover = (Total intercept ÷ length of transect) × 10

Example of how to record shrub intercepts and estimate shrub cover.

Shrub Intercept | Transect Length = 15 ft (or 180 inches)

Plant Intercept	Intercept (inches)	Plant Intercept	Intercept (inches)	Plant Intercept	Intercept (inches)
1	5	7	9	13	5
2	3	8	11	14	4
3	7	9	4	15	
4	14	10	4	16	
5	7	11	6	17	
6	8	12	8	18	
Subtotal =	44	Subtotal =	42	Subtotal =	9
				Total Intercept =	95
				% Cover =	53%

Appendix A: CDE Plant List

								Forage Value				
	Growth Form			Life Span		Origin		Grazers		Browsers		
Common Name	*G*	*F*	*W*	*A*	*P*	*N*	*I*	*D*	*U*	*D*	*U*	*Toxic*
Grasses and Grass-likes												
Baltic Rush	X				X	X			X		X	
Basin Wildrye	X				X	X		X		X		
Bluebunch Wheatgrass	X				X	X		X		X		
Crested Wheatgrass	X				X		X	X		X		
Elk Sedge	X				X	X		X		X		
Foxtail Barley	X				X	X			X		X	
Idaho Fescue	X				X	X		X		X		
Indian Ricegrass	X				X	X		X		X		
Intermediate Wheatgrass	X				X		X	X		X		
Nebraska Sedge	X				X	X		X			X	
Needle-and-Thread	X				X	X		X			X	
Orchardgrass	X				X		X	X		X		
Prairie Junegrass	X				X	X		X		X		
Purple Threeawn	X				X	X			X		X	
Saltgrass	X				X	X			X		X	
Sandberg Bluegrass	X				X	X		X			X	
Smooth Brome	X				X		X	X		X		
Squirreltail	X				X	X		X			X	
Timothy	X				X	X		X		X		
Forbs												
Arrowleaf Balsamroot		X			X	X		X		X		
Curlycup Gumweed		X			X	X			X		X	
Locoweed		X			X	X			X		X	X
Louisiana Sage (or Cudweed Sagewort)		X			X	X			X		X	
Lupine		X			X	X			X		X	X
Mule-ears		X			X	X			X		X	
Penstemon (or Beardtongue)		X			X	X			X	X		
Scarlet Globemallow		X			X	X		X		X		
Tall Larkspur		X			X	X			X		X	X
Tansymustard		X		X		X			X	X		
Tapertip Hawksbeard		X			X	X		X		X		
Western Yarrow		X			X	X			X	X		

								Forage Value				
	Growth Form			Life Span		Origin		Grazers		Browsers		
Common Name	G	F	W	A	P	N	I	D	U	D	U	Toxic
Woody Plants (Shrubs, Sub-Shrubs, & Trees)												
Antelope Bitterbrush			X		X	X		X		X		
Big Sagebrush			X		X	X			X	X		
Chokecherry			X		X	X			X		X	X
Coyote Willow			X		X	X		X		X		
Curl-leaf Mountain Mahogany			X		X	X			X	X		
Fourwing Saltbush			X		X	X		X		X		
Gambel Oak			X		X	X			X		X	X
Greasewood			X		X	X			X		X	X
Mormon Tea			X		X	X		X		X		
Pinyon Pine			X		X	X			X	X		
Quaking Aspen			X		X	X			X	X		
Rabbitbrush (Green or Rubber)			X		X	X			X		X	
Redosier Dogwood			X		X	X			X	X		
Saskatoon Serviceberry			X		X	X		X		X		
Shadscale Saltbush			X		X	X		X		X		
Skunkbrush Sumac			X		X	X			X	X		
Winterfat			X		X	X		X		X		
Woods' Rose			X		X	X			X	X		
Weeds & Invasive Plants												
Canada Thistle		X			X		X		X		X	
Cheatgrass (or Downy Brome)	X			X			X		X		X	
Halogeton		X		X			X		X		X	X
Hoary Cress (or Whitetop)		X			X		X		X		X	
Leafy Spurge		X			X		X		X		X	
Medusahead Rye	X			X			X		X		X	
Poison Hemlock		X			X		X		X		X	X
Salt Cedar			X		X		X		X		X	
Russian Thistle (or Tumbleweed)		X		X			X		X		X	X
Spotted Knapweed		X			X		X		X		X	
Ventenata	X			X			X X		X X		X X	

Plant Name: provide common name
Growth Form: G=grass or grass-like / **F**=forb / **W**=woody plant
Life Span: A=annual / **P**=perennial
Origin: N=native / **I**=introduced

Forage Value: D=desirable/ **U**=undesirable
Grazers = cattle, sheep, bighorn sheep, and elk
Browsers = goats, deer, moose, and pronghorn
Toxic: Plant is toxic.