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Rangeland Plant Life Forms

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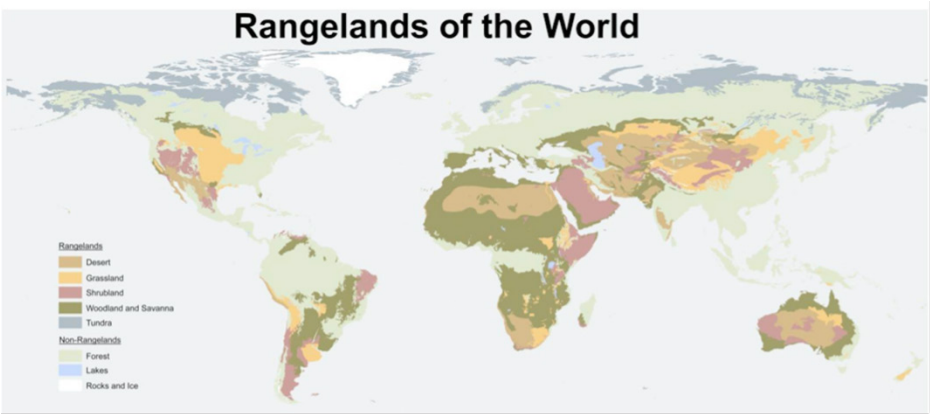

Figure 1. Rangelands of the world (*Dr. Karen Launchbaugh, Public domain, via Wikimedia Commons*).

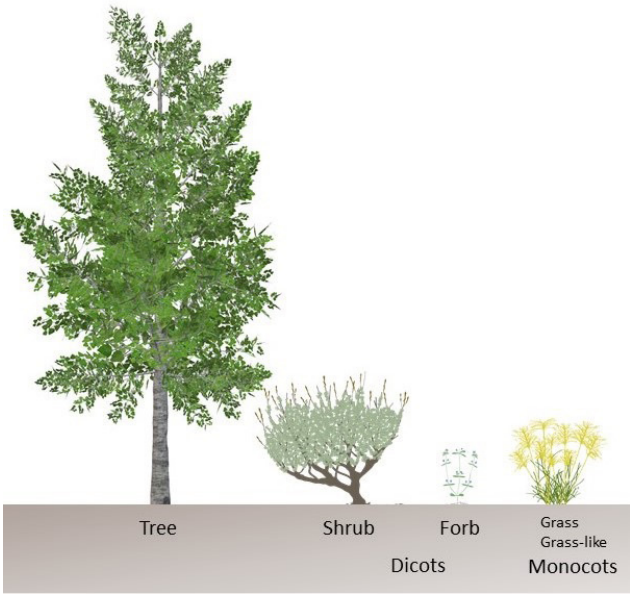

Figure 2. Major plant life-forms on rangelands (icons provided by Microsoft 3D and Sage Grouse Initiative).

Introduction

Allen et al. (2011) defined rangelands as:

Arid and semi-arid land on which the indigenous vegetation is predominantly grasses, grass-like plants, forbs, or shrubs that are grazed or have the potential to be grazed, and which is used as a natural ecosystem for the production of livestock and wildlife. Rangelands may include natural grasslands, savannas, shrub lands, many deserts, steppes, tundras, alpine communities, and marshes.

Rangelands are recognized as the largest land type on the planet, occupying up to 70% of the Earth's terrestrial surface area, excluding Antarctica (Figure 1). In this article, we discuss common life forms (Figure 2), life cycles (annuals, biennials, and perennials), and growing seasons (cool vs. warm season) of rangeland plants.

Grasses

Grasses are the most abundant and diverse plant life form on most rangelands. About 12,000 species of grasses have been identified (Christenjusz and Byng, 2016) which are estimated to cover >20% of the earth's terrestrial surface (Nunez, 2020). Grasses are in the Poaceae family and range in size and structure from small annuals like six weeks grama (*Bouteloua barbata*) to large, spreading perennials like bamboo which is used to manufacture furniture and flooring. Some common characteristics of grasses related to their form and function include:

- Grasses are herbaceous plants, meaning they do not contain substantial woody material like shrubs and trees.
- The leaves of grasses are long and thin and have parallel veins running the length of the leaf.
- Grasses typically have jointed stems (i.e., nodes or visible bulges) where leaves attach to the stem.
- Stems of grasses are usually round and hollow between the nodes.
- Grasses have small, inconspicuous flowers called spikelets.
- Grasses have fibrous root systems (especially perennial grasses) compared to those of forbs and trees which typically have deep tap-roots and/or branching roots.
- Grasses are monocots meaning they grow from a single cotyledon (one embryonic leaf) after germination.
- The growing points (meristems) of grasses remain near or slightly below the soil surface throughout most of their growing season which facilitates rapid regrowth following defoliation events (e.g., fire and grazing).

Grasses appear on rangelands in two primary growth forms, bunchgrasses and sod-forming grasses (Images 1 and 2). Bunchgrasses (also called cespitose grasses) grow vertically and in "bunches" from a common root crown, while sod-forming grasses "creep" laterally via stolons (above-ground stems) or rhizomes (below-ground stems).

Image 1. Cane beardgrass (*Bothriochloa barbinodis*) is a perennial, warm-season bunchgrass (cespitose). Photo Max Licher (SEINet).

Image 2. Curly mesquite (*Hilaria belangeri*), shown here in central Arizona, is a perennial, warm-season, sod-forming (stoloniferous) grass. Photo Ashley Hall.

Species of grasses may be classified as annuals or perennials. Annual grasses complete their life cycle in about one year (or less) and reproduce only by seed. Perennial grasses may live for many years and most are capable of reproducing vegetatively and by seed.

Grasses can also be grouped into two categories related to optimum temperatures for growth, i.e., warm or cool season. Warm season grasses have evolved to grow and reproduce when or where temperatures are warmer. Examples of warm season annuals include six-weeks grama, needle grama (*Bouteloua aristidoides*) and mucronate sprangletop (*Leptochloa filiformis*). Warm season perennials include many species from the genera of *Bouteloua, Andropogon*, and *Hilaria*.

Cool season grasses have evolved to grow and reproduce optimally in cooler climates or during cooler seasons. Examples of cool season annuals include little seed muhly (*Muhlenbergia microsperma*), cheatgrass (*Bromus tectorum*), and wild oat (*Avena fatua*). Examples of cool season perennials include many species found in the grass tribes of Poeae, Stipeae, and Triticeae such as Kentucky bluegrass (Poa pratensis), needle and thread (*Hesperostipa comata*), and bluebunch wheatgrass (*Pseudoregneria spicata*).

Grass-Like Plants

Grass-like plants, as the name implies, are very similar to the true grasses in that they share many of the same characteristics (i.e., narrow leaves, parallel veins in leaves, monocots, fibrous root systems, inconspicuous flowers, low growing points at or below the soil surface). One main difference is that grass-like plants have solid stems without joints compared to grasses which have hollow, jointed stems. Grass-like plants include sedges and rushes which commonly grow in riparian areas or other locations where

Image 3. Needle spike rush (*Eleocharis acicularis*) is a "grass-like" plant. Photo by Max Licher (SEINet)

Image 4. Showy flowers are a common characteristic of many forbs like this Arizona poppy (*Kallstroemia grandiflora*). Photo by Sarah Noelle

perennial subsurface water is available, although there are also dryland (upland) sedges, not associated with wetter areas. Most grass-like plants are cool-season perennials (Image 3).

Forbs

Forbs (aka broad-leaved plants), like grasses, are herbaceous (non-woody) plants but differ from true grasses and grass-like plants in the following ways:

- Forbs typically have showy flowers and broad leaves (Images 4 and 5).
- Veins in the leaves of forbs are usually netted.
- Forbs may have long tap roots (e.g., most biennial forbs) or branching, creeping root systems (e.g., many perennial forbs).
- Forbs are classified as dicots meaning they grow from two cotyledons (i.e., two embryonic leaves) after germination.
- The growing points of forbs are often elevated which diminishes their ability to tolerate fire and grazing compared to monocots whose growing points tend to be more protected.

Many forb species are valuable components of rangeland plant communities due their contribution to biodiversity, nutritional value as forage for both wildlife and livestock, and many other ecosystem services. For example, many rangeland "wildflowers" that germinate during wet winters and springs are cool-season annual forbs (Image 4).

Image 5. Alkali phacelia (Phacelia neglecta) has broad leaves and netted venation which are common characteristics of most forbs. Photo by Ashley Hall

Image 6. Mullen (*Verbascum thapsus*) in the rosette stage of development. Photo by Priyantha Wijesinghe

Image 7. Mullen after a reproductive stalk has "bolted". Photo by Max LIcher (SEINet)

Like grasses, forbs grow as warm or cool season annuals or perennials, as well as biennials which is a growth cycle unique to forbs. Some annual forbs evolved to germinate and grow mostly when temperatures are warm like scared datura (*Datura wrightii*). Other annual forbs germinate and grow when and where temperatures are cooler, e.g., various species of mustard (*Brassica* spp.).

Seeds from biennial forbs, like mullen (*Verbascum thapsus*) and thistle species (*Cirsium* and *Centaurea* species) germinate in the spring and quickly form a basal "rosette" of prostrate (flattened), herbaceous leaves by mid-summer (Image 6). The rosette begins to die back in the fall and into the winter when the plant's survival depends entirely on a deep tap root that is rich in carbohydrates. However, in Arizona's bimodal weather pattern, some annual or biennial forbs may germinate with summer monsoon or with fall precipitation, and then bolt the next spring or summer.

The following spring, reproductive stalks "bolt" from the plant's base; these stalks usually produce showy flowers and substantial numbers of seeds by its second summer (Image 7). During the plant's second fall/winter, the plant dies, but by then it has produced plenty of seed which may remain in the soil in a dormant but viable state for several years. The seeds will germinate when the right environmental conditions occur and the new plant then repeats its 2-year biennial cycle. Since invasive biennials (and annuals) reproduce only by seed, one key to controlling them is to reduce seed production to the extent possible. Perennial forbs, like perennial grasses, can reproduce via seed and/or vegetative roots, rhizomes, or stolons such as Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia virgata*), and yellow toadflax (*Linaria vulgaris*). Thus, controlling perennial forbs may require reducing reproduction by seed and via vegetative propagation.

Image 8. Big sagebrush (*Artemisia tridentata*) is an evergreen shrub. Photo by Kristen Phillips (SEINet)

Image 9. Aspen (*Populus tremuloides*), a deciduous tree, is turning yellow before it drops it's leaves and is growing with ponderosa pine (Pinus ponderosa), an evergreen tree. Photo by Ashley Hall

Image 10. Catclaw acacia (*Senegalia greggii*) resprouts from its base following rangeland disturbances such as fire or mechanical control. Photo by Ashley Hall

Shrubs And Trees

Shrubs and trees are called "woody" plants because they have highly lignified trunks and stems. The distinction between a shrub and a tree is somewhat subjective. Shrubs are lower-growing woody plants, typically less than ~8-10 feet in height, with multiple stems originating from the base of the plant (Image 8).

Conversely, trees commonly grow from a single main trunk for several feet before exhibiting multiple branching above ~8-10 feet in height (Image 9). Shrubs are typically much more common than trees on most rangelands. Both shrubs and trees usually have broad leaves but distinguish themselves from forbs due to their woody composition. All woody plants are perennials that can be broken down into two general categories: evergreen and deciduous.

Evergreen species, such as pine (*Pinus* spp.), fir (*Abies* spp.) and sagebrush (*Artesmisia* spp.) retain most of their photosynthetic material throughout the year (Images 8 and 9). Deciduous species, like most willows (*Salix* spp.) and aspen (*Populus* spp.) lose their leaves during the fall and winter when lower temperatures occur (Image 9). Evergreen woody plants can be an important source of emergency forage for rangeland herbivores during drought and winter because they retain their leaves throughout most seasons and environmental conditions. However, evergreen leaves often contain high levels of unpalatable compounds that may negate some or most of their nutritional value. Deciduous leaf material from woody plants like false mesquite (*Calliandra eriophylla*) or range ratany (*Krameria erecta*), is highly palatable to ungulate herbivores when available, but much of this forage resource is lost after leaf drop.

Woody plants may also be sprouters or non-sprouters. Sprouters, like many mesquite trees (*Prosopis* spp.), catclaw acacia (*Senegalia greggii*), and shrub live oak (*Quercus turbinella*), can bounce back quickly after disturbances (e.g., fire, mechanical control) remove the above-ground portion of the plant (Image 10). Non-sprouters like one-seed juniper (*Juniperus monosperma*) and Rocky Mountain juniper (*Juniperus scopulorum*) are more easily controlled because they may die after the above-ground portion of the plant has been removed.

Summary

To properly manage rangelands, it is important to know the plant life forms that occupy a management area. This article summarizes the major plant life forms that commonly occur on rangelands. Understanding the types of plant life forms that have the potential to grow and thrive is critical to evaluating whether changes in rangeland vegetation are moving in the desired direction based on management goals and objectives (Schalau 2010).

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