RANGELAND PLANTS (GRASSES, FORBS, SHRUBS AND TREES): ROLE AND FUNCTION

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Summary

A general overview is provided of rangeland plants, their characteristics, ecological roles and strategies for survival. The principles of classification of rangeland plants, both structural and floristic, are outlined. Examples are drawn from Central Asia and North America to illustrate the key points.

The most important point to remember is that plants play a key role in the functioning of ecosystems and without them, the rest of the system begins to change dramatically, breaks down, eventually fails and collapses. The cost of this downward spiral in biodiversity and productivity has a ripple effect in wildlife populations and dependent human communities.

A more encompassing view and dissemination of information on the goods and services supplied by rangeland plants has made planners and the non-scientific public more aware of where plant communities fit in the big picture. New knowledge of their role in water regulation and soil stability has been key in triggering management changes in watersheds to ensure adequate and sustainable supplies of water for drinking, bathing and growing food to downstream users.

Since most people in the world now live in urban settings; their link to landscapes has been lost to the point where they do not understand what impact their footprint has on rural landscapes. The increase in motorized vehicle use by "*wreckreationists*" coupled with development of primary range areas into condo sites to accommodate the throngs of vacationers who want a piece of this unspoiled paradise comes at a cost to society with increasing conflicts with wildlife and unsustainable use of resources.

This phenomenon of unsustainable use has gone on for centuries in China, Asia, South America and Africa where large populations have forced people to extend their activities into areas not suited for sedentary agriculture practices. North America is now seeing the first signs of ecosystem collapse (the Arctic landscape) due in part to practices in other parts of the globe that affect this area.

New studies of the interrelatedness and interdependence of species has come a long way in the last 100 years. Pollination and seed dispersal mechanisms have evolved in combination with other species over long periods creating complex relationship webs which can easily break down if a key element goes missing. More and more information on the pharmaceutical and cultural values associated with wild plants (traditional medicine and use) is being documented every day in a race against time due to the destruction of the habitats they occur in.

Human populations have been manipulating landscapes as long as they have been on the planet. However with the advent of machines, the pace and sheer amount of change increased exponentially in the 20th century. Restoration of landscapes is one solution to

"fixing" broken ecosystems but the input costs are high and the road to recovery long. More education about the value of rangeland ecosystems and humans role in maintaining their function would go a long way in ensuring their sustainability.

1. The Role of Plants in Native Rangeland Ecosystems

1.1. What are Ecosystems?

Ecosystems are communities of interacting organisms and the environment in which they are located. . They can be large scale (like grasslands) or small scale (a wet area within a grassland). Ecosystem components are both living and non-living and include the following: **parent material** (underlying weathered and broken down rock below the soil and above the bedrock); **soil** (the complex mixture of tiny particles of inorganic minerals and rocks, decaying organic matter, water, air and living organisms); **climate** (a composite of day to day weather conditions and atmospheric elements within an area over a long period of time); **topography** (the lay of the land as determined by elevation, slope and aspect); **producers** (the green plants which fix the energy of the sun and convert it into food, the energy capturing base of the ecosystem); **consumers** (herbivores who only eat plant material, carnivores who only eat flesh and omnivores who eat both) and lastly **decomposers** (break down organic molecules in the remains of dead animals and plants or the waste products of living organisms into inorganic substances).

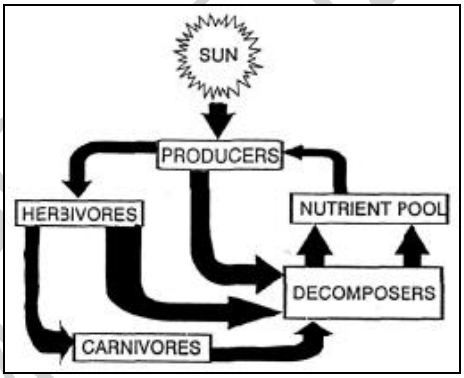

Figure 1. Trophic levels within ecosystems ensure that there is a flow of energy (from the Grazing and Livestock Technical Manual Sustainable Agriculture Development Project)

There is a direct relationship between soil, plant and animal health. If the soil degrades plants will suffer and grazers will struggle to eat enough plant material to maintain their fitness and gain weight.

1.2. What is Rangeland then?

"Rangeland is any area that has either native or non-native plant species and has the potential to be grazed by either wildlife or livestock". Plants within rangeland areas are treated as native ecosystems, not agriculture systems. What this means is they are not

irrigated, fertilized or plowed, they are left in their natural state and manipulated in other ways which try to mimic natural conditions. World wide, grasslands of various types occupy the greatest percentage (42%) but shrublands (23%) and woodland (12%) are also important

1.3. What is a Plant Community?

It is a group of plants growing together in an area due to factors which promote their growth. The following groupings of plants in northern hemispheres could be classified as rangeland community types: grassland, shrubland, open forest, riparian areas, subalpine steppe, alpine meadows, power line right-of-ways, road allowances, cutblocks, abandoned fields, wet meadows and arctic tundra to name a few The actual species of plants in communities is most affected by soil, slope, aspect, elevation, moisture availability, past history (disturbance, grazing/harvesting), nutrient regime and the number of frost-free days.

One example of the main broad classification of grasslands world wide and their locations are as follows:

Tropical grasslands- Africa, South America, northern Australia, India
Prairie/steppe- North America, Central Eurasia, South Africa
Temperate grasslands- Europe, North America, Australia, New Zealand, Asia
Tundra- all subarctic grasslands
Each broad community type can be further subdivided into smaller groupings (Ref To Other Eolss Volumes)**.**

2. Goods and Services Provided by Rangeland Plants

2.1. What Services do Rangeland Plants Offer to Keep Ecosystems Functioning?

Rangeland plants are integral parts of the ecosystems that they are a part of. They sit quietly on the landscape performing countless deeds throughout their lifetimes without much notice from the human species, unless of course they produce a bloom that warrants a closer look, emit a smell that triggers a memory or start to disappear from the landscape. They wait patiently for all of their basic needs that are provided by the other components of ecosystems.

2.1.1. Photosynthesis

Without plants the rest of the living things on this planet could not exist due to the fact that plants use solar energy to perform photosynthesis. This is the conversion of carbon dioxide and water into oxygen and sugars. **Solar energy + $6CO_2$ + $6H_2O$ yields $C_6H_{12}O_6$ + $6O_2$** All of this is going on invisibly day after day while plants are actively growing, enabling the rest of us to carry on with our lives. Plants in rangeland ecosystems are no different than those in other places' they are just different species adapted to the natural conditions of rangeland systems.

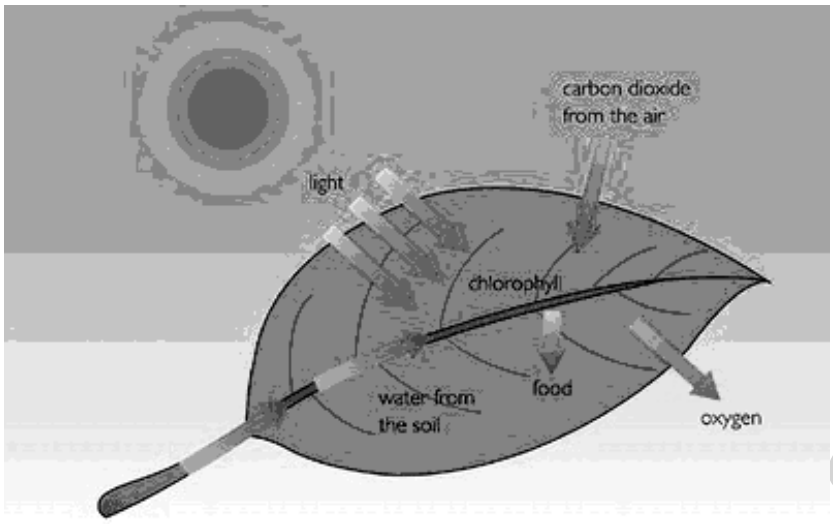

Figure 2. How photosynthesis works

2.1.2. Food Source for Grazers

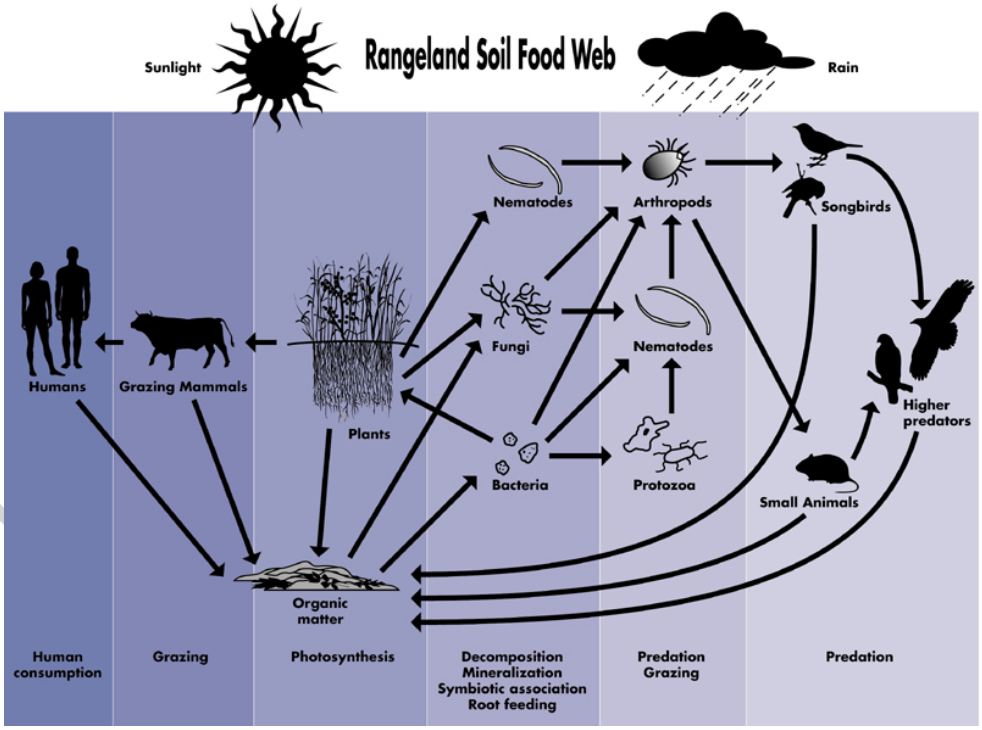

Figure 3. The soil food web in rangelands

Besides utilizing CO2 and providing atmospheric oxygen, photosynthesis results in another important service of providing a food source for **primary consumers.** These animals (rabbits, sheep, deer and cows) only eat plant material. Animals feed directly on the plants converting some of it into protein in their bodies which in turn provides food

for **secondary consumers**, or carnivores and omnivores like humans. If there are no plants there are no higher life forms since they are the base along with soil of the energy system.

2.1.3. Maintenance of Soils

Not only do rangeland plants play a large role in building soil but they also help regulate soil temperature, moisture, heat loss and fertility. The parts of the plants that drop to the ground at the end of the growing season and stay in place (litter) provide a covering for the soil much like a blanket. This debris will eventually break down and become part of the organic layer of the soil and slowly release its nutrients which will be used by vegetation growing on the site. Grassland areas with adequate litter tend to "green up" (emerge and grow) earlier in the spring than sites where every last bit of litter has been removed because there is more soil moisture available.

2.1.4. Regulation of Fresh Water Supplies within the Hydrological Cycle

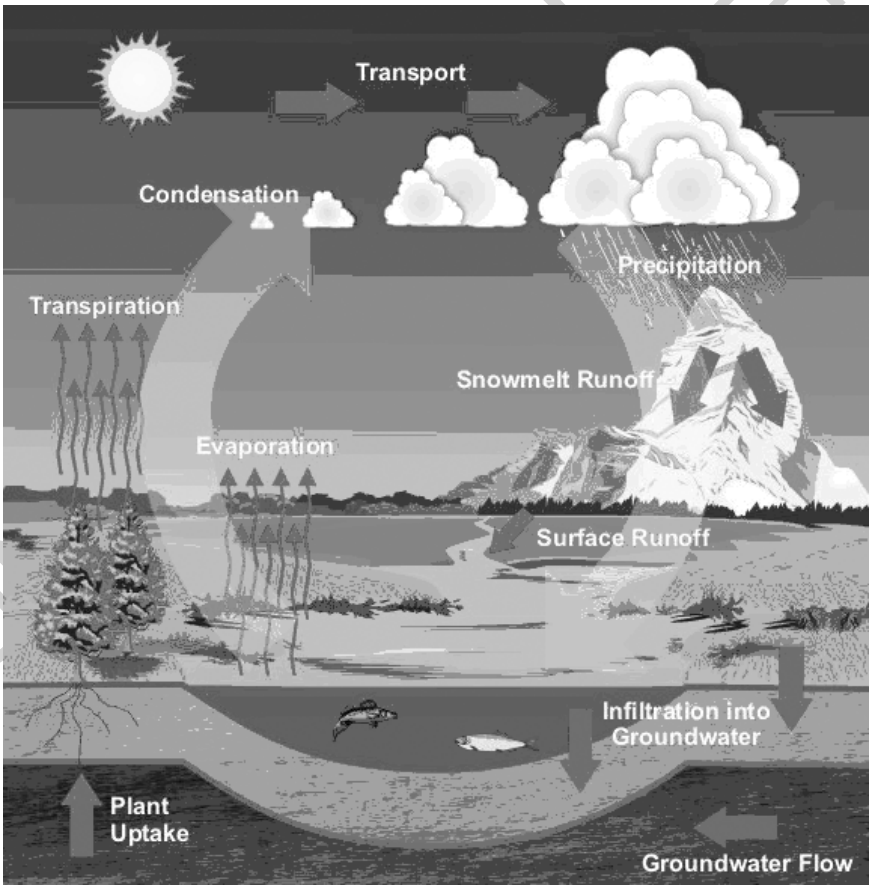

Figure 4. A generalized hydrological cycle (Image adapted from the National Oceanic and Atmospheric Administration (http://www.noaa.gov/index.html)

A watershed is any area that collects and stores precipitation (*Catchment Management:a framework for managing rangelands*). Watershed boundaries can be located by looking

at a map and following the water bodies to their origin, which is generally at a higher elevation. Watersheds consist of three main components: uplands, riparian/wetland areas and the aquatic zone. When a watershed is functioning properly it captures normal amounts of precipitation and slowly releases it. Watersheds are important components of the hydrological cycle and rangelands form large parts of watersheds as is illustrated below.

When rainfall events occur the water tends to flow downhill and pool in depressions or find its way into stream systems if there is nothing to impede its progress. Good condition rangeland areas with sufficient vegetation cover will absorb some of this water which sinks into the ground to be later absorbed by plant roots. If the rain is heavy and the water starts moving along the soil surface, plant structures and litter play a large part in slowing the process down by trapping and absorbing or diverting the water as it moves along. This allows the capture of more water to be released later and helps prevent erosion of soil.

2.1.5. Symbiotic Nitrogen Fixation

Leguminous plants occurring in rangeland areas have a symbiotic relationship with nitrogen-fixing bacteria (*Rhizobium*) in their root nodules which make nitrogen available in the soil surrounding them. Nitrogen is widely used by plants during their active growth period to make new leaves

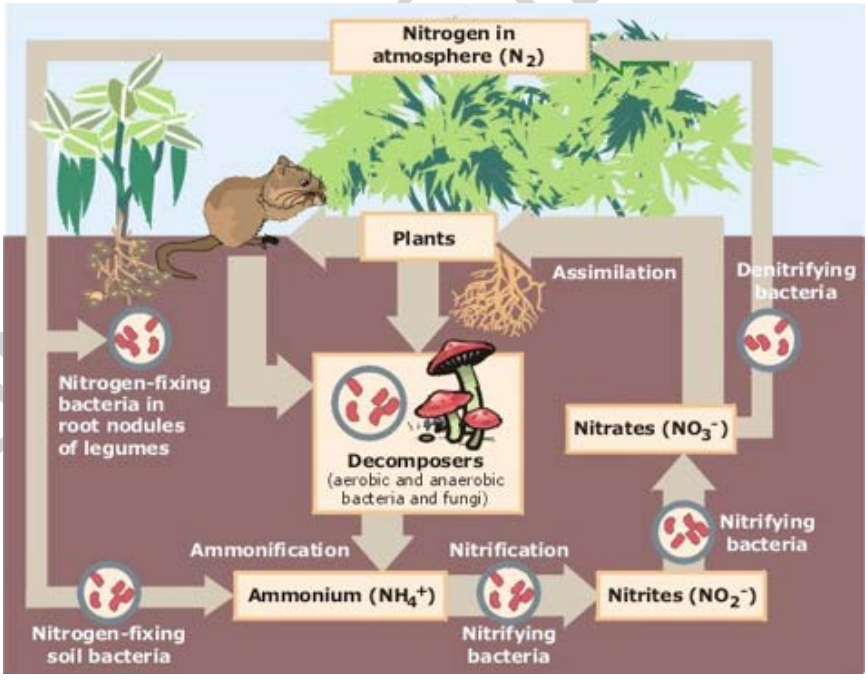

Figure 5. Symbiotic nitrogen fixing in rangelands depends on a wide range of organisms (This image is the work of an Environmental Protection Agency employee, taken or made during the course of an employee's official duties. As works of the U.S. federal government, all EPA images are in the public domain)

2.1.6. Natural Control of Pathogenic and Parasitic Organisms (Pest Control)

Intact and functioning ecosystems can sustain repeated small scale attacks of insects, pests and disease. All plants have strategies or coping mechanisms for survival. Some plants have developed genetic resistance to disease over long periods of time while others have succumbed and died off. Disease resistance is one of the main characteristics that plant scientists look for when they are trying to develop cultivars from wild stock. It is estimated that there are over 500 types of canola in the Tibet Autonomous Region that farmers have saved and planted for centuries all of which came from wild stock originally. Each type has special adaptations for growing in specific niches in the many regions of Tibet. Although many of them do not have high rates of production, their natural resistance to many pests and diseases makes up for the loss.

Other rangeland plants contain volatile oils which discourage browsing by some herbivores or in some cases can repel attackers. Sagebrush is a classic example of this adaptation and only Pronghorn antelope, which have evolved with sagebrush are able to eat large amounts of the plant without becoming sick.

In their reactions to attack, plants evolve as the pests change. Although attacks may weaken certain targeted plants, others nearby will benefit and occupy the space until the other plants have sufficiently recovered to grow again.

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Biographical Sketch

Gail was raised on the prairies in small town Alberta, Canada. She completed a Certificate in Physical Education from Mount Royal College in Calgary in 1970. She went on to the University of Arizona but lost interest and did not finish the degree. Attendance at an Outward Bound School held in Mexico in 1971 changed her thinking which led to 10 years of homesteading in the remote Kispiox Valley of British Columbia from 1974-84.

She eventually attended the University of Victoria in 1985 (as a single parent with three sons) and received a Bachelor of Science degree with emphasis on Plant Ecology and Physical Geography in 1989. This led to ten years of work in rangeland management with the British Columbia Ministry of Forests in Invermere, from 1992-2002. She has contributed to various published articles and authored papers related to endangered plants, grass id and collection, ecosystem restoration, plant community change and has also edited several theses and papers for Chinese students and scientists.

The closure of the Ministry of Forests office created an opportunity to work overseas on two different CIDA funded projects in Tibet and Xinjiang provinces in China from 2002-2007. Currently she is contracting to the government of the Republic of Tajikistan on a World Bank funded Community Agriculture and Watershed Management project. When not engaged overseas work, she lives in Windermere, British Columbia in the Columbia valley between the front ranges of the Rocky Mountains and the Purcells.