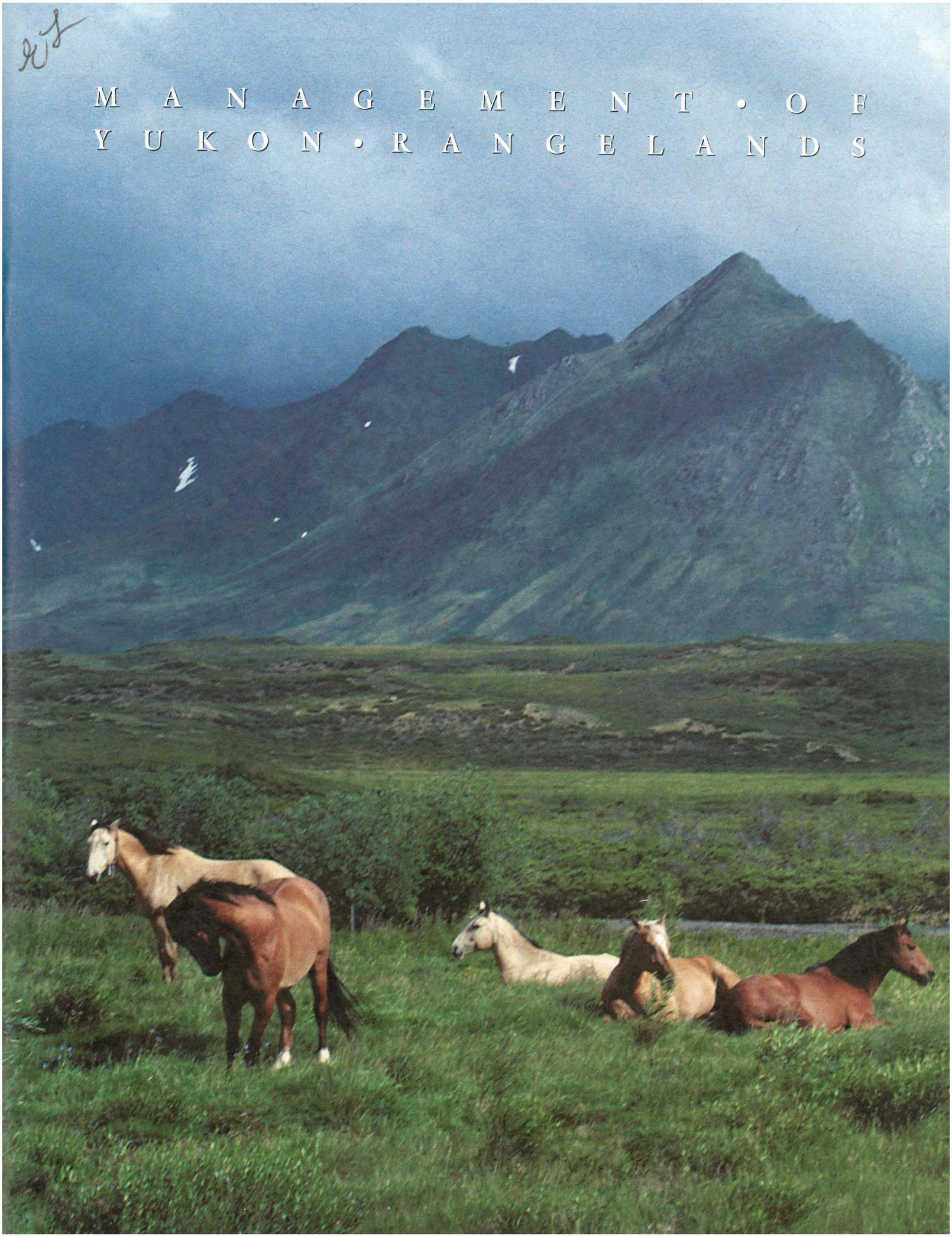
MANAGEMENT • OF YUKON • RANGELANDS



M A N A G E M E N T • O F
Y U K O N • R A N G E L A N D S

by

Arthur Bailey
Michael Willoughby
Robert Johansen
Scott Smith

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ABOUT • THE • AUTHORS

ARTHUR W. BAILEY is professor of range ecology and management, Department of Plant Science, University of Alberta, and president of Western Rangeland Consultants Ltd., Edmonton, Alberta. For the past 25 years, he has conducted research, management studies, and consulted in range management with particular emphasis on fire ecology and the effects of grazing in western Canada. His work has taken him to the Yukon, the Northwest Territories, Alberta, British Columbia, Saskatchewan, Texas, Southern Africa, and Israel.

MICHAEL G. WILLOUGHBY is a rangeland ecologist with the Alberta Forest Service. At the time of the grazing lease study, he was a rangeland research technologist, Department of Plant Science, University of Alberta. His M.Sc. research in range management included studying rangeland plant communities and their grazing capacity near Smithers, British Columbia. Subsequently, he has continued similar studies for the University of Alberta and the Alberta Forest Service.

ROBERT L. JOHANSEN is Grazing Management Co-ordinator for the Agriculture Branch, Department of Renewable Resources, Yukon Territorial Government. He has conducted range surveys throughout the Yukon Territory for the past three years, ascertaining grazing capacities and completing grazing management plans. He obtained a diploma in Renewable Resource Management from Lethbridge Community College in 1986.

C.A. SCOTT SMITH is a soil scientist with Agriculture Canada's Yukon Soil Survey Unit in Whitehorse. He has worked in the Yukon for 8 years mapping soils and undertaking research in soil development, soil climate and permafrost. Previously, he worked on forest soil management in British Columbia. He holds an M.Sc. degree in soil mineralogy from the University of Alberta.

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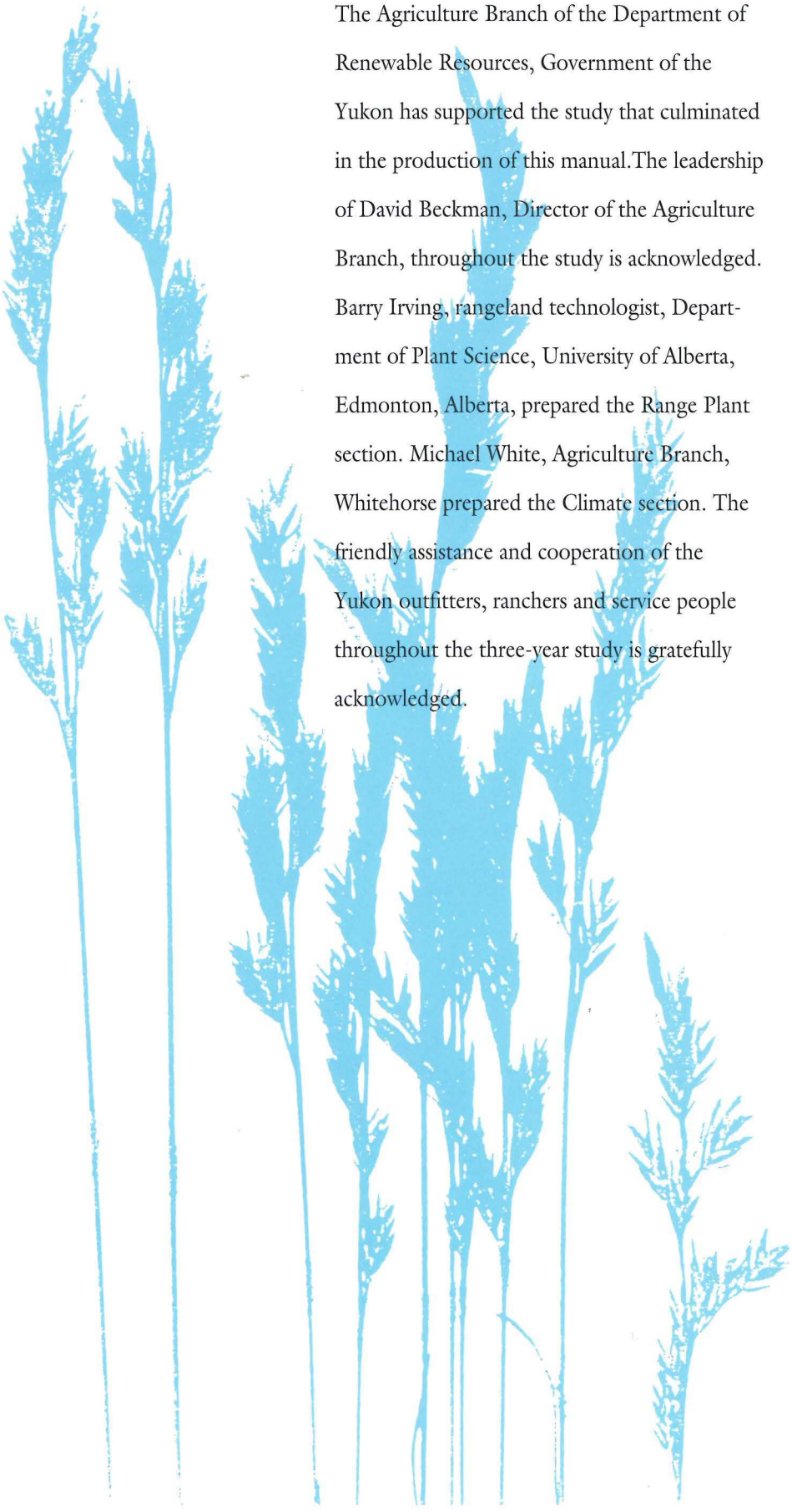

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Importance of rangelands to the Yukon economy and lifestyles

Rangelands are a key component of Yukon tourism, wildlife, guiding and outfitting. They provide the grazing, water, shelter, escape terrain and cover needed by wildlife and livestock. Termed graze, wildlife habitat or pasture by some, these lands will be described as ***rangeland*** in this manual.

Effective management of rangelands requires that there be an understanding by both government administrators and grazing agreement holders alike of how climate, soils, vegetation and grazing animals function together. This manual concentrates on the principles of rangeland management for grazing agreements being used by horses. These general principles could also be expanded by someone else to include the management requirements needed for the conservation and utilization of wildlife habitat.

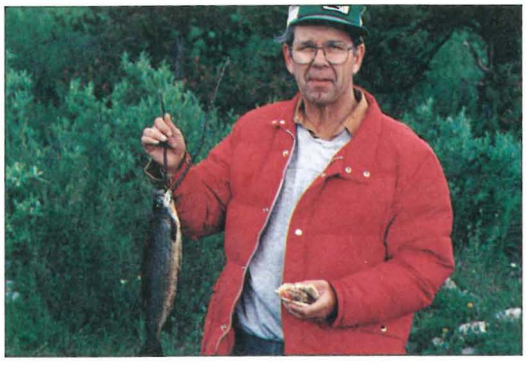


FIGURE 2: *An arctic grayling caught in the Swift River by the senior author, another product of Yukon rangelands.*

This manual introduces some of the key principles of rangeland management. The major rangeland plant communities and associated soils important to horse grazing in the Yukon are also identified followed by a description of major rangeland plant species. The final section deals with grazing systems and rangeland improvement practices important to the wise use and conservation of Yukon rangelands under crown grazing lease.

The three-year study of grazing agreements

This manual was developed by the participants of a 1988 to 1991 study of existing Yukon grazing agreements. Most crown leases provide grazing for horses used by guides and outfitters while a few others are grazed by cattle or other livestock.

The purpose of the study was to develop methods of evaluating the grazing potential of Yukon range land. The rangeland plant com-

munities were described and herbage production figures estimated in each lease before calculations were made to estimate grazing capacity for livestock. The study was restricted to grazing leases, particularly those in the southern Yukon extending from Watson Lake to Haines Junction and then northwards to Dawson.

In 1987 a Yukon government grazing policy was established. Under this new policy grazing management plans are required for each grazing area. Managed areas are referred to as grazing agreements. In this manual we use the terms grazing agreements and agreement-holders to correspond to the present policy terminology.

The grazing capacity study was the first of its kind in the Yukon. Some of the site data available to the participants was limited, so best estimates were made where required. No detailed studies had been done in the Yukon on the palatability of plants grazed by horses. Listed in the appendix are palatability ratings which have been derived from our observations and best estimates for the average management situation found on grazing agreements in the Yukon. We are aware that palatability of many rangeland species decreases as the plant matures. Additional studies in future years will be required to refine the palatability ratings, grazing capacity estimates, and knowledge of major Yukon rangeland plant communities. The study did not extend north of Dawson.

GRAZING • HISTORY

Herbivores have grazed Yukon rangelands for a very long time. Their influence on the landscape and the vegetation remains largely unknown to this day.

Recent history of grazing on rangelands by wildlife

During the Peistocene epoch 2 million to 10,000 years ago, Yukon rangeland provided the habitat used by grazing animals. There were woolly mammoths, primitive hyaena, large camels, giant moose, muskox, short-faced skunks, giant beavers and ground sloths, along with other species.

Much of the Yukon remained ice-free during the major glaciation events of the Pleistocene Ice Ages. The northern and central Yukon are thought to have had a cold, dry climate which provided a high grazing capacity for the large pleistocene mammals.

Today, the territory supports a wide range of wildlife which fill specific ecological niches. They include upland birds, waterfowl, moose, mountain goats, Dall and stone sheep, woodland and barren ground caribou, wolves, cougar and grizzly bears. Recently, mule deer along with introductions of elk and wood bison, have been added to the list of rangeland grazers.

There have been dramatic swings in wildlife populations over the past 100 years. Undocumented reports indicate that prior to the Gold Rush of 1898, Aishihik, Kluane, and Teslin Lakes were black with caribou during winter migration. Subsequently, the caribou population has dwindled while moose populations rose considerably. Deer and coyotes are said to have entered the Yukon at the time of the Gold Rush and cougars arrived since the opening of the Alaska Highway. According to native elders wood bison were in the Liard River drainage and as far northwest as the Pelly River in the 1850s.

Wildlife populations were greatly affected by the Gold Rush in 1898 and construction of the Alaska Highway in 1942. The Gold Rush brought in thousands of people who lived off the land and decimated wildlife. After the hordes of miners left, wildlife numbers increased and then followed a period of stability until the 1940s. Construction of the Alaska Highway brought in people and provided access to many remote areas. Improved road access has had a devastating effect on wildlife populations.

History of livestock from the goldrush to the present

There were limited numbers of livestock in the Yukon prior to the gold rush. With the frenzy of the Klondike, starting in 1898, livestock numbers increased dramatically. The need for grazing land was immediate as thousands of prospectors sought fresh meat. Entrepreneurs drove cattle over the mountain passes from the coast and barged them downriver to the mining camps. According to a Northwest Mounted Police report of 1904 there were 2248 cattle, 3154 sheep, and 245 hogs in the Dawson area alone. This census did not include the hundreds or thousands of horses in the region.

White Pass and Yukon Route used horses on the winter coach road between Whitehorse and Dawson. The horses were predominantly grazed on rangelands during the summer. Many of the productive natural meadows were cut for hay to furnish feed during the winter for the fifteen posts along the stage line. Horses were also used to skid firewood to the river banks to provide fuel for the boilers of paddle wheel steamers.

The Alaska Highway brought new enterprises to the territory. The new road from the south provided access for big game hunters. Once they reached the destination, access to the hinterland was made on horseback and their trophies were brought out by pack horse. During that period, many outfitter's horses grazed Yukon rangelands year-round.

Today there are about 3000 horses, 125 cattle, 60 goats, and 80 sheep in the territory. Most graze Yukon rangelands during the spring, summer and fall. Many horses are transported south to the Peace River area for wintering. Other horses graze Yukon rangelands year-round while most other livestock are supplementary fed during the winter.

Many of the areas grazed today were utilized a century ago. This has had a tremendous impact on the vegetative composition of some rangeland communities. Uncontrolled grazing has frequently caused major shifts from palatable grasses and sedges to less palatable forbs and other species. Some areas are now denuded and exposed to the forces of erosion whereas other rangelands are highly productive and are relatively pristine following a century of grazing by livestock.

RANGE•MANAGEMENT•PRINCIPLES

Rangelands refer to the lands in the Yukon that wild and domestic animals depend upon to provide forage and habitat. ***Range management*** is the discipline that has studied and developed the principles needed to manage and conserve grazing lands. These principles enable us to use the rangelands wisely and to conserve for tomorrow thereby best serving the needs and wants of society.

Rangeland ecosystems

Plants and animals do not exist in isolation from one another. They live together in complex communities called ecosystems and compete with and among each other for food, light, water, nutrients and space. The environment influences the plants, animals and soil that exist at each site. The two factors which most influence forage productivity are precipitation and grazing activity.

The ecosystems that occur on Yukon rangelands will be described in this manual as ***rangeland plant communities.*** Each rangeland plant community describes a unique combination of climate, soil, plant species and animals. The energy source for each ecosystem comes from the sun (Figure 3). Energy is used by plants in photosynthesis to produce plant parts, leaves, stems, roots, flowers and seeds. Plants are ***primary producers.*** They are the source of

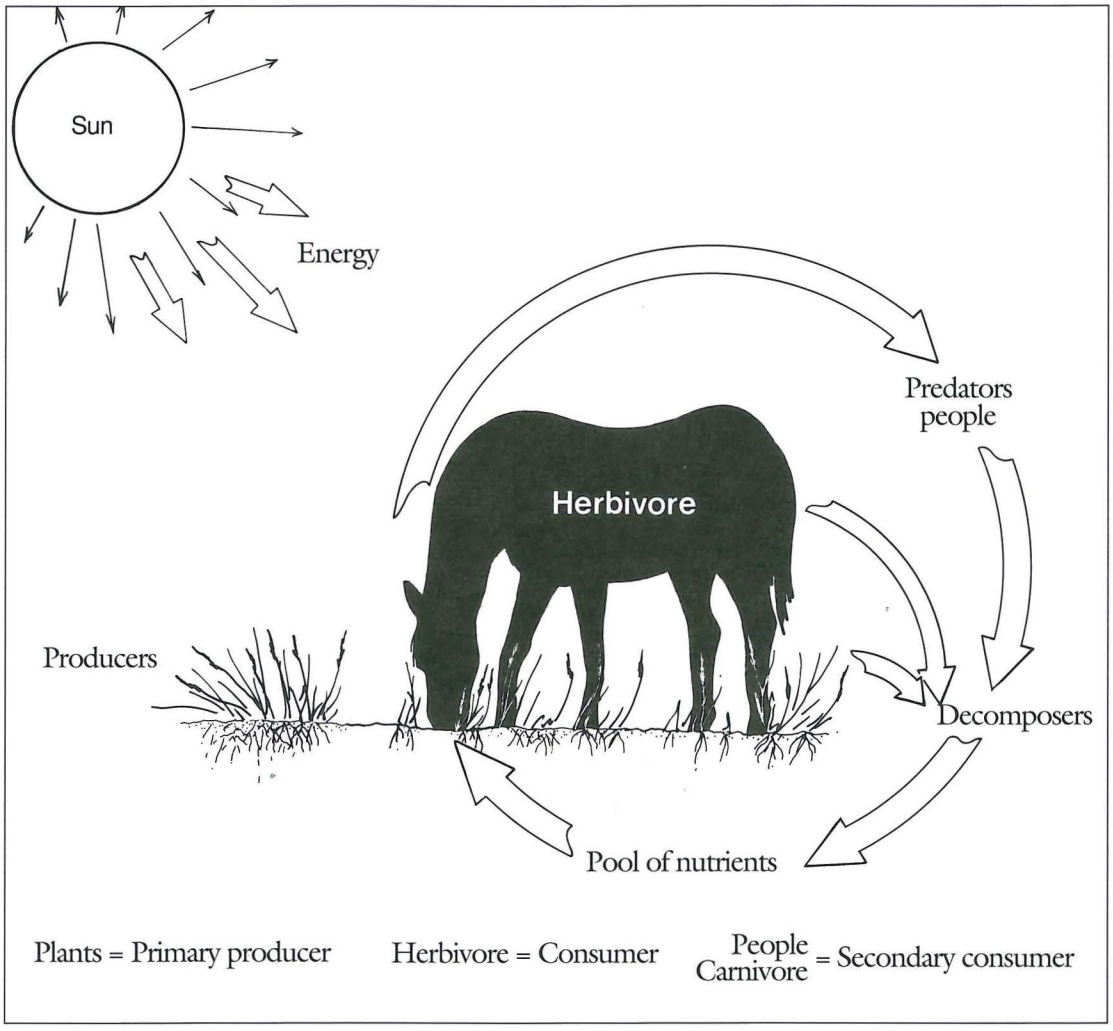


FIGURE 3: *The relationship of plants to animals, people and the soil in an ecosystem.*

food and habitat for the ***primary consumers***, the wild and domestic herbivores. The herbivores are a food source for carnivores and people, the ***secondary consumers***. As the uneaten plants, carnivores and people die, the ***decomposers***, bacteria and fungi, multiply and break down the dead tissue returning nutrients to the soil upon their death. These nutrients enter the soil nutrient pool and are recycled back into a new generation of plants. The two most critical requirements of every plant community are sunlight and water.

Management can be used to manipulate each rangeland community to favour the particular combination of plants and animals most favoured by people (Johnson 1990).

Forage growth cycle

Yukon plants have a short growing season. Growth often does not start until late May, it peaks by mid-June and then slows down by July (Figure 4).

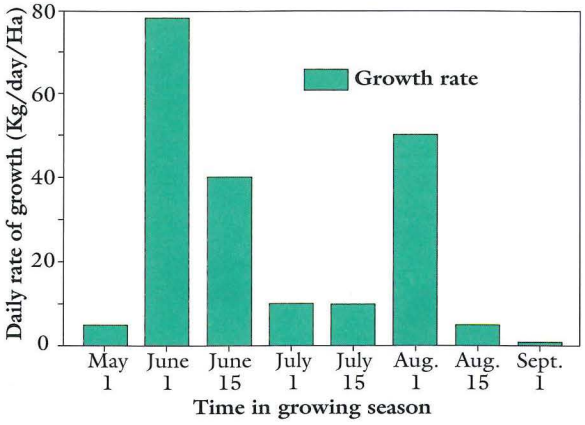


FIGURE 4: *Rate of growth of sedge meadow.*

If there are summer rains, growth rate will pick up again (i.e.: increase in growth for August 1) but if drought is prevalent, then there will be little growth during August. Most plants go into dormancy by late August or early September.

The quantity of forage produced varies by rangeland plant community, soil characteristics, current and previous grazing practices and growth cycle of each forage species. In Figure 5B it can be observed that the Awned Sedge Meadow Community produces more forage throughout the growing season and retains a greater quantity of it longer into the fall than does the Alkali Grass–Foxtail Barley Community.

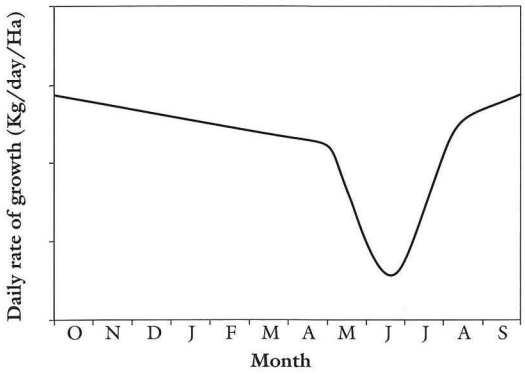


FIGURE 5A: *Annual cycle in stored energy for typical grass plant.*

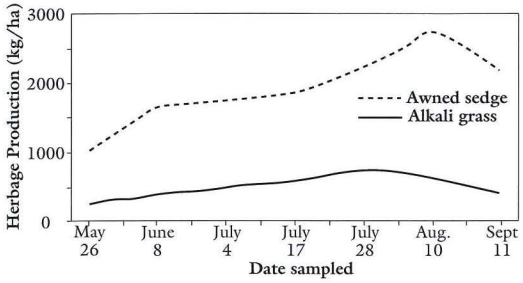


FIGURE 5B: *Forage growth cycle of two meadows.*

Although both are meadow communities, the lower producing rangeland community occurs on saline soils and is dominated by alkali grass and foxtail barley. Both these species break down in late summer and disappear more rapidly than does awned sedge. Thus, there is little forage available from the Alkali Grass–Foxtail Barley Community in fall and winter simply because of the properties of the major grasses. Similarly, shrubs that drop leaves in early fall suddenly lose one-third to one-half of the available browse. Since the highest forage quality is in the leaves, browse quality declines sharply in these species in September.

Forage nutrient cycle

The forage nutrient cycle is closely tied to the forage growth cycle. Early in the growing season forage quality is high and it declines

gradually over the growing season as plants mature and produce more fibrous tissue. Forage quality declines sharply, specifically the percentage of crude protein, at the end of summer when plants go into dormancy (Figure 6).

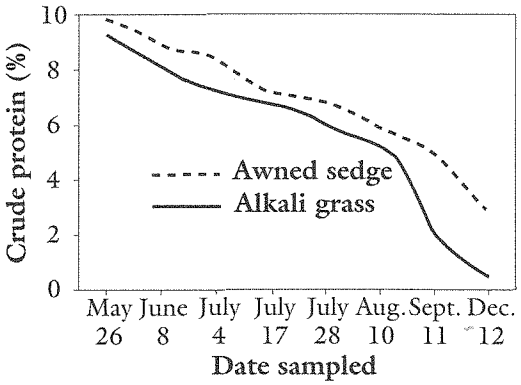


FIGURE 6: *Crude protein in two meadows.*

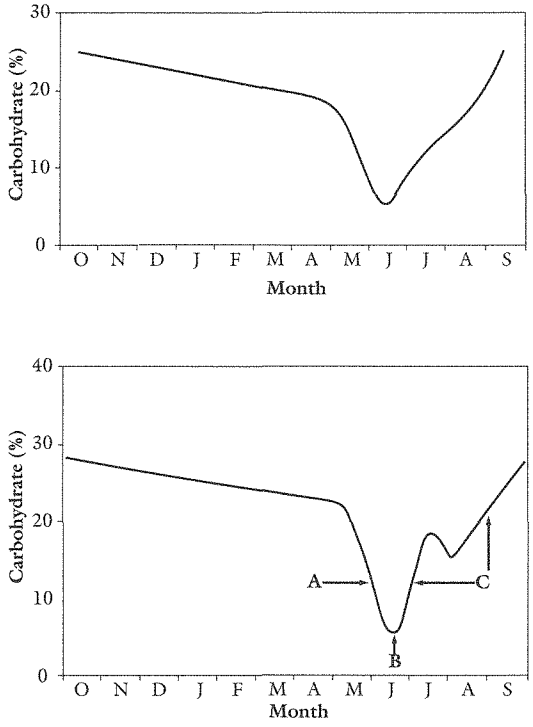


FIGURE 7A and 7B: *Carbohydrate cycle in Yukon grass. Annual fluctuation in carbohydrates reserves in smooth bromegrass in Alberta. (A) Spring growth reduces carbohydrate level. (B) New photosynthetic area supplies enough sugars for continued growth. (C) Carbohydrate reserves replenished.*

The nutrient requirements of grazing animals needs to be compared with the quality of forages available. Northern forages usually can supply the energy and protein requirements of horses in spring and early summer but in fall and winter problems can arise as more deficiencies appear.

Carbohydrate storage cycle

Perennial plants survive the long northern winters on mobile energy reserves that are stored during the brief, but intense growing season. When spring comes, plant growth places high demands on the available energy in plant storage organs. This results in a rapid drawdown of stored energy reserves (Figure 7A and 7B). As growth proceeds into June and then July, plants normally replenish lost reserves.

This continues throughout the growing season with stored energy reserves reaching a peak at the end of summer as plants go into dormancy. The energy storage cycle can be used to illustrate why palatable plants that are eaten every year are more vulnerable than unpalatable plants which are not grazed. The unpalatable plants are healthy and have lots of energy for winter survival. Moderately grazed palatable plants also go into dormancy with sufficient stored energy to survive the winter. On overgrazed rangelands, however, the palatable plants enter winter with depleted energy reserves. Some plants survive the winter and grow less vigorously next spring producing less than normal quantities of forage. Other palatable plants run out of energy and die.

Response of rangelands to grazing

Plant response to grazing

Plants respond to grazing in different ways. Those responses to grazing can be grouped and the plant species described as decreasers, increasers or invaders. ***Decreasers*** decline under grazing pressure as a greater and greater proportion of leaves and stems of these tall, palatable plants are removed, eventually they disappear from poor condition rangeland (Figure 8). ***Increasers*** respond to grazing in two different manners. The ***Increaser I*** plant species are palatable and increase under moderate grazing pressure in response to the decline

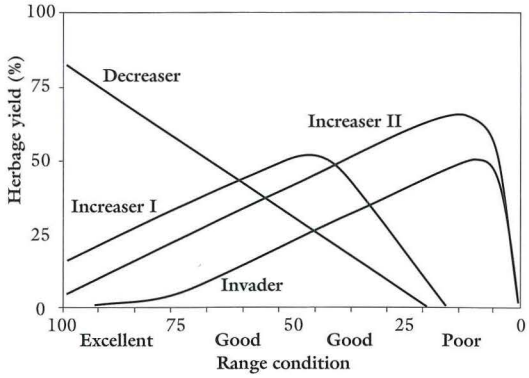


FIGURE 8: *A schematic diagram of range condition in a grassland in relation to types of plants and herbage yield.*

in decreaser plant species. If overgrazing intensifies, the Increaser I species, which are reasonably resistant to grazing, start to decline and can eventually disappear under extreme grazing pressure. The ***Increaser II*** plant species are unpalatable native plants that gradually expand on the site under overgrazing as more nutrients become available for their growth. The ***Invader*** plant species are foreign to the rangeland plant community but are adapted to the environment of the ecosystem and will encroach on the site as nutrients and light become available for their growth. The invaders are often unpalatable or very aggressive palatable species. Both the Increaser II and Invader plant species remain in the community until stocking density becomes so great that livestock or wildlife are forced to graze anything to try and survive. Under such severe conditions, trampling damage and overgrazing cause a rapid decline in plant cover, leaving bare ground. With no plant cover both water and wind erosion will first remove the topsoil, permanently reducing the productivity of the ecosystem. If bare ground continues for a long time, then the subsoil is eventually removed, further reducing productive potential and creating a desert.

In Yukon grasslands and meadows tall, palatable, decreaser grasses or sedges are often the most productive forage species for horses, cattle, bison, elk and wild sheep. Under heavy grazing they usually have a competitive disadvantage because a high proportion of the leaves and stems are removed by grazing. Low growing, palatable, Increaser I grasses or sedges respond to this decline by expanding on the site. Unpalatable Increaser II forbs or shrubs also expand as the decreasers decline and they continue to expand under considerable overgrazing pressure. In some rangeland plant communities, invader species like foxtail barley and dandelion become established on overgrazed areas and will expand extensively should overgrazing continue. Usually the increasers and invaders do not produce as much forage as do the tall, palatable decreasers.

When grazing is moderate or light, the desirable forage plants, the decreasers, produce abundant forage in the grasslands and meadows (Figure 9) but under prolonged overgrazing,

FIGURE 9: *A moderately grazed purple reedgrass plant community near Ross River.*

especially in spring and summer, forage production declines sharply (Figure 10). In subsequent years the forage production on overgrazed rangeland will be lower because of the low vigour of the palatable plants. On some fragile dry grasslands, it may take over 10 years

FIGURE 10: *An overgrazed purple reedgrass plant community near Ross River has less purple reedgrass and sedges more bare ground and numerous wild strawberries and goldenrod.*

to recover normal forage production following a prolonged period of overgrazing. When grazing becomes extreme even unpalatable plants cannot survive. This leads to bare ground and to a marked increase in erosion (Figure 11).

FIGURE 11: *Hardy willows survive. Evidence of erosion is commonplace.*

Range condition

Range condition refers to the state of health of the rangeland plant community. For grasslands and sedge meadows it is assumed that the stable climax vegetation is the most desirable and productive. As overgrazing kills the decreasers, it pushes the vegetation away from the climax to a less desirable stage of range condition. The range condition scale is usually arbitrarily divided into four classes (Abouguendia, 1990):

1. Excellent range condition: has 75 to 100% of the total yield contributed by the original desirable plant species;
2. Good range condition: has 50 to 75% of the total yield contributed by the original desirable plant species;
3. Fair range condition: has 25 to 50% of the total yield contributed by the original desirable plant species;
4. Poor range condition: has 0 to 25% of the total yield contributed by the original desirable plant species.

Rangeland in one of the lower range condition classes has less forage available to be grazed than one in good or excellent condition. When a grazing lease is inspected and such a situation is found, the grazing capacity will need to be reduced accordingly. Thus the leasee would not be allowed to graze as many animal unit months and will need to find an alternate source of grazing or remove surplus animals.

The species of animal must be taken into account when one applies this concept. Horses and cattle eat similar plants but moose do not. They eat mainly browse. Thus, when horses or cattle overgraze, the grasses, sedges and forbs are the first to decline. Where there is an excessive moose population, the palatable willows and other browse species will decline.

There is currently insufficient information available on the range condition concept presented in this section to be applied in detail to Yukon rangelands. There is an inadequate understanding of what happens in plant succession under grazing and browsing of the Yukon grasslands and shrublands. The range condition concept described above was developed in the Great Plains for stable, climax grasslands. Many of the primary rangelands used by horses in the Yukon are being influenced by forest succession. Further studies need to be done on the plant species and plant community response to grazing, and on forest succession under grazing and burning before this concept can be applied in a detailed manner to Yukon grassland and meadow rangelands. The application of the concept to forested rangelands requires considerable study before detailed applications can be made.

The basic concepts of range condition are being applied to Yukon rangelands using the current information base. As more information becomes available, further refinements will be possible.

Effect of grazing on plants

Most plants can endure moderate intensities of grazing. There have been wild herbivores grazing plants for millenia. Thus, many plants are adapted to surviving and producing forage under reasonable grazing pressures. Growing plants can endure about 50% of the top growth

being grazed. The remaining top growth is left enabling leaves to continue capturing the sun's energy permitting photosynthesis and the resulting growth and energy storage. A higher proportion of foliage can be safely grazed or browsed on range plants during the September to May dormant season. Plants in dormancy tend to be more resistant to defoliation. However, it is common practice to use the estimate of 50% to calculate the decrease of top growth removed during the dormant season. This is because most forage production measurements are recorded in July or August at the peak of production and there is a normal decline in yield of about 20% by October, due to senescence (Figure 5A).

The more frequently plants are grazed during the growing season, the more likely they will be unable to function normally. There must be enough leaves present to permit maintenance and growth. Rotational grazing is one means to ensure plant survival and continued high forage production. This will be described later.

Heavy continuous grazing on the drier grassland and forested rangelands during the growing season, will reduce forage production by 60–80% within a few years. In meadows, where soil moisture conditions are more favourable, the decline in forage yield would be about 40%. Heavy grazing during the growing season effectively reduces or eliminates productive forage plants, replacing them with low growing or unpalatable plants (Figure 12). The most productive and palatable decreaser plants are the first to decline followed by the Increaser I plant species.

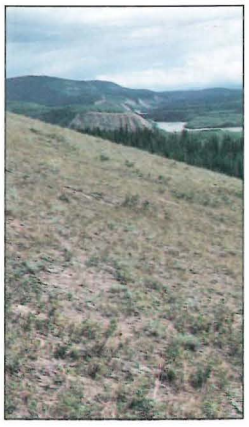


FIGURE 12: *The purple reedgrass plant community near Ross River has been heavily grazed in the growing season. There is considerable bare ground, low growing grasses and sedges as well as unpalatable forbs and shrubs.*

As palatable plants decline in availability, grazing animals start to eat the less preferred species and eventually, if overgrazing is permitted to continue, animals will be forced to eat unpalatable plants just to attempt to survive. These unpalatable plants may have secondary compounds that have repulsive odours, or cause digestive upset, weight loss, or poisoning.

Living plants and decaying vegetation (litter), cover the soil surface and intercept falling raindrops thereby absorbing their impact. If there is no vegetative cover the raindrops hit the soil surface and splatter fine soil particles over the surface plugging the coarse pore spaces. This seals the surface forming a crust and slowing down the infiltration of water into the soil. Subsequently, more water runs off the site. With less available soil moisture forage production declines.

The absence of good ground cover promotes erosion. This is very important in the Yukon because many soils are low in organic matter and have a sandy soil texture (Figure 13). When rangeland is extremely overgrazed both wind and water erosion can remove the thin layer of topsoil. Since the Yukon climate is favourable to plant growth for only a few months each year, it is appropriate for every rangeland user to ensure that overgrazing, as illustrated in Figure 11, is not commonly practiced.

FIGURE 13: *Sandy soil in a small patch of a large smooth brome field exposed to the forces of erosion along the Stewart River.*

Range management planning

The management of rangelands requires planning. There should be a properly conceived and implemented range management plan for each grazing agreement. It is the government's responsibility to adequately evaluate the rangeland plant communities on the grazing

agreement, establish the grazing capacity and put certain restrictions on the agreement. Most of this planning involves the agreement holder who must ensure that there is adequate livestock forage for both the duration of the current lease and the subsequent generations of agreement holders.

There are recent bulletins available regarding range management planning. It is recommended that interested readers refer to the Saskatchewan publication by Abouguendia (1990) for a good review of the range management planning process. The following steps should be taken in developing a range management plan:

1. Define the goals and objectives of the operation;
2. Gather the necessary information about climate, soils, vegetation and horse requirements;
3. Carry out a rangeland inventory;
4. Carry out the necessary range evaluation;
5. Assess the economics of the plan;
6. Finalize the plan;
7. Monitor the range and update the plan periodically.

Range management plans are currently being developed for Yukon grazing agreements. It is desirable for each agreement holder to develop more detailed range management plans which will more specifically address their individual needs.

Grazing capacity concepts

"Carrying capacity" refers to the optimum quantity of forage available to grazing animals under ideal range conditions. There are always practical reasons limiting the distribution of grazing animals and the availability of forage. The term "grazing capacity" refers to the optimum quantity of forage available for removal by grazing animals under the range management being practiced now. It is usually estimated in animal unit months (AUMs). An AUM is the amount of forage (455 kg (1000 lb)) an average-sized Yukon horse requires in one month. The estimate of grazing capacity is lower than carrying capacity. On some agreements, management can be changed to enable a greater proportion of the forage to be safely eaten by livestock, thus raising the grazing capacity closer towards the carrying capacity.

Primary, secondary and non-use range

The area on each grazing lease most used and preferred by grazing livestock is called ***primary range***. ***Secondary range*** refers to the areas not grazed until the primary range is used to capacity. Secondary range is not preferred graze due to reasons such as distance from water, steepness of slope or the presence of fallen trees that restrict access. Not all available forage on secondary range will be grazed so that the unused portion needs to be discounted from the grazing capacity calculations. ***Non-use range*** refers to that portion of the grazing agreement area that is not grazed. This may be because there is simply no forage available such as in many coniferous forests, or because of poor access due to deadfall, cliffs or large water bodies. Where forage is not accessible, as on non-use range, it should be removed from the estimate of grazing capacity.

Evaluation of grazing capacity

To begin the estimate of grazing capacity each grazing agreement area is subdivided into the appropriate rangeland plant communities. The herbage and browse production is estimated for each rangeland community and calculated on an air dry or oven dry basis. The acreage (hectares) of each rangeland plant community is calculated. Then the total herbage (or herbage plus browse) is determined for the area. From this total the proportion of unpalatable plants that the livestock do not eat is deducted. This is the forage supply. It is multiplied by the safe use factor (50% expressed as a decimal fraction) to give the available forage. Since there are always reasons for livestock favouring certain areas and

forages, the resulting management problems require another fraction of the forage supply being discounted. In the Yukon, the most common management factors are long, steep slopes and windfallen trees. Once the proportion of unavailable forage is removed, the remainder is called the consumable forage. The weight of the dry forage required/AUM is divided by the weight of the consumable forage/ha on the grazing lease to determine grazing capacity (AUM/ha).

A sample calculation is presented below:

Herbage production is 350 kg/ha, unpalatable herbage is 20%, safe use factor is 50%, steepness of slope causes 10% of the forage to be inaccessible, windfallen trees cause 50% of the forage to be inaccessible. (These last two factors relate to accessibility problems for the livestock).

The calculation is as follows:

$$350 \times 0.8 \text{ (unpalatable)} \times 0.5 \text{ (safe use factor)} \times 0.9 \text{ (steepness)} \times 0.5 \text{ (windfall)} = 63 \text{ kg/ha}$$

$$\frac{\text{Forage required/AUM}}{\text{Consumable forage kg/ha}} = \frac{455 \text{ kg}}{63 \text{ kg/ha}} = 7.2 \text{ ha/AUM}$$

The grazing capacity for this example is 7.2 ha/AUM.

Range nutrition

Nutritional components can be subdivided into what plants can supply and what livestock require. Since most of the livestock in the Yukon are horses, their nutrition will be emphasized.

There is little information available about the forage quality of Yukon native rangeland plants. In this study, analyses were made for crude protein since it is frequently used as a general indicator of forage quality. The crude protein content of two important rangelands (see Figure 5B) is presented due to their importance to Yukon horses. One meadow represents the Alkali Grass–Foxtail Barley Plant Community on a saline area. The other is an Awned Sedge Meadow Community, which grows on non-saline areas. In the non-saline area, crude protein was 10% in late May, declining to 8% by early July and then declining steadily to 3% in December, In the saline meadow, crude protein was highest in late May at 9.5%, was still 6% in August and then declined to nearly zero by December. This is the usual pattern. Succulent young forage should have higher crude protein values than more mature forage. The nutrient quality of forage in these meadows tends to be low, particularly during the dormant season. It would appear that livestock will have to be supplementally fed during the winter months throughout the Yukon to meet their crude protein requirements.

Nutritional requirements of the horse

Animal nutrition is a broad subject. In this manual emphasis is placed upon the "basic" requirements of the horse. For more specific information regarding animal nutrition, it is recommended that a veterinarian or the Agriculture Branch be contacted.

A balanced ration for horses should provide the nutrients required for body maintenance, growth, reproduction and work. These nutrients include carbohydrates and fats (energy), protein, vitamins, minerals and water.

Animals differ considerably in the amount of energy they use. Voluntary feed consumption of mature animals will generally be 1.5 to 2.5% of body weight per day. The percentage varies depending upon the roughage content of the ration and on individual variation. Growing foals and lactating mares may eat up to 3% per day of their body weight. During periods of heavy energy demand, concentrated feeds must be furnished since the digestive tract of the horse is not large enough to accommodate enough roughage to meet the high energy demands. When energy requirements are low, as with the idle, mature horse, roughage alone is sufficient. Energy deficiency can cause reduced growth, loss of weight, poor digestion and in severe circumstances, starvation.

The extent to which horse rations should be supplemented with protein depends on the age

of the horse and on the quality of the forage being eaten. Growing or lactating animals require more protein than those that are breeding or working. Generally, idle, mature horses require 7–8% crude protein in the diet, pregnant or lactating mares need 12–14%, and newborn foals need approximately 22%. Protein deficiency can result in muscle deterioration, weight loss and loss of appetite.

The need for vitamins, like other nutrients, depends on the quality of the forage base. The need for vitamins A and D is relatively constant but will increase if badly weathered or mature hay is being provided. The B-complex vitamins need not be added to the ration of most horses unless they are under the stress of performance.

Good quality rangeland and free-choice minerals usually satisfy the nutrient requirements of mature horses performing up to medium levels of work and the requirements of mares during early gestation. If the grazing is primarily grass, a mineral mixture containing two parts of calcium to one part of phosphorous is recommended.

Salt is generally included in the mineral mixture to improve palatability to the animals. Additional free-choice salt is recommended. Trace minerals may be included either in the salt or in the mineral mixture.

Water aids with the transport of other nutrients, removal of body wastes, control of body temperature, lubrication and many other body functions. Horses require about 3 kg of water for each kg of food consumed. A restricted water intake can reduce performance, growth rates, vigour or the digestion of foods. Forcing horses to eat snow during winter will result in an insufficient water intake and reduced performance.

Physiography

The relief and topography of the Yukon is characterized by numerous southeast-northwest trending mountain ranges interspersed by broad plateau areas. The Yukon lies within the northern-most extension of the Cordilleran region of Canada. The mountains create local areas of increased precipitation at higher elevations on their windward (westerly) flanks and broad rain shadow belts on the lee or easterly flanks. These physiographic effects on climate influence the nature and distribution of grazing communities in the territory.

Most of the southwestern Yukon lies within the rainshadow of the St. Elias Mountains. Major peaks within this range have elevations in excess of 12,000 feet (3657 metres). The southern Yukon plateau from Whitehorse to Carmacks lies between 2,000 feet (610 metres) and 2,500 feet (762 metres) above sea level. North of Carmacks the plateau lies at an elevation of between 1,500 feet (457 metres) and 2,000 feet (609 metres) and is downcut by the major river systems of the Yukon, Stewart and Pelly Rivers. These major river systems lie as low as 1,000 feet (305 metres) above sea level. Permafrost is scattered to discontinuous in this physiographic region. It is on semi-arid, lower elevations of the Yukon Plateau and its associated river valleys that much of the livestock grazing occurs.

The subalpine and alpine areas offer the unique set of conditions of higher summer rainfall, and therefore good herbage production through the growing season, together with warm winter temperatures relative to valley-bottom locations. Outfitters have long utilized the inversion effect to advantage to over-winter horses on high elevation rangelands in the south-west Yukon.

The Cassiar Mountains exist in the south-central Yukon. Peaks range up to 6,500 feet (1980 metres) and create higher precipitation zones along their western flanks. The Liard Basin to the east of the Cassiar Mountains lies at 1,500 feet (457 metres) and is bounded by the Mackenzie Mountains to the east which form the boundary with the Northwest Territories. For the most part, the basin is covered by closed boreal forest. Under these vegetation conditions grazing capacity is usually low.

The Pelly, Wernecke and Ogilvie Mountains form a series of ranges with moderate elevations which essentially divide the southern and central Yukon from the northern region. Permafrost is widespread north of these ranges and tundra conditions exist at elevations above 3,000 feet (915 metres). These sub-alpine and alpine areas of the northern mountain ranges provide some seasonal grazing for horses of some outfitters.

North of these mountains lie the Richardson, Northern Ogilvie and other ranges along with the broad Porcupine and Peel intermountain basins. The relief and climate of the northern region of the territory combine to create widespread permafrost. Moss and tussock tundra surface vegetation conditions support low grazing capacities. There is little grazing of domestic livestock in the northern Yukon, however, the sub-arctic tundra provides rangeland that support vast numbers of caribou.

Climate

The Yukon is located entirely within the sub-arctic continental climatic zone of Canada. Its climate is the most variable in North America in terms of seasonal high and low temperatures. In general, climatic conditions are characterized by severe cold Arctic air masses in the winter, warm dry spells in the summer, and mild maritime fronts which primarily affect the southwest region and rainshadow effects on the leeward side of large mountain ranges. Within the mountain ranges there is great variation in

precipitation and temperature due to elevation. The location, composition and productivity of plant communities are directly linked to these macro and microclimatic characteristics.

For agricultural purposes, the most limiting factors in all regions of the Yukon are available heat and length of frost-free period. Climate heat factors which limit cultivated agriculture do not necessarily eliminate or restrict rangeland productivity.

Whitehorse has an average annual temperature of -1.2 degrees C (29.8 degrees F) and about 260 mm (10") of precipitation (Atmospheric Environment Service, 1982). Dawson City is cooler with an average annual temperature of -5.1 degrees C (22.8 degrees F) and about 305 mm (12") of precipitation. Watson Lake has intermediate temperatures (-3.3 degrees C) (26.0 degrees F) but much higher precipitation at 425 mm (17"). Summer temperature at Dawson is approximately 16 degrees C (60.8 degrees F); at Watson Lake it is 15 degrees C (59.0 degrees F); and at Whitehorse it is only 14 degrees C (57.2 degrees F). The trend is reversed in the winter with Dawson having the colder January temperatures. The driest area is Carcross (210 mm) (8") which sits in the rainshadow of the Coastal Mountains in the extreme southwest; Swift River which sits in the Cassiar Mountains is the wettest with about three times the precipitation of Carcross.

An overview of the Yukon landscape allows several distinct regional climatic patterns to be discerned in terms of agricultural and grazing potential. The region north of Dawson is an area of either extremely severe agroclimatic limitations or is unsuitable for any agricultural purposes. The central and southern regions of the Yukon are distinguished by mountain ranges and plateaus that are interspersed with dry, warm river valleys. Within these valleys are climatic zones which have moderate to very severe limitations. Examples of this pattern are the Yukon, Stewart and Liard River basins (see section on physiography).

Very little research has been undertaken in the Yukon to study the effect of elevation on climate characteristics. It is generally accepted that elevations of greater than 2,500 feet (762 metres) have extremely severe climatic limitations due to a lack of heat during the growing season and a short frost free period. However, during the winter season, the valley bottoms trap cold dense air which results in colder temperatures than those found at higher elevations. Moisture deficits are known to decrease with elevation in mountainous terrain to a point where there is a soil moisture surplus. This is a result of decreased soil evapotranspiration rates and higher precipitation rates at greater altitudes.

Examples of elevation effects can be seen when comparing the mean January temperature and annual precipitation at Mayo (-29.0 degrees C, 305 mm) (-20.2 degrees F, 11") with nearby Keno Hill (-19.6 degrees C, 590 mm) (-3.3 degrees F 23") which is 3,300 feet (100 m) higher in elevation. Subalpine areas can be as much as 10 degrees C warmer during the winter and have double the precipitation. This pattern applies to most of central and southern Yukon.

Another distinctive characteristic of mountainous terrain is the presence of a rainshadow effect on the leeward side of mountain ranges. The effect is even more pronounced on slopes with a southerly aspect. Under these conditions the soil moisture deficit can become quite severe, greatly altering the plant communities present. This distinctive climatic pattern on southerly facing slopes is most common in the southwestern Yukon and often results in the formation of grassland communities.

Soil resources

Rangeland plant communities are established on a wide variety of Yukon soils. In a very general sense Yukon soils tend to be colder, less weathered and more deficient in nutrients than rangeland soils in southern Canada.

Saline meadows form where ground water is discharged at or near to the soil surface. These ground waters contain dissolved solids that leave a crust on the soil surface when the water

evaporates. The soils in such meadows are saline; they form as a result of ground water movement. Under extreme salinity, the soils tend to be lightly vegetated except for some specially-adapted grass species. The soils of saline meadows and their associated plant communities produce low to moderate grazing capacities.

The non-saline meadows are associated with landscape depressions which collect surface water run-off. These waters pond in the depressions and may infiltrate the regional ground water system in permafrost-free environments. The soils associated with these depressions do not contain salts because the water present does not contain the dissolved materials found in the saline meadows. The soils of the non-saline meadows tend to be more productive and under some conditions, represent the finest combinations of soil and water for rangeland plant communities. Some non-saline meadows form peat deposits from the decaying sedge debris.

The forest soils (non-meadow) of the Yukon are usually well-drained except in areas of near-surface permafrost. In regions of low precipitation the soils tend to be droughty and alkaline (i.e.: they contain lime in the subsoil). In higher precipitation areas the soils remain moist through most summers and may be acidic. In all cases these soils tend to be low in humus and nutrients.

Forest soils may support moderate to low grazing capacities depending on how closed or dense the tree canopy is. The tree cover is controlled by climate and also fire history. Forested soils with open stands of mixed conifers and aspen are most productive. Some soils under aspen may show some topsoil development.

South-facing slopes within forest areas are often too dry to support tree growth and true grassland plant communities become established. The south-facing grasslands of the southern Yukon have droughty soils formed on stoney or sandy soils. The soils can have appreciable topsoil layers if they have not suffered erosion. These grasslands are important rangelands. As described elsewhere in this manual, it is important to preserve the topsoil layers in these soils in order to sustain the productive capacity of these rangeland communities.

Because the Yukon climate is generally cold and semi-arid, Yukon soils tend to be shallow and therefore more susceptible to disturbance than rangeland soils of southern Canada. They can however, with proper management, provide the foundation for very productive rangeland communities in a variety of environments throughout the Yukon.

Horses eat mostly grasses and sedges so the vegetation they depend upon is mostly in the valleys. In some areas, however, the subalpine area is very important.

The rangeland plant communities can be subdivided into the following major groupings:

1. Communities of southerly-facing slopes;
2. Lowland meadow and brushland communities;
3. Forest communities;
4. Cultivated field and hay meadow communities; and
5. Subalpine rangeland communities.

Detailed descriptions of these and other communities are found in Bailey and Willoughby (1991).

It should be noted that many of the species responses to grazing described in the following rangeland plant communities are approximations. Further work will be required before more definitive responses to grazing can be confirmed.

Communities of southerly-facing slopes

The warmest, driest sites occur on the southerly-facing slopes along every river valley. The grasslands that dot the slopes are very conspicuous in a sea of forest (Figure 14). Associated with these dry grasslands are aspen forests that are also adapted to the dry, shallow soils found on these slopes.

FIGURE 14: *The southerly-facing slopes near Ross River produce forage for horses. Purple reedgrass grasslands and aspen forests are the most common communities.*

The vegetation on these slopes is adapted to growing on the warmest and driest soils in the Yukon where there is no permafrost. There is adequate soil moisture for spring growth due to snowmelt but the higher evapotranspiration stress combined with the shallow, often stone, soils produces a soil moisture deficit each summer. The vegetation must be adapted to enduring annual summer drought.

Purple Reedgrass–Fringed Sage Community

Purple reedgrass is the most important grass on lightly to moderately grazed grasslands throughout the southern Yukon (Figures 9 and 15). This community becomes rare north of Dawson. Other palatable grasses of importance include bearded wheatgrass, northern awnless brome, northern rough fescue and sheep fescue. Two shrubs, fringed sage and kinnickinnick are very important components of the community.

FIGURE 15: *An ungrazed stand of the Purple Reedgrass–Fringed Sage Community.*

This community is found on steep 30–60% slopes that face towards the south. The soils have no permafrost, are often stoney and sandy and have limited moisture holding ability. Surface soil colour is dark brown to black indicating a high organic matter content and a long history of soil development under grasslands.

The response of vegetation to grazing is summarized below. Most grasslands can withstand grazing in fall and winter much better than they can withstand spring and summer grazing during the short growing

period. These grasslands are particularly sensitive to horse or wildlife grazing during spring because this is the only assured time that growth can occur due to the regularity of summer drought. There is insufficient summer rainfall to ensure a prolonged period of growth during July and August on these warm, southerly slopes.

Horses selectively graze the taller growing purple reedgrass and northern rough fescue. When grazing occurs during spring and summer, these grasses tend to decline as does fireweed which is grazed in early spring. As the majority of taller grasses decline, there is an increase in the low growing grasses and sedges: sheep fescue, blunt sedge and greenland bluegrass. The greatest increasers, however, are the unpalatable shrubs: fringed sage, kinnickinick and juniper. Also increasing are the unpalatable forbs: pussytoes, prairie crocus and yarrow. Figure 16 shows the abundance of fringe sage on an overgrazed southerly-facing slope.

Two variants have been found to the Purple Reedgrass–Fringed Sage Community. They are the Fringed Sage–Sheep Fescue and the Wheatgrass–Upland Sedge Communities (Bailey and Willoughby 1991). Both are caused by decades of spring and summer overgrazing by horses or cattle. The purple reedgrass has either disappeared or is a minor grass. Fringed sage, sheep fescue and blunt sedge are the most important species in the Fringed Sage–Sheep Fescue Community. The Wheatgrass–Upland Sedge Community occurs on steep south facing slopes with shallows soils. Slender wheatgrass, fringed sage and low sedges are the most important species. There has usually been some soil erosion as a result of the overgrazing in these stands.

FIGURE 16: *Spring grazing has apparently been the cause of the marked increase of fringed sage and the decline of purple reedgrass in this Purple Reedgrass–Fringed Sage Community near the Pelly River.*

Response to grazing: Purple Reedgrass–Fringed Sage Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
purple reedgrass	greenland bluegrass	fringed sage
northern awnless brome	bearded wheatgrass	kinninckinick
northern rough fescue	sheep fescue	juniper
fireweed	blunt sedge	crocus
		pussytoes
		wild strawberry
		yarrow

Range in herbage production: 250-750 kg/ha

Range in grazing capacity: 4-18 ha/AUM

Fringed Sage–Sheep's Fescue Community

This community was found along the north shore of Kluane Lake. It is not known how widely distributed it is. Sheep's fescue is the principle grass which is quite appropriate since Dall sheep grazed the observed area. Other grass and grass-like species include glaucous bluegrass and blunt sedge. The most abundant plant is fringed sage, a half shrub; kinnickinick is also important.

Stands of this community occur on steep, southerly-facing slopes. The soils have a well-developed profile and are stone-free with ample humus. It would appear that windblown sediment continues to be deposited on these slopes. This is a result of the high winds which pick up particles as they blow down the valleys of glacier fed rivers flowing eastward out of Kluane National Park. The addition of loess seems to enhance the productive capacity for grazing on these soils.

Response to grazing: Fringed Sage–Sheep's Fescue Community		
Decreasers	***Increaser grasses***	***Increaser forbs and shrubs***
purple reedgrass	sheep's fescue	kinnickinick
northern awnless brome	blunt sedge	fringed sage
	greenland bluegrass	beardstongue
		crocus
Range in herbage production: 400 kg/ha		
Range in grazing capacity: 4 ha/AUM		

Aspen–Purple Reedgrass Community

An aspen poplar community occurs on the more moist parts of the southerly-facing slopes adjacent to stands of the Purple Reedgrass–Fringed Sage Community. The aspen stands are usually on the lower part of the slopes, in natural drainage ditches on the slope and wherever the soils tend to be deeper and soil moisture conditions are more favourable. This forest is creeping into the grassland on many slopes, possibly as a result of fire suppression on rangeland.

Aspen poplar is the main tree. In some stands white spruce does occur and it is assumed that with fire suppression more spruce would establish resulting in reduced forage production. The principle shrubs in the understory are kinnickinick and wild rose. Lupine, hedysarum and fireweed are important forbs. The main grasses include purple reedgrass, northern awnless brome, fringed brome and bearded wheatgrass.

The soils under this community often lack the organic-rich topsoil layer which characterizes grassland sites. Forest floor litter (leaves, and decaying plant debris) replace the topsoil horizon on these soils. The amount of litter is controlled by fire history. The soils tend to have a higher moisture content for a longer period into the growing season than the adjacent grasslands. The soil surface is somewhat more shaded and does not have the direct south-facing aspect that the grassland sites have. A more open tree canopy results in fewer shrubs and greater grass growth. Many of these forest stands show evidence of past burning. Continued burning of stands at the appropriate times should promote increased forage production.

In many areas aspen trees are invading the Purple Reedgrass–Fringed Sage Community. The community is changing from what used to be a dominant grassland into an area dominated by trees and shrubs, consequently forage production is declining.

Response to grazing: Aspen–Purple Reedgrass Community		
Decreasers	***Increaser grasses***	***Increaser forbs and shrubs***
purple reedgrass	sheep's fescue	kinnickinick
northern awnless brome	blunt sedge	labrador tea
wild rose	bearded wheatgrass	lupine
fringed brome	greenland bluegrass	buffaloberry
hedysarum		fringed sage
Range in herbage production: 370-800 kg/ha		
Range in grazing capacity: 3-4 ha/AUM		

Aspen–Kinnickinick Community

This community is associated with the Aspen–Purple Reedgrass Community and has similar soil conditions. It is located in areas that have a higher moisture content. It has a very well developed shrub layer dominated by kinnickinick (Figure 17). The forb and graminoid layer is poorly developed. This results in low herbage production for domestic livestock.

FIGURE 17: *A stand of the Aspen–Kinnickinick Community along the Klondike River near Dawson.*

Response to Grazing: Aspen–Kinnickinick Community		
Decreasers	***Increaser grasses and grass-like***	***Increaser forbs and shrubs***
purple reedgrass	sheep's fescue	kinnickinick
hedysarum	blunt sedge	labrador tea
wild rose	greenland bluegrass	bearberry
fringed brome		fringed sage

Range in herbage production: 100-750 kg/ha

Range in grazing capacity: 3-33 ha/AUM

FIGURE 18: *The six mile meadow near Minto illustrates a progression of communities from the wetter areas near the centre to drier communities at the meadow edge where willow communities often predominate.*

Lowland meadow and brushland communities

There are wetlands and low-lying lands in many valleys of the Yukon. Soil moisture conditions are often favourable and forage productivity is often high. However, some geologic and hydrologic conditions have caused the development of saline soils.

There is a complex array of plant communities on Yukon wetlands (Figure 18). Although a simplified approach will be taken, we will attempt to cover the range of community types found.

Saline meadow community complex

High salt content in some soils results in saline meadow communities that are adapted to these environmental conditions (Figure 19). Forage production in meadows having saline soils is much lower than on non-saline soils. As most of these meadows represent former small lake basins, soils are formed on clays and silt which have a high water holding capacity.

Saline meadow communities are influenced to varying degrees by the movement of ground water to the soil surface through evaporation. Dissolved salts in the ground water are concentrated at the soil surface by the evaporation process. Soils with high water tables have the most moisture within the zone where water can be drawn to the surface by evaporation. The more water evaporated from the surface, the greater the potential to accumulate salt. These are referred to as ground water discharge sites.

FIGURE 19: *A saline meadow complex in the Takhini Valley.*

A high salt content is often revealed by the presence of a white salt crust on the soil surface. Usually common plants growing on these salty soils include alkali grass, baltic rush, foxtail barley and white prairie aster.

There is a moisture and salinity gradient from the salty lakes and ponds through to the non-saline upland soils. Along this gradient occur:

1. no plants at the edge of the lake;
2. a sea blite or samphire community;
3. alkali grass–foxtail barley;
4. willow–arctic rush; and
5. sedge–baltic rush.

Range plant communities 3, 4, and 5, as illustrated in Figure 19, will be described.

Alkali Grass–Foxtail Barley Community

This community is common along the Takhini Valley and the associated valleys between Haines Junction and Whitehorse. It is also found in other areas in the southern Yukon.

Alkali grass is the principle grass species in lightly to moderately grazed stands. Other important grasses include tufted hairgrass, several sedge species and bearded wheatgrass. All of these additional grasses and sedges are better adapted to meadow sites that are less saline than the areas where alkali grass grows.

Silverweed and white prairie aster are common forbs. Many of these meadows are overgrazed and foxtail barley replaces alkali grass as the major forage. Silverweed, white prairie aster, fringed sage, pussytoes and other unpalatable forbs increase with overgrazing. Forage production is severely depressed by overgrazing in spring or summer. The community has been found to recover rapidly when grazing pressure is reduced.

The topography is nearly level. The soils are clay to clay loam texture and the water table is usually within one metre of the soil surface throughout the growing season. These soils are considered to be moderately saline. They have a topsoil layer that may show crusting in patches.

Response to grazing: Alkali Grass–Foxtail Barley Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
alkali grass	foxtail barley	silverweed
tufted hair grass	bearded wheatgrass	white prairie aster
sedges	arctic rush	fringed sage
purple reedgrass		pussytoes

Range in herbage production: 400-1800 kg/ha

Range in grazing capacity: 0.6-4.5 ha/AUM

Willow–Arctic Rush Community

This community occurs near the edge of depressions associated with saline meadows. The soils have lower salinity levels as revealed by the presence of willows and several other shrub species.

The principle shrubs are willows, kinnickinick and wild rose. The understory consists mainly of water sedge, greenland bluegrass, arctic rush, horsetail and northern awnless brome. There are many forb species present in small quantities.

The water table remains below the surface most of the growing season, and water is drawn up by shrub roots rather than by evaporation. As such, salt crusts are rare. A well-developed topsoil layer is usually present.

Response to grazing: Willow–Arctic Rush

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
water sedge	arctic rush	willows
willow	greenland bluegrass	kinnickinick
northern awnless brome	foxtail barley	wild strawberry
wild rose		yarrow

Range in herbage production: 130-600 kg/ha

Range in grazing capacity: 1-5 ha/AUM

Upland Sedge–Arctic Rush Community

This community is associated with the Alkali Grass–Foxtail Barley Community. As one moves upslope away from the saline meadow, this plant community is encountered on dry ridges. This community occupies a narrow strip around the saline meadows and therefore provides little herbage to the total production of a grazing lease. The community is extensively grazed and most of the plant species are palatable.

Response to grazing: Upland Sedge–Arctic Rush

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
tufted hair grass	arctic rush	dandelion
tickle grass	sheep's fescue	goldenrod
northern rough fescue	foxtail barley	yarrow
awned sedge	greenland bluegrass	many flowered aster
alkali grass		penstemon
		cut-leaf anemone

Range in herbage production: 680-1100 kg/ha

Range in grazing capacity: 0.5-1.5 ha/AUM

Non-saline meadow community complex

The most common sequence of wetland meadow rangeland communities in the Yukon are non-saline. The distribution of the plants is largely governed by soil moisture levels especially during the spring and summer growing period. The highest production comes from those communities growing at the edge of standing water. Communities on dry ground and those growing in standing water are less productive.

Tall sedges are important forage-producing plants for livestock in these meadows. Willows are more important in this non-saline sequence than in saline meadows (see Figure 18). The cross-section of communities commonly found in non-saline meadows is illustrated in Figure 20. While these communities are also influenced by a high water table, the water tends to be collected as local run-off. Water tends to drain downward into the regional ground water system and therefore does not contain appreciable dissolved salts. While evaporation does occur from the surface, no accumulation of salts will occur on the soil surface.

FIGURE 20: *Cross-section of a typical nonsaline meadow. Water sedge, awned sedge, tufted hairgrass and willow communities generally occur along the gradient from the pond to the drier parts of the meadow.*

Non-saline meadow communities may develop in depressional landscape positions, where run-off water can collect, or they can be found adjacent to rivers and streams where soil drainage is poor.

Water Sedge Meadow Community

Water sedge is the most important plant in this wetland meadow. This meadow is common in the southern Yukon. There is usually free-standing water during the growing season and this limits growth. Some willows are able to grow at the edge of this meadow. Other common plants include dwarf raspberry, arctic rush, and northern reedgrass.

The soils are very poorly drained and may be composed entirely of decayed plant debris and referred to as peat or organic soils. The peat is underlain by silt or clay usually within one metre depth and permafrost may occur in some locations.

Response to Grazing: Water Sedge Meadow Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
water sedge	arctic rush	willows
tufted hair grass	northern reedgrass	shrubby cinquefoil
		coltsfoot

Range in herbage production: 1000-1800 kg/ha

Range in grazing capacity: 0.6-1.1 ha/AUM

Beaked Sedge Meadow Community

In northern areas there is more Beaked Sedge Meadow Community and less Water Sedge Meadow (Figure 21). This is apparently a response to the lower soil and water temperatures. These meadows were found mostly in the Klondike and Mayo areas.

There is normally free-standing water throughout the growing season in the old river channels. The water levels often partially limit access to the forage by horses. Beaked sedge is the most important forage producer although there is some water sedge as well. The annual grass, slough grass, and marsh cinquefoil are also major plants in this community.

FIGURE 21: *A Beaked Sedge Meadow Community in northern Yukon.*

The soils are similar to those described for the Water Sedge Community. In the central Yukon these meadows may be underlain by permafrost. Adjacent to rivers and streams the peats are underlain by sandy and gravelly material.

Response to Grazing: Baked Sedge Meadow Community		
Decreasers	***Increaser grasses***	***Increaser forbs and shrubs***
beaked sedge	slough grass	horsetail
water sedge	fowl bluegrass	marsh cinquefoil
awned sedge		sweet-scented bedstraw
marsh reed grass		veronica
Range in herbage production: 1400-3000 kg/ha		
Range in grazing capacity: 0.5-1.3 ha/AUM		

Awned Sedge Meadow Community

The awned sedge meadows occupies slightly drier sites than either the water sedge or beaked sedge meadows. This meadow is often located upslope on higher moist ground while one of the other communities occupies the wettest lands. Awned sedge is the most important forage producer followed by northern reedgrass, water sedge, and arctic rush. These meadows are some of the most important forage resources for horses in the Yukon. Some meadows are occupied only by the Awned Sedge Meadow Community (Figure 22).

FIGURE 22: *A typical productive Awned Sedge Meadow Community near Whitehorse.*

The soils tend not to have the same degree of peat formation as described in meadow communities although thin formations of peat (less than 40 cm) can occur. The underlying mineral soils can vary from sand to clay and they remain saturated for the entire growing season.

Response to Grazing: Awned Sedge Meadow Community		
Decreasers	***Increaser grasses and grass-like***	***Increaser forbs and shrubs***
awned sedge	arctic rush	dock
water sedge	northern reed grass	horsetail
	foxtail barley	seaside arrowgrass
Range in herbage production: 1100-2000 kg/ha		
Range in grazing capacity: 0.5-1 ha/AUM		

Tufted Hairgrass–Sedge Community

This community is often found upslope on slightly higher ground than the water sedge community (Figure 23). It is very common in the Yukon and is a major source of forage for horses at all times of the year.

The most productive forages are tufted hairgrass, northern reedgrass, water sedge, awned sedge, and awned wheatgrass. Many of the stands have been overgrazed favouring foxtail barley, awned wheatgrass, northern reedgrass, silverweed and seaside arrowgrass.

The soils of the Tufted Hairgrass Community are similar to those of the Awned Sedge Meadow Community but somewhat drier. Peat formation is thin and the soils may become dry late in the growing season. These soils are imperfectly drained indicating a fluctuating water table and a consequent variation in moisture conditions throughout the year.

FIGURE 23: *A Tufted Hairgrass–Sedge Community is in the right foreground. Awned Sedge and then Water Sedge Meadow Communities are closer to the water. Several willow communities can be observed on drier meadow soils in the background.*

Response to grazing: Tufted Hairgrass–Sedge Community		
Decreasers	***Increaser grasses and grass-like***	***Increaser forbs and shrubs***
tufted hairgrass	bearded wheatgrass	silverweed
water sedge	northern reed grass	seaside
		arrowgrass
awned sedge	foxtail barley	
Range in herbage production: 1400-2300 kg/ha		
Range in grazing capacity: 0.4-0.7 ha/AUM		

Willow–Sedge Community

Stands of this community often occur upslope on the edge of the various kinds of sedge meadows (Figure 23). The soils are often slightly better drained than the sedge meadows.

The most common willows are glaucous willow and snow willow although there is also some dwarf birch. In the understory, water sedge, beaked sedge, marsh reedgrass, tufted hairgrass, silverweed and horsetail are common.

With overgrazing the willows tend to be favoured over the sedges. Silverweed and horsetails increase.

The community forms under a variety of conditions and soils vary accordingly. If the community has formed in association to sedge meadows, the soils are often silt or clay textured and have a thin topsoil layer but no surface peat. If the community has formed near moving water, the soils may be silty to gravelly in texture.

Response to grazing: Willow–Sedge Community		
Decreasers	***Increaser grasses and grass-like***	***Increaser forbs and shrubs***
water sedge	marsh reedgrass	silverweed
beaked sedge	foxtail barley	dandelion
tufted hairgrass	arctic rush	dwarf birch
northern rough fescue	horsetail	willows
Range in herbage production: 700-2300 kg/ha		
Range in grazing capacity: 0.5-1.6 ha/AUM		

Willow–Dwarf Birch–Northern Rough Fescue Community

Stands of this community, found in moist sites along streambeds, are associated with sedge meadows (Figure 24). There are pockets of willows and dwarf birch and openings having grasses and sedges. The most common forages are northern rough fescue, water sedge,

FIGURE 24: *Northern Rough Fescue Community*

kobresia and arctic rush. Common woody plants include dwarf birch, willows (glaucous willow, snow willow, and bebb's willow). There is some white spruce in a few stands.

The soils are of a variable nature and may be silty to gravelly if found adjacent to water courses. They are imperfectly drained (subject to periodic flooding or high water table). When found at higher elevation under forest cover they may be moderately well drained. There is ample moisture supply during the growing season. Soils tend to be slightly acidic and are transitional to forest community soils.

Response to grazing:
Willow–Drawf Birch–Northern Rough Fescue Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
northern rough fescue	willows	dandelion
water sedge	dwarf birch	
hedysarum	bog sedge (kobriesia)	
	arctic rush	
	yarrow	

Range in herbage production: 400-1200 kg/ha

Range in grazing capacity: 0.8-2.2 ha/AUM

Forest communities

Much of the Yukon is covered by forest. The more mature stands often have no forage but the recently burned forests frequently are highly productive rangelands. Presented first is a description of the more mature forest communities, usually of little value for grazing, followed by descriptions of the various disturbed forest communities which may provide forage for livestock.

White Spruce–Moss Community

White spruce is the most common coniferous tree on the better-drained, upland sites in southern Yukon. This community is the climax forest for the area and over many decades succession produces this forest unless fire or disease intervene. The understory is very sparse, only northern rough fescue is common. There is so little forage that the mature community is of little benefit to livestock.

Wildfires naturally burn through these forests in a cyclic manner. Recent and old burns from this forest community provide forage for livestock and wildlife. The burned communities will be described later.

Soils under the White Spruce–Moss Community tend to be permafrost-free, moderately well to rapidly drained, and have brown forest soils low in humus. In the southwestern Yukon these soils tend to be neutral to alkaline, in the central and southeast Yukon they tend to be slightly acidic.

Lodgepole Pine–Kinnickinick Community

Lodgepole pine forests usually occupy the coarse textured soils. The main shrubs are kinnickinick and buffaloberry. There is a scattering of northern awnless brome, purple reedgrass and northern rough fescue. This forest has very little forage for grazing animals.

The soils under this community tend to be well to rapidly drained. The soils are usually sandy or gravelly and are very droughty during the growing season. The soils are permafrost-free, have a light reddish brown colour and are very low in humus and nutrients. These tend to be non-productive soils. This community is common only in the southern Yukon. Lodgepole pine has only sporadic occurrence in the Klondike, Mayo Lake and Ross River regions.

Black Spruce–Labrador Tea Community

The black spruce forest is the stable, mature forest from the Klondike River area northwards (Figure 25). Labrador tea is the main shrub and there are very few grasses or forbs in the understory. This forest produces little or no forage for grazing. Grazing by livestock is not recommended because of the lack of forage and the fragile nature of the ecosystem. These are largely non-productive soils with frozen sub-soil which are common in the discontinuous permafrost zone of the Yukon.

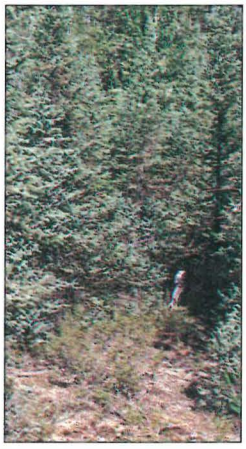


FIGURE 25: *A black spruce forest in the Stewart River valley. There is no grass and few palatable shrubs.*

Aspen Poplar–Wild Rose Community

After the burning of mature coniferous forests aspen is the most prolific tree. Over many years succession proceeds towards a white spruce climax if a seed source is available. The conifer cover causes a gradual shading of the understo-

ry grasses and forbs, slowly reducing their forage production.

This is an extensive type in the southern Yukon and is very important for horse grazing. Cover of aspen, white spruce and shrubs largely determines the herbage production available for grazing. Generally, the lower the forest cover, the greater is the herbage production. Summer wildfires have been the most important disturbance mechanism in this community and have provided much forage for horses and wildlife. This extensive community type has been subdivided into mature forests with a dense tree cover (usually more than 15 years since the last burn) (Figure 26), and recent burns having an incomplete forest cover (Figure 27).

FIGURE 26: *A mature Aspen–Wild Rose Community in the Pelly River valley provides a moderate amount of forage for horses.*

The recently burned aspen–wild rose forests have fireweed and grasses as major plants for a few years. Gradually the willows and aspen expand in cover and start to shade the grasses and forbs. Shrub and tree cover can be either sparse or thick for years, sometimes decades. The highest forage production is in the first 15 years and it gradually declines as willow, aspen and white spruce cover increases.

FIGURE 27: *A ten year old burn in the Pelly River valley has abundant grass growing amongst the fireweed. Aspen is the principle tree for many years following burning of either White Spruce–Moss or Aspen–Wild Rose Communities.*

Soil conditions are described in the White Spruce–Moss Community.

Response to grazing
Aspen Poplar–Wild Rose Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
purple reedgrass	bearded wheatgrass	willows
northern awnless brome	blunt sedge	wild rose
marsh reedgrass		buffaloberry
northern rough fescue		wild strawberry
tufted hairgrass		fireweed
		yarrow

Aspen–Wild Rose Community (15+ years)

Range in herbage production: 200-600 kg/ha

Range in grazing capacity: 4-15 ha/AUM

Recent Burns, Aspen–Wild Rose Community (0-15 years)

Range in herbage production: 400-1500 kg/ha

Range in grazing capacity: 1-10 ha/AUM

Cultivated field and meadow communities

Some cultivated fields have been established on grazing agreements in the past and some meadows have been so disturbed by haying, grazing and drainage that the new rangeland communities now show little resemblance to the native vegetation.

Smooth Brome Community

The most common hay grass introduced into the Yukon is smooth brome. There are extensive stands developed on private land but some stands also exist on grazing agreements. Some of the most productive grazing agreement land sampled was in lightly grazed areas of smooth brome grass (Figure 28). Smooth brome is the major grass and all other plants are secondary.

Cultivated fields have usually been located on favourable soil conditions. The soils vary from region to region but all tend to be stone-free, loam or sandy loam and be well drained.

FIGURE 28: *Horses in a smooth brome field in the Stewart River valley.*

Response to grazing: Alkali Grass–Foxtail Barley Community		
Decreasers	***Increaser grasses and grass-like***	***Increaser forbs and shrubs***
smooth brome	quack grass	willows
	foxtail barley	hawk's beard
		fireweed
Range in herbage production: 1200-2000 kg/ha		
Range in grazing capacity: 0.5-1 ha/AUM		

Kentucky Bluegrass–Smooth Brome Community

Some sedge meadows have been cultivated, drained, intensively grazed or disturbed in other manners over the past century. Kentucky bluegrass and smooth brome are now the main grasses along with a variable smattering of bearded wheatgrass, foxtail barley, and awned sedge (Figure 29). Forage production is variable depending upon soil moisture availability, location in the meadow and past grazing history.

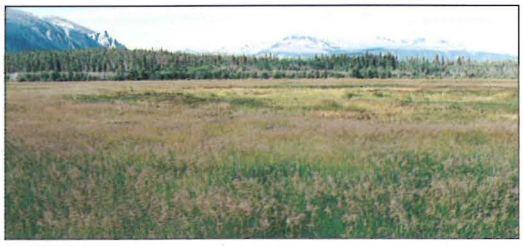


FIGURE 29: *The original awned sedge meadow near Tagish Lake has been modified by drainage, cultivation, haying and overgrazing. Now, cultivated grasses produce abundant forage.*

Response to grazing: Kentucky Bluegrass–Smooth Brome Community		
Decreasers	***Increaser grasses and grass-like***	***Increaser forbs and shrubs***
awned sedge	bearded wheatgrass	dandelion
smooth brome	Kentucky bluegrass	yarrow
	foxtail barley	goldenrod
Range in herbage production: 800-2400 kg/ha		
Range in grazing capacity: 0.5-1.5 ha/AUM		

Subalpine rangeland communities

The subalpine rangeland communities of the southern Yukon usually occur above 2500 feet (820 metres) in elevation. The frequent occurrence of warmer winter temperatures in the subalpine area results in highly valued forage for both wintering horses and wildlife. Valuable nutritious forage is available on some subalpine areas throughout the year. These higher elevation rangelands need careful management because the growing season is short, soils and air temperature are cold and the vegetation is fragile and sensitive to overgrazing. Considerable improvements in forage productivity and ecosystem stability can be realized by relatively minor modifications to stock distribution, particularly during the short growing season.

The main rangeland communities found on grazing leases of the southern Yukon include one open forest community, a wet meadow and a dry meadow. There are other communities in the subalpine but they were not observed.

White Spruce–Dwarf Birch–Rough Fescue Community

White spruce is the main tree in this forest community. The main shrubs are dwarf birch and glaucous willow (Figure 30). Northern rough fescue is the principle grass although there are lesser amounts of tufted hairgrass and sedges. Trees are spaced so that many grasses and shrubs grow between each tree. Forage

FIGURE 30: *The White Spruce–Dwarf Birch–Rough Fescue Community in the 33 year old Teslin Burn.*

production is low where tree or shrub cover is dense. One of the main reasons for the high rangeland value of this community is the high nutrient quality and productivity of northern rough fescue (Figure 31).

Preliminary indications indicate that this grass is sensitive to continued overgrazing during the short growing season. Management of horses requires some rotational grazing during June and July to facilitate sustained high productivity of this grass and to prevent possible soil erosion.

The soils under this community tend to be formed on glacial deposits that are loamy but contain numerous stones and boulders. In upland areas with good drainage the soils are cold but not underlain by permafrost. The soils have moderate to good moisture-holding capacity and are slightly acidic.

FIGURE 31: *A stand of northern rough fescue surrounded by the White Spruce–Dwarf Birch–Rough Fescue Community.*

Response to grazing: White Spruce–Dwarf Birch–Rough Fescue Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
northern rough fescue	trisetum	fireweed
water sedge	sheep's fescue	lupine
tufted hairgrass	blunt sedge	yarrow
northern awnless brome		tall lungwort
		wild strawberry
		northern bedstraw

Range in herbage production: 200-1500 kg/ha

Range in grazing capacity: 1-11 ha/AUM

Intermediate Oatgrass Community

Dry, gravelly or stony soils support this moderately productive grassland that is dominated by intermediate oatgrass but also has a considerable amount of northern rough fescue (Figure 32). Small pockets of this community occur periodically throughout the subalpine.

FIGURE 32: *An Intermediate Oatgrass Community on stony soil in the Swift River valley.*

These small meadows are thought to form in depressions which act as pronounced frost pockets. The soils are underlain at 1-2 metres (3-6 feet) depth with permafrost and are affected by frost churning. The combination of cold air collection and soils churning by frost inhibits the growth of most tree species and promotes meadow development.

Response to grazing: Intermediate Oatgrass Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
northern rough fescue	sheep's fescue	dwarf birch
intermediate oatgrass	wheatgrass	kinnickinick
		goldenrod

Range in herbage production: 300-600 kg/ha

Range in grazing capacity: 1.5-3 ha/AUM

Willow–Sedge–Hairgrass Community

This rangeland community occurs on moist soils where drainage is slow. Willows occupy the edges of stands while water sedge and tufted hairgrass produce most of the forage in the central parts. Horse grazing in the growing season can produce hummocks in this community (Figure 33).

FIGURE 33: *The Willow–Sedge–Hairgrass Community in the Swift River valley. Rotational grazing is recommended for horse use of this sensitive community when grazed during the growing season.*

Response to grazing: Willow–Sedge–Hairgrass Community

Decreasers	*Increaser grasses and grass-like*	*Increaser forbs and shrubs*
water sedge		willows
tufted hairgrass		dwarf birch
		horsetail

Range in herbage production: 500-1000 kg/ha

Range in grazing capacity: 1-3 ha/AUM

The rangelands of the Yukon have a short growing season of only about 6 weeks because many grasslands occur on soils that regularly experience summer drought. Other rangelands grow in the subalpine where low summer temperatures, a short growing season and drought in some communities, combine to produce a relatively fragile vegetation. The management of grazing animals under such conditions needs to be aimed not just at providing sufficient horse feed but also at maintaining good range condition. Agreement holders need a positive attitude towards the rangeland so that when they retire and pass it on to a younger generation, they can be proud that the rangeland is in better condition than when they started.

Range improvement practices

There is good potential for improved range condition and increased forage production on many Yukon rangelands. Overgrazing, especially in the growing season, is a problem in some instances although it appears to have been even more serious in past decades. Continuing maturation of trees and shrubs is causing a decline in forage production on many forested rangelands.

Grazing systems

Most grazing agreements only have partial perimeter fencing and horses continuously graze the entire area. In the dormant season from September to May, that is not a serious problem provided the horses are able to eat enough to meet their needs. It is a problem from about June 1 to July 15, the height of the growing season. It is recommended that cross fencing be implemented on grazing agreements permitting the rotation of horses from field to field. A simple system would include grazing one field in early June and another field in late June and July. Then the next year, the first field should be rested and grazed in late June and July or even later into the dormant season while the second field would be grazed in early June. The third year would be a repeat of the first year.

The important principle with rotational grazing is that all grazing lands need to be rested from grazing for part of each growing season to ensure that the desirable decreaser forages can grow without interference from horses and thus be able to survive (Figure 34). Nothing can withstand continuous heavy grazing throughout the growing season year after year.

FIGURE 34: *A Willow–Sedge–Hairgrass Community in the subalpine that would benefit from a well-planned rotational grazing system.*

Modern temporary electric fences with solar powered chargers and higher voltage, low amperage energizers makes cross fencing and rotational grazing of most agreements economically feasible.

Wildfire and prescribed burning

Current policy that permits rapid suppression of natural forest fires ultimately results in a decline in forage productivity of many rangelands. This comes about because the highest forage production occurs in early successional stages of most forested rangelands for livestock, moose, elk and wild sheep. A "hands off" policy regarding natural wildfires is highly desirable, recognizing that some suppression is needed to preserve human interests. It will be desirable in some areas in the future to promote prescribed burning of certain forested lands to provide forage for horses and wildlife.

Forest clearing

Any method of removing forest and shrub cover normally results in an increase in forage for livestock. Clearing trees and shrubs, burning, woodcutting, logging and trailcutting all

FIGURE 35: *A wide trail cleared through this forest produced much forage for summer horse grazing.*

reduce the competition trees and shrubs give to grasses and sedges (Figures 35 and 36). Windfallen trees in recently burned forests can prevent horses from reaching many forage supplies. Logging, trail cutting and occasionally prescribed burning can open up unavailable grazing lands (Figure 37).

Cultivated forages

Some of the most productive land found was on sites of old cultivation where the forest had been cleared and introduced forages seeded (Figure 28). The potential increase in forage production is substantial although the cost of clearing and seeding is high. In addition, current grazing policy prohibits this method.

FIGURE 36: *Clearing a white spruce forest in winter near Mayo allowed native northern rough fescue to grow vigourously the next summer.*

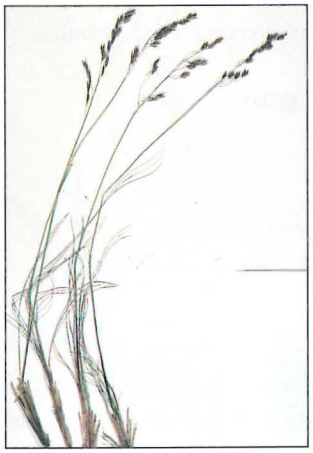
While the current grazing policy prohibits cultivation on grazing lands, agreement holders are urged to explore possible range improvement schemes in consultation with the Agriculture Branch. Techniques such as brush cutting, scarification and overseeding can improve the capability of grazing agreement areas. Stock distribution can be accomplished by crop-financing, digging water ponds and placement of salt blocks.

FIGURE 37: *Woodcutting of fire-killed trees has helped keep this 30-year old burned forest producing forage for horses.*

Grasses

Northern rough fescue
Festuca altaica

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: .2–.6 mm
Blade: Folded or flat, 1–3 mm wide

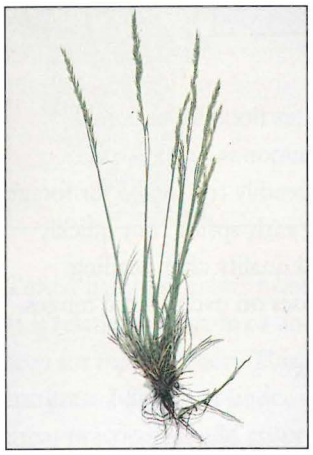


An erect, densely tufted bunchgrass. Inflorescence a panicle, usually with two primary pedicles per node. Spikelets usually purplish with 3-4 (6) florets. Glumes much shorter than the spikelets, commonly with a transparent margin, giving the inflorescence a sheen. Lemmas rounded, awned (.2-.7 mm), and prominently veined. Vegetatively, rough fescue can be identified by its narrow leaves, and bunchgrass growth habit.

Rough fescue is an important forage plant on Yukon rangelands. It is common in meadows, grasslands, rocky slopes, and open forests. Prolific vegetative growth makes it an excellent forage species. Its dense, tufted growth habit make it resistant to moderate grazing and to cool fires.

Sheep's fescue
Festuca saximontana

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: Very short, or rudimentary
Blade: Needle-like



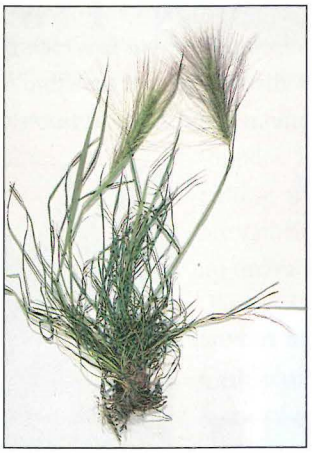
A relatively short, densely tufted bunchgrass. Inflorescence a panicle, usually with two primary pedicels per node. Spikelets small, 2-4 flowered. Lemmas with a prominent awn (1-3 mm long). Sheep's fescue is easily distinguished from rough fescue by its shorter leaves, smaller spikelets, and more prominent awns.

Sheep's fescue grows in dry meadows, open woods, and on slopes. Its low growth makes it well adapted to areas where there is not a buildup of litter. It is adapted to grazing and usually increases with grazing pressure.

Foxtail barley
Hordeum jubatum

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: 1 mm
Blade: Flat, 6 mm wide

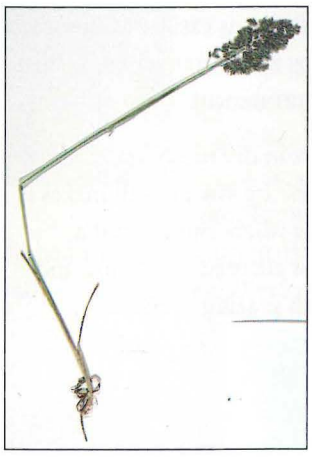
An erect, densely tufted bunchgrass. Inflorescence is a spike. Foxtail barley is easily identified by its long, slender awns.



Foxtail barley tolerates flooding and mild alkalinity so it is common in areas of salt concentration. It is readily consumed for forage by herbivores in the early spring, but quickly loses palatability and quality after heading. Foxtail barley increases on overutilized ranges.

Kentucky bluegrass
Poa pratensis

Life span: Perennial
Origin: Introduced
Auricles: Absent
Ligule: 1 mm
Blade: Flat, 5 mm wide, with boat-shaped tips



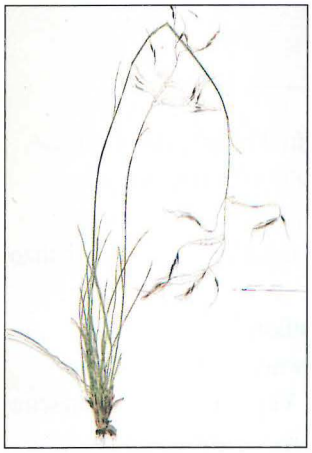
An erect, sod forming grass with long rhizomes. Inflorescence a panicle, usually with five primary pedicels per node. Spikelets usually a deep green in colour and containing 3-5 florets. Glumes about one-half the length of the first floret. Lemmas rounded on the back and awnless.

Kentucky bluegrass is easily confused with greenland bluegrass (Poa glauca). Kentucky bluegrass has rhizomes and cobwebs at the base of the lemma while greenland bluegrass lacks rhizomes and is finely pubescent on the lower one-half of the lemma. Both can be identified vegetatively by their boat-shaped leaf tips.

The bluegrasses are important forage species throughout North America. Spring growth is palatable and nutritious, but unless grazed it loses quality rapidly. Bluegrasses flourish on mesic sites, but are poor producers on dry and wet areas. Both Kentucky and greenland bluegrass increase on overgrazed rangelands.

Richardson needle grass
Stipa richardsonii

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: To 1 mm
Blade: Needle like



An upright, tufted bunchgrass. Inflorescence an open panicle usually with drooping branches. Spikelets one flowered, with long glumes. Each floret is tipped with a long (2-3 cm) awn. Richardson needle grass can be confused with fescues when in the vegetative state. However, the fescues usually occur in larger, denser tufts.

Richardson needle grass is common on south-facing grasslands and open forests. It generally decreases as grazing pressure increases.

Alkali grass
Puccinellia nuttalliana

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: to 5 mm, continuous with the sheath margin
Blade: Flat or involute, 3 mm wide

An erect or spreading, tufted grass with fibrous roots. Inflorescence an open panicle, with numerous primary branches at each node. Spikelets several flowered, with the glumes much shorter than the spikelet. Glumes unequal, the first being about one half the length of the second.

Alkali grass grows in wet areas, commonly with high salt contents. It is an acceptable forage, but loses quality rapidly as growth progresses. It may be replaced by foxtail barley if grazing pressure is extreme.

Tufted hair grass
Deschampsia caespitosa

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: ? to 10 mm
Blade: Flat or folded, 5 mm wide

Erect and densely tufted, with fibrous roots. Inflorescence an open panicle, the branches often drooping at maturity. Spikelets mostly two-flowered, with long glumes that completely enclose the florets. Lemmas with a delicate awn, from below the middle. The inflorescence is green when immature, but has a characteristic salt and pepper colour when mature. Tufted hairgrass can be identified vegetatively by its long ligule, and deep-cut veins that run the length of the leaves.

Tufted hairgrass grows mainly in wetter areas. It is relatively short-lived and relies totally on seed for reproduction. This makes tufted hairgrass a decreaser under grazing. Management practices should ensure periodic seed set if tufted hairgrass is to be maintained. Tufted hairgrass is highly palatable to all classes of livestock.

Intermediate oatgrass
Danthonia intermedia

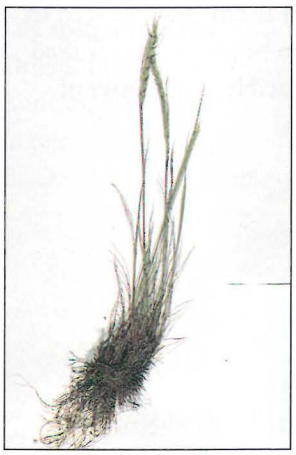
Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: A ring of hairs
Blade: Flat or involute, 3 mm wide

A short, tufted grass with fibrous roots. Inflorescence a closed panicle. Spikelets many flowered, the florets with a conspicuous awn arising from the back of the lemma. Glumes longer than the spikelet. Intermediate oatgrass can be identified vegetatively by its narrow leaves, bunchgrass growth habit, and hairy ligule.

Intermediate oatgrass grows in meadows, upland prairie, and forest openings. It is not rated as a good forage species, being palatable only in the early spring. Intermediate oatgrass is quite resistant to grazing, probably because livestock frequently avoid it.

Bearded (slender) wheatgrass
Agropyron trachycaulum

Life span: Perennial
Origin: Native
Auricles: Absent or rudimentary
Ligule: to 1 mm
Blade: Flat, 6 mm wide



An erect, tufted grass with very short rhizomes. Inflorescence a solitary spike. Spikelets solitary at the nodes, with numerous florets. The glumes nearly as long as the spikelet. Slender wheatgrass can be identified vegetatively by its upright, bunched growth habit, and rudimentary auricles.

Slender wheatgrass has excellent growth on moist, well drained soils; it is somewhat tolerant to saline soils and drought. It is palatable to livestock at all stages of growth. Slender wheatgrass is short-lived, so overgrazing quickly results in thinner stands.

Smooth brome
Bromus inermis

Life span: Perennial
Origin: Introduced
Auricles: Absent
Ligule: 1 mm
Blade: Flat, 5-15 mm wide

A rhizomatous perennial. Inflorescence a panicle, usually with three or more primary pedicels per node. Spikelets usually elongated, with numerous florets. Glumes short, the first one nerved, the second one three nerved. Lemmas large, awnless, or with a short awn. Smooth brome can be identified vegetatively by the wide leaves and closed leaf sheath.

Smooth brome is very palatable to all classes of livestock. It tends to mature rapidly and become unpalatable early in the growing season if not grazed. Its rhizomatous growth habit makes it very resistant to grazing.

Northern awnless brome
Bromus pumpellianus

Life span: Perennial
Origin: Native
Auricles: Usually present
Ligule: 1-2 mm
Blade: Flat, 5-15 mm wide

Very similar to smooth brome but can be differentiated by the presence of auricles, the longer ligule, and by the hairy lemmas and nodes (smooth brome is not hairy). Northern awnless declines under grazing pressure.

Fringed brome grass
Bromus ciliatus

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: 1 mm
Blade: Flat, 4-8 mm wide

A slender, erect, bunchgrass. Inflorescence a panicle, the spikelets large and usually drooping. Lemmas with a prominent awn (3-5 mm long) and hairy margins. Fringed brome can be vegetatively distinguished from the other bromes by its hairy foliage and bunchgrass (lacking rhizomes) growth habit. Fringed brome is similar to smooth brome in its forage quality and growth.

Marsh reed grass
Calamagrostis canadensis

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: 3-6 mm long
Blade: Flat, 4-8 mm wide

An erect grass with creeping rhizomes. Inflorescence an open panicle, with numerous primary pedicels. Spikelets are one flowered, the glumes as long as the single floret. Florets with a distinct tuft of hairs at the base. Lemmas with a slender awn, arising from below the middle.

Marsh reed grass usually grows on high moisture sites, where it may form pure stands. It has been given varying grades as a forage species. It is most palatable in the spring, but becomes unpalatable rapidly with age. Its response to grazing has not been determined, but it has been reported to be reduced by trampling.

Purple reed grass
Calamagrostis purpurascens

Life span: Perennial
Origin: Native
Auricles: Absent
Ligule: 2-5 mm long
Blade: Flat, 2-4 mm wide

A tufted bunchgrass, occasionally with short rhizomes. Inflorescence a closed panicle, usually pinkish or purplish. Spikelets similar to marsh reed grass, but can be distinguished by a longer, stouter, bent awn and shorter hairs at the base of the lemma. Purple reed grass is an upland grass, favouring coarse textured soils. Purple reed grass declines under grazing pressure and is replaced by fringed sage and greenland bluegrass.

Sedges and rushes

Sedges can be differentiated from grasses by their leaf arrangement and by inflorescence characteristics. Sedge leaves arise in three's, often giving the stem a triangular appearance, while grass leaves arise in two's, giving the stem a flat appearance. Sedge inflorescences are usually spikelike, with individual flowers having no stalks. Sedge florets are imperfect, having male and female flower parts in separate heads or separate parts of the same head. Grass florets are perfect. Consequently, sedges have two distinct types of florets, while all grass florets are similar.

Awned sedge
Carex atherodes

One of the most important species of sedge across North America. Awned sedge grows in thick stands in lowland areas that dry up for at least part of the growing season. The female flowers develop in spikes amongst the leaves, while the male flowers are formed in terminal spikes. Awned sedge can be easily identified by its wide, hairy leaves. This characteristic differentiates it from water sedge and beaked sedge.

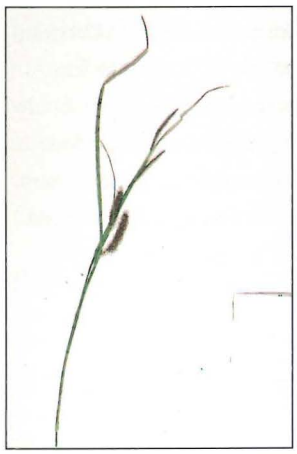
Awned sedge is a good producer of palatable forage, but it is susceptible to over-utilization. It is often found in close association with water sedge, which is unpalatable, making it a favoured forage species.

Water sedge
Carex aquatilis

Water sedge is also quite common in the wetlands of North America. It tends to concentrate silicates, and is less palatable to herbivores than associated species of sedge. Water sedge tends to grow on slightly wetter sites than awned sedge or beaked sedge. Water sedge can be identified by its restriction to high moisture areas (standing water) and by its compact spikes of female flowers

Utilization of water sedge by livestock is often inhibited by its unpalatable nature and its restriction to wet sites.

Beaked sedge
Carex rostrata

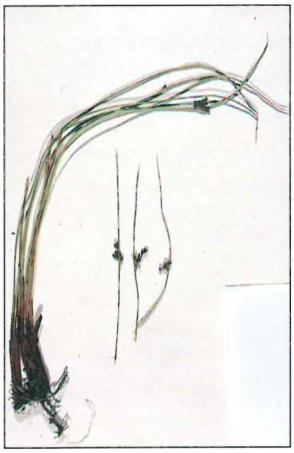


Beaked sedge replaces awned sedge as the dominant sedge in the northern areas of the Yukon. Beaked sedge is similar to awned sedge in productivity and forage quality. It can be differentiated from awned sedge by the lack of hair on the leaves, and from water sedge by its loosely arranged florets. Beaked sedge florets end in a characteristic beak, which is also distinctive.

Dryland sedge
Carex obtusata

Dryland sedges are common on well drained soils. They can be differentiated from grasses by their bunched growth habit, triangular stems, and distinctive flowers. Dryland sedges produce little usable forage, because of their low growth form. What is produced is good quality forage, but livestock can rarely utilize it. Dryland sedges are usually increasers under grazing.

Baltic rush
Juncus balticus

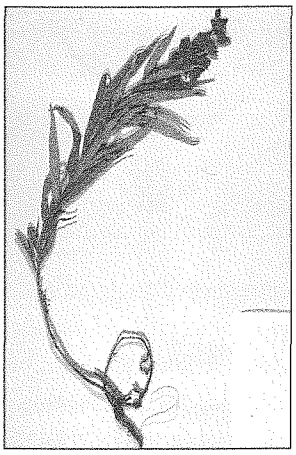


Baltic rush grows mainly on wetter sites (prefers sites slightly drier than awned or beaked sedge), and has considerable tolerance to salinity. Baltic rush is easily identified by its round stems and its flower clusters on the sides of the flowering stalks. A similar species, arctic rush (Juncus arcticus) is not readily distinguished from baltic rush.

Baltic rush is grazed readily if it is young and green, but its palatability declines as the season progresses. It makes good (but light) quality hay if cut at the right time.

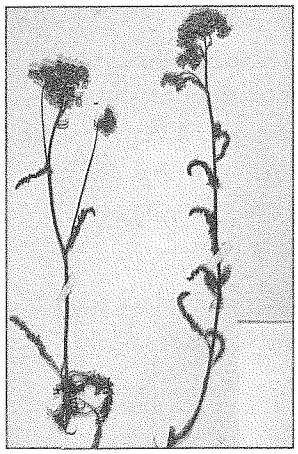
Forbs

Fireweed
Epilobium angustifolium



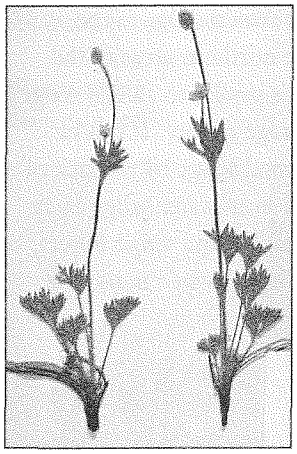
A tall, erect forb with narrow, alternate leaves. Common throughout Canada. Most common on moist sites that receive adequate sunlight. Can be found in forest openings, under open forest canopies, and disturbed sites. It grows from an immense network of underground rhizomes, and flourishes after disturbance. Fireweed flowers in mid-season, producing an elongated stalk of purple or pink flowers. Fireweed is a satisfactory forage early in the season but will be avoided by livestock if allowed to mature.

Yarrow
Achillea millefolium



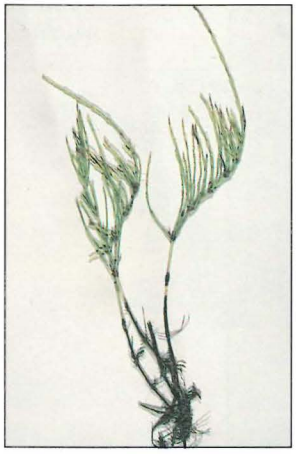
A tall, erect forb with finely dissected, alternate leaves. Yarrow is common throughout Canada, and can be found on mesic sites, similar to fireweed. Yarrow is easily identified by its finely divided leaves (fern-like) and its musty odour. Yarrow flowers in late summer. Yarrow flowers (white) are clustered in heads, in a flat-topped arrangement. Yarrow is not palatable to livestock, and has a weedy growth form. Common yarrow increases under grazing pressure.

Cut leaved anemone
Anemone multifida



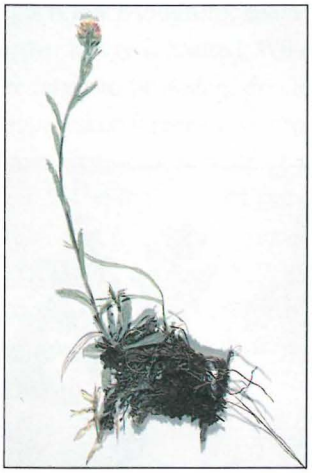
A plant of medium height, with numerous basal and three stem leaves. Leaves almost circular in outline, with deep incisions. Cut leaved anemone has white, yellowish, or red flowers. It grows on dry sites, in open grassland or dry forest openings. It is of moderate palatability to livestock.

Horsetail
Equisetum arvense



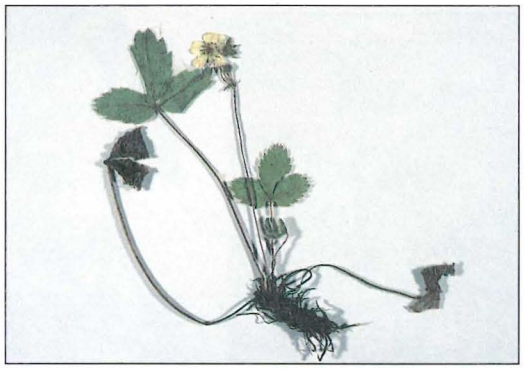
A plant of medium height, stem with numerous branches. Horsetail can be identified by its jointed stems and branches. It grows on moist sites and invades disturbed areas. It is persistent in cultivated areas. It is of moderate palatability to horses, but is not considered an important forage species.

Pussytoes
Antennaria rosea



A short forb, the flowering stalks being the only part to elongate above ground level. The leaves grow in a dense mat, with the flowering stalks elongating in mid-summer. Pussytoes grows on dry sites in open grassland. It is not palatable and its growth form precludes grazing. If abundant, it is an indicator of overgrazing.

Wild strawberry
Fragaria virginana



A short forb, with long creeping stolons. Strawberry has compound leaves with three leaflets. It grows best on moist sites exposed to moderate levels of sunlight. It is palatable to livestock, but its low growth form limits its usefulness for forage.

Dandelion
Taraxacum officinale

A short forb, growing from a rosette of basal leaves. Dandelion favours moist sites, but can tolerate some moisture stress. It is not native, but is naturalized throughout North America. It is palatable to livestock, but can assume a low growth form, making most foliage unavailable for grazing. It is common on moist, overgrazed areas.

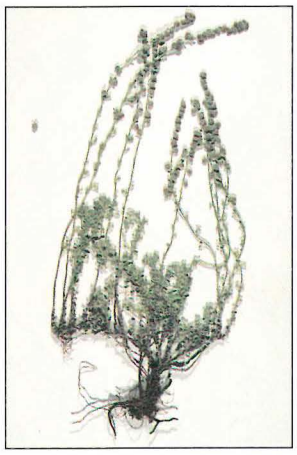
American vetch
Vicia americana

A slender, tall forb that grows by climbing up other vegetation. American vetch has tendrils at the ends of its leaves and uses other vegetation for support. It is easily identified by its pinnately compound leaves, and tendrils. American vetch produces excellent forage, similar in quality to alfalfa. It is common in aspen understories and the edges of aspen groves. It decreases under grazing, because of its upright growth and excellent palatability.

Creamy vetchling
Lathyrus ochroleucus

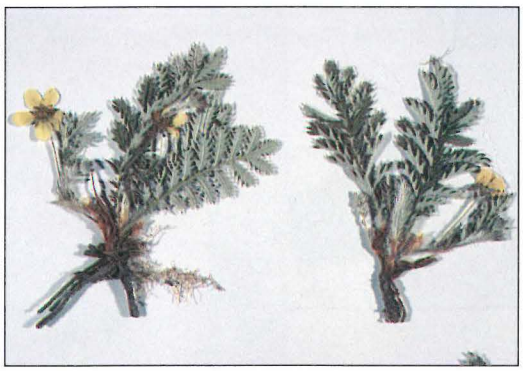
Similar in growth and quality to American vetch. Favours slightly more open areas. Creamy vetchling can be differentiated from American vetch by its larger stipules and white flowers. Creamy vetchling decreases under grazing pressure.

Fringed sage
Artemisia frigida



A half shrub, dying back to a woody base each fall. Fringed sage can be identified by its blue green foliage and sage odour. Its leaves are finely dissected, making it easily confused with common yarrow. Fringed sage is not palatable to livestock and increases on overgrazed sites. An abundance of volatile oils in its foliage makes it unattractive to grazers. Its growth form also makes it resistant to defoliation. Heavy stands of fringed sage are an indicator of overgrazing.

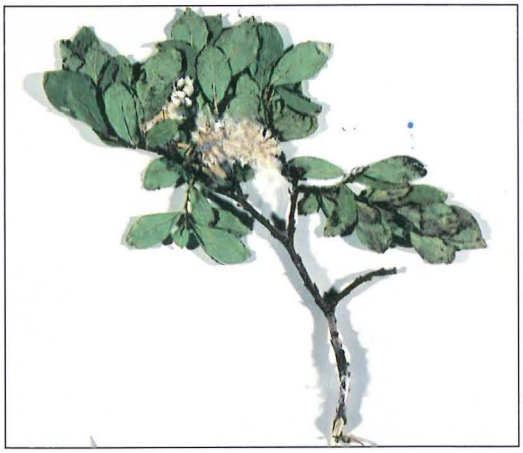
Silverweed
Potentilla anserina



A weedy forb that spreads by long, creeping stolons. Silverweed has pinnately compound leaves that are green on top and densely hairy below. Silverweed establishes by seed and spreads by slender stolons. It is most common on moist sites that have been disturbed. Overgrazing, and the bare ground that accompanies it, generally promotes the establishment and spread of silverweed.

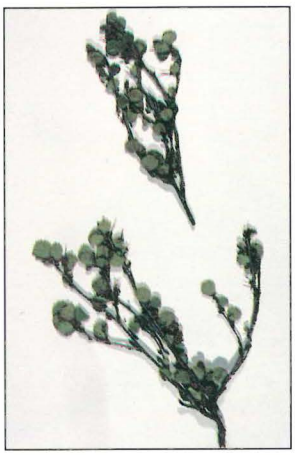
Shrubs

Willows
Salix spp.



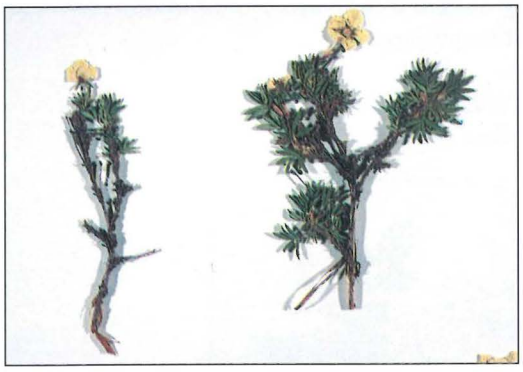
Willows are tall shrubs, reaching heights of 2-3 metres. Most willows favour moist sites, but a few species can be found on dry slopes. Willows can be identified by their site preference, leaf shape (linear-oval), and single bud scale (for winter twigs). Willows are important winter browse species for most ungulates, especially moose. Livestock will consume willow browse if it is low enough for them to reach and if other forage is limited. Willows are fairly resistant to browsing, developing a hedged appearance under heavy browsing levels. A combination of top killing and heavy browsing can kill willows immediately. Beaked willow (Salix bebbiana) and smooth willow (Salix glauca) are tall while Salix reticulata and Salix myrtilloides are shorter. All are common willows growing on wet sites.

Dwarf birch
Betula glandulosa



A short, densely branched shrub. Dwarf birch favours moist sites, similar to that of willows. Dwarf birch can be identified by its glandular bark, round leaves, and pine cone like flower clusters. Dwarf birch is not palatable to ungulates, and increases, often at the expense of willows.

Shrubby cinquefoil
Potentilla fruticosa

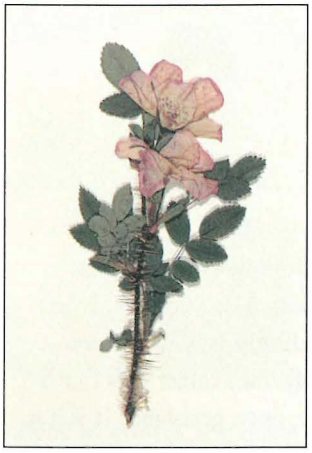


A shrub of medium height, with a densely branched canopy. Shrubby cinquefoil has compound leaves, with 3 or 5 leaflets. It has shredding bark and bright yellow flowers. Shrubby cinquefoil favours moist sites but is also common in dry, open grassland. It is not palatable to ungulates and increases under grazing. Occasionally, an abundance of shrubby cinquefoil indicates a shallow soil over bedrock, and not overgrazing.

Buffaloberry
Shepherdia canadensis

A shrub of medium height. Buffaloberry has rusty, opposite twigs. Its leaves are green above, rusty pubescent below. Buffaloberry grows on drier sites under conifer canopies, forest edges, or in forest openings. It is not palatable to ungulates, but does not increase under grazing. Its berries are eaten readily by bears and birds. Buffaloberry is one of the few native shrubs that fixes nitrogen from the atmosphere, making it attractive for reclamation purposes.

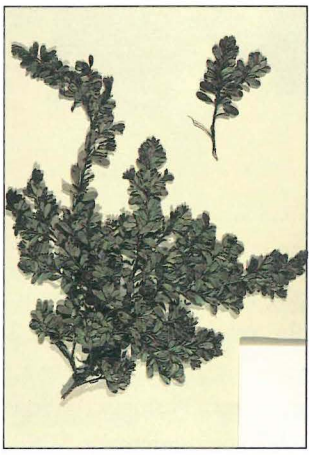
Wild rose
Rosa acicularis



A prickly shrub of medium height. Roses are common on moist sites under aspen forest, along forest edges, and in forest openings. It is palatable to livestock early in the growing season when the thorns are soft. Rose hips provide winter food for numerous bird species. Wild rose can be eliminated by overgrazing early in the growing season. It is generally quite persistent under most grazing regimes.

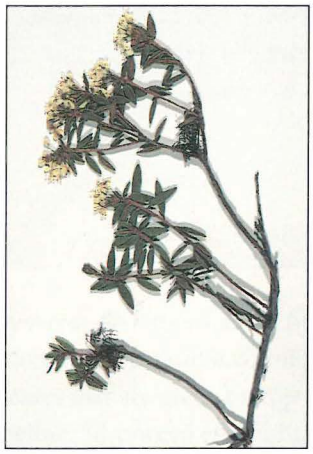
Kinnickinick, bearberry
Arctostaphylos uva-ursi

A low growing shrub, forming dense mats.



Kinnickinick favours growth on dry sites, in the open, along coniferous forest edges, or under an open coniferous canopy. It is not used by ungulates as a forage source. Its berries are eaten occasionally by bears. Its dense mats and creeping stems provide ground cover and slow erosion on gravelly and sandy soils.

Labrador tea
Ledum groenlandicum

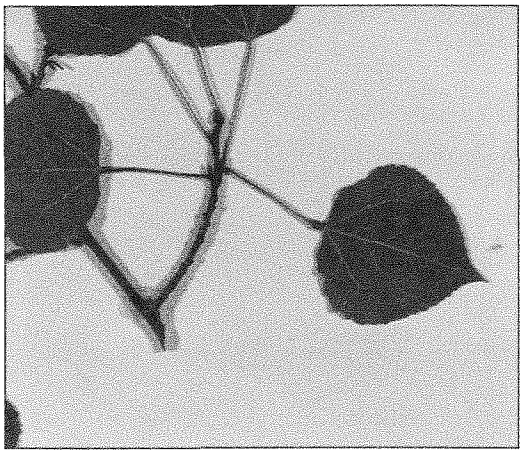


A shrub of medium height. Labrador tea has distinct leaves, green above, rusty pubescent below, with the edges rolled inward. It grows mostly in bogs and muskegs, commonly in

association with paper birch and black spruce. It is not eaten by ungulates, but is very common. The leaves can be dried and made into a pleasant tea, which has slight laxative properties.

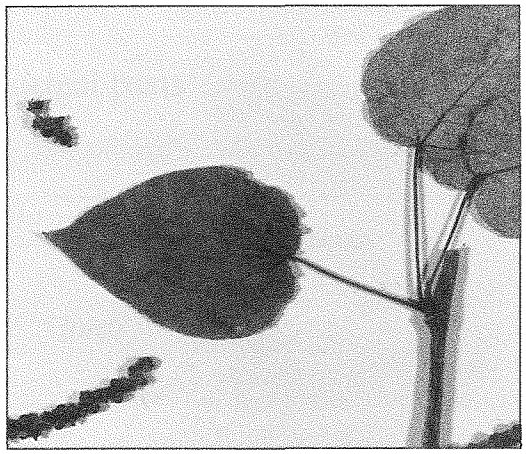
Trees

Aspen poplar
Populus tremuloides



A broadleaved tree. Identified by its smooth (to ground level), whitish bark. The leaves are ovoid, with a short, sharp point. Aspen leaves have a flattened petiole (leaf stalk), that cause the leaves to flip in the wind. Aspen poplar occupies moist, upland sites. Aspen is not tolerant to shade, and is outcompeted by white spruce in older stands. Aspen sprouts vigorously if the canopy is top killed. Aspen browse is palatable to ungulates throughout the year, but is often out of their reach.

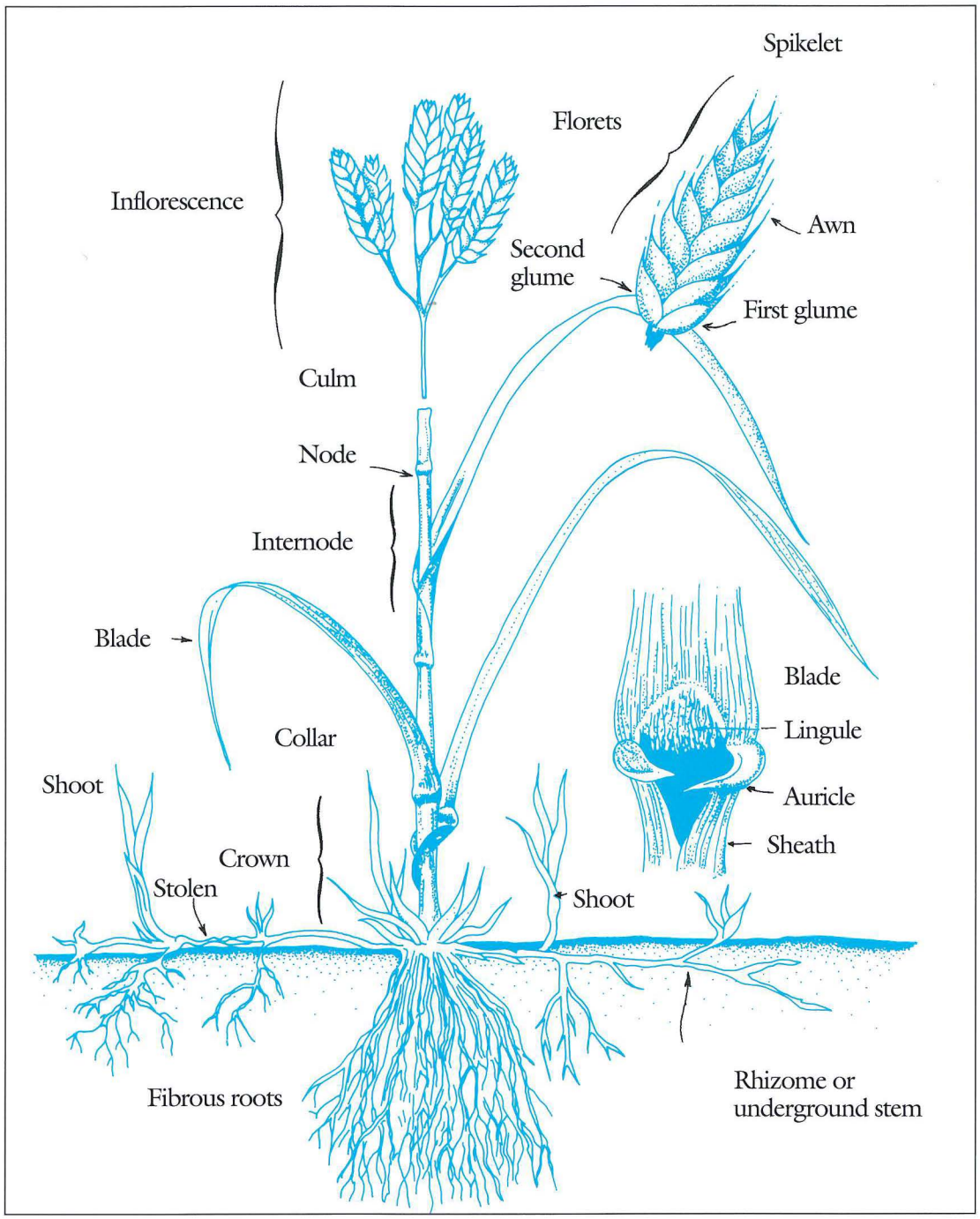
Balsam poplar
Populus balsamifera



Similar to aspen but favours wetter sites. It is common in moister areas, often being found on sites between aspen and willow. Balsam poplar has rough bark, at least to the bottom third of the bole. Balsam leaves are larger than aspen, and have a longer, more prolonged point. Balsam also has large, resinous buds. Balsam poplar browse will be consumed by ungulates, but is second in preference to willows and aspen poplar. Balsam also sprouts after being top killed, but not to the same extent as aspen.

APPENDICES

Appendix I: A grass plant showing principal parts



Appendix II: Grazing capability field plot sheet

GRAZING CAPABILITY

Applicant:

Application Number:

Location:

Size/Area:

Date/Source:

Polygon #	Vegetation Type	Herbage Prod'n Kg	Ha	Total Herbage Prod'n	Safe Use Factor	Slope Factor	Deadfall Factor	Palatibility	% Actual Use	Total Forage Kg	AU
	Pop/ Colamagrostic	450	100	45000	0.5	-	0.25	0.63	0.2	8505	18.6
	Bromus/ Festuca	680	50	34000	0.5	0.2	-	0.71	0.1	6690	19
			150								37.6

Summary and Recommendations:

3.9 ha per Animal Unit month

47.8 ha per Animal Unit year

Signature

Appendix III: Common and scientific names as well as palatability ratings of important Yukon rangeland plants

Common name	Scientific name	Palatability rating
GRASSES		
Alkali grass	Puccinellia interior	0.9
Bearded (slender) wheatgrass	Agropyron trachycaulum	1.0
Fowl bluegrass	Poa palustris	0.9
Foxtail barley	Hordeum jubatum	0.8
Fringed brome grass	Bromus ciliatus	1.0
Greenland bluegrass	Poa glauca	1.0
Intermediate oatgrass	Danthonia intermedia	0.9
Kentucky bluegrass	Poa pratensis	1.0
Marsh reed grass (bluejoint)	Calamagrostis canadensis	0.9
Northern awnless brome	Bromus pumpellianus	1.0
Northern reed grass	Calamagrostis inexpansa	0.9
Northern rough fescue	Festuca altaica	1.0
Purple reed grass	Calamagrostis purpurescens	0.9
Richarson needle grass	Stipa richardsonii	1.0
Sheep's fescue	Festuca saximintana	1.0
Slough grass	Beckmannia syzigachne	0.9
Smooth brome grass	Bromus inermis	1.0
Tickle grass	Agrostis scabra	1.0
Trisetum	Trisetum spicatum	1.0
Tufted hair grass	Deschampsia caespitosa	1.0
SEDGES AND RUSHES (GRASS-LIKES)		
Sedge	Carex species	0.9
Arctic rush	Juncus arcticus	0.6
Awned sedge	Carex atheroides	1.0
Baltic rush	Juncus balticus	0.6
Beaked sedge	Carex rostrata	0.8
Dryland (blunt) sedge	Carex obtusata	0.9
Bog sedge	Kobresia	0.6
Water sedge	Carex aquatilis	0.9

Common name	Scientific name	Palatability rating
FORBS		
American vetch	Vicia americana	1.0
Coltsfoot	Petasites sagittatus	0.3
Creamy vetchling	Lathyrus ochroleucus	1.0
Crocus	Anemone patens	0.0
Cut leaved anemone	Anemone multifida	0.3
Dandelion	Taraxacum officinale	0.5
Dock	Rumex	0.1
Fireweed	Epilobium angustifolium	0.3
Goldenrod	Solidago	0.1
Hedysarum	Hedysarum alpinum	0.9
Horsetail	Equisetum arvense	0.3
Lupine	Lupinus argenteus	0.0
Marsh cinquefoil	Potentilla palustris	0.3
Northern bedstraw	Galium boreale	1.0
Penstemon	Penstemon gormanii	0.1
Pussytoes	Antennaria rosea	0.0
Seaside arrowgrass	Triglochin palustris	0.0
Silverweed	Potentilla answerina	0.1
Wild strawberry	Frageria virginiana	0.5
White prairie aster	Aster pansus	0.1
Yarrow	Achillea milifolium	0.0
SHRUBS		
Buffaloberry	Shepherdia canadensis	0.0
Dwarf birch	Betula glandulosa	0.1
Fringed sage	Artemisia fridgida	0.0
Juniper	Juniperus communis	0.0
Kinnickinick	Arctostaphylos uva ursi	0.0
Labrador tea	Ledum groenlandicum	0.0
Red osier dogwood	Cornus stolonifera	0.5
Shrubby cinquefoil	Potentilla fruticosa	0.0
Wild rose	Rosa acicularis	0.5
Willow	Salix	0.2
TREES		
Aspen poplar	Populus tremuloides	0.5
Balsam poplar	Populus balsamifera	0.1
Black spruce	Picea mariana	0.0
Lodgepole pine	Pinus contorta	0.0
White spruce	Picea glauca	0.0

GLOSSARY

Alkaline soil—Soil with a pH of above 7.0. Alkaline soils contain abundant base elements (calcium, magnesium, potassium and sodium) and are typically found in arid to semi-arid environments normally associated with grass and parklands.

Acid soil—Soil with a pH value less than 6.5. Acid soils are usually well "leached", that is stripped of base elements and are typical of regions with moderate to high precipitation normally associated with forests.

AUM—Animal Unit Month is the amount of forage consumed by a 1000 pound cow or horse in one month. Traditionally a figure of 1000 pounds of dry matter per month has been considered the norm.

Carbohydrates—Non-structural carbohydrates which are the energy source in plants and are translocated within the plant and used for growth, reproduction and respiration (maintenance).

Climax—Final, stable stage of plant succession.

Carrying capacity—Optimum quantity of forage available for removal by grazing animals under ideal range management, thus refers to the maximum stocking rate. It is expressed as AUM/hectare.

Decreaser—Plant species of the original or climax vegetation that will decrease in relative amount with continued overuse by grazing.

Decomposers—Microorganisms which breakdown organic matter into humus and liberate nutrients into the soil.

Ecology—Study of the interrelationships between organisms and their environment.

Ecosystem—Functional unit consisting of organisms and environmental variables of a specific area with an exchange of energy among these elements. It is an ecological system.

Forage—Herbage and browse available and acceptable to grazing animals.

Grazing capacity—Optimum quantity of forage available for removal by grazing animals under the range management being practiced now and thus refers to stocking rate. It is expressed as AUM/hectare.

Herbivore—Animal which feeds on plants.

Herbage—Biomass of all herbaceous vegetation at one point in time. Some of it may not be palatable.

Increaser—Plant species of the original vegetation that increases in relative amount, at least for a time, under overuse by grazing.

Invader—Plant species that were absent in undisturbed portions of the original vegetation of a specific range site and will encroach following disturbance or continued overuse.

Litter—Dead vegetation that is left on the surface of the soil to decompose.

Non-use range—Areas of rangeland that are not used by livestock because of site factors which restrict access.

Nutrient pool—Supply of nutrient elements, principally nitrogen, phosphorus, potassium and sulphur which reside within an ecosystem and are utilized by living organisms, i.e.: plant and animals.

Palatability—Relish with which a particular species or plant part is consumed by an animal

Photosynthesis—Conversion of the sun's energy into carbohydrates by plants.

Primary producer—Plants are primary producers because they convert the sun's energy into chemical energy.

Primary consumer—Wild and domestic herbivores which consume plants.

Primary range—Areas which animals will preferentially graze when there is minimal management.

Range condition—Current productivity of a range relative to what that range is capable of producing.

Rangeland—Lands that wild and domestic animals depend upon to provide forage, habitat and shelter.

Range management—Manipulation of rangeland components to obtain the optimum combination of goods and services for society on a sustained basis.

Saline—Non-sodic soil containing sufficient soluble salts to impair its productivity.

Secondary consumer—People and carnivores which eat the primary consumers, the herbivore.

Secondary range—Area of rangeland that will normally only be grazed after the primary rangeland has been utilized under minimal management.

Senescence—Phase of plant growth where the leaves have matured and start to die. It is often associated with the preparation of the plant for winter dormancy by dropping leaves and storing non-structural carbohydrates.

Stocking rate—Number of animals on a unit area of land during a month or a grazing season. Expressed as AUM/area or area/AUM.

Succession—Replacement of one plant community by another over time until the final plant community is reached. The final stable plant community in equilibrium with the environmental conditions is called the climax.

Topsoil—Surface layer of mineral soil composed of well decomposed humus mixed with sand, silt or clay. The term roughly corresponds to the Ah soil horizon.

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