An Introduction to Managed Grazing for Sheep and Goat Producers

Alberta Lamb Producers

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Key Concepts

- **"Managed Grazing"**
- **Benefits of Managed Grazing**
- **Are You Using Managed Grazing?**

What is Managed Grazing?

Managed grazing is about focusing your management on the **forage** you need for your sheep and goats not on the sheep and goats themselves. Pasture can be more than a place to keep animals over the summer.

Managed grazing is managing your pastures to regulate how often and how much they are grazed. Essentially, you are allocating feed. Using certain techniques, you work to control the quality, yield, consumption and survival of the forage produced. With managed grazing you try to increase the amount of high-quality forage available per acre and reduce the amount of forage wasted. The ultimate goal is to match your forage supply to the needs of your grazing sheep or goats.

Managed grazing is used to improve the efficiency of forage use, reduce your cost of production and help maintain or improve the quality of pastures and the environment.
Importantly, managed grazing:

- Increases animal production per acre
- Improves soil conservation and water quality
- Reduces need for supplemental feeds
- Reduces feed costs and increases potential for profitable livestock production

In some managed grazing systems, producers control and limit the access their sheep and goats have to a **pasture** by dividing it up into smaller **paddocks**. **Paddocks can be made** using permanent or temporary fencing. The paddocks are then grazed one at a time, allowing plants in the paddocks not being grazed to rest and rebuild vigour. If the soil fertility is good, vigorous plants replenish their energy reserves and deepen their root systems making them better able to survive winter and periods of drought. **Rest** periods are critical to the long-term survival and productivity of your pastures.

Managed Grazing *– managing pasture land by controlling how much and how often each pasture is grazed. Managed grazing means forages and livestock are purposefully managed.*

Pasture *– large area of land suitable and set aside for grazing by livestock.*

Forage *– plant material, including grasses, legumes, weeds, or shrubs, that is available and accepted by animals for consumption. Can be grazed or mechanically harvested.*

Rotational Grazing *– a managed grazing method that uses alternating periods of grazing and resting for two or more paddocks.*

Why Use Managed Grazing?

Economic Benefits

Managed grazing can help reduce feed costs for your sheep or goats. Instead of harvesting and hauling feed to your livestock, you have them harvest it by grazing in the field themselves. This saves the labour and machinery costs needed to make hay/silage, to transport it to the pens and feed the livestock, and to haul manure from the feed pens. It can also assist cash flow by reducing the need to buy additional or improved feed during the growing season.

Environmental Benefits

Well-managed pastures have environmental benefits that affect the long term viability of your farm and its value.

- Grasses and legumes have larger root systems that stabilize the soil and increase the water holding capacity of pastures.
- Studies have shown that pastures effectively store carbon in the soil, reducing the amount of carbon dioxide being released into the atmosphere.
- Pastures maintain water quality of nearby lakes and streams, with year-round ground cover decreasing run-off. Managing run-off not only holds water where your pastures can use it, it also reduces the level of unwanted materials, or contaminants that move into water sources.
- Plant residue, or the material left over after grazing, helps holds snow and can also be used by wildlife. Plant residue provides nesting sites for birds and ducks in the early spring, increasing suitable habitat for them.
- By managing where and when your sheep or goats graze, you are able to limit access to riparian areas. At the very least you can limit the amount of time your sheep and goats spend in and around **riparian areas**, reducing the damage from overgrazing so often seen in these sensitive areas.

Paddocks *- small areas fenced off with temporary or permanent fences that divide up a larger pasture, enabling improved management of forage and livestock.*

Rest *- a period when plants are not being grazed. Resting allows plants to recover from being grazed, increasing productivity and sustainability.*

Riparian Area *- a narrow band of land next to a stream, lake, slough or river. Plants along the water source reduce run-off and help maintain water quality.*

Pasture Benefits

Managed grazing helps improve the long-term health and productivity of your pastures.

- The rest each pasture gets between grazing periods allows plants to recover and remain healthy.
- Good managed grazing techniques increase the number of desirable plant species and increase overall forage production.

- Moving your sheep or goats through smaller paddocks helps distribute manure more evenly. The nutrients in manure and even distribution of manure result in improved plant growth.
- Sheep and goats can also help with weed control. They more readily graze certain weed species that would otherwise reduce forage production of the species you want in your pasture. Sheep or goats will eat thistles at certain stages of their growth and can assist chemical control programs to reduce thistles in the pasture.

Animal Benefits

Managed grazing is about monitoring pastures and forages. Producers check pastures and move sheep or goats from paddock to paddock more frequently–at times daily, or for much of the season every four to five or more days. That frequent contact provides producers with more opportunities to observe their animals' behaviour. As a result they are often able to detect problems like predation and health issues more quickly.

Where Is Managed Grazing Used?

Managed grazing can, and is, used everywhere livestock graze. Any operation with pasture land that can be divided up into smaller paddocks can implement managed grazing. The principles of managed grazing apply whether you have 10 or 1,000 sheep or goats, or with 10 or 1,000 acres of pasture on your operation.

Tip

- managed grazing lets you decide which paddocks your flock or herd grazes and when. With managed grazing, you will be able to adjust to changing conditions faster.

When Should Managed Grazing Be Used?

Increasing competition for land and for feed has increased the cost of producing sheep or goats. As part of a profitable and sustainable business plan, sheep or goat business operators should consider implementing managed grazing. Improving grazing management allows increased utilization of available forage in existing pastures, setting up the potential for extending the grazing season or just increasing the forage on an existing land base.

Managed grazing requires extra labour and advanced skills. But every operator can properly consider managed grazing as a potential business option, and then weigh the pros and cons of implementing it.

Who Uses Managed Grazing?

Many livestock producers with grazing animals can benefit from managed grazing. Globally, sheep producers have adopted the principles of managed grazing and are continuing to improve their systems because they've seen increased forage production, reduced feed costs and improved pastures and environmental health. Sheep producers in New Zealand, Australia and Great Britain use managed grazing to reduce feed costs and improve profitability.

Are You Using Managed Grazing?

In all types of grazing systems, sheep or goats are used to efficiently convert grass into a marketable product (meat, milk, fibre). How many of the following managed grazing practices are you doing on your farm right now?

- Seed grasses and legumes suited to your area that will provide good quality forage for the entire grazing season.
- Use many different types of plants (perennial legumes and grasses, annual crops) to create a flexible grazing system.
- Actively plan to reduce the number of days you feed harvested forage (hay and silage).
- Arrange paddocks and gates to easily move your flock or herd between paddocks.
- Monitor pasture production frequently and move your flock or herd to a new paddock as plant growth determines the need.
- Know about stocking density and how to use it as a tool to manage your pastures.
- Keep records on sheep or goats, on days of grazing or pasture production.

It can take many years to learn about, fully adopt and understand all the components of a managed grazing system. Producers who have made the change to managed grazing have experienced many of its benefits, including increased forage production, increased soil health and reduced feed costs. This manual will help you create a managed grazing plan for your farm.

Tip

Find out what local grazing resources you have. To start with, check out the applied research or forage association in your area on the ARECA website (www.areca.ab.ca).

Getting Started

The purpose of this manual is to give an overview of managed grazing, to provide information and tips to use in applying managed grazing principles to sheep or goat operations including:

- Plant growth and how to use it to your advantage
- Management techniques to create and maintain productive pastures
- Sheep/goat nutritional considerations and grazing behaviour
- How to develop grazing plans and set up a managed grazing system
- Potential grazing issues

Practical Ideas

- Visit with a few farmers who are practising managed grazing.

2. Understanding Plant Growth and Making It Work for You

Key Concepts

- **How Pastures Grow**
- **How Pastures Handle Grazing**
- **How to Get the Most Out of Your Pasture**

How Grasses and Legumes Grow

Knowing the basics of how the plants in your pastures grow is essential to managing healthy and productive pastures.

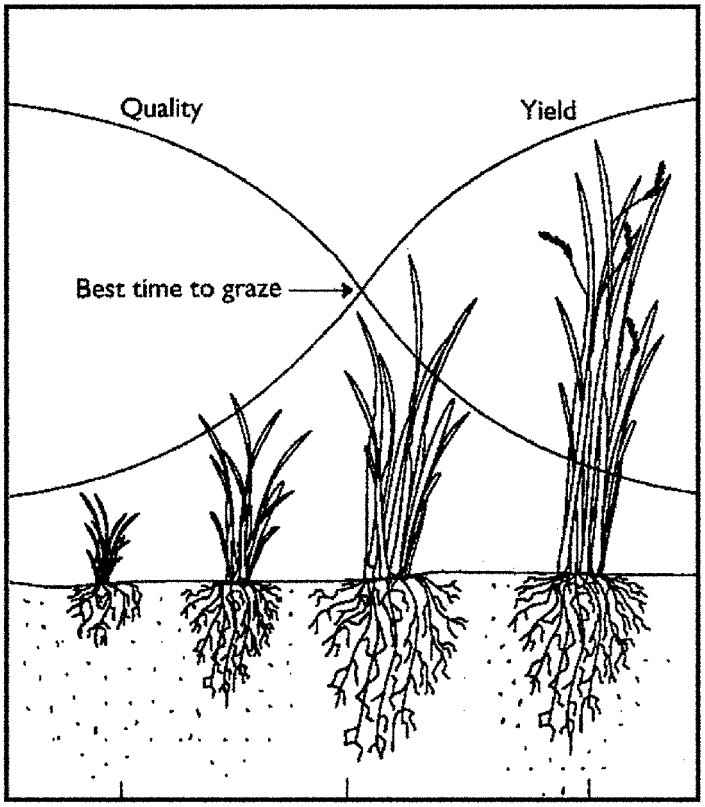
- The energy plants need for growth and development comes from the sun. They use sunlight to power **photosynthesis**, which occurs in green leaves.
- Photosynthesis produces **carbohydrates** that are used immediately to power new growth, or stored for use in the future.
- In the fall, plants store carbohydrates to survive the winter and grow again the following spring.
- In the spring, plants use carbohydrates to fuel new growth.
- When plants are small, such as in the early spring or after being grazed, their growth is slow. They have few green leaves and have to rely more on stored carbohydrates to supply energy for growth.
- Once the plant starts to get bigger and grow more leaves, photosynthesis increases, allowing plants to grow faster. At this point, the plant produces enough carbohydrates for both growth and storage. Once plants start to mature, growth slows down; most of the energy is being used for flower and seed production, instead of leaf production.
- **The best time to graze is at the top of the period of rapid growth (after the three or four leaf stage in grasses) and before the plant flowers and produces seed**. At this time, the plant is able to build up its carbohydrate reserves enough to power regrowth after being grazed, and the plant material is high in nutrient quality (2-1).
- Grazing before the plant has reached this optimal stage weakens it and reduces its ability to re-grow after being grazed. It also reduces the plant's production and its ability to survive the winter.
- Grazing too low, leaving the plant residue level too small, will slow down regrowth and can also damage plants and their ability to survive.

Photosynthesis *- a process by which plants use carbon dioxide, water and sunlight to make carbohydrates.*

Carbohydrates *- compounds, such as starch, sugar and fibre, made by plants from carbon, hydrogen and oxygen.*

- Grazing after the plants have started flowering means lower quality forage is being consumed by your sheep or goats (more fibre and less protein).
- Plants that have matured and produced a seed head are lower in quality because they have more stem than immature plants. Plant stems and mature plants, particularly grasses, contain less **digestible fibre** and have less protein than leaves. Protein and digestibility are important considerations for grazing ewes or does producing milk for their young and also for growing lambs or kids.

Non-digestible Fibre
- parts of plants that cannot be broken down and easily digested, including lignin. Forages with high levels of non-digestible fibre are lower in energy and quality.



2-1. Relationship between plant growth stage and quality

How Grasses Grow

Grasses have **determinate growth**. This means that plant growth stops once a seed head has been produced. That is critically important for forage and grazing management.

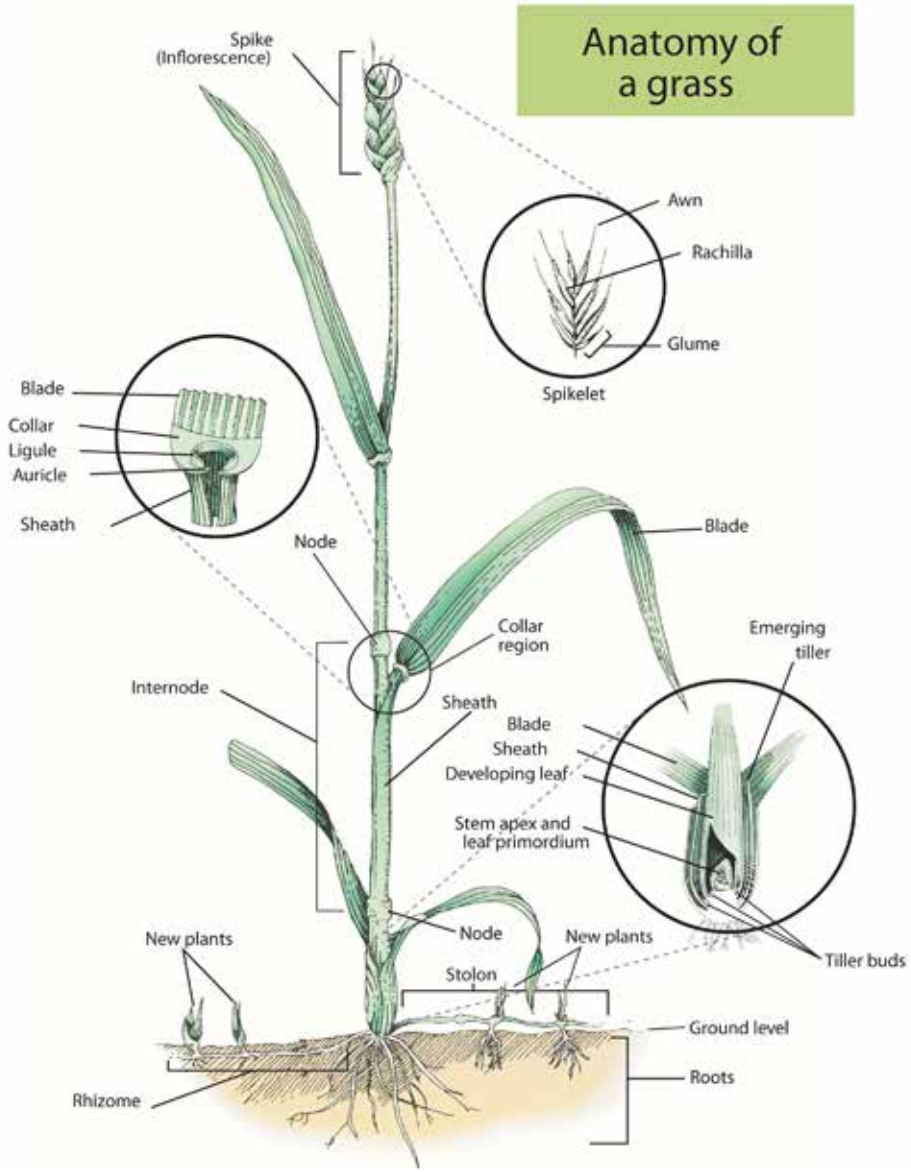
When first seeded, grass seeds germinate and a single shoot emerges from the soil.

As the growing season progresses, additional shoots called **tillers** develop from the base of each true leaf (2-2).

Removing the top growth of the grass by cutting or grazing can encourage new tillers to grow.

Determinate Growth *- vegetative growth that stops once the plant begins to flower.*

Tillers *- new stalks from the base of a plant or the axis of one of its leaves.*



2-2. Grass structure and growth

Some grasses, called **bunch-grasses**, produce tillers from buds on the original shoot (2-3). Orchard grass, tall fescue, and ryegrass are bunch grasses. These grasses do not have runners (rhizomes or **stolons**), so they cannot easily fill in empty spaces around them. Bunch-grasses planted in rows will still clearly show those rows years later.

Other grasses send out short underground stems called **rhizomes** that form new shoots. These are called **sod-forming grasses** (2-4). Creeping red fescue and Kentucky bluegrass are sod-forming grasses. If managed properly, these grasses will spread and fill in empty spaces between plants.

Most of the perennial **cool-season grasses** found in Alberta pastures (except for timothy) will not form seed heads in the year of establishment.

In the second year, early grass growth is all leaves, followed by **stem elongation**, flowering and seed production.

2-3. Bunchgrass

2-4. Sod-forming grass

Bunch-grass *- a grass that grows in tufts, or bunches.*

Sod-forming Grass *- a grass that spreads by sending out horizontal shoots–rhizomes– developing new plants that form a sod, or dense mat of plants and plant roots.*

Rhizomes *- plant shoots or stems that are produced underground and develop into new plants.*

Stolons *- some grasses, creeping bentgrass and rough bluegrass, have stolons.*

Cool-season Grasses *are the common grasses growing in Alberta. They are most productive early in the growing season and in the fall, but go through a slump in growth during mid-summer.*

Stem Elongation *- the stem of a grass plant lengthens and the plant increases in height. This happens with the reproductive tiller.*

How Legumes Grow

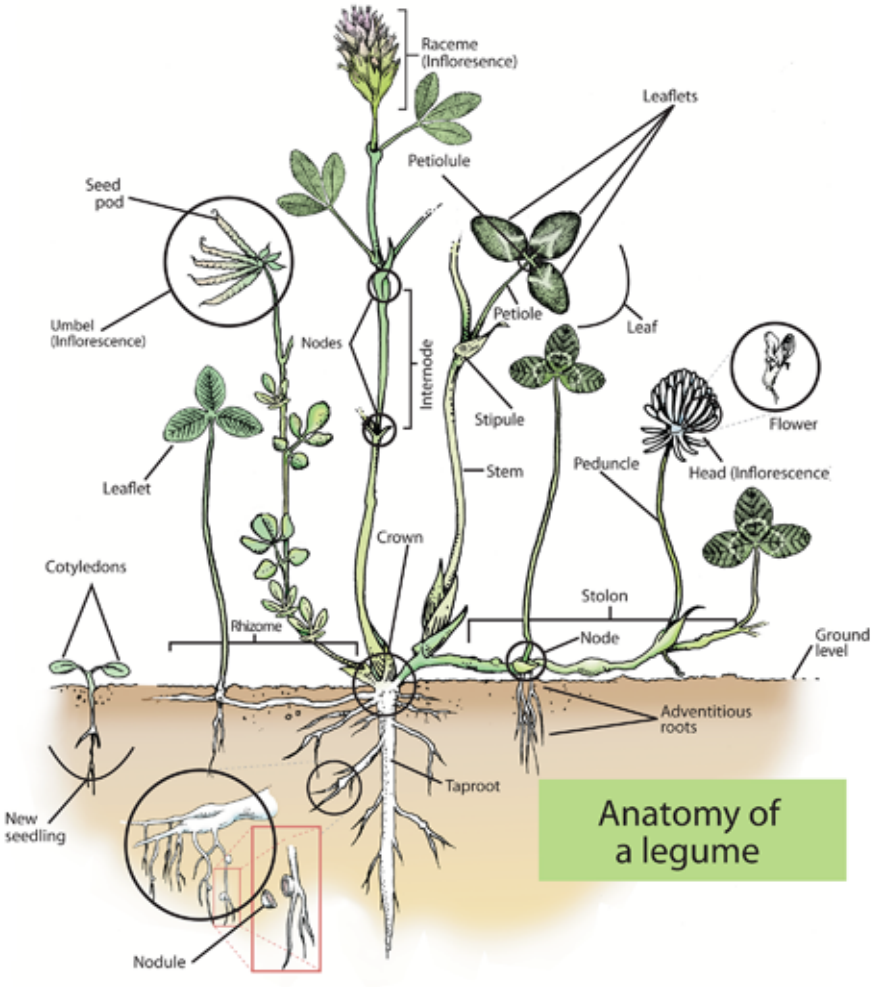
Legumes have indeterminate growth. This means that they will flower and produce leaves at the same time.

Legume seedlings have a single shoot. More shoots (tillers) come from buds that form from below the soil surface. These buds create the **crown** of the plant (2-5).

Grazing the top growth encourages the development of new buds at the crown. Shoots can also form from buds that develop in the **leaf axils** above-ground. Re-growth can come from buds in the crown or on the stem (**axillary buds**).

Some legumes spread using **stolons**, which are above-ground rhizomes. These plants are low growing and can handle heavy grazing. One example is white clover.

Legumes will flower in the year they were established and in all following years.



2-5. Legume structure

Legumes *- plants with seeds in a pod that split into two halves, have leaves composed of more than one leaflet and fix nitrogen.*

Indeterminate Growth *- vegetative growth in plants that does not stop once they flower and produce seed.*

Crown *- the base of a legume plant where new buds form and growth starts from in the spring. Also where carbohydrates are stored.*

Leaf Axil *- the space between the top of a leaf and the stem where it is attached.*

Axilary Bud *- a bud that grows from a leaf axil and can become a new leaf or branch.*

Stolon *- a horizontal above-ground stem that can produce a new plant.*

How Your Pastures Respond to Grazing

Grazing isn't bad for the plants in your pastures. In fact, grazing can actually help stimulate growth. Removing the older or dead leaves means the young leaves are not shaded and can capture more energy from the sun and grow more effectively. However animal management is important. Sheep and goats prefer the young, more succulent leaves. When a producer introduces sheep and goats, especially sheep, into a mixed forage pasture, the animals will inevitably graze the youngest plants and regrowth first.

Most of the forage plants in your pastures will re-grow from stems, crowns or roots that are either underground or very close to the ground. They still benefit greatly from rest, though, even with their growing points protected. Very few forage plants are adapted to continuous grazing without rest periods. Forage plants that will survive, though not thrive, under continuous grazing are Kentucky bluegrass, white clover and some **prostrate** weeds.

Prostrate *– lying flat along the ground.*

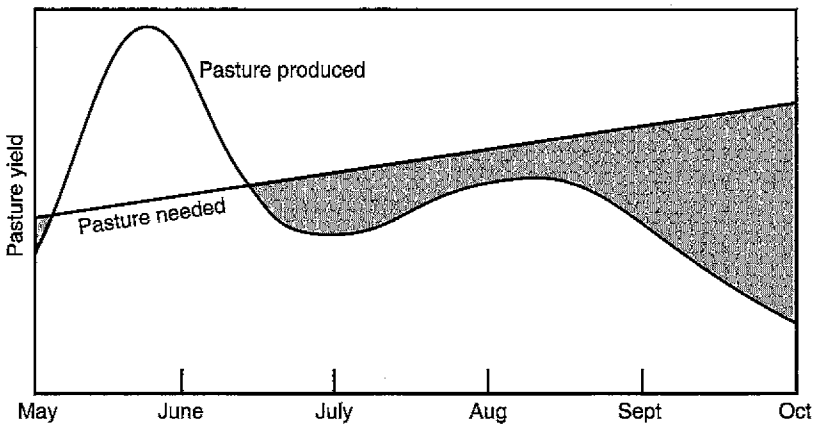
To survive, taller forages like smooth brome need longer rest between grazing periods. If they are constantly grazed, they start to weaken and die as their new leaves are removed. Once those leaves are gone, the plants are unable to capture the energy from the sun to power photosynthesis and the production of the carbohydrates they need for growth. Tall fescue or orchard grass can be better suited to rotational, or managed, grazing systems.

How to Get the Most Out of Your Pasture

Your sheep or goats need forage all year round. With Alberta's growing season ranging from fewer than 160 days to 185 days, grazing livestock has challenges.

Forage production over the course of the growing season rarely matches the nutritional needs of your sheep or goats (2-6). The quality of forage in your pastures also changes.

Note
- the amount of forage your pastures produce changes during the growing season!



2-6. Pasture production and animal feed requirements

As the grass and legume plants in your pastures mature and start to head out, forage quality and nutritional value drop. At the end of the growing season there might be a lot of plant material out there but mature or dead plants are not great feed. Low nutrient value and high fibre will likely keep your sheep or goats alive but productivity and health can be impaired.

Grazing management is about meeting the needs of plants in your pastures so they meet the needs of your sheep and goats!

Managing Forage Growth

Manage forage and grazing to deal with uneven forage growth, quality and quantity:

- Make hay with excess forage growth in pastures.
- Even out pasture production with rotational grazing, varying the number of sheep or goats in each paddock to meet forage growth, and changing the effective pasture sizes by using temporary and moveable electric fences.
- In some pastures, you may be able to strategically overgraze during mid-spring to slow down the spring regrowth and extend the surge of forage growth across more weeks.
- Strategically use fertilizer, especially nitrogen, to promote forage growth at different times of the season.
- Seed **annuals cereals** or **winter cereals** to supplement perennial pastures or for **swath grazing**.
- Plan to have **stockpiled forage** for extended season grazing.
- Choose pasture grasses and legumes that have different growth patterns (e.g., early or later spring growth) to help even out production.

Annual Cereals *- plants that grow and produce grain in a single season such as barley, oats and triticale.*

Winter Cereals *- annual cereals that are seeded in the fall, germinate, overwinter and continue to grow the following spring. Examples include winter triticale and fall rye.*

Swath Grazing *- when annual cereals are swathed at the dough stage and the swaths are grazed in the field during the fall and winter.*

Stockpiled Forage *- plant growth in pastures is allowed to build up during the summer and then grazed in the fall or winter.*

Use Plant Growth Patterns

Different forage grasses and legumes have different growth patterns (2-7). Some, like crested wheatgrass, start growth very early and also mature very early. Meadow brome starts growing early in the spring and maintains fairly even production until July. Others, like orchard grass, have their most productive period from June to July. In general, the grasses found in Alberta pastures are **cool-season grasses**. This means they are most productive early in the growing season and in the fall, but go through a slump during mid-summer.

Legumes tend to have a bit more even growth during the season, even though they might take longer than grasses to get started. They are also better able to handle heat and drought than grasses,

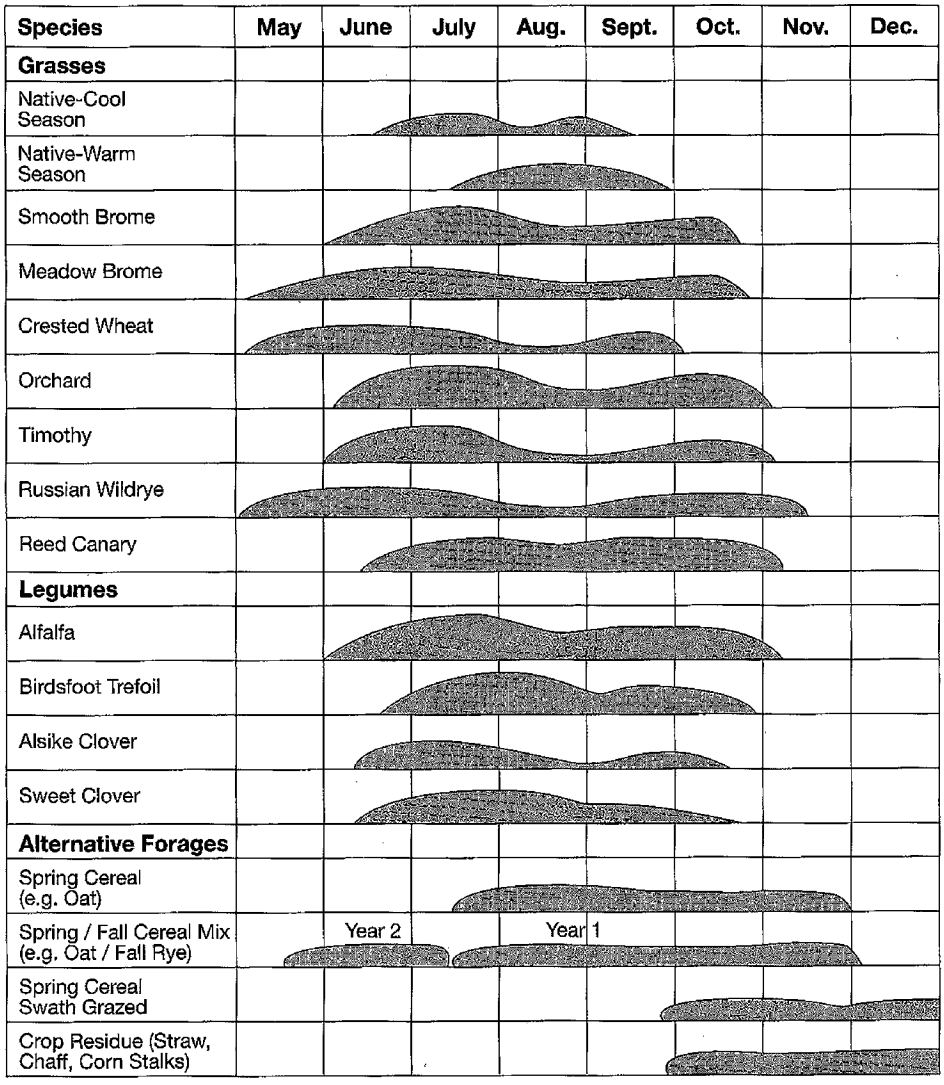
due to their large taproots. In order to keep pastures productive, you want to graze before the stem starts to elongate and the grasses go to seed. This will ensure that the plants stay vegetative, and produce high quality forage.

Cool-season Grasses - *grass species that grow best during cool, moist periods during the year. They like temperatures between 15 and 25°C.*

To make the most of your pasture, try to choose forage species with different growth patterns to help even out production while grazing. Different growth patterns of grasses and legumes offer opportunities for managed grazing and forage production.

Some species are fairly compatible in a mixed forage pasture. Seeding meadow brome with a small percentage of legumes, like the clovers or alfalfa, is a common practice in establishing pastures in many parts of Alberta.

Bloat can be a problem for sheep or goats grazing some legumes like alfalfa.



2-7. Relative yield and period of growth of native grass and seeded pastures

Consider carefully which mixed forage species work well when seeded together. Crested wheatgrass matures much earlier than most grasses and legumes. That early maturity can be an advantage for early season grazing. It makes crested wheatgrass difficult to manage in pasture mixes with forages that start growth later in the spring. By the time the later growing grasses, such as meadow brome grass, are ready to graze, crested wheatgrass is more mature, less palatable. Sheep and goats will choose the lush, young grass, wasting the potential of earlier grasses.

Grazing Systems to Help Manage Plant Production and Quality

This section contains some helpful descriptions of different types of grazing systems you can use to better match up pasture production and the forage needs of your sheep and goats.

Use Rotational Grazing

This managed grazing system helps you manage plant growth in your paddocks. By moving your flock or herd between many paddocks, you will be able to keep your sheep or goats grazing younger grasses and legumes with higher quality. Research has shown that increasing paddock rotation from twice a month to twice a week increased the number of grazing days by 40% (Simon, K. 2011).

- **Simple rotational grazing** uses two or more paddocks. Animals are rotated through each slowly. Many producers have found this system generally doesn't work well. If sheep and goats remain in paddocks too long they will consume forage regrowth, which effectively is the same as continuous grazing.
- **Intensive rotational grazing** has many paddocks. Livestock are rotated frequently through each, based on forage growth and allocation of feed.
- Rotating livestock through paddocks reduces plant stress by allowing rest periods when another paddock is being grazed.
- Plants will be healthier and have better developed root systems to start growing earlier in the spring, to produce more forage during the growing season and to grow longer into the fall.
- Rotational grazing gives you more control over the **timing** (when your pastures are grazed) and **intensity** (how much of the plants your sheep or goats consume) of grazing.
- Smaller paddocks allow forages to be grazed off more evenly. This reduces **overgrazing** near water sources, gateways or alleys, and **forage waste** at the far end of the pasture.
- Keep records on numbers of sheep and goats, of first and last date of grazing on each pasture or paddock and on notes on forage production in the paddock.

2-8. Rotational grazing goats

Graze Annual Cereals or Winter Cereals

Annuals and winter annuals add flexibility to your operation by providing supplementary or emergency pastures when needed (2-9). They can also provide forage for specific animal requirements, such as for lactating ewes or does, growing lambs or kids, and for flushing ewes or does before breeding.

Both types of annuals are productive in the late summer and early fall, when perennial plants have matured, need rest and are not as productive.

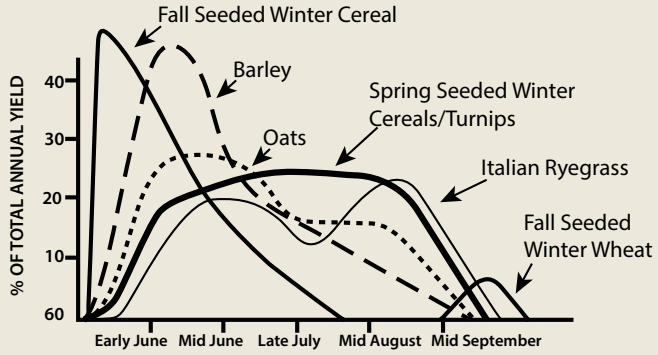
Annual Cereals

- The most commonly used annuals for grazing are oats, barley and pasture rape.
- Spring seeded annual cereals are ready to be grazed six to eight weeks after seeding. They provide more forage for grazing than spring seeded winter cereals.
- Spring seeded annual cereals produce most of their yield early in the growing season. They need to be frequently grazed to keep them from heading out.

Winter Cereals

- Fall rye, winter triticale and winter wheat are commonly used for grazing.
- They can be easily used in a rotational grazing system.
- With adequate rainfall and soil fertility for establishment, winter cereals seeded in the late summer can overwinter and provide early spring grazing the following year. This is a very important grazing technique and should be utilized more.
- In the spring they are often ready to graze before perennial grasses and legumes are.

Growth Patterns of Forage Crops



You can select an annual crop to supplement your perennial pastures based on when you need the additional feed

2-9. Annual and winter annual cereal growth patterns

Extend the Grazing Season - Stockpiling Forage

Stockpiling forage means you plan for the growth in your pasture to accumulate during part of the growing season, to use for grazing late in the fall, over winter or even early the following spring. Stockpiled forage can be left standing so sheep or goats graze the plants as they are or, the forage can be cut and left in swaths.

- Controlled access to stockpiled forage with temporary fencing reduces waste and preserves quality.
- Standing stockpiled forage should be selected for its ability to stand up under some snow. Orchard grass is very palatable to sheep or goats. It is a softer grass that tends to flatten under very little snow, increasing trampling and waste.
- Stockpiled grasses hold their leaves better than legumes. Legumes like alfalfa lose leaves rapidly after freezing.
- Stockpiled forages are not harvested forage like baled hay. Significant forage quality can be lost in swaths exposed to the weather, particularly wet weather in the fall. Additionally, quality can be reduced due to wildlife and rodents.
- Select forage species for stockpiling that maintain quality longer into the fall, such as meadow brome, creeping red fescue, Kentucky bluegrass, crested wheatgrass and tall fescue. Orchardgrass does not stand up under snow.
- Smooth brome and alfalfa do not maintain quality and should be stockpiled for late fall only.
- Stockpiled forage plants should not have headed out. You can manage maturity by grazing the pasture you want to stockpile during the growing season and allowing regrowth to accumulate for late grazing. Determining when animals should be removed from a pasture so the forage can be stockpiled will depend on the amount of plant material you leave to initiate regrowth, the fertility of the soil, the rainfall and the first killing frost in your area.
- You should only stockpile forage if you have enough paddocks and forage for the number of sheep or goats you plan to graze. Plan carefully. Stockpiling shouldn't result in overgrazing any paddocks or forage shortages that must be met by purchasing extra feed.

2-10. Stockpiled perennial forage for late season grazing

Extend the Grazing Season with Swath Grazing

Swath grazing one way to stock pile forages, usually annuals, to extend the grazing season.

- Seed annual forages, such as oats, barley or triticale, from mid-May to mid-June.
- Swath forage in late August or early September at the soft dough stage.
- Plan for cross-fencing the swaths to be grazed during the fall, winter and/or spring.
- Start fall grazing on the swaths furthest from the wintering/lambing or kidding pens so that as the weather deteriorates the animals are moving closer to feed and shelter.
- Sheep or goats inexperienced with swath grazing need to learn there is forage under the snow. Feeding hay along the swaths after a snow is usually enough to get them digging for the swaths.
- Monitoring the size of the grazing area is critical to ensure the sheep or goats clean up the forage, not just the more desirable seed heads.
- Use electric fencing to limit access to one to three days' worth of forage at a time.
- Regularly check body condition score and remove any animals that are not maintaining body condition.
- Have protection from the wind, particularly for goats; low areas will work for sheep.
- Have a back up plan and easy access to supplemental feed if needed.

2-11. Late season swath grazing

2-12. Fall annual pasture

Estimating Forage Yield

Knowing how to estimate the forage your paddocks produce during the growing season helps you develop a managed grazing plan that meets the needs of your flock or herd. There are many different methods you can use to estimate forage yield of your paddocks. Experience helps. Some producers measure off one acre and turn in a set number of animals for a set period of time to get a rough idea of forage production. Another practical method is to learn how to make a visual estimate of pasture yield. You can train your eye by carefully measuring the forage yield in a small area and learning what that amount of forage looks like so you can apply it to a larger pasture. Do this with a number of different yields, and over time you can calibrate your eye to that you can look at a field and make a reasonable estimate of that field's yield. A practical method of measuring the yield in a small area is outlined below.

Clipping

- Obtain a small scale that weighs to the nearest gram.
- Weigh an empty paper bag to get a 'tare' weight (this example: 15 grams)
- Clip a circle of forage, 42 inches in circumference, to the ground. You are trying to estimate the entire amount of forage dry matter in this area. Don't leave any residual forage.
- Put all the forage into the paper bag.
- Weigh the fresh forage and bag on the scale. Record the weight to the nearest gram (this example: 101 grams)
- Determine the amount of dry matter as follows.
  - Place the bag and its forage in a microwave with a glass of water on high for two minutes.
  - Remove the bag and weigh it. Record the weight.
  - Microwave for two minutes two more times; each time record the weight.
  - Then microwave for only one minute and weigh. Repeat the one minute weighings until weight loss stops. (this example: final weight 34 grams)
  - Occasionally during this process, replace the glass of water with a different glass of water so the glass doesn't get too hot.
- Determine the forage yield of your paddock as follows:
  - Subtract the 'tare' weight of the bag. 34 grams minus 15 grams = 19 grams
  - Multiply this dry forage weight x 100 = forage yield (lb./acre)
  - **In this example, the yield would be (19 x 100) = 1,900 lbs DM/ac**
- **Remember what the original forage plot looked like. Repeat this procedure for a number of different plots until you feel comfortable with your visual estimates of different amounts of forage yield for the particular type of pasture.**

Very rough estimates of the forage yield can also be based on the height of the grasses and legumes present (Table 2.1). These should be used with caution. Factors like soil type, fertility, plant density, precipitation and temperature affect forage yields from year to year in pastures.

Table 2.1 Estimated Dry Matter Yield (lbs/acre) Per Inch of Height for Pasture Types and Stand Conditions

Pasture Species	Pasture Condition		
	Fair	Good	Excellent
Smooth brome / Legume	150-200	250-350	350-450
Alfalfa	150-200	200-250	250-300
Orchard grass / Legume	150-200	250-300	300-350
Mixed Pasture	150-200	250-300	300-350

Source: ARECA. Pasture Stick.

Practical Ideas

- Learn how to recognize different levels of growth for every type of forage or forage mix in your fields.
- Learn to identify grasses and legume species when they are still in their vegetative stage. If you can't identify what you are growing, you can't manage it properly.
- Become proficient at estimating forage yield. These numbers are critically important in your decisions.

3. The Road to a Productive Pasture

Key Concepts

- **Creating a Successful Pasture**
- **Assessing Pasture Health**

Productive pastures are critical for a managed grazing system and for flock or herd productivity.

Fertility

Low **soil fertility** tends to be one of the **limiting factors** when it comes to forage production. To maintain good forage growth, the right balance of **nutrients** needs to be available in the soil for your grasses and legumes to use.

Limiting Factor - *something needed for survival, like a nutrient, that is in limited supply.*

You can think of the soil underneath your pastures as a bank. Your pasture plants make withdrawals from this bank to get the nutrients they need for growth. As with any bank account, you can't make only withdrawals. Nutrient deposits need to be made into this soil account to ensure the right balance is available for the plants.

Nutrients can be added to the soil by decomposing plant material (shoots and roots), manure and commercial fertilizer applications.

Grazing animals typically return nearly all of the nutrients they consume. By using a managed grazing system with small paddocks, these nutrients should be spread evenly over each paddock (3-1).

Nutrients *- substances that provide energy or building materials plants use to grow.*

Soil Fertility *refers to what nutrients, and how much, are present in the soil and the ability of a soil to provide plants with the nutrients they need.*

3-1. Even sheep and nutrient distribution

3-2. Uneven sheep and nutrient distribution

Continuously grazed pastures typically seen on sheep or goat operations end up with nutrients increasing faster in some spots than in others. Sheep and goats are creatures of habit. They will linger in shady areas or around minerals and water sources, depositing more manure and urine there than in the far corners of the paddock (3-2). By managing where they graze you can control areas they spend their time.

Even with all those nutrients returning to the soil, you still might need to apply commercial fertilizer every few years to keep the nutrients in the soil at the right levels. To find out if you need to add fertilizer, take a soil test.

Soil Testing

Take regular soil tests to find out the nutrient status of the soil in your pastures. These tests should be done every two to three years in pastures.

These soil tests will help you decide which nutrients you need to apply and how much of each is needed to maintain forage production.

The fertilizer recommendations you receive with your soil test are based on many different factors. These include soil type, climate, plant species, yield goals, pH, and organic matter.

Soil testing is essential in the management soil fertility. If you don't know what you have, how will you know what to apply?

- Take 15 to 20 different samples at two different depths; 0 to 15 cm (0 to 6 inches) and 15-30 cm (6 to 24 inches), or deeper, depending on the species in your pasture.
- The samples should be taken at random in the pasture. Make sure the samples you take are representative of the different areas in that pasture. Avoid fence lines, areas around trees and other areas of shade, lanes, waterways, riparian areas, manure piles, and other unusual spots in a field.
- Thoroughly mix the samples and take a sub-sample to air dry and submit to a soil lab for testing.
- For information on soil sampling and soil testing labs go to the Alberta Agriculture and Rural Development website (*www.agriculture.alberta.ca*).

What Nutrients Are Important?

The main nutrients you should be concerned with are:

Nitrogen (N)

- Nitrogen is generally the most limiting nutrient for grasses.
- It is needed in high amounts to keep plants productive.
- Legumes **inoculated** with the correct **rhizobia** bacteria are able to "fix" enough nitrogen to meet their needs. These rhizobia form **nodules** on the roots of legumes where they fix nitrogen from the air and supply it to the plant. Talk to your seed supplier about the correct inoculant for the legume you're using.

Phosphorous (P)

- Phosphorous tends to be the limiting nutrient for legume production.
- It is important for both root development and overall plant growth.

Inoculation *- applying a legume bacterium that is specific to that legume species to the seed before seeding. This can be done using a sticking agent and mixing it with the seed and inoculant.*

Inoculant *- microbes (bacteria or fungi) added to the seed or soil that will help plant growth.*

- Applying enough phosphorous for a few years when seeding your pasture will help maintain grass and legume growth.

Potassium (K)

- Potassium tends to only be needed when a soil test shows signs of deficiency.
- It is very important to legumes and their ability to overwinter.

Sulphur (S)

- Sulphur is deficient in many soils found in central and northern Alberta in the Black and Grey Wooded soil zones.
- It is needed for nodule formation in legumes and protein formation in all plants.

Rhizobia *- soil bacteria that fix nitrogen after becoming established in nodules on legume roots.*

Nodules *- bumps that form on a legume root, where the rhizobia that fix nitrogen and supply it to the legume plant live.*

Controlling Weeds

There are many different definitions of what a **weed** is, depending on whom you ask. Some weeds compete with the plants you want in your pastures and reduce forage production. Aggressive weeds, assisted by overgrazing, can completely take over pastures. Some weeds contain substances that are poisonous to livestock. Controlling weeds is a part of a managed grazing program.

Sheep and goats will graze a number of weeds when the plants are young and nutritious. Quack grass, lambs quarters and dandelions contain high nutrient levels at certain growth stages. Weeds sheep or goats won't graze are the ones that will cause problems. Identify the weeds you have in your pastures. Tailor your weed control plan to control those weeds. Keep an eye on what is going on with your pastures to ensure the time and money you spend on weed control is effective.

A Weed *- a plant growing in an area where it is not wanted, competing with desired plants and lowering pasture production.*

Weed control methods fall into the following categories:

Cultural Control

Healthy pastures that are not overgrazed tend to have fewer weed problems. Weeds move into pastures onto open ground, when forages are weakened through poor fertility, winter kill or inadequate rest.

- Fertilize pastures to keep grasses and legumes strong and competitive.
- Dense, well-managed pastures will often out-compete many weeds.
- Let paddocks rest between grazing periods to maintain plant health.
- Avoid spreading weed seeds between pastures with equipment, feeds, or manure.
- Control any weeds along fence lines before they move into the pasture.
- Feeding in the same spot in a pasture can kill the grass, allowing weeds to move into the bare spots.

Mechanical Control

Mechanical control can be expensive; preventing weed establishment is cheaper.

- Mow, clip and hand weed to reduce weed infestations and to help control thistles.
- Cut thistles in the bud to early bloom period to weaken the plants by depleting root reserves and stopping seed production.
- Some species of brush can be controlled with mowing or bark scraping.
- When renovating a pasture, consider using tillage to suppress weeds.

Animal Control

Sheep and goats can be used to control weeds.

- Sheep and goats like to graze **forbs** (broad-leaved plants found in fields, weeds, legumes, etc.). For sheep, in particular, how much they will graze weeds depends on the species of weed, the stocking density (how many other sheep are competing for the forage), their previous experience with the forage and access to alternative forages, which can be based on the layout of the field.
- Sheep or goats can be conditioned to graze weeds like leafy spurge and are effective in controlling it.
- Sheep and especially goats are very effective in controlling brush.
- You can use high stocking densities of dry ewes or dry does to eliminate patches of weeds.

- Sheep and goats are well suited to controlling weeds in sensitive areas or areas less accessible to equipment such as forestry cut blocks and under power lines. In riparian area where herbicides cannot be used sheep and goats, properly fenced, graze weeds without reducing water quality.
- You can't rely solely on sheep or goats to control weeds in pastures. They won't eat all the weeds. Forcing the animals to control weeds can mean the sheep's or goats' nutrient requirements aren't being met and production will suffer. Use dry ewes and does to control weeds when possible.

3-3. Sheep grazing Dalmatian toadflax

3-4. Goats grazing nettles

Herbicidal Control

Herbicides are used to control problem weeds that can't be controlled by cultural or mechanical methods.

- Properly identify your problem weeds before purchasing herbicides. Check the label to ensure the product controls the right weed.
- Select herbicides registered for use in pastures. Most herbicides kill legumes as well.
- Carefully check the product for grazing restrictions. It is important to know how long to wait between spraying and turning your sheep or goats into the treated pasture. Some herbicides cannot be used for food animals so are not safe to use on pastures.
- Spot spray weed patches.
- Use a weed wiper that only applies herbicide to target weeds taller than pasture plants.
- Weed infestations over the entire pasture will require spray control on the entire pasture.
- For information on herbicides, check out **Alberta Agriculture and Rural Development's Crop Protection Guide** (The Blue Book).

Integrated Control

More than one weed control method is usually needed to maintain productive pastures.

- Your weed plan should be an organized system that combines the cultural, mechanical, chemical and biological measures best suited to control your weed spectrum.
- To start, check out the current weed status of your pastures.
- Identify what weeds you have and where they are a problem.
- Create a three to five year plan to improve those weedy pastures.
- You can start with the basics of weed control, but also look at the fertility status of the soil to create healthy forage plants that will compete with those weeds.

Rejuvenation: How to Rejuvenate Your Current Pastures

Moving to a managed grazing system often brings to light years of pasture mismanagement. Sometimes the problems seem overwhelming. However, before you tear up your current pasture and start over from scratch, consider improving what you already have. Seeding new pastures is costly. **Rejuvenating** your existing pastures can be less expensive than breaking and reseeding new ones. Rejuvenation means improving the condition of your already established pastures. **Renovation** involves breaking your pasture up and starting from scratch. Rejuvenation can sometimes be carried out without having to remove, spray out or cultivate out the current pasture forages. That can save losing a year of forage production.

Rejuvenate *- restore your existing pasture to a healthy condition.*

Renovation *- redo pastures using tillage to break them up and then replant with new seed.*

Symptom *- visible sign something is wrong. For example, weeds moving into your pasture are a symptom of low forage production/ pasture health. Low forage production is the problem.*

Assess the Current State of Your Pastures

It is critically important to realize the difference between the **symptom** and the actual problem. You can be running a fever–that's a symptom. The problem could be a cold, the flu or something more serious. Weeds moving into your pasture are a symptom. The problem you face is low forage production. The low production can be due to poor grazing management, over-grazing, weed infestation, or low soil fertility–poor pasture health, in other words. The goal is to create healthier plants in healthier pastures that are better able to compete with weeds.

The problem of rejuvenating a poor-producing pasture requires an integrated approach that includes soil tests, addressing soil fertility

issues, identifying the forage species already present in the pasture, weed control, and definitely changing the grazing and cutting management of that pasture. Rejuvenation is only successful only if good seed and/or good forages are already in the field. If good species are not present in the field, then adding fertilizer is a waste of money. Using any of one these treatments in isolation makes the odds for producing a sustainable higher yield very slim. Adding fertilizer without changing grazing management will result in the same problem reoccurring. Treating only the symptom, increasing weeds, with weed control alone also means the problem will reoccur.

- Clearly identify what the problem with your pasture is.
- Consider the type of livestock you have and how many you have or want to have in your flock/herd.
- What are the grazing and nutritional needs of your livestock? Do you have only non-lactating mature sheep or goats on pasture? Do you have young animals on pasture?
- When do you need high quality forage to graze (e.g., flushing/breeding, lactation)? When will lower quality forage work for maintaining open animals?
- How can you use open animals to manage pastures and eliminate weeds?

Pasture Assessment

A pasture assessment should answer the following questions:

- What plant species are currently there (grasses, legumes, weeds)? What is their density and distribution in the pasture? How healthy are they?
- Which plant species do you want there?
- What is the current pasture yield?
- How severely have you been grazing the pasture? Is the grazing even?
- How much plant residue and litter is present? Is there evidence of soil movement or loss?
- How does this pasture fit into your entire operation?

For a more detailed pasture assessment, check out the Alberta Tame Pasture Scorecard, available from **Alberta Agriculture and Rural Development** (*www.agriculture.alberta.ca*).

Planning to Rejuvenate Pastures

There are many different ways you can rejuvenate your pasture. Careful planning is needed; all pasture rejuvenation methods involve investments of time, money, and equipment. When deciding which method to use to rejuvenate your pastures, consider the following:

> ***Note***
> *- don't forget that the success of rejuvenating or renovating pastures depends on the weather too!*

- How much money are you willing or able to spend?
- What is the cost of **not** rejuvenating the pasture?
- How much time and effort are you willing to put into planning? Will the change impact pasture available for your sheep or goats? Will the changes result in actual improvements in quality and quantity of grazing forage?
- How long can you stand having that pasture out of production? How will you feed your sheep or goats when the pasture is out of production for at least one year or more? And how will that feed affect your cash flow?
- How long can you wait to get good forage establishment? What is your 'plan b' if the forage establishment is poor due to weather conditions?
- Are you willing to use herbicides, tillage, etc.?
- What equipment will you need, do you have access to equipment, and can you rent equipment? Renting rarely used equipment, such as forage seeders, is a direct cost that affects cash flow and tax deductions.

Methods to Use to Rejuvenate Your Pastures

This section contains descriptions of different methods that can be used to rejuvenate your pastures. Be sure to consider all that is involved with each method and select the one that fits your operation the best. Not every option will suit every operation.

Managed Grazing

When pastures are **continuously** grazed (when you leave your sheep/goats in a single pasture for an extended period of time, and the plants in the pasture are not given a chance to rest), you end up with uneven use of the plants in the pastures. Continuous grazing doesn't only mean for the entire season, it means leaving animals in a pasture long enough so they can graze the forage regrowth. This can be as little as five to seven days if there is good water and soil fertility, although that period is usually longer in the relatively dry areas of Alberta where regrowth is slower.

- Your sheep or goats will selectively eat the plants they like the most, and keep going back to them over and over again. Plant regrowth is leafy and green, making it more appetizing than the ungrazed plants around it.
- This causes those favourite plants to be **over-grazed**, while less desirable plants and less palatable weeds are not grazed at all.

- The plants that are over-grazed are stressed as they do not get to rest and recover.
- They become weakened and eventually die out.
- Once this happens, those plants that your animals did not favour take over.
- Weeds also might work their way into your pasture, lowering overall production.

By adopting managed grazing, you control where, when and how much of your pasture your flock or herd grazes. By dividing your pasture into smaller paddocks, you can force your flock or herd to evenly graze the area. Now they have to eat the plants they like and the plants that aren't their first choice.
As you move your flock or herd through the smaller paddocks, you give the ones that were grazed a chance to rest. This rest allows them to regrow and build up their carbohydrate stores in their roots to withstand another grazing.

Fertilizer

You can use fertilizer to rejuvenate your pastures when **nutrient deficiencies** (when there is not enough of a nutrient in the soil to support plant growth) have been found.

- Sometimes, pastures with low production are thought to be sod-bound (when growth is slowed down or stopped due to a crowding of the soil by plants and roots) even when there are nutrients available in the soil. This can happens with the creeping rooted grasses like smooth brome grass, Kentucky bluegrass and creeping red fescue.
- Applying fertilizer can stimulate new leaf, root and rhizome growth
- Applying nitrogen to sod-bound fields can tie up the nitrogen in the breakdown of the dead plant material. Applying nitrogen and sulphur onto these pastures may not show any response for a year or more.

Perennial forages will respond to fertilizer applications when the levels of nutrients in the soil are low.

- This response will depend on the species of grasses and legumes in the pasture, soil moisture, nutrient levels and which nutrient is applied.
- A lack of nitrogen tends to limit grass production the most. Under good moisture conditions, you will see a large response in your grass pastures when nitrogen is applied to areas where it is deficient.
- If phosphorus and/or potassium are greatly deficient, applying extra N without additional nutrients will produce a disappointing yield. Take a soil test first.

It is always important to soil test first, before applying any fertilizer. This way you know what nutrients are deficient in your soil and what you should apply.

The nutrients to pay the most attention to are nitrogen, phosphorus, potassium and sulphur. Are the soil test results for nitrogen and sulphur accurate for your soils? Do they provide reliable information to guide farmer decisions about fertilizer application?

Herbicides

Before using herbicides, you should carefully assess the conditions of your pastures. Very often, weed infestations are a symptom of poor grazing management. You will have to address that problem as well as the weeds.

You can use herbicides to selectively control certain weeds that are an issue. Some of these herbicides will also remove the legumes from your pastures, so be sure to read the label before applying.

Winter Feeding on Pastures

Feeding during the winter on perennial pastures is another way to rejuvenate older and unproductive stands if it is done properly. Proper feeding on pasture means it is critical to distribute your animals evenly across the entire pasture.

- The nutrients from the feed not used by your flock are excreted, returned to the soil and are then available in the spring and during the growing season for the plant use.
- Every feeding should be in a different spot in the pasture. This spreads nutrients and forage residue over the entire pasture.

Seeding Legumes or Grasses into Under-Producing Pastures

Seeding into an existing stand of forage is a method that can be used to renovate pastures. It is a higher risk seeding option than seeding into a well-prepared seed-bed. Seeding success is also improved by using quality, certified seed.

Alsike clover, white clover, red clover, alfalfa, and orchardgrass have been the most commonly used species established by over-seeding. Timothy is generally not a good species for intensive grazing as it does not persist in many situations.

When you are looking at seeding legumes into established pastures, understand that there are different methods used in different areas. Talk to local producers, forage associations and seed companies to find out what might work best in your area.

Tip

- successful seeding into an existing forage stand depends on what you do and on the weather!

Sod-Seeding / Direct Seeding

- Use a no-till drill designed for sod seeding to penetrate through the existing layer of sod so the seeds are in contact with the soil.
- Competition from the existing grasses in your pasture makes it difficult for new seedlings to get started. Before sod-seeding heavy grazing, mowing or the application of herbicide to 'burn off' existing forages may help.
- Of the three options listed here, this tends to be the most successful way to introducing new forages into existing pasture.

Over-seeding

- Involves broadcasting seed on top of the pasture and using hoof action, chain link harrows, a shallow cultivation or aeration to work the seed into the soil.
- Competition from the existing stand should be reduced by a heavy grazing, mowing or herbicide application prior to broadcasting.
- This method is only successful where there is consistent moisture to enable seed germination and establishment.
- It can take two or more years to see the effect of over-seeding/broadcasting legumes on an established pasture.

Frost Seeding

- Involves broadcasting seed onto the pasture in the early winter or early spring after the snow has melted. The theory is that natural frost-heaving action of the thawing/freezing soil works the seed into the ground. Unfortunately, in Alberta that process also tends to damage germinating seeds or seedlings as they begin to grow.
- This method has met with very limited success, and results in uneven stands as not all of the seeds will be buried. Seed cost, time and effort need to be carefully considered as this method is very high risk.
- This method may work with legume seeds on open ground. It is nearly impossible to accomplish with grass seed.
- Competition from the existing plants also needs to be addressed if you are considering this method.

Renovation: Establishing Successful Pastures

If you have decided to take your current pasture out of production and start from scratch (renovation), or if you are looking to establish a new pasture, there are a few things you need to consider. Establishing a successful pasture starts with planning at least a year or two before seeding.

Planning Before You Start to Seed

If you have decided to take your current pasture out of production and start from scratch (renovation), or if you are looking to establish a new pasture, there are a few things you need to consider. Establishing a successful pasture starts with planning at least a year or two before seeding.

- Grass and legume species selection
- Pre-seeding perennial weed control and herbicide residue
- Cropping history and type of crop stubble
- Seedbed preparation
- Soil fertility
- Seeding date, rate and depth
- Companion (cover) crop
- Seeding technique
- What are the physical characteristics of the pasture: aspect, slope, drainage, soil type, etc.?
- How does this field fit into your operation?
- What exactly do you want to use this pasture for? When do you want it to produce forage?

The species of forage you select for pasture should be based on considerations such as what grows well in your area and how much it will cost to establish your pasture, rather than on the livestock species that is going to graze it. Good grazing can be done with any livestock species. Some forage grasses and legumes are better than others in pastures. Select species to seed that are known to have good regrowth in your area. Sheep and goats are able to graze much closer to the ground than cattle and can do more damage to the **growing points** if the grazing management is not good (e.g., animals remain too long in the pasture).

Growing Point *– the point on a stem where new growth starts.*

Growing Points and Grazing

Grasses are adapted to being grazed. They have many growing points located at the base of the plant near the ground, and they can grow new tillers from ground level to compensate for having been grazed.

Many species have growing points close to the ground, below the height at which animals graze. When a sheep or goat bites off the leafy end of the shoot, the growing point is left behind. The leaves are able to continue growth from the growing points. In the spring, most grasses have low growing points and handle grazing well.

As the plant matures and the stem starts to elongate to form a seed head, the growing point in certain grass species moves up off the ground. It can now be bitten off, slowing regrowth.

Grasses are split into two groups (3-5):

- Short-shoot: have many growing points below bite height
  - Re-grow quickly after being grazed
  - Better for pasture
  - Meadow brome grass, perennial and Italian ryegrass, orchardgrass, Kentucky bluegrass, creeping red fescue, tall fescue
- Long shoot: have fewer growing points below bite height
  - Take longer to recover after grazing. These species need longer periods of rest between grazings.
  - Better for hay
  - Timothy, smooth brome grass, crested wheatgrass, tall wheatgrass, reed canarygrass

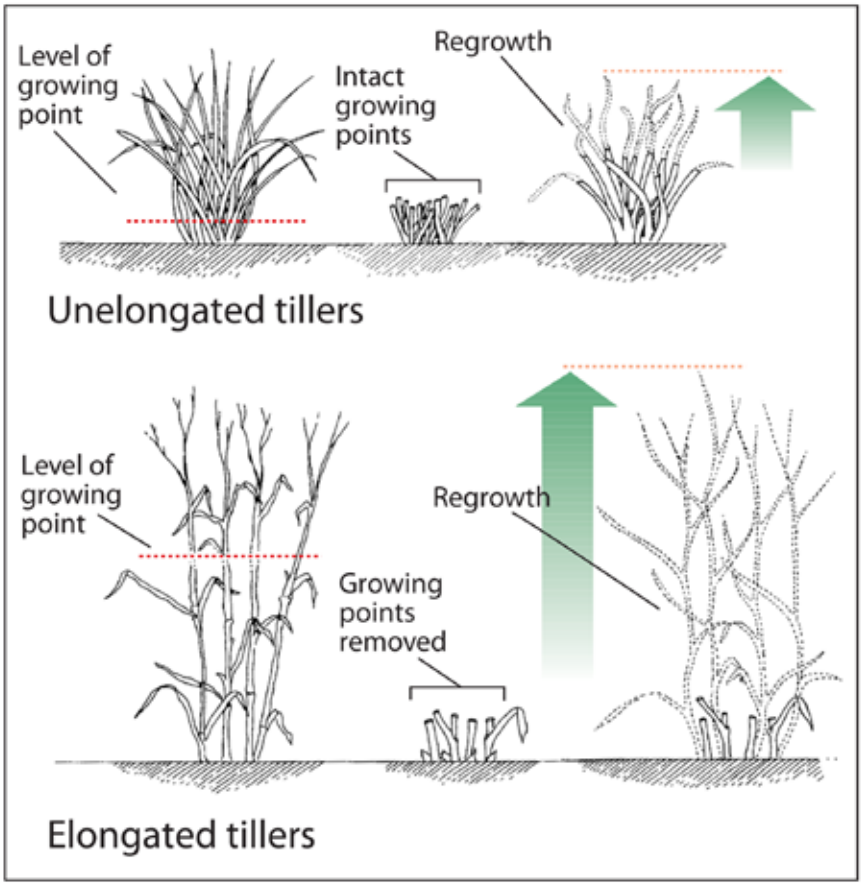


Fig. 3-5. Growing points of grasses and regrowth

If part of your managed grazing plan is to stockpile some or all of the pasture for use in the late fall or winter you will want to choose species that hold quality better in the non-growing season.

Forage species commonly seeded for sheep and goat pastures in Alberta include:

- Grasses: meadow brome grass, hybrid brome grass, Kentucky bluegrass, orchard grass, creeping red fescue, meadow fescue, tall fescue
- Legumes: alfalfa, birdsfoot trefoil, white clover, alsike clover, cicer milkvetch, sainfoin

The grasses and legumes you choose need to be able to handle the soil and climatic conditions in your area. Species also differ in their tolerance of acidic soils, waterlogged soils and salinity. Winter hardiness and longevity also vary among species. Talk to seed companies about what works in your area.

Because grasses and legumes are different, mixtures of different species tend to handle variable conditions better than a pasture with only one plant species. A pasture with mixed grasses and legumes has more uniform forage production during the growing season. Managing a mixed species pasture in more challenging than a single species pasture with a uniform growth period. Managed grazing using rotationally grazed smaller paddocks will help reduce damage to plant species that aren't mature enough to be grazed.

Weed Control before Seeding

Perennial weeds can be extremely competitive with newly established seedlings. Controlling weeds before seeding will increase long term pasture production and quality.

Perennial weeds that need to be controlled include Canada thistle, foxtail barley, toadflax and dandelions. Annual weeds should also be controlled prior to seeding.

For information on grazing restrictions in new pastures, refer to the manufacturer's label and Alberta Agriculture's Crop Protection book.

Seed Quality

Purchasing **certified seed** helps ensure forage **variety, purity** and high **germination** rates of forage seed. Certified seed also has low allowable limits for impurities, reducing or eliminating weed seeds. Certified seed comes with a seed certificate. You can request the certificate before purchase. It will clearly state the variety, purity and germination rate.

Certified Seed – *seed that has been inspected and certified by the Canadian Food Inspection Agency. It meets a strict set of production requirements.*

Variety – *each plant species will have many varieties that are available, each with different characteristics.*

Time of Seeding

The best time to seed forages is always when soil moisture conditions are good.

Good moisture conditions generally occur in the spring. Seeding in the early spring offers the best chance to get pastures established,

and it may also provide some light grazing that fall. Pasture seeding is usually done between May 1 and June 15, depending on location in the province and on local conditions. Soil temperatures need to be between 10°C and 20°C for good germination.

Forages seeded in the late summer require adequate moisture for germination and growth. Grasses and legumes need at least six to eight weeks of growing time before it freezes in the fall. This growing time ensures enough shoot and root growth has occurred for the plants to survive the winter. Seeding in the summer is riskier than seeding in spring.

Dormant season seeding, seeding just before the soil freezes, can also work to establish pasture. However, the soil temperature must stay below 2°C to prevent the seed from germinating. This way is most successful when direct seeding into stubble. Variations in moisture and temperature in the fall and winter make this a riskier choice.

Purity *– refers to sample quality; mainly what weed seeds, other crop seeds and other materials are present.*

Germination *– the rating on a seed test certificate of how well and how many seeds will grow from a specified lot of seed.*

The best results In Alberta come from seeding pastures in the spring.

Fertility

Take a soil test from your fields before seeding to find out soil pH, and to determine what nutrients will be insufficient for good pasture growth and will need to be applied before or during seeding. Fertility is extremely important to forage seedlings. Legumes have higher requirements for phosphorous, potassium and sulphur, while grasses need more nitrogen. By banding or broadcasting large amounts of phosphorous, potassium and sulphur into the soil before seeding, you create a banked supply that the new pasture can use for a few of the coming years. Additional nitrogen may need to be applied in the first year. You can also request that the soil testing lab look at the micronutrients, such as copper and boron, if you think your soil might be lacking them.

For more information on soil testing and soil nutrients, you can check out the International Plant Nutrition Institute (*www.ipni.net*).

When seeding legumes, make sure they have been inoculated with the correct strain of rhizobia. This will ensure good nodule formation and nitrogen fixation.

Seedbed and Seeding Systems

Most forage seed is incredibly small. As a result forage seeds need a **firm seedbed** that allows for shallow and uniform seeding depth. A firm seedbed also ensures good seed to soil contact, which is vital to germination and seedling emergence. When the seeded has been properly packed, the tractor tire marks should be visible. Soil should be firm enough that the soil doesn't come over the top of your shoes.

Forages can be seeded into annual crop stubble. This helps conserve soil moisture and the stubble provides wind and sun shelter for the new seedlings. When direct seeding into stubble, make sure the straw and chaff left over after the harvest has been chopped and evenly spread. Too much harvest residue from the previous year will interfere with the placement of the forage seed.

Once the seedbed has been prepped, seeding can begin. There are seed drills specifically made for seeding forages that are available through Alberta machinery rental companies. Forage seed can also be broadcast onto the prepared seedbed. Be sure to get even distribution and after broadcasting the seed on the soil surface, roll or harrow-pack the field to improve the seed to soil contact. Good seed to soil contact allows the forage seed to absorb moisture from the soil and ensures germination.

Firm Seedbed *– when you walk over the soil, your footprint should not be more than ¼ inch deep in the soil. If you are wearing a boot or shoe with a heel, the sole and heel of the shoe should make contact with the soil and the instep should not.*

Seeding Rates

The size of forage seed varies widely between species. Seed size affects the number of seeds per kilogram. The smaller the seed the higher the seed count, or number of seeds per kilogram (or pound).

Creeping red fescue has very small seeds. There are approximately 826,000 seeds per kilogram (375,000 seeds per pound). Meadow brome grass has larger seeds with only 182,000 seeds per kilogram (83,000 seeds per pound)

When calculating seeding rate, be sure to take into account the following:

- Seeds per kilogram
- Purity
- Germination percentage
- Species ratio in the mixture
- Ability of equipment to seed a mix (large and small seeds together)

A forage seeding rate calculator is available from Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*). It can be found in the "Decision Making Tools" section. If you would like to work through the calculations on your own, you can check out the Perennial Forage Establishment publication, also available on Alberta Agriculture and Rural Development's website.

Seeding Depth

How deep you seed your forage grasses and legumes will depend on their seed size, soil texture and moisture conditions. Placing the seed too deeply results in poor emergence. The small size of most forage seed means they will not have enough energy to emerge from deep seeding. The seed should be no more than 1 to 2 cm (1/3 to 3/4 inch) deep.

Companion Crops

Companion, or cover, crops are annual crops that are seeded with perennial forages. The companion crop can provide an economic return from the field in the year of forage establishment, **but companion crops will compete with the forage seedlings for light, nutrients and moisture**. They also increase the risk of poor forage establishment and reduce forage yield in the following years.

When using a companion annual crop, be sure to reduce the seeding rate of that annual crop by at least 50%. Select a less competitive crop, such as triticale, early maturing barley or oats, wheat or canola. Seed the annual crop early and remove it early. Harvesting at the dough stage provides good quality silage or greenfeed.

Greenfeed swathes need to lie on the field to dry and cure. If baling is delayed the forage seedlings under the swaths can be damaged.

Removing a companion crop lessens the competition forage seedlings have to deal with, particularly when moisture is limited.

Practical Ideas

- Test your soils–for every paddock. Without these numbers, you are flying blind.
- Learn how to use the numbers in a soil test. Treat them like ball scores–they are statistics that give you insight about the teams.
- The forage in a pasture exists there because it survived under that pasture's management. Hands-off continuous grazing is a type of management. Renovation is an expensive strategy. But if you try to renovate a paddock without changing your management, the forage will revert back to its original composition and yield in a few years.
- Some forages work well under intensive grazing systems; some don't. Learn which is which before you plant them.
- Don't discount annuals. They have a place. They can be excellent tools to help you use pastures strategically to fill your feed calendar.
- If you have any doubts, test your seeds before planting them in a paddock. Place twenty seeds on a wet paper towel in a warm room and see how many germinate. If none germinate, you may have a problem.
- Treat pastures like lawns. Your goal is to cover the ground with solar panels (green leaves) in a lush, dense stand. Open ground between plants is space not used to capture sunlight and make feed.

4. Sheep and Goat Nutritional Needs

Key Concepts

- **What You Need to Know about Ruminants and Their Nutrient Needs**

Nutrition has a major influence on sheep and goat production. It affects reproduction, growth, health and all production of meat, milk and fibre. Feed is also the single highest cost in sheep and goat production. The first step in managing feed costs is to feed every sheep or goat so that its nutrient requirements are met for the stage of production it is in.

Using pasture as a part of a managed feeding program can meet animal needs and help manage feed costs. In general, sheep and goats will consume between two to six percent of their bodyweight in **dry matter** per day. When on pasture, they can meet this need if there is available forage. Sheep and goats both graze on pasture grasses and legumes. They also readily browse on leafy shrubs, bushes and available trees. Bison and cattle, as true grazers, prefer grasses.

To properly manage grazing it's important to have an understanding on how sheep and goats digest feed, what nutrients they need at different ages or stages of production, and how their nutritional needs change over the grazing season.

What You Need to Know About Ruminants

Sheep and goats are **ruminants**. This means they have evolved to efficiently use plant material to meet their nutritional needs. Due to their efficient **digestive system**, sheep and goats can typically get most of the nutrients they need for growth and production solely from good-quality pastures.

To digest plant materials, ruminants have large, complex digestive systems. This system efficiently converts fibrous parts of plants that humans can't digest.

For a complete description of the anatomy and digestive processes in sheep and goats, please refer to *Sheep and Goat Management in Alberta: Nutrition*, available from **Alberta Lamb Producers** (*www.ablamb.ca*).

Dry Matter (DM) *– plant material that has been dried and contains no moisture.*

Ruminant *– a mammal that has a stomach divided into four compartments and chews cud.*

Digestive System *– a system that breaks down food into parts that can be absorbed and used by the body to provide energy and nutrients for life.*

Fermentation *– the chemical breakdown of feed by micro-organisms.*

What Nutrients Do Sheep or Goats Need?

A **nutrient** is a consumed substance necessary for life and daily activities. Sheep and goats use nutrients for body maintenance, growth, reproduction, milk, meat, and fibre production. The amount of nutrients an animal needs depends on a number of factors:

- Weight
- Age
- Stage of production
- Level of production
- Activity level
- Environment
- Breed (to some extent)

Essential nutrients:

- Energy
- Protein
- Minerals
- Vitamins
- Water

A minimum level of each nutrient is required for the basic maintenance requirements of the animal's body, to keep it warm and maintain body weight. Growth, pregnancy, lactation, meat and fibre production have nutrient requirements above what the animal needs for body maintenance. Production can be seriously limited by a shortage of one of more nutrients.

Energy is the nutrient required in the highest amount by sheep and goats. It is also most likely to be deficient or in excess in a ration. The energy content of feed is described by the **total digestible nutrients** (TDN) on a feed test. The average TDN content of forage ranges from 50 to 65%.

Nutrient *– a substance necessary for animal life: growth, reproduction, production and daily activities.*

Total Digestible Nutrients *– the energy value of feed.*

Protein *– complex compounds containing carbon, hydrogen and oxygen. They are essential for growth, lactation and reproduction.*

Macro-minerals *– minerals required in large amounts. Examples are calcium and phosphorous.*

Micro-minerals *– minerals required in small amounts. Examples are iodine and cobalt.*

Protein quantity is more important than protein quality for sheep and goats than for non-ruminants. Ruminants get nitrogen or other low-quality protein from their feed and are able convert it into a more usable form.

Minerals, such as calcium, phosphorous, magnesium, sodium, potassium, sulphur and chlorine, are required in large amounts, usually expressed as a percentage of the diet. They are called **macro-minerals**.

Other minerals, called **micro-minerals (also called trace minerals**), are needed in smaller amounts. These are usually expressed as parts per million (ppm) of the diet. Trace minerals, such as iodine, selenium and copper, are vital to sheep and goat health. Some minerals will be sup-

plied in sufficient amounts by the forage in your pastures. Others are in short supply. Always provide salt and the correct mineral mixture when sheep and goats are grazing.

Certain vitamins, such as vitamins A, D and E, are critically important to production. Most commercially available mineral supplements formulated specifically for sheep and goats provide the vitamin and minerals required your grazing flock/herd.

How Your Sheep and Goats' Nutritional Needs Change

The annual cycle of female sheep (ewes) or goats (does) is broken down into the following production stages: maintenance, flushing, early pregnancy, late pregnancy, early lactation, mid lactation and late lactation. Each production stage has different requirements for energy, protein, minerals and vitamins. The basis for sheep or goats producing well on pasture is to make sure the nutrient requirements for each stage of production are met by the forage production of the pasture.

The protein and energy requirements of ewes or does (or any class of livestock) in the maintenance stage are low. As the ewe or doe progresses from early to late pregnancy, those needs increase quite significantly. Some of the different nutrient requirements of a 175 lb. ewe can be found in the table below (Table 4.1).

Table 4.1 How Nutritional Needs of Ewes Change

Stage	Energy (lb. TDN)	Crude Protein (lb.)	Calcium (lb.)	Phosphorous (lb.)
Maintenance	1.60	0.27	0.0060	0.0062
Late Gestation (carrying twins)	2.90	0.49	0.0183	0.0112
Early Lactation (raising twins)	4.30	0.96	0.0247	0.0190

Adapted from: Kleinschmidt, J. 2009. Sheep and Goat Management in Alberta: Nutrition.

Nutrient requirements for growing lambs are higher than those for mature sheep. Higher levels of nutrients are needed to support this growth and meet their daily maintenance needs. The weight of the lamb and the speed of its growth determine what and how much nutrients it needs.

The key point is that a shortage of one or more nutrients will limit lamb growth. It is critical that flock managers are aware of the changing nutritional needs of sheep and goats on pasture.

Grouping Your Livestock

Practical experience and guidance in using animal groups may be necessary to protect forage regrowth; otherwise using subgroups and sequential grazing will result in overgrazing. Later groups will consume regrowth unless removed in a timely way or kept out of the pastures.

To make managing sheep and goats on pasture less complicated:

- Plan how to group animals together based on their nutritional requirements.
- Tailor plans to meet the nutrient requirements of the group or groups.

- One management strategy is to give the sheep or goats with the highest nutritional requirements (e.g., lactating females or growing young animals) first access to pastures with the highest quality forage. (Table 4.2)

Table 4.2 Possible Grazing Groups Based on Sheep and Goat Nutritional Needs

Very High Performance	High Performance	Moderate Performance	Maintenance
Milking ewes (dairy)	Ewes with lambs Weaned lambs	Pregnant ewes	Dry ewes
Milking does (dairy)	Pregnant does Weaned kids	Does with kids	Dry does

Source: Lane, W. 2012.

Your ability to divide a flock or herd into more manageable groups depends on their needs, the number of paddocks you have and on the growing season. When you design a managed grazing system with different grazing groups, possible options are:

- Graze the groups in sequence based on forage production and nutritional needs.
  - The group with the highest nutritional needs grazes first, giving those animals access to the highest quality forage.
  - The group of animals with the next lower nutritional needs grazes the paddock next, and those animals with the lowest requirements, basic maintenance requirements, move through the paddock last.
  - Cattle can also be used to 'clean up' paddocks if there are no sheep or goats with low nutrient requirements.
  - Know when to remove animals from the paddock to prevent overgrazing.
- Graze different groups in with different nutrient requirements in different paddocks.
- In theory, 'forward grazing' is a technique in which a creep gate is placed between the paddock currently being grazed and the next paddock to be grazed, but not many producers use this technique. A creep gate keeps out adults and allows lambs to move through it to un-grazed forage where they can select the highest quality plants. Young lambs rarely leave their mothers and it can be a perfect training for older lambs that the grass is greener on the other side of the fence.
- Placement of creep gates or creep pens in the paddock being grazed can be used for supplementary feed. Generally where paddocks are well-managed the forage quality is maintained to support good lamb growth.

Multiple groups of sheep and goats are ideal tools for managing the forage. They can be used strategically to slow down forage growth in some pastures, clean up weeds, or graze the top off forage in pastures.

Groups of animals, combined with proper use of temporary electric fencing and high stocking densities, can allow flexible and efficient management of multiple types of pastures on a farm.

Water for Your Grazing Flock or Herd

Planning a good supply of clean water is essential when you are developing your managed grazing system. If the water supply is limited, feed intake will be reduced and animal performance will decrease faster than if any other nutrient was deficient.

Roughly 60 to 70% of an animal's live weight is water, making water consumption greater than forage intake. Sheep and goats typically consume between eight and twelve litres of water a day. This varies depending on their stage of production, their body size, the amount of moisture in the forage they are grazing and the weather. When it is hot and sunny sheep and goats need more water.

Water quality is also important. Sheep and goats will drink poor quality water if they are thirsty enough. Reduced water consumption also reduces how much feed sheep and goats eat, negatively impacting overall health, development and production. For ruminants like sheep and goats, clean drinking water means free of manure, dirt or mud and algae growth. For anyone with concerns on the quality of drinking water, take a sample and have it analyzed.

Water **palatability** is also important. If your sheep and goats do not like the taste of the water you provide to them, they will not drink it or enough of it. Fecal contamination of waterers is very common and can lead to reduced palatability, decreased water consumption and the transmission of disease and parasites (e.g., coccidiosis). Clean all waterers regularly.

Palatable *– acceptable in taste/agreeable enough in flavour to be consumed.*

While sheep and goats can get most of their water from grazing the lush forage in pastures, an external water supply is essential to cover for decreasing water content in feeds, water requirements for lactation and growing lambs and for hot weather. Laneways can be used to access a central watering site in a pasture or a corral. Good pasture management ensures that water is readily available for grazing animals. Animals do best when water is available in each paddock. Reducing the distance your livestock have to travel for water increases water intake, particularly for older, slower or young animals, and also reduces trampled forage and soil compaction around the waterer.

There are many different types of water systems you can use (4-1). Plan the water source, the delivery system and the waterer that the animals drink out of. Some producers opt to drill wells as water sources, and set up electrical or solar powered pumps to move the water. Others use existing farm wells and pressure systems with above-ground plastic pipe/tubing to deliver water to the waterer in each paddock. A water tank on a trailer is also used to haul water to grazing animals.

4-1. Goats at waterer

Sheep and goats are less able to access water from dugouts with muddy access than are cattle. Gravelled and fenced access areas

increase use of dugouts and water intake. Drinking directly from dugouts is not advised for any livestock as water quality is reduced by manure contamination and algae growth.

Small waterers, troughs, bowls or tanks are easier to keep clean. Larger numbers of sheep or goats need larger waterers so all animals drink before the flock or herd returns to graze (4-2 to 4-4). Water consumption in the winter is increased if kept the waterer is heated and ice-free. Sheep that are not in late pregnancy, lactating or growing young animals can utilize snow on stockpiled out-of-season grazing. Close monitoring of feed intake, body condition and environmental conditions (temperature and snow crust) is required.

4-2. Lambs at waterer

4-3 and 4-4. Sheep at a mobile water source used in rotational grazing.

Pasture Water System

Your managed grazing plan should include a well-designed water system in your pasture that is able to supply water to each paddock.

Water Sources (where the water for your livestock comes from)

- Drilled wells
- Dugouts
- Rivers, creeks and sloughs
- Hauled water

Water Delivery (Figures 4.5 and 4.6)

- How the water gets from the source to your livestock waterers
  - Pasture pipeline system
  - Solar pump, trough/tank system
  - Water tank for hauling
- Water holding container that sheep or goats drink out of
  - Troughs, tanks, bowls, buckets
  - Manual or float self-watering (float and valve system)

For more information on pasture water system designs, check out the **Remote Pasture Water Systems for Livestock** factsheet from Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*).

4-5. Pasture water system

4-6. Water tank for hauling

Meeting Sheep and Goat Nutritional Needs with Your Pastures

The nutrient value of the forages in your pastures is affected by many factors, including:

- Maturity
  - As plants mature, the amount of fibre increases.
  - The more fibre the lower the forage quality.
- Time of Year
  - Second-cuttings or aftermath cuttings are often higher quality than first cutting.
- Growing conditions
  - Plants growing under drought conditions can have lower fibre levels that those growing with adequate water.
- Species (grass or legume)
  - Plant species vary widely when it comes to forage quality.
  - Plant maturity has the most impact on nutritional quality.
  - Legumes (alfalfa and clover) tend to be higher in protein and digestible energy than grasses.
- Soil nutrient levels
  - Some forage mineral levels will reflect the mineral levels of the soil.

There are published 'book values' for quality for different forage species. Book values cannot represent what is going on in pasture; they are used as only as guidelines on nutrient value of different forages at different stages of maturity.

Forage quality declines as the plants mature from the vegetative to reproductive stages. The highest forage quality is found in immature, leafy legumes and grasses. How the average feeding value of grasses and legumes changes during the growing season is illustrated in Table 4.3 below.

Table 4.3 Feed Value of Forages

	Grass Crude Protein (%)	Legume Crude Protein (%)
Vegetative	13.4	21.5
Boot or Bloom	10.0	17.0
Bloom	6.7	16.2
Mature	5.8	15.6

Adapted from: OMAFRA. 2009. Forage Harvest and Storage.

Forage Sampling and Testing

Test your forage to find out exactly what the quality of your forage is. This lets you see if it meets the needs of your flock. To get a forage test done, all you need to do is collect a series of representative samples from your pasture, mix them, chose a composite sample to submit, and package it. Then, you can contact one of the feed testing labs in the province and send the sample in for analysis.

Sampling Pasture Forage

The feed quality of the plants in your pasture and paddocks can change over the growing season. You should test the quality of the material in your paddocks if you have not done so before or are going to be stockpiling or swath grazing.

- Walk through the field and collect 30 to 50 small grab samples. Take the sample by reaching down and cutting a small handful of the plants there. Make sure the samples come from random locations from the entire field. Avoid unusual places like manure piles, fencelines, shade trees, etc.
- Take the sample from the height at which your sheep or goats will be grazing. Make believe that you are a sheep or goat and sample the forage as they would graze.
- Once you have collected all the samples you need, mix them together and place in a bag. Label the bag with the date the samples were taken and the field they are from.
  - Use a paper bag to store the sample. This will let the sample air dry and keep it from spoiling.
- Send the sample in to a lab for a forage quality analysis. A list of labs in the province can be found on the Alberta Agriculture and Rural Development website (*www.agriculture.alberta.ca*). Follow packaging and shipping directions carefully.
- Check out the **Forage and Grain Feed Testing** clip on Alberta Agriculture and Rural Development's YouTube channel for more on testing forage for quality.

Most feed tests will look at moisture, dry matter, crude protein, acid detergent fibre, neutral detergent fibre, total digestible nutrients, relative feed value and the concentration of any macro-minerals and micro-minerals requested. It is important to always use the "dry matter" values when examining the quality of your forage material.

What Feed Analysis Terms Mean

For more information, refer also to the **Alberta Sheep and Goat Management in Alberta: Nutrition Module** located on *www.ablamb.ca*.

In general, your forage should be analyzed for:

- Dry Matter (% DM)
  - The percentage of forage that is not water.
  - % DM is used to make rations as how much an animal eats is based on the DM content on the forage.
  - When reading your forage analysis results, always look at the DM values.
- Crude Protein (% CP)
  - The amount of nitrogen in the forage numerically converted to a protein value
- Acid Detergent Fibre (% ADF)
  - ADF is the fibrous, least digestible portion of the forage.
  - Forage high in ADF is less digestible and lower in energy.
  - ADF values higher than 40% mean the forage is poor quality.
- Neutral Detergent Fibre (% NDF)
  - Is a measure of the fibre found in the cell walls and gives a closer estimate on how much total fibre is present in the feed.
  - High NDF levels limit how much forage an animal can eat.
  - NDF levels higher than 60% mean intake will be reduced.
- Total Digestible Nutrients (% TDN)
  - How the energy found in the forage is reported.
  - Is based on calculations using the amount of fibre found in the forage material.
- Macro-minerals
  - Calcium (Ca)
  - Phosphorus (P)
  - Potassium (K)
  - Sulphur (S)
  - Magnesium (Mg)
- Micro-minerals
  - Copper
  - Molybdenum
  - Iron
  - Others

When trying to match the nutritional needs of sheep and goats with forage, you should:

1. Inventory what forage resources you have.
   - Make a list of all the paddocks you will be grazing.
   - List the type of forage (grass, legume, annual cereal) found in each paddock you will graze.
2. Learn to assess forage quality.
   - Sampling forage in pastures that are actively growing is costly and generally not useful in establishing a grazing rotation. Forage quality changes with time and plant maturity.
   - Sample forages to learn more about the types of forages you have in your pastures or particular paddocks and to establish the range of quality you have to work with.
   - When sampling forages follow the steps outlined in the "Sampling Pastures for Forage Quality" tool to collect samples.
3. Match up the forage quality of each paddock with the needs of your flock.
   - Identify which paddocks have the highest quality feed. Valid comparisons of grazable fields can be made with experience.
   - If forages are kept in vegetative growth–which is one major goal of managed grazing–then nutritional quality is not an important criterion for deciding where to move livestock.
   - Put the animals from your flock with the highest nutritional needs in the paddocks with the highest quality forage.

Practical Ideas

- Vegetative growth is high-quality feed. It generally contains more than enough energy and protein for highly productive sheep and goats, but you still may have to supply minerals.
- If you have questions about the quality of a forage, take a grab sample (composite of 15-20 cuttings) and send it to a laboratory. Nutritional quality changes over time and with plant maturity.
- The new SheepBytes ration balancer software (*sheepbytes.ca*) can be used along with forage feed test results as a guideline to determine if pasture is meeting animal requirements. Data from sampling and testing of pasture forages, unlike that from dry forage hays or silages, is limited. Using your own test results will provide some guidance and a starting point in monitoring forage quality. Work with a nutritionist when you have questions about flock nutrition.

5. Sheep and Goat Grazing Behaviour

Key Concepts

- **How Sheep and Goats Graze**
- **Sheep and Goat Grazing Behaviour**

Why You Should Know How Animals Graze

Do you have any idea why your sheep or goats behave the way they do and what that behaviour might mean for the management of your flock or herd? Why do sheep or goats moved from pasture to confinement, or lambs moved from feeding pens to pasture, often do so poorly? Why do some animals eat toxic plants and others don't? And why does changing grazing management have an effect on animal performance?

Understanding the preferences of your animals, their grazing behaviour and the impact of grazing on the plants in your pastures helps when you are planning and developing a grazing system. Tightly-managed grazing with high stocking densities minimizes variations in grazing behaviour and issues of forage palatability or voluntary intake disappear.

The amount of forage your sheep or goats can consume while grazing is critical in meeting their nutritional needs. If they are not consuming enough, or if the material they are consuming is not meeting their needs, their health, growth and development will suffer. This means lower production.

What affects the amount of forage sheep and goats consume?

- The palatability of the forage
  - Affects choice when there are choices available.
  - Doesn't necessarily affect intake over a 24 hour period where intake may be the same for forages of different palatability.
  - Is about taste and the interaction between flavour and the effect of the food on the animal after it has eaten it. Flavour is a combination of odour, taste and texture; positive feedback after feed has been eaten increases palatability.
  - Sheep or goats learn to avoid certain forages based on experience and by watching their mothers.
- How the individual animals graze has an impact on grazing ability. While we manage for the average in the flock or herd, individual differences in response allow selection for the sheep or goats that adapt well to grazing management. Individual sheep or goats also have physical differences (feet, legs, teeth) that make them better or poorer grazers.
- In flock and herd species the impact of the social group is important for grazing management. The young lamb or kid learns feeding behaviour from its mother and peer group that has a lifelong influence on grazing and forage selection skills.
- Forage quantity, density and availability

- The more forage that is present, the thicker the stand of plants, the more feed is available for your animals. Managed grazing uses animals as tools for forage management.
- Research in the UK has found that sheep grazing in the morning will graze on clover then switch to grass in the afternoon. Hungry sheep initially choose clover because it is highly digestible. A combination of being full and the ability to choose different forages leads the sheep to switch to grass.

- The energy and fibre content of the forage
  - More fibre means less digestible energy; sheep or goats have to eat more forage to meet their energy needs.
  - High levels of fibre in forage can limit how much sheep or goats can physically eat.
- Environmental conditions
  - High temperatures limit the time sheep or goats want to spend out in the sun grazing.
  - Hot, very cold or windy conditions can also change what time of day sheep or goats will graze.
- The growth stage of the animal
  - Younger, growing lambs need higher quality forage than mature, dry ewes.
  - Young animals inexperienced at grazing take time to adjust.
- Presence of guardian dogs
  - An Idaho State University study (Webber, 2012) found that sheep will roam and graze more freely in the presence of a guardian dog (5-1).
  - The presence or threat of predators makes a significant impact on the length of time sheep or goats spend grazing. Increased grazing time and, likely, reducing stress improves animal health and weight gain.

5-1. Sheep grazing with guard dogs

Grazing Habits

Livestock generally do not like to graze during the hottest part of the day. The heaviest grazing period tends to be right after sunrise for two to three hours. A second grazing period will occur when the temperature starts to drop in the early evening. Occasionally a third grazing period can occur around midnight, depending on forage availability, environmental conditions and animals' needs. About 60% of grazing happens during the day, with the remaining 40% going on at night. If the day has been quite hot, then this ratio changes, with grazing mostly occurring at night.

It is important to realize that the quality of forage in your paddocks affects how long your sheep or goats spend grazing each day. When quality is poor, they have to spend more time grazing to get enough nutrients to meet their needs. If both quality and quantity are poor, they spend more time walking around searching for forage than grazing. Making sure pastures are healthy and productive is essential in supplying your flock or herd with enough high quality forage.

Livestock like to graze the youngest, most nutritious leaves first. They will leave the older leaves and stems for later. Sheep and goats have the ability to graze right down to the soil surface (5-2), grazing the new shoots at the base of plants. Their small mouths allow them to be much more selective than cattle.

5-2. Sheep grazing close to the ground.

Sheep

Sheep spend anywhere from nine to eleven hours **grazing** each day. They also will **browse** on shrubby plants. If possible, they avoid grazing in areas with natural predator cover.
A survival mechanism is their strong flocking instinct which means they like to be able to see other sheep while grazing. If managed improperly, sheep and goats can graze pasture plants into the ground and destroy a forage stand.

Grazing *– to feed on growing forage in a pasture, for example, eating grasses and legumes in preference to shrubs, woody plants.*

Browsing *– feeding on shrubby, leafy, often taller growing plants than grasses and legumes, for example, eating brush and shrubs.*

Goats

Goats will also spend around nine to eleven hours grazing/browsing a day. They are very active while foraging and will cover a wide area. Goats prefer to move in family units when on pasture. They are very athletic and able to stand on their hind legs and stretch up to reach tree leaves (5-3). They also will readily eat bark from trees and shrubs. Goats tend to graze the tops of the plants first and graze close to the ground when forage is limited.

5-3. Goats grazing on leaves of a shrub.

Grazing Preferences

All livestock can be selective when it comes to what they eat. They choose to eat the plants that taste the best, are the most nutritious and easiest to get. They will choose certain types of plants over others, but will always go for younger versus mature plants. This is called **selective grazing**.

Selective Grazing – *when livestock are able to select which plants they want to graze. They often choose the same ones over and over again.*

Selective grazing can lead to some of the plants in your paddocks being grazed down while others are ignored (5-4 and 5-5). For example, if crested wheatgrass plants are not grazed early in the season when they are young and leafy, they will quickly become mature and stemmy. Sheep and goats will avoid these older, stemmy plants, grazing the younger grasses around them. The resulting tufts of left over plant materials are "rogue" crested wheatgrass plants that have not been grazed and will not be grazed if there is any other plant material to choose from.

Selective grazing can lead to yield losses as the forage quality of the more mature material becomes too low and is wasted. Adding to the pasture management problem is having the choice spots constantly grazed, with plants weakened and dying out.

5-4. A sheep grazing selectively.

5-5. Goats selectively grazing willow leaves.

Goat (5-6) and sheep mouths are small and well-equipped to select specific plant parts. As browsers, goats have even narrower muzzles and more mobile lips and tongues than sheep allowing them to be even more selective than sheep when grazing.

5-6. Close up of a goat's mouth

One goal of a managed grazing system is to reduce the ability of sheep and goats to graze selectively, wasting some plants and overgrazing others. Dividing large pastures into smaller paddocks and rotating sheep or goats through the paddocks, forces them to graze a higher percentage of the plants in each paddock.

Sheep and goats learn what to graze through trial and error. Lambs and kids also learn what to eat by watching their mothers. They consume familiar forage plants, at first avoiding ones they haven't seen before.

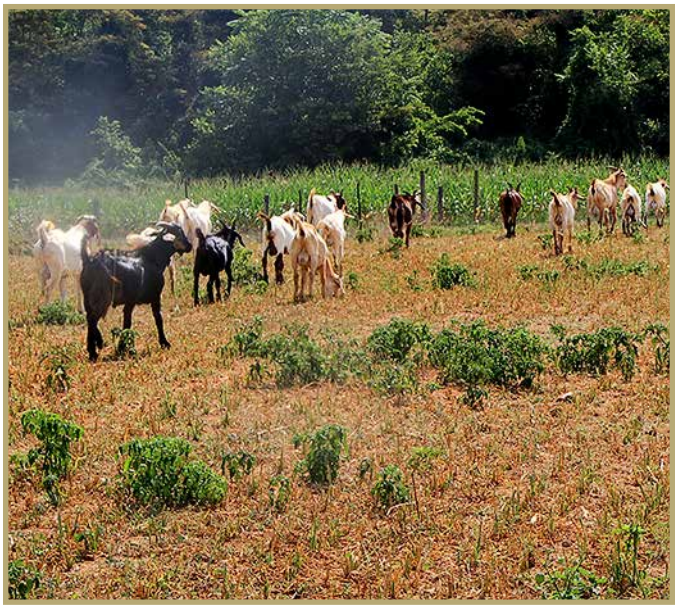
5-7. Poor teeth can impact grazing and body condition score in sheep.

Impact of Pasture Condition on Grazing Behaviour

Pasture condition has a huge impact on the nutritional status of your flock/herd.

Grazing behaviour is affected by:

- How much forage is present in the pasture (5-8)
  - How much forage is present affects how much forage they can get in each bite.
  - If the pasture has been overgrazed and there is not much grass present, your sheep and goats won't be able to get very much forage in each bite. This means they will have to spend more time taking bites to get enough food. Monitoring the time your sheep or goats graze is one way to judge how well the pasture is supplying their nutritional needs.
- How dense the forage is in the pasture (5-9)
  - The goal is to maximize the amount of forage sheep and goats get with each bite.
  - Pastures with a high **density** of plants provide a lot of forage with each bite.
  - The fewer plants available in pastures, the fewer plants in each bite, the more the sheep and goats have to walk and the longer time sheep and goats will have to graze.



5-8. Goats on an overgrazed pasture

***Density** – the amount of plant matter in a given area (for example, how many plants are present in your pasture.*

5-9. A thin pasture

- How tall the forage is in the pasture (5-10 and 5-11)
  - If pasture plants are too tall, sheep and goats will trample them, wasting valuable forage resources.

5-10. A pasture with forage that is over-mature and headed out is higher in fibre, lower in nutrient value wasting pasture value.

5-11. A pasture with forage that has grown too tall is wasted by animal trampling unless fenced for high animal density and paddock rotation.

Impact of Grazing Animals on Your Pastures

Grazing animals influence the health and productivity of the plants and soil where they graze. Be aware of the potential damages, and benefits, caused by grazing sheep and goats.

Weed Control

High stocking density forces your sheep and goats to graze the paddocks more uniformly. It also reduces their ability to graze selectively and, as a result, they consume more of the plants present. If weeds are present in your paddocks, increasing the stocking density forces your sheep or goats to graze these plants. This helps reduce their spread and can help control these weeds over time. The sheep and goats will also trample those weeds that they do not consume, also reducing their ability to survive.

Treading and Compaction

Grazing animals tread (walk) on the soil and plant material in the pastures as they graze. This is unavoidable. A certain level of treading will not harm the plants, but can lead to wasted forage if the plants are tall.

Heavy **hoof action** in an area can also help break up the soil surface, which increases water penetration into the soil. Be aware, though, that too much treading can lead to **soil compaction**.

Sheep and goat hooves are small and tend to pack the soil, while cattle hooves can punch through sod, making holes in wet areas. This happens where there is high animal traffic, such as laneways. It can also happen in wet conditions or if the flock or herd is left in a pasture too long (5-12).

Keeping sheep and goats out of a pasture and off the soil after heavy rainfall will help reduce soil compaction.

Hoof Action *– the impact of an animal's hooves on the soil. Too much can damage the plants and soil in an area.*

Soil Compaction *– pressing the soil with enough force that the soil structure is damaged. Soil pores are eliminated and the water and air-holding capacity of the soil is reduced.*

5-12. Hoof action of sheep causing pasture damage.

Erosion

Wind and water cause soil erosion that reduces the productivity of land. In pastures, soil erosion can be an issue where plants have been trampled or overgrazed and die out. Managed grazing helps reduce the risk of soil erosion by moving animals through a series of different paddocks. This decreases the amount of time sheep or goats spend walking over the same area.

Soil Erosion *– loss of soil due to wind and water.*

Manure

One of the biggest benefits from grazing is the recycling of nutrients and organic matter in manure across a pasture. Sheep produce around 4% of their bodyweight in manure per day, while goats produce around 5% of their bodyweight in manure. That manure contains nutrients essential for plant growth and production. Nitrogen, phosphorus and potassium are three key nutrients found in manure. These nutrients will move from the manure into the soil and, eventually be taken up by plants. Effective manure management reduces the need for, and expense of, fertilizer applications.

Too much manure in any one area, though, can be a problem.

Sheep and goats tend to congregate in certain favoured areas (5-13). Over time this leads to those spots getting more manure than others. Nutrients become concentrated in the heavily used areas and other areas in the pasture are short-changed. Dividing pastures into smaller paddocks forces sheep and goats to spread out over the entire area. This means all areas of the paddocks will receive the benefit of manure nutrients. Use strategic placement of shade, water and salt/mineral sources.

5-13. Sheep stayng close to shade in a pasture.

Practical Ideas

- Management Intensive Grazing is not just moving animals between small paddocks. The emphasis is not intensive grazing. Animals always graze intensively. The emphasis is on intensive management.
- In a good managed grazing system, animals want to go into the next paddock. Moving them should become very easy and free of stress.

6. How to Set Up Your Managed Grazing System

Key Concepts

- **Inventory Your Resources**
- **Adjust Grazing Principles to Fit Your Operation**

What Are Your Management Goals?

Before jumping into managed grazing, think about business goals of your sheep or goat operation.

- What is the main product your flock or herd produces to generate income?
- What is essential to controlling the costs of the product, whether meat, milk or fibre?
- How are pastures and grazing currently used in production?
- What do the sheep or goats need for efficient production?
- What resources are available now or will be needed?
- Do you consider forage as one of your products?
- Do you wish to think of yourself as a "grass farmer"? Managed grazing is a shift from the traditional use of pastures.
- How much of your resources are you willing to devote to proper managed grazing?

Write down the business goals for this year, for next year and for the next five or ten years.

When goals are written down it is much easier to develop plans. A managed grazing system takes careful planning, design and implementation. It also requires on-going monitoring, review and adjustment and goals that can be updated at the start of the next grazing season. A managed grazing system needs to be flexible to adapt to experience as well as changing business goals.

It is also important to remember that a managed grazing system is not focused on the animals. It is focused on the forages. This system is tailored to produce forage at increased yields and in the most efficient, sustainable and profitable manner. Your sheep or goats are used to harvest this forage and provide a marketable product.

Resource Inventory: Land

Take time to carefully review what your operation looks like now before designing a managed grazing system. Once you know what you have, it will be much easier to identify what you need for your managed grazing system. The land available for grazing can be a key opportunity or a limitation for a grazing management plan.

Answer the following questions about your land:

- What grass and legume species are present in each of my pastures?
- What are the soil fertility characteristics of each of my pastures?
- How does each pasture fit into the annual cycle of supplying feed for my operation?
- What is the overall condition of my pastures (healthy, productive, etc.)?
- When does each pasture produce feed? How can this be altered?
- What is the condition of the fencing around my pastures?
- Which pastures have water sources/access to water for my livestock?
- Are there any weed problems in my pastures that need to be dealt with before grazing begins?
- Do I need to establish new perennial pastures before starting my managed grazing program?
- Do I need to acquire more pasture land to graze?
- What are the average yields for my pastures based on their condition?

Resource Inventory: Livestock

Here are some considerations. These questions are actually very difficult to answer in a simple way. Your operation will have moving targets—animal weights change over time, nutritional needs change with production cycles, some groups of animals can be fed with supplements and some cannot. The table below provides one option for planning forage resources and animal requirements.

- How many lambs, ewes, rams, does, kids, bucks, etc. will you be grazing in each month of the growing season?
- When will each group be grazing?
- About how much do the animals in each group weigh?
- About how much will the animals in each group eat in a day?
- What level of nutrients do the animals in each group require while grazing? Will nutrient requirements change as the grazing season progresses?
- Will the forage in the pastures meet the needs of animals in each group, or will some of them need supplementation, or will alternate feeding programs be more cost effective?

If the land area is fixed, you may need to adjust the number of livestock you have based on the acreage available for grazing or increase the productivity of the pastures to provide more feed.

Sheep and goats need about 2-6% of their body weight in feed (on a dry matter basis) per day. On average, you can estimate that each animal will eat and waste about 5% of their body weight per day on pasture. This means your paddocks would need to supply each 150 lb. ewe with 7.5 lb. of forage per day. You can create a livestock balance sheet like the one below to help give you an idea as to how much forage your livestock will consume each month of the grazing season:

Livestock Monthly Balance Sheet								
Kind of Livestock	Number of Animals	Average Weight (lb.)	Forage Requirement Per Month (lb.)					
			May	June	July	Aug	Sept	Oct
Ewe	50	150						

Basic Grazing Principles

Managed grazing systems are based on a few basic principles:

- Plants need time to **rest** and recover after being grazed to stay healthy and productive.
- **Grazing pressure** can be manipulated (forage available relative to animal intake) to achieve specific plant and animal goals.
- When animals are concentrated in smaller paddocks, they graze more evenly and have less opportunity to select specific plants. This also improves utilization of all forage in each paddock and improves distribution of manure within the paddock.
- Grasses and legumes in pastures grow and mature at different times. Grazing must match growth.
- Managed grazing systems should be able to adapt to changes in the environment, market and production conditions.
- Always match forage quality and quantity to the needs of your animals.

Grazing Pressure *– The stress on plants in a pasture due to grazing animals.*

Rest *– when plants are not being grazed. This gives them time to replenish their energy reserves and grow new leaves.*

When to Start Grazing

In the spring, grasses and legumes need to reach a certain height before being grazed. This allows the plants time to grow enough leaves to build up energy reserves in their roots to power regrowth.

In Alberta, a good rule of thumb is to start grazing when grasses have hit the four-leaf stage, or when the grasses are six inches to eight inches tall. Legumes might not be ready to graze until they are eight inches tall.

Start walking paddocks as they start to green up in the spring to assess when the plants are ready for grazing.

Grazing Periods

Managing how long sheep or goats stay in a paddock is just as important as how long that paddock is rested. Shorter grazing periods can be more beneficial to both livestock and plants than longer ones.

When first turned into a new paddock, livestock tend to select the highest quality and most desirable plants to graze. Once all these plants have been consumed, they are then forced to clean up the remaining lower quality material. This can result in some sheep or goats, such as lactating ewes or does or growing lambs, not being able to meet their nutritional needs for the last part of that grazing period. Move high needs animals more rapidly and use animals with low nutrient requirements to clean up paddocks.

Leaving sheep or goats in a paddock for too long can result in over-grazing the favoured plants. Over-grazing weakens plants reducing forage production. **A good rule of thumb is to leave around three inches of stubble behind after each grazing.** This residue or stubble will help the plants recover and re-grow. The more plant remaining, the faster the regrowth.

Do not keep animals in a paddock long enough to graze the regrowth. Your best forages will try to grow back quickly. If your animals are still in the paddock at that time, they will prefer to graze the young leaf regrowth, which systematically puts stress on your best plants.

Rest Periods

This is a complex topic, as rest periods depend on many factors that change from year to year, season to season and even week to week some years. In the broadest terms, rest periods allow the plants in your pastures time to re-grow after being grazed helping them stay healthy and productive.

- Plants use up the energy reserves stored in their roots to re-grow after being grazed.
- Once plants have enough new leaves, they begin to build up root reserves.
- When paddocks are not allowed to rest, plants have no chance to produce new leaves and re-fill their fuel tanks. This weakens them over time and reduces pasture forage production.

The length of the rest period depends on:

- The grass and legume species
- How close down to the ground they were grazed
- Weather conditions

Plants that are under **stress** will need longer rest periods. Plants growing under conditions of minimal stress can handle less rest. The amount of rest needed by plants is different between the start of the grazing season and the end. Early in the grazing season plants are growing rapidly. Moving a flock or herd through paddocks faster than normal will take advantage of this growth and stop the plants from becoming mature. Later in the summer, plant growth slows and paddocks need longer rest periods.

Grazing pastures too early in the spring will set back production and can reduce the **hardiness** of plants. On the other hand, waiting too long before starting to graze allows the plants to become over-mature and reduces feed quality. Managing the number of livestock to make use of early spring growth is critical–clipping and bringing in more sheep or goats or cattle are useful in managing growth.

With experience you will be able to observe how the plants in your paddocks grow and react to grazing, and how long their rest periods need to be. Experience is needed to effectively fine-tune managed grazing systems.

Tip
- move your animals based on the state of your plants and not on the date on the calendar.

Stress *– factors and conditions that can lead to the death of the plant. Examples include lack of nutrients, drought and cold weather.*

Hardiness *– the ability of a plant to handle adverse/poor growing conditions.*

Rest

Paddocks should be grazed about a week before the grasses head out or when the legumes are in the early to mid-bud stage. At these stages, they have recovered enough from the previous grazing and will be high in quality.

Table 6.1 Average Rest Periods (in Days) For Forage Species		
	Cool Weather	Hot Weather
Cool-season grasses	14	35-50
Legumes	21-28	21-28
Source: West Central Forage Association. 2009. Pasture Planner		

As previously mentioned, rest periods are difficult to estimate. In general, a short rest period might be around three weeks under optimal conditions, while a long rest period could be around six or seven weeks (Table 6.1). The amount of rest will also depend on moisture, soil fertility, and the amount of residual forage left from the previous grazing. Below are examples of some plant species and how much rest they need between grazing periods.

- Long rest, slow regrowth: timothy, smooth bromegrass, cicer milkvetch
- Moderate rest, moderate regrowth: alfalfa, sainfoin, alsike clover
- Short rest, rapid regrowth: orchardgrass, tall fescue, Kentucky bluegrass, meadow bromegrass, Italian ryegrass, creeping red fescue, white clover

Pasture Regrowth

As you saw in Section 2, figure 2-7, the grasses and legumes in your paddocks do not grow at the same rate, or produce the same amount of forage, during the growing season.

Growth tends to be highest in the spring and early summer, peak around the start to the middle of July (depending on location in the province) and slow down moving into August and September.

Managed grazing systems must be adapted to match the forage production occurring in paddocks.

Cool-season grasses grow rapidly at the start of the grazing season. Shorten rotations through paddocks, reducing grazing periods and rest time, to keep plants from heading out and becoming over mature. Haying should be an option for managing fast growing forage in paddocks. As production slows later in the summer plants take more time to regrow.

Animal Units and Stocking Rates

Animal Units

An **animal unit (AU)** is defined as one mature 1,000 pound cow, with or without her suckling calf. It is assumed that the 1,000 pound cow will consume an average of 26 pounds of dry matter each day.

An **animal unit equivalent (AUE)** is a way to figure out how much forage other types and sizes of animals need. Adjusting the calculation for ewes or does should be based on their average weights when nursing lambs or kids. While knowing the actual weight of the animals in your flock or herd helps fine-tune pasture management, a rule of thumb with some margin is five ewes per cow or six does per cow.

An **animal unit month (AUM)** is the amount of forage needed by one AU for one month. Based on the daily consumption rate of an AU and a waste factor of 25%, about 1,000 pounds of dry matter are required to meet the nutritional needs of one AU for one month.

After calculating how many animal units will need forage, calculate how much forage will be required every month and match the forage required to the estimates of monthly production for each paddock.

Stocking Rate

The **stocking rate** is the number of AUMs supplied by one acre of pasture for one year. It can also be thought of as the number of animals on a pasture during a month or grazing season.

Stocking rate changes based on plant species, soil moisture, soil fertility and growing conditions. **Carrying capacity** is the average number of animals a certain paddock or pasture can sustain over a period of time.

In contrast, **stocking density** refers to the amount of animal pounds grazing a particular area at a single point in time. Stocking density is usually expressed as pounds of animal per acre. It provides a snapshot of a grazing situation and allows for meaningful comparisons across fields, species and operations. For example, a stocking density of 2,000 lb. per acre means there are 20 goats weighing 100 pounds in an acre or 10 rams weighing 200 pounds in an acre.

Animal Unit (AU) *– a standardized measure of animals used to calculate how much forage they consume.*

Animal Unit Equivalent (AUE) *– used to represent other types and sizes of animals in relation to an AU. For example, five ewes equal one AU.*

Animal Unit Month (AUM) *– the amount of forage needed by one AU for one month.*

Stocking Rate *– the number of animals on a given area of land over a certain period of time.*

Carrying Capacity *– the average number of animals a certain pasture can sustain over time.*

Stocking Density *– the amount of animals (in pounds) grazing a specific area at a single point in time.*

Managed grazing often requires these calculations, and those of pasture production, to be done monthly. This allows "feed holes" in your paddocks to be identified. The estimated feed budget must be matched against the expected forage yield, for each paddock. Managed grazing requires a deeper analysis of each month and each paddock on the farm. Stock movement depends on the forage available in your paddocks, which varies on a monthly and yearly basis.

For detailed information on how to calculate stocking rate, carrying capacity and stocking density, check out **Alberta Agriculture and Rural Development's** website (*www.agriculture.alberta.ca*).

How Many Paddocks Do I Need and How Big Should They Be?

There is no single "best" number of paddocks for a managed grazing system. Any number of paddocks is better than one big pasture continuously grazed the entire season. Deciding on the number of paddocks depends on:

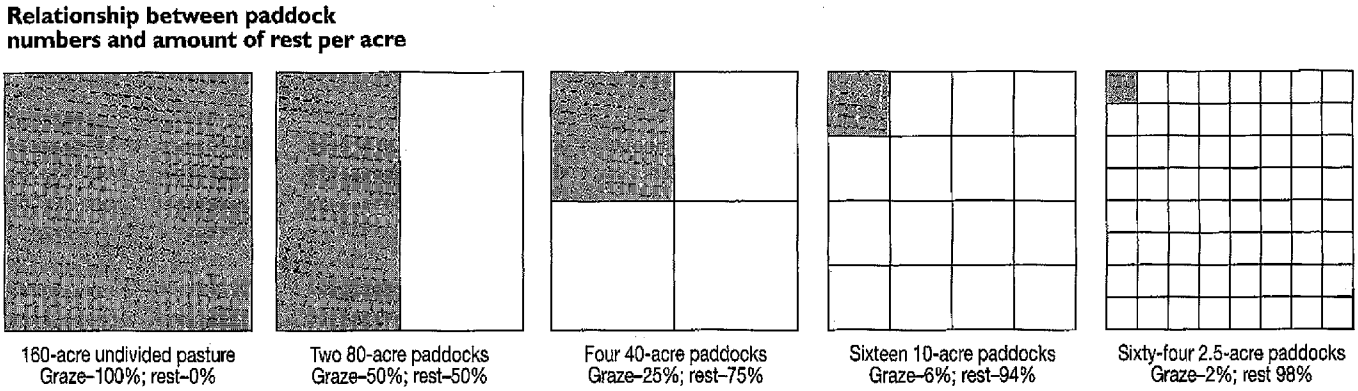
- Existing fences
- Cross-fencing
- Topography
- Forage type
- Soil type
- Water access
- Land base

Initially the number of paddocks will be determined by any of the factors listed above. Starting out with anywhere from two to eight paddocks will increase both pasture condition and animal performance over a continuously grazed pasture. Using temporary fencing (6-1 and 6-2), electric tape or flexible net fencing, works well to divide pastures into paddocks. Both types are visible and easily moved. This allows you to adjust the size of your paddocks based on production each year.

6-1. Temporary electric fencing

6-2. Dividing a large pasture into two paddocks

The more paddocks a larger pasture is divided into, the more rest plants will get and the healthier they will be (6-3).

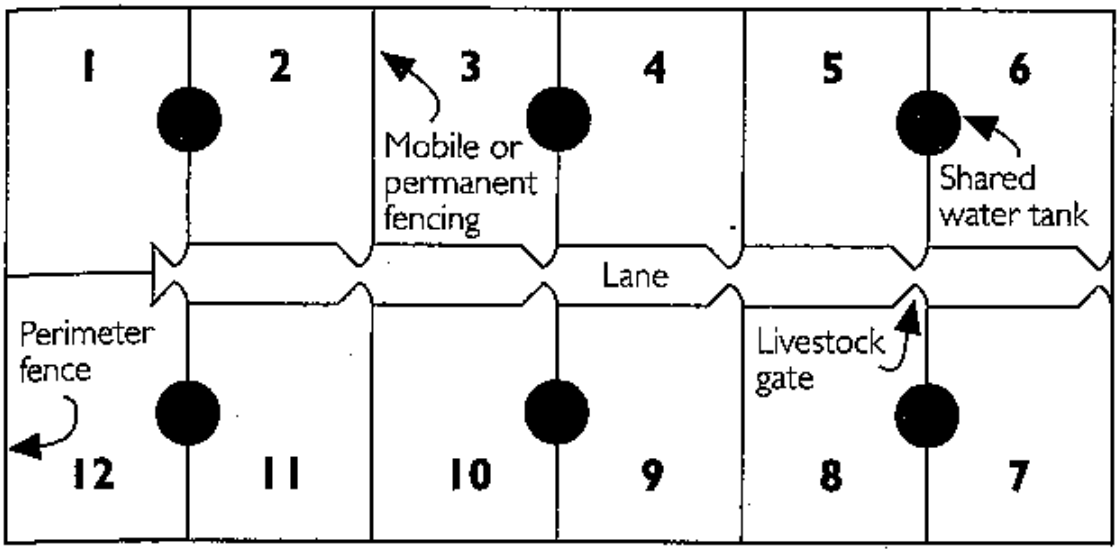


6-3. The relationship between the number of paddocks you have and the amount of rest your plants get between grazing periods

More paddocks tend to be better than fewer, for both the plants and the animals, but they also require more time to manage. The number of paddocks doesn't have to be set in stone; vary paddock size and number using portable electric fencing.

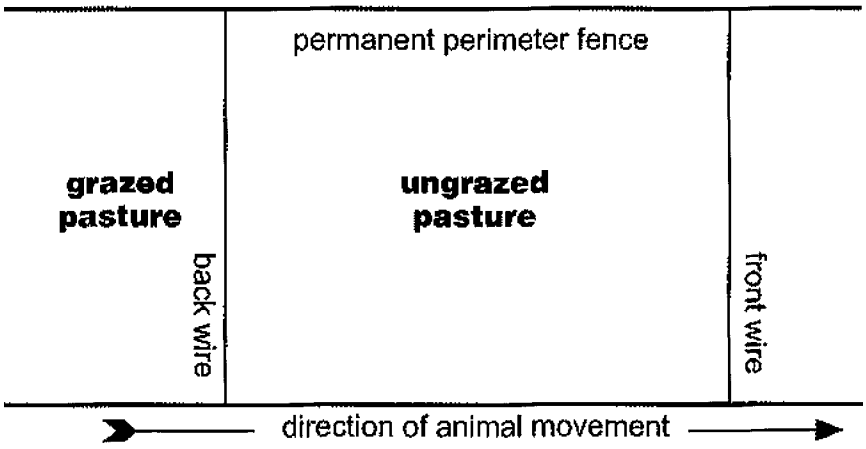
Paddock Layout

When planning the layout of paddocks, remember that the easiest way to put up fencing around pastures is to make square or rectangular pastures of roughly the same size. This allows easier subdivision of larger pastures into smaller paddocks with movable, electric fences. Square paddocks also use the least amount of fence, maximizing their area and encouraging more even grazing and manure distribution (6-4).



6-4. Square paddocks

Long rectangular pastures and strip grazing using moveable electric fencing help keep sheep and goats in the area scheduled for grazing (6-5).



6-5. Rectangular pasture divided into square paddocks for strip grazing.

Pastures have differences in slope, in plant species and forage quality; some have sloughs and areas of brush. These differences can lead to uneven grazing. Strategic use of fencing will allow you to manage these differences effectively. Difference can also be managed to add forage in different seasons or of different quality for different sheep or goat requirements.

When deciding how to split large pastures up into smaller paddocks for managed grazing, set up fencing to create as even a grazing environment within each paddock as possible.

How to Design Your Paddocks

Some tools that will come in handy when you are deciding on your paddock layout include:

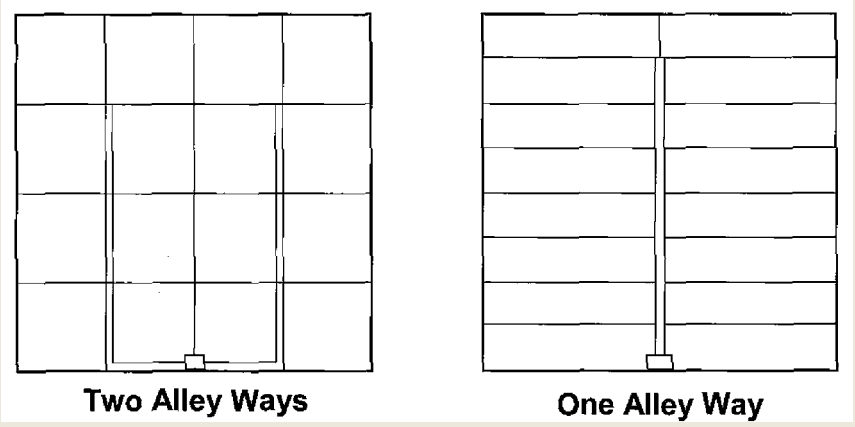
- Soils and soil moisture maps of your area
- Topographic map
- Aerial photographs of your pastures
- Electric fencing
- Google Earth

Paddock Design: Getting Started

Start by using the aerial photographs to create a scaled map of the land base for pasture. Place markers for water sources, buildings, existing fences, etc.. Divide larger pastures into smaller paddocks. Keep in mind:

- Topography
  - Be sure to separate areas with different slopes into different paddocks.
  - To reduce erosion, lay out paddocks so they run across the slope's contour, not top to bottom.

- Forage Type
  - Different forage species start growing in the spring at different times and have different growth curves based on the growing season and weather.
  - Grazing certain forage species at specific times of the year reduces their longevity.
- Soil Type
  - Try to separate different soil types as they will vary in productivity.
- Sensitive Areas
  - Highlight riparian areas (wetlands, streams, etc.) that need to be fenced in order to keep livestock away from them.
  - Try to avoid grazing steep areas that are prone to soil erosion.
- Limiting Features
  - Sandy soils with a high potential for drying out should be kept separate.
  - Flood-prone areas have reduced forage growth and limited seasonal access.
  - Extreme slopes make some pastures difficult to access.
  - Water access may limit how pastures are divided. Options include portable water systems, temporary water lines or solar-powered waterers.
- Shade
  - Fence shady and sunny areas separately to limit access by sheep and goats. Portable shade allows grazing and resting areas to be moved, spreading manure over the paddock.
- Alleys and Gates (6-6)
  - Keep lanes as short and narrow as possible. The forage found in the lanes will be trampled, less palatable; keep the waste to a minimum.
  - Lanes which are about 12 feet wide work well for smaller flocks (350 sheep), but if you have a larger one you may need to increase their width to 20 or 30 feet.
  - Gates should be located in the corner of the pasture nearest to the alley.



6-6. Examples of paddock layouts with alleys

Fencing

Good fencing is vital to all managed grazing systems. When deciding what type of fence you will install, think about:

- The purpose of the fence
  - Is it a permanent, perimeter fence going around your pasture?
  - Is it a temporary fence you are using to divide your pasture into smaller paddocks?
  - Are you using it for creep feeding lambs on pasture?
- Kind and class of livestock you will be using it to contain
  - Do you have sheep? Goats?
  - How high can they jump?
  - Can they squeeze through small openings in the fence?
- Predator control
  - Do you have an issue with coyotes? Neighbours' dogs?
  - Do you have other large predators?
- Cost
  - How much do you have to spend on the fence?
  - How much do different types of fencing supplies cost?
  - Do you want woven wire (6-7) or electric fences (6-8)?
  - Are there any yearly maintenance costs?

6-7. Woven wire fence

6-8. Permanent electric perimeter fence

Permanent Fencing

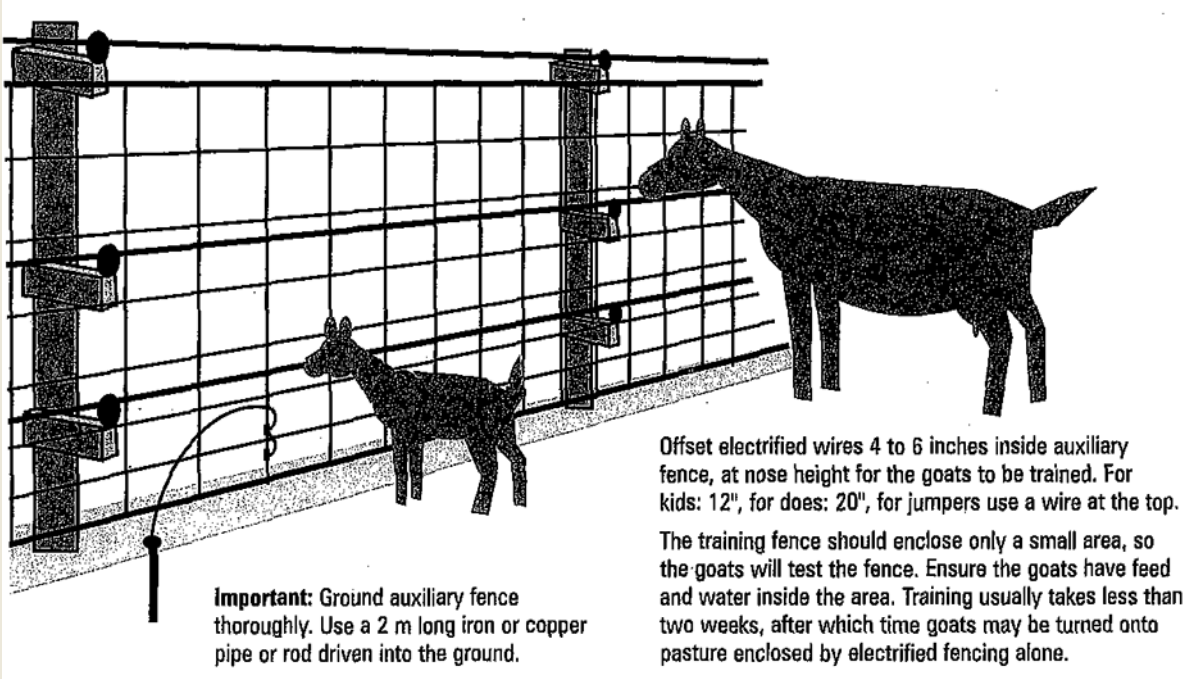
Permanent fencing will be used for the perimeter of your larger pastures. Before you go out and purchase new fencing, take an inventory of what permanent fences you already have and where they are located. It might turn out that what you already have is in good enough shape to be used effectively in your new system.

If it looks as if, based on your managed grazing design, you need to build new permanent fences, be sure to purchase quality materials. The most important thing is to build the fence to keep your livestock in and predators out.

Woven wire fencing is used for sheep and goats. It requires a lot of labour to install, but provides a nearly predator-proof exterior fence for your small livestock.

Many producers are now using **high tensile electric fencing** when building new permanent fences. It is relatively inexpensive, long-lasting, and very effective. It also can be built so that some, or all, of the strands can be electrified if needed.

You can use four to five strands of smooth electrified wire as perimeter fencing. The space between the wires will vary from six to eight inches near the ground and eight to twelve at the top. The fence should be at least 42 inches high (6-9).



6-9. Permanent electric perimeter fence

Movable or Mobile Electric Fencing

Mobile electric fencing lets you easily change the size of your paddocks to deal with changing conditions. Temporary electric fences are light weight, easy to install and very adaptable to your operation. A pasture divided into temporary paddocks this way can also be easily accessed by machinery or altered to meet different production goals for sheep and goats. Electric netting or three strands of hot wire or electric tape are generally needed when you are building these interior electric fences.

Some of the equipment needed for constructing electric fencing includes:

- Charger (energizer) and grounding rods
- Poly tape or poly wire or electric netting to section off your paddocks
- Voltmeters, lightning arrestors and surge protectors
- Posts (permanent and corners) and step-in posts (temporary)

A few factors will determine the effectiveness of your electric fencing system:

- Proper construction of the fence
- Sufficient grounding
- Amount of vegetative growth in contact with the fence
- Quality and power of the fence charger

There are many companies that sell equipment for electric fencing. Be sure to do your research when it comes to pricing out supplies and designing the layout of your electric fences. The retailer you end up purchasing your supplies from should be willing and able to assist you in determining the supplies and design that will best meet your needs.

Putting It All Together

It's time to put everything about plant growth and production, the nutritional needs of your livestock, sheep and goat grazing behaviour, grazing, stocking rates, fencing into building a grazing management plan.

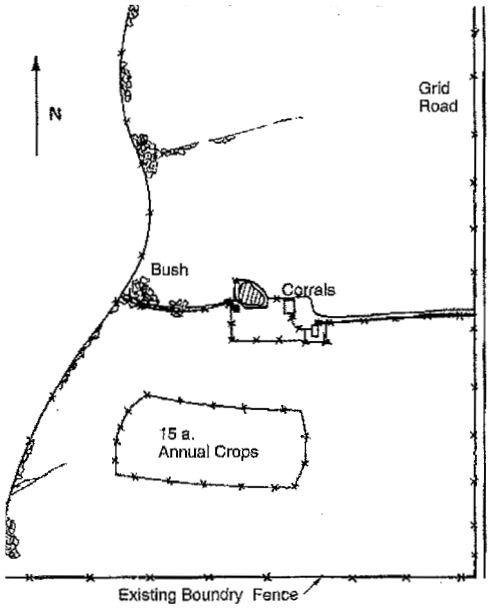
> ***Note***
> *- flexibility is critical to a managed grazing system!*

The only way to gain experience in managed grazing is by trial and error. Start by slowing increasing the number of paddocks you graze based on forage production and animal needs. As you track and evaluate how your systems in working, you will continuously move towards a more complex system. You will need to adjust weekly to different conditions, based on weather, forage growth and animal performance.

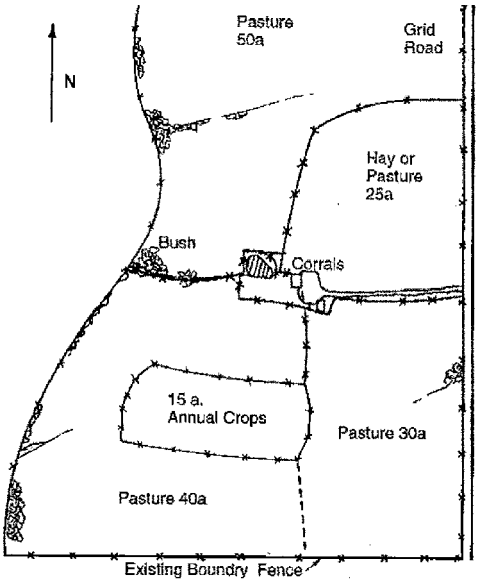
Follow this Example Farm as it Moves towards Managed Grazing

This farm has a five acre field at the top of a hill south of the yard site. There is a slope to the north and south of this pasture. There is also a low area northwest of the yard site and a south slope that follows the northern property line.

The yard site and perimeter fence is shown in 6-10. A permanent fence has been added to split the pasture into two paddocks right at the yard site (roughly the middle of the pasture).



6-10. A division fence has been added that split the pasture into two paddocks.

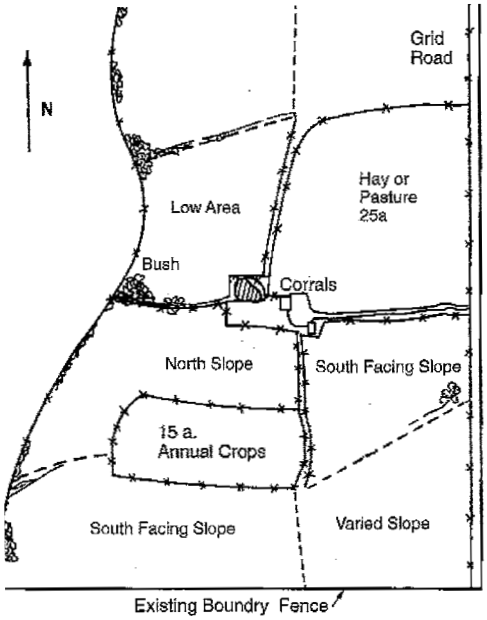


6-11. Land has now been subdivided into four paddocks with permanent (x-x) and temporary (- -) fencing.

In 6-11, the farm has been divided into four paddocks. To make sure the water quality of the dugout stays high, it has been fenced off. Water from the dugout will now be pumped into a livestock waterer in the yard. All four paddocks will have a gate leading to the yard, creating a single water source for all four paddocks.

The paddock northeast of the yard site is fenced off as it is flat. It can be used for hay or silage if needed. The different slopes found on this farm were not fenced separately as there were limits to what the farmer could fence at this stage.

6-12 shows the next set of paddock divisions the farmer has made. Portable fencing has been used to fence off low areas and sloped areas. These fences could be easily moved and used to adjust paddock size and number as the grazing season progresses.



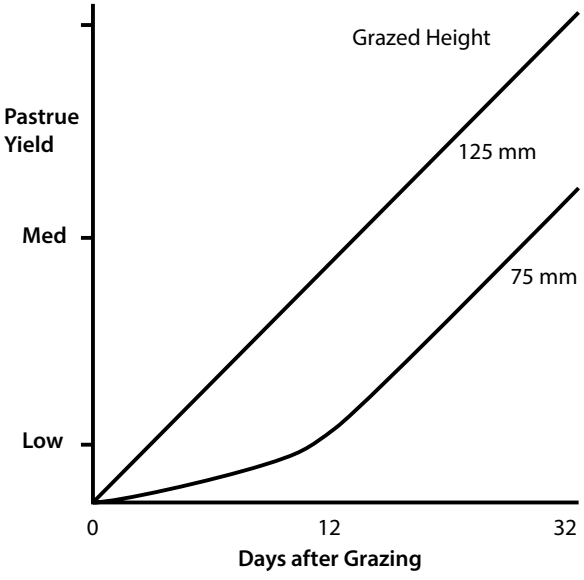
6-12. Eight paddocks have been created with temporary fencing based on the farmer's observations during previous grazing seasons.

When to Move Your Sheep or Goats

For your managed grazing system to work, you need to be flexible. Yes, it is important to draw up a plan of which paddocks to rotate through and when, but you need to be able to adapt to changes. You don't have to stick to grazing the "right" paddocks in the "right" order. The number of paddocks you have, the order in which you graze them and the length of time they are rested will vary with the rate of forage production.

Note

- you will likely need to adjust your grazing periods in each paddock to deal with the slow-down in forage growth as you move from the spring into the late summer.



6-13. The relationship between the height of pastures after being grazed and pasture yield.

Be sure to remove no more than 40-50% of the forage material during grazing.

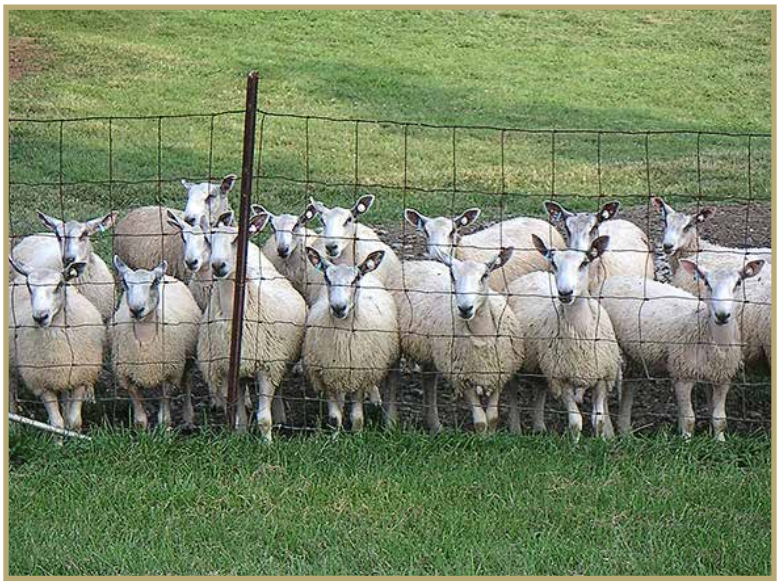
It is important to leave enough of the living plants behind to allow them to regrow quickly. Overgrazing rapidly weakens the plants in your pastures by reducing root biomass. Smaller roots negatively impact the plants' ability to survive periods of drought and can lead to lower production. For example, pastures were grazed down to two heights, 125 mm and 75 mm (five and three inches). You can see that the pasture which was grazed closer to the soil took longer to regrow and had lower forage production than the pasture that was left taller after being grazed (6-13).

How to Move Your Sheep or Goats

Moving sheep or goats doesn't have to be time consuming, or traumatic, for you or them. The key to effective animal handling is minimizing stress. Research has identified humans yelling and dogs barking as two major causes of stress for sheep. Forcing sheep or goats to go somewhere they don't want to go is stressful for all. Having sheep or goats move on their own accord takes experience, some thought and planning. It is more effective to make them want to move. You want them to remain calm while moving to avoid stress and damage to animals, fences or handlers.

The good thing is that, in a managed grazing system where animals move to a new paddock every few days or even sooner, they quickly learn that this movement brings them fresh, highly-palatable feed. Sheep and goats quickly adapt to this system and within a few days will flow without stress into each new paddock when you open the gate or move the fence. If you always move them at the same time each day, you might find that at that time they will gather near the perimeter of their paddock waiting for you to open the gate, or they will follow you or come when you call (6-14). Quiet movements and good animal husbandry skills go a long way here.

Livestock are creatures of habit, so moving them at the same time each day will help let get used to it. It usually does not take long for sheep and goats to learn the system when fresh feed is at the end of each movement.



6-14. Sheep waiting to be moved into a new paddock.

Some producers prefer to move their flock or herd in the morning, near sunrise. Sheep and goats start to graze then, they are starting to get hungry and there is enough light so they can see where they are going. Later in the morning they can be so hungry they pressure gates and fences making moving more difficult. Managed grazing helps you avoid the problem of animals being over hungry. Some experienced grazing managers choose to have the flock or herd move itself. Gates to new paddocks are opened during the heat of the day when the sheep or goats are resting. This reduces crushing at the gate and makes opening gates easier. It also allows the animals to calmly get up when they are ready and move to new forage. Sheep and goats learn quickly and feed is an effective incentive.

Designing a Simple Managed Grazing Plan General Tips

- Put what you know about your operation to use.
- Try to keep costs low at the start. Use as much of your existing resources (water sources, fences, buildings, etc.) as possible.
- Make sure your flock or herd has access to a reliable source of clean water and a trace mineral mixture in each paddock.
- Make sure you keep assessing the state of your pastures and flock or herd during the grazing season.
- Starting out with a simple managed grazing plan can help you manage the risks associated with a new system. If possible, use temporary electric fencing for your internal fences. You can use this first year to build your knowledge and confidence with new grazing management techniques.
- Be sure to have a back-up plan in case of drought or poor pasture production. This might mean haying one of your paddocks or purchasing feed from off-farm.

Monitor, Evaluate and Adjust

Move slowly to a managed grazing system, plan each different phases and move step-by-step. It will take a few years to get pastures to the condition you want and to get an idea of their yields and growth over the grazing season. It also takes time to adjust the operation's existing resources (fencing, water sources, etc.) to work with the managed grazing system.

Monitoring Performance: Pasture

Create a "pasture calendar" or "pasture worksheet." This gives you a place to record your observations of plant species, pasture growth, yields and observations of how your animals graze. The calendar or worksheet should cover the entire grazing year. Divide it into monthly and weekly sections based on your annual feeding plan your sheep or goats.

Use your camera or cell phone to take pictures of your paddocks at different times of the year to help you track growth and production. Weigh at least some animals in and out of pastures to assess gain and cost per pound of gain.

Pasture Observations

In your pasture calendar, try to answer the following questions:

- What grass and legume species are in each pasture?
- Track the growth stages of your pastures. When are they highly productive? When does growth slow?
- What are the average yields of your pastures?
- How long does it take your pastures to recover from grazing? Are your rest periods too short or too long? Are your grazing periods too long or too short?
- How much residue is left after each grazing? Is it enough to allow for quick pasture recovery?
- What alternate feed(s) will be available for what group(s) of sheep or goats if pastures are inadequate?

Pasture Assessment Worksheet

This worksheet can help you track the progress of your managed grazing plan. You can use it to monitor pasture productivity and see where things might be improved.

Table 6.2 Pasture Assessment Worksheet

Paddock #	Acres per Paddock	Date Animals In	Date Animals Out	Grazing Days	Days of Rest	Grazing Animals	Animal Units	Animal Grazing Days/Ac	Total per Acre	Total ADA per Paddock	Average ADA per Paddock
1	8	5/10	5/15	5		20 Ewe, 39 Lmb	7.9	4.9	4.9		
	8	6/25	6/30	5	41	20 Ewe, 39 Lmb	7.9	4.9	4.9		

*Adapted from West Central Forage Association. 2009. Pasture Planner.

Monitoring Performance: Livestock

When you move your flock from one paddock to the next, be sure to keep an eye out for any changes in behaviour, body condition score or health (lameness, udders, wounds, etc.). Write down animal observations alongside your pasture observations.

Animal Observations

- Keep track of stocking rates. Are there enough animals in each paddock to prevent selective grazing? Are there too many animals, leaving too little plant residue and setting back pastures?
- Are your animals getting enough forage from your pastures? Are they contented? What is their body condition score? How much do they weigh?
- Are your animals hanging out in certain areas of each pasture too much? Why?
- Are there any animal health issues that might be related to grazing? Loose manure? Scours?

Practical Ideas

- Find one or two farmers who have successfully implemented Management Intensive Grazing—with any livestock species (goats, sheep, beef cattle, dairy cattle)—and work with them for a couple of weeks. Move animals, set fence, become involved in the discussions about making decisions.
- Form or join a discussion group of farmers who are interested in managed grazing. Meet regularly, take pasture walks together, discuss issues with the host and share ideas among the group members.
- For cross-fencing, initially don't build any permanent fence. Only use temporary electric fence (step-in posts, etc.). Electric fencing gives you flexibility yet still provides effective barriers between paddocks. After a couple of years of experimenting with different paddock arrangements, if you still want build permanent cross-fences, you'll have a better idea about their best locations.
- If you leave a temporary fence in the same place for three or four years, then that is probably the place to build a permanent fence.
- Learn how to use the concept of stocking density in a managed grazing system. Stocking density is a tool that can be used for broadcast seeding, weed control, manure distribution, feed allocation and manipulation of plant growth. It is also useful to make comparisons with other operations.
- Train yourself to move animals out of a paddock when there is still an appropriate amount of residual forage. This may be more forage than you think is necessary, and leaving it requires discipline. Initially, it will seem hard to leave so much ungrazed forage, so talk to other farmers who have done it successfully.

7. Potential Grazing Issues

Key Concepts

- **Be Aware of All Potential Issues**
- **Learn How to Manage Grazing Issues**

Predators

Predation is an issue faced by all livestock producers in Alberta. Sheep and goats are particularly vulnerable to predation as they lack the ability to defend themselves. Losses from predation can be financially disastrous. They are also stressful for the remaining flock. Predation management has to be a component of all livestock management, and in particular is critical for managed grazing systems where major investments in time, money and effort are expended.

Signs of predation can include:

- Change in behaviour. The animals are nervous, tend to flee and can be very vocal, particularly if lambs/kids are missing.
- Wool pulls on sides or rumps of sheep, torn ears
- Signs of a struggle, drag marks on the ground
- Crushed and broken plants
- Blood, wool, hide at the point of attack or around the kill site
- Ravens, crows or magpies congregating in the paddock or pasture
- Changes in guardian dog behaviour

Common Predators

Coyotes are the most common predators of sheep in Alberta. Domestic dogs can also be a problem. Dogs tend to harass or kill for fun. Often sheep or goats are mutilated or chased to exhaustion by dogs alone or in packs. Knowing neighbours' dogs, as well as your own, can help reduce dog problems, as can good fencing and flock monitoring.

Predation *– the preying of one animal on another, leading to stress, injury or death of the prey.*

Coyotes are quick and competent killers that usually hunt alone, except when females are training their young. Inexperienced pups will harass sheep and goats, pull wool and tear ears until they learn to kill. Coyotes will target the weakest and most vulnerable animals, such as sick, old or injured sheep. However, they readily select healthy sheep or goats if opportunity arises.

Orphaned lambs and kids are especially vulnerable to predation. They are less likely to stay with the flock, have no mother for example or protection, and are curious.

Depending on your location, other predators that pose varying threats to sheep and goats include wolves, bears, cougars, eagles and ravens.

Predation Management

A predation management plan is essential for every flock or herd manager whose animals leave the safety of the barn. Focus on prevention. Learn the basics of predator behaviour. Reduce the opportunities predators have to prey on your sheep or goats (7-1).

7-1. Properly trained guard dogs are the preferred (and most effective) guard animals.

Parasites

One of the challenges you may face when grazing your flock or herd is internal parasites. Internal parasites can be difficult to manage in small ruminants, particularly young lambs or kids. They have a negative impact on the health of your livestock, reduce gains, increase susceptibility to disease and can lead to death. Malnourished animals are at higher risk of infection by certain parasites.

For more information on parasite and parasite management, please refer to the Sheep and Goat Management in Alberta Health module (*www.ablamb.ca*).

Bloat

Pasture bloat can be a serious issue when grazing livestock. Sheep and goats grazing immature, lush pastures containing a **bloat-causing llegume** (alfalfa, white clover, and alsike clover) can be at risk of developing bloat. Bloat can also occur when animals are introduced to lush annual cereal pastures for the first time.

The material on bloat is covered in greater depth in the Sheep and Goat Management in Alberta: Health module, and the Sheep and Goat Management in Alberta: Nutrition module. They are both available on the Alberta Lamb Producers website (*www.ablamb.ca)*.

Pasture Bloat *– a form of indigestion due to the accumulation of gas in the rumen that the animal cannot expel.*

Bloat-causing Legumes *– legumes that can increase the risk of bloat when grazed. They include red clover, alsike clover, white clover and alfalfa.*

How to Reduce the Risk of Bloat

There are steps you can take to reduce the risk of pasture bloat. They include:

- Never move hungry sheep or goats into legume pastures for the first time in the morning. Wait until after they have had their morning graze and their stomachs are full.
- If animals are coming from barns or yards, make sure they are filled with hay or silage before moving them to legume pastures.
- Wait until the dew is off the plants before moving your sheep or goats into legume pasture.
- Feed another source of dry roughage (fibre), such as grass hay or cereal straw, when grazing a bloat-causing legume pasture during a high-risk period.
- Maintain regular intake once your sheep or goats have started grazing the legume pasture. Once they've been introduced into a legume pasture, leave them there continuously. Moving the animals into and out of that pasture increases the risk of bloat.
- Birdsfoot trefoil, sainfoin and cicer milkvetch are considered bloat-safe legumes.
- A high-risk bloat situation occurs immediately after frost. Move animals out of legume pastures on the afternoon prior to the first frost.

Nitrates

What are Nitrates?

Plant roots take up **nitrate**, a form of nitrogen, from the soil. The nitrates are transported to the leaves and converted to protein. When plants are stressed or injured, or if there are long periods of heavy cloudy weather, this process is interrupted and nitrates may accumulate. Herbicide applications, drought, hail or frost can temporarily halt normal plant growth and lead to nitrate accumulation.

Nitrate *– a compound that contains nitrogen and water (NO_3).*

The application of high rates of nitrogen fertilizer and manure can increase soil nitrate, and the risk of nitrates accumulating. Immature plants usually have higher nitrate levels than those in the milk stage and onward.

Certain plants have the tendency to accumulate nitrate when soil nitrate levels are high and the environment is not conducive to normal plant growth. Annual cereals and certain weeds tend to accumulate greater nitrate levels than perennial forages (Table 7.1).

Table 7.1 Common Crops and Weed Species that Accumulate Nitrates			
Agricultural Crops		Weeds	
Barley	Beet tops	Bull thistle	Canada thistle
Wheat	Flax	Fireweed	Kochia
Oats	Sorghum	Lambs quarters	Mustards
Rye	Sugar beet tops	Russian thistle	Pigweed
Canola		White ragweed	Millet

Source: AARD. 1991. Nitrate Poisoning and Feeding Nitrate Feeds to Livestock.

Nitrates will accumulate over time when the crop has been damaged or injured. The nitrate level in the plants will peak two or three days after the stress event. It is recommended that you harvest the material within one day of the damage occurring. If this is not possible, nitrate levels will gradually decline 10 to 14 days later as long as the plants are able to resume normal growth.

Plants under drought stress will often accumulate high levels of nitrates, especially in the lower parts of the plants.

More information on nitrates in plants can be found in Sheep and Goat Management in Alberta: Health module and Nutrition module. They are both available on the Alberta Lamb Producers website (*www.ablamb.ca*).

How Nitrates Affect Sheep and Goats

Ruminants convert nitrate into nitrite in the rumen. Nitrite is absorbed by the bloodstream and reacts with haemoglobin, the oxygen carrying molecule. This reaction prevents haemoglobin from carrying oxygen throughout the animal's body. The animal ends up being starved for oxygen and death can occur. Clinical signs of nitrate poisoning include:

- Respiratory distress
- Weak and stumbling livestock
- Diarrhea
- Vomiting
- Salivation

How to Reduce the Risk of Nitrate Toxicity

You can take the following steps to reduce the risk of nitrate toxicity when grazing:

- Avoid grazing annual cereal pastures for 10-14 days after the crop has been sprayed or hailed on or after a frost has occurred.
- Dilute the nitrate content of the ration by feeding low and high nitrate feeds together.
- Allow your sheep or goats to adjust to low levels of nitrate before increasing the content. Introduce them to suspect feeds over a period of a few days.

- Avoid grazing annual cereal pastures for 10-14 days after the crop has been sprayed or hailed on or after a frost has occurred.
- Dilute the nitrate content of the ration by feeding low and high nitrate feeds together.
- Allow your sheep or goats to adjust to low levels of nitrate before increasing the content. Introduce them to suspect feeds over a period of a few days.
- Test your feed for its nitrate level if you are worried about nitrate poisoning. Table 7.2 lists the breakdown of nitrate levels in feed and what they mean.
- Sheep have the highest nitrate tolerance of the ruminants, but are still at risk of nitrate poisoning.

Table 7.2 Method of Nitrate Analysis and Data Reporting

	% NO3	%NO3-N	%KNO3	Remarks
1	0.5	0.12	0.81	Generally safe.
2	0.5 – 1.0	0.12 – 0.23	0.81 – 1.63	Caution: some subclinical symptoms may appear.
3	1.0	0.23	1.63	High nitrate problems: death and abortion losses may occur.

Values reported on a dry matter (DM) basis.
Source: AARD. 2008. Nitrate Risk in Forage Crops.

Poisonous Plants

Poisonous plants contain toxic substances that can harm sheep and goats. They may also possess spines that can cause physical injury. The illness caused by ingesting the plants can be immediate or symptoms may not show up until weeks after the material is consumed. Often, early signs of poisoning can be detected, allowing the animal to be treated before the damage becomes permanent, or death results.

Overgrazing can reduce the availability of good forages in your pasture. This increases the risk of your animals consuming less desirable plants, some of which may be poisonous. Drought can increase losses from poisonous plants. The reduction in feed may drive your animals to consume plants they normally avoid.

Poisoned animals can be hard to treat so the best plan of action is to prevent the poisoning from occurring in the first place. Know what plants are in your pastures before letting your animals in to graze.

Some Common Poisonous Plants

There are a number of poisonous plants found in Alberta. A few are listed below (Table 7.3).

Table 7.3 Poisonous Field Plants

Plant	Scientific Name	Poisonous Part
Black Henbane	Hyoscyamus niger	All parts, especially the roots
Bittersweet (Climbing Nightshade)	Solanum dulcamara	Immature fruit and leaves
Jimson Weed (Thorn Apple)	Datura stramonium	All parts, especially the seeds and leaves
Water Hemlock	Cicuta douglasii	All parts

Source: AARD. 2010. Poisonous Outdoor Plants – Field Plants.

Drought

How Your Pastures Deal with Drought

How your pastures will respond to drought depends on how they were managed in the past. Plants that have deep root systems will be able to reach sub-surface moisture. Those with shallow roots will be negatively affected much sooner.

Overgrazing weakens the plant and results in a shortening of the root systems. This decreases their ability to handle a drought, and will cause a reduction in production. Grazing plants, stocking rates and recovery periods all play a part in the ability of your pastures to make it through a drought.

7-4. Sheep grazing during dry conditions.

What You Can Do To Deal with Drought

If you are heading into a period of dry weather, you should first adjust your rest periods. A pasture will need more time to recover from grazing as the plants' ability to restore their root systems is reduced when moisture is lacking. Combine your grazing groups into one flock or herd to decrease the number of paddocks being used at any one time. This will make it easier to increase the rest periods between grazings for each one.

You may need to reduce the number of animals you have in order to match their needs to forage production. Alternatively, you could seed annual cereals for grazing. They would be ready six to eight weeks after seeding, and could provide you with extra forage and give your perennial plants a chance to rest and recover.

Leave behind as much plant residue as possible. Residue shades the soil surface and helps increase moisture retention. It also reduces evaporation from the soil once you start getting rain

again. Check the nutrient status of your soil. You may need to add fertilizer if nutrients are lacking. This will help your stand recover from the negative effects of drought once moisture is available.

Plants under drought stress may tend to accumulate high levels of nitrates, especially in their lower parts. This is particularly true with annuals and some weeds.

Drought is an issue that might not crop up every year, but one that you should prepare for. Developing a drought management plan before experiencing a drought should help you weather the storm and maintain healthy and productive pastures.

Drought Management Checklist

When developing your drought management plan, make sure you consider what your stock forage needs will be, your pasture condition, and water availability. The following is a checklist you can use throughout the year to help prepare for, and deal with, drought.

- Spring
  - Have I checked the current and long-term forecasts for my area?
  - Do I have alternate plans in place for feeding my livestock if spring pasture production is poor?
  - What is my soil moisture situation?
- Summer
  - If I need emergency hay, grain or pasture, have I made arrangements to access it?
  - Do I have a dependable water source?
  - Should I consider reducing my livestock numbers to better match my current pasture production?
- Fall
  - Have I used proper soil moisture conservation techniques to improve growing conditions for next spring?
  - Do I have adequate feed and water supplies for my livestock to make it through the winter?
  - Have I checked long-term weather forecasts for my area?
- Winter
  - Have I made plans to adjust my pasture management next spring?
  - Do I have enough information to make informed decisions regarding my livestock numbers depending on my pasture conditions next spring?

For more information on drought, check out the "Options for Alberta Producers During Dry Conditions" section on *www.agriculture.alberta.ca*.

Practical Ideas

- The Internet can be a marvellous tool for obtaining information about specifics of grazing issues. In a Google search to find scientifically-based information, in addition to your search terms, add the phrase "site:edu" or "site:gov" in the search box to limit your search to (generally American) websites of educational institutions or government agencies, respectively.

Acknowledgements

An Introduction to Managed Grazing for Sheep and Goat Producers is largely based on two earlier publications:

- Pastures for Profit
  - Written by Dan Undersander, Beth Albert, Pamela Porter and Neal Martin and published by the University of Wisconsin and Minnesota Extension Services
- A Guide to Management Intensive Grazing
  - Written by Dennis Joosse and Fraser Stewart, Manitoba Agriculture, Paul McCaughey, Agriculture and Agri-Food Canada, and Val Goodwin, Val Goodwin Communications, and published by Manitoba Agriculture

An Introduction to Managed Grazing for Sheep and Goat Producers has been updated and adapted to Alberta conditions for sheep and goat production by:

- Stephanie Kosinski, Forage Specialist, Alberta Agriculture and Rural Development
- Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development

Reviewed by:

- Woody Lane, Ph.D, Lane Livestock Services, Oregon

Appendix 1 – Where to Go for More Information

1. Managed Grazing

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - Alberta Forage Manual, 2nd Edition
  - Grazing Tame Pastures Effectively (Agdex 130/53-1)
- Foragebeef (*www.foragebeef.ca*)
  - Grazing Management
- Manitoba Agriculture, Food and Rural Initiatives (*www.gov.mb.ca/agriculture*)
  - A Guide to Management Intensive Grazing
- University of Wisconsin Cooperative Extension (*www.uwex.edu*)
  - Pastures for Profit: A Guide to Rotational Grazing

- University of Minnesota Extension Service (*www.extension.umn.edu/agriculture*)
  - Grazing Systems Planning Guide

2. Understanding Plant Growth and Making It Work for You

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - Alberta Forage Manual, 2nd Edition
  - Grazing Annual Forages – Frequently Asked Questions
  - Grazing Tame Pastures Effectively (Agdex 130/53-1)
  - Swath Grazing in Western Canada: An Introduction (Agdex 420/56-2)
  - Swath Grazing – Frequently Asked Questions
  - Using Fall Rye for Pasture, Hay and Silage
  - Winter Cereals for Pasture (Agdex 133/20-1)
- Foragebeef (*www.foragebeef.ca*)
  - Grasses
  - Legumes
  - Sward Management
  - Using Annuals
  - Using Perennials
  - Using Stockpiled Forage
  - Using Swath Grazing
- Pasture Planner – West Central Forage Association
- University of Wisconsin Cooperative Extension (*www.uwex.edu*)
  - Pastures for Profit: A Guide to Rotational Grazing

3. The Road to a Productive Pasture

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - Agronomic Management of Stockpiled Pastures (Agdex 420/56-4)
  - Alberta Forage Manual, 2nd Edition
  - Applying Manure on Perennial Forage
  - Assess Tame Pastures before Rejuvenation – Frequently Asked Questions
  - Crop Protection (Agdex 606-1)
  - Field Scouting
  - Forage Seed Mixture Calculator
  - Forage Species
  - Forage Stand Establishment Troubleshooting
  - Integrated Weed Management Principles: Reducing the Risk of Crop Failure (Agdex 642-3)
  - Nutrient Management on Intensively Managed Pastures (130/538-1)
  - Perennial Forage Establishment in Alberta (Agdex 120/22-3)
  - Plant and Insect Identification

- Sod Seeding Techniques
- Soil and Nutrient Management of Alfalfa (Agdex 121/531-5)
- Weed Control Act and Regulations
- Weed Prevention

- Foragebeef (*www.foragebeef.ca*)
  - Brush Control
  - Fertility for Perennial Stands
  - Forage Establishment
  - Forage Rejuvenation
  - Grasses
  - Legumes
  - Soil Improvement
  - Weed Control

- Manitoba Forage Council (*www.mbforagecouncil.mb.ca*)
  - Sod Seeding (Seeding Forages into Existing Stands Using Minimum Tillage)

- Saskatchewan Agriculture (*www.agriculture.gov.sk.ca*)
  - Rejuvenation of Tame Forages

- Saskatchewan Forage Council (*www.saskforage.ca*)
  - BMPs for Invasive Plant Species

4. Sheep and Goat Nutritional Needs

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - A Primer on Water Quality
  - Average Analysis of Alberta Feeds 1984-1994
  - Feed Testing – Frequently Asked Questions
  - Feed and Water Testing Laboratories
  - Know Your Feed Terms (Agdex 400/60-2)
  - Quality Farm Dugouts
  - Remote Pasture Water Systems for Livestock (Agdex 400/176 (C30))
  - Salt and Minerals for Sheep
  - Water Requirements for Livestock (Agdex 400/716-1)
  - Water Analysis Interpretation (Agdex 400/716-2)
  - What You Feed Sheep is Not Necessarily What They Eat

- Alberta Lamb Producers (*www.ablamb.ca*)
  - Feeding Lambs – Frequently Asked Questions
  - Feed Testing in Alberta
  - SheepBytes (ration balancing software)
  - Sheep and Goat Management in Alberta: Nutrition

- Canadian Sheep Federation (*www.cansheep.ca*)
  - Virtual Toolbox: Nutrition
  - Virtual Toolbox: Grazing
- Foragebeef (*www.foragebeef.ca*)
  - Feed Sampling
  - Feed Test Interpretation
  - Feed Testing
  - Pasture Pipelines
  - Pasture Water Pumps
  - Pasture Watering Systems
  - Ruminant Physiology and Function
  - Spring Developments
  - Tanks and Troughs
  - Water as a Nutrient
- Manitoba Agriculture, Food and Rural Initiatives (*www.gov.mb.ca/agriculture*)
  - A Guide to Management Intensive Grazing
- NRC Nutrient Requirements of Sheep 6th Edition (*www.nap.edu*)
- Ontario Ministry of Agriculture, Food and Rural Affairs (*www.omafra.gov.on.ca*)
  - Frequently Asked Questions on Sheep Nutrition
  - Nutrient Requirements of Sheep
  - Sheep – General Nutrition
  - Sheep – Feeding the Flock
  - Sheep – Pasture
- Sheep 201: Flock Nutritional Requirements (*www.sheep101.info*)
- University of Minnesota Extension Service (*www.extension.umn.edu/agriculture*)
  - Grazing Systems Planning Guide
- University of Wisconsin Cooperative Extension (*www.uwex.edu*)
  - Pastures for Profit: A Guide to Rotational Grazing
- West Central Forage Association (*www.areca.ab.ca/wcfa*)
  - Pasture Planner

5. Sheep and Goat Grazing Behaviour

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - Nutrient Management on Intensively Managed Pastures (Agdex 130/538-1)
- Alberta Lamb Producers (*www.ablamb.ca*)
  - Sheep and Goat Management in Alberta: Nutrition

- ATTRA (*https://attra.ncat.org/*)
  - Goats: Sustainable Production Overview
- Canadian Sheep Federation (*www.cansheep.ca*)
  - Virtual Toolbox: Grazing
- Foragebeef (*www.foragebeef.ca*)
  - Grazing Behaviour
  - Manure on Forages
  - Sward Management
- Saskatchewan Agriculture (*www.agriculture.gov.sk.ca*)
  - Grazing Management for Sheep Production
- Manitoba Agriculture, Food and Rural Initiatives (*www.gov.mb.ca/agriculture*)
  - A Guide to Management Intensive Grazing
- University of Minnesota Extension Service (*www.extension.umn.edu/agriculture*)
  - Grazing Systems Planning Guide
- University of Tennessee Agricultural Extension Service (*http://animalscience.ag.utk.edu/Sheep/Publications-Sheep.html*)
  - Applied Sheep BehaviourUniversity of Wisconsin Cooperative Extension (*www.uwex.edu*)
  - Pastures for Profit: A Guide to Rotational Grazing

6. How to Set Up Your Managed Grazing System

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - Alberta Forage Manual, 2nd Edition
  - Calculating Grazing and Forage Needs
  - Fencing with Electricity
  - Grazing Spring Grazing – Frequently Asked Questions
  - Grazing Tame Pastures Effectively (Agdex 130/53-1)
  - Meat Goats
  - Range and Pasture Litter: How Much is Enough?
  - Spring Grazing Decisions Affect Farm Bank Accounts
  - Stocking Rates and AUM – Frequently Asked Questions
  - Tame Pasture Health Assessment
  - Using the Animal Unit Month Effectively (Agdex 420/16-1)
- Alberta Lamb Producers (*www.ablamb.ca*)
  - Fencing in Alberta
- ATTRA (https://attra.ncat.org/)
  - Paddock Design, Fencing and Water Systems for Controlled Grazing

- British Columbia Ministry of Agriculture (*http://www.gov.bc.ca/agri/*)
- Grazing Frequency and Utilization
- Monitoring Grazing Lands
- Pasture Design
- Seasonal Considerations for Grazing Management

- Canadian Sheep Federation (*www.cansheep.ca*)
  - Virtual Toolbox: Grazing

- Foragebeef (*www.foragebeef.ca*)
  - Braces/Wires/Staples
  - Electric Fencing
  - Grazing Management
  - Pasture Design
  - Pasture Health Assessment
  - Pasture Management
  - Planning Fencing Systems
  - Stocking Rates

- Manitoba Agriculture, Food and Rural Initiatives (*www.gov.mb.ca/agriculture*)
  - Animal Unit Months, Stocking Rate and Carrying Capacity
  - A Guide to Management Intensive Grazing

- Oklahoma Cooperative Extension Service (*http://www.oces.okstate.edu/*)
  - Electric Fencing for Sheep (ANSI-3855)

- Ontario Ministry of Agriculture, Food and Rural Affairs (*http://www.omafra.gov.on.ca/*)
  - Budgeting and Measuring Pasture Production

- Saskatchewan Agriculture (*http://www.agriculture.gov.sk.ca/*)
  - Grazing Management for Sheep Production

- University of Minnesota Extension Service (*www.extension.umn.edu/agriculture*)
  - Grazing Systems Planning Guide

- University of Missouri Extension (*http://extension.missouri.edu*)
  - Types of Goat Fences
  - Goat Fencing for Predator Control

- University of Wisconsin Cooperative Extension (*www.uwex.edu*)
  - Pastures for Profit: A Guide to Rotational Grazing

- Virginia Cooperative Extension (*http://www.ext.vt.edu/*)
  - Sheep Grazing Management

- West Central Forage Association (*www.areca.ab.ca/wcfa*)
  - Pasture Planner

7. Potential Grazing Issues

- Alberta Agriculture and Rural Development (*www.agriculture.alberta.ca*)
  - Coyote Predation of Livestock Agdex 684-19
  - Grazing Legumes and Bloat – Frequently Asked Questions
  - Methods of Investigating Predation of Livestock Agdex 684-14
  - Nitrate Poisoning and Feeding Nitrate Feeds to Livestock (Agdex 400/60-1)
  - Nitrate Risk in Forage Crops – Frequently Asked Questions
  - Options for Alberta Producers during Dry Conditions
  - Poisonous Plants
  - Preventing Predation in Sheep Flocks
- Alberta Lamb Producers (*www.ablamb.ca*)
  - Guardian Animals for Alberta
  - Predator Control
  - Sheep and Goat Management in Alberta: Health
  - Western Canadian Flock Health Program
- Canadian Biodiversity Information Facility (*www.cbif.gc.ca*)
- Canadian Poisonous Plants Information System (*www.cbif.gc.ca/pls/pp/poison*)
- Canadian Sheep Federation (*www.cansheep.ca*)
  - Virtual Toolbox: Flock Health
  - Virtual Toolbox: Predation
- Foragebeef (*www.foragebeef.ca*)
  - Drought on Pastures and Rangeland
  - Health and Disease – Bloat in Pastures
- "Stock-poisoning Plants of Western Canada" by W. Majak, B.M. Brooke and R.T. Ogilvie (available from most local forage associations)
- University of Minnesota Extension Service (*www.extension.umn.edu/agriculture*)
  - Grazing Systems Planning Guide

Appendix 2 – Diagrams and Photographs

2. Understanding Plant Growth and Making It Work for You

2-1. Relationship between plant stage and quality. Source: Manitoba Agriculture, Food and Rural Initiatives. Unknown date. A Guide to Management Intensive Grazing: Managing Grazing for Better Results. Winnipeg, MB. 29 pp.

2-2. Grass structure and growth. Source: University of Missouri Extension. Dairy Grazing: Growth of Pasture Plants. M 182.

2-3. Bunchgrass. Source: Queen's Printer for Ontario, 2006.

2-4. Sod-forming grass. Source: Queen's Printer for Ontario, 2006.

2-5. Legume structure. Source: University of Missouri Extension. 2012. Dairy Grazing: Growth of Pasture Plants. M 182.

2-6. Pasture production and animal feed requirements. Source: Manitoba Agriculture, Food and Rural Initiatives. Unknown date. A Guide to Management Intensive Grazing: Managing Grazing for Better Results. Winnipeg, MB. 29 pp.

2-7. Plant growth and quality. Source: Aasen, A. and M. Bjorge. 2009. Alberta Forage Manual, 2nd Ed. Alberta Agriculture and Rural Development. Edmonton, AB. 346 pp.

2-8. Rotational grazing goats. Source: Jackie Dunham, GoatKeeper Magazine.

2-9. Annual and winter annual cereal growth patterns. Source: Manitoba Agriculture, Food and Rural Initiatives. 2008. Annual Crops An Excellent Way to Increase Your Feeding Flexibilty.

2-10. Stockpiled perennial forage for late season grazing. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

2-11. Late season swath grazing. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

2-12. Fall annual pasture. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

3. The Road to a Productive Pasture

3-1. Even sheep and nutrient distribution. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

3-2. Uneven sheep and nutrient distribution. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

3-3. Sheep grazing Dalmation toadflax. Source: Lisa Surber. Montana Sheep Institute.

3-4. Goats grazing nettles. Source: Jackie Dunham, GoatKeeper Magazine.

3-5. Growing points of grass and regrowth. Source: University of Missouri Extension. Dairy Grazing: Growth of Pasture Plants. M 182.

4. Sheep and Goat Nutritional Needs

4-1. Goats at a waterer. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

4-2. Lambs at a waterer. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

4.3 and 4-4. Sheep at a mobile water source used in rotational grazing. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

4-5. Pasture water system. Source: Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

4-6. Water tank for hauling. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

5. Sheep and Goat Grazing Behaviour

5-1. Sheep grazing with a guard dogs. Source: Tracy Lamb, Mopani Communications.

5-2. Sheep grazing close to the ground. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

5-3. Goats grazing the leaves of a shrub. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

5-4. Goats selectively grazing willow leaves. Source: Jackie Dunham, GoatKeeper Magazine.

5-5. A sheep grazing selectively. Source: Tracy Lamb, Mopani Communications.

5-6 Close-up of a goat's mouth. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

5-7. Poor teeth can impact grazing and body condition score in sheep. Source: Tracy Hagedorn, Alberta Agriculture and Rural Development.

5-8. Goats on an overgrazed pasture. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

5-9. A thin pasture. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

5-10. A pasture with forage that is over-mature and headed out is higher in fibre, lower in nutrient value wasting pasture value. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

5-11. 'A pasture with forage that has grown too tall is wasted by animal trampling unless fenced for high animal density and paddock rotation. Source: Jackie Dunham, GoatKeeper magazine.

5-12. Hoof action of sheep causing pasture damage. Source: Tracy Lamb, Mopani Communications.

5-13. Sheep stayng close to shade in a pasture. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

6. How to Set Up Your Managed Grazing System

6-1. Temporary Electric Fencing. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

6-2. Dividing a large pasture into two paddocks. Source: Susan Hosford, Sheep Industry Specialist, Alberta Agriculture and Rural Development.

6-3. The relationship between the number of paddocks you have and the amount of rest your plants get between grazing periods. Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2002. Pastures for Profit: A Guide to Rotational Grazing. University of Wisconsin-Extension. Madison, WI. 39 pp.

6-4. Square paddocks. Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2002. Pastures for Profit: A Guide to Rotational Grazing. University of Wisconsin-Extension. Madison, WI. 39 pp.

6-5. A rectangular paddock divided into square paddocks for strip grazing. Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2002. Pastures for Profit: A Guide to Rotational Grazing. University of Wisconsin-Extension. Madison, WI. 39 pp.

6-6. Examples of paddocks with alleys. Steve Kenyon, Greener Pastures Ranching Ltd., skenyon@greenerpasturesranching.com, www.greenerpasturesranching.com.

6-7. Woven wire fence. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

6-8. Permanent electric perimeter fence. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

6-9. Permanent electric perimeter fence. Source: Sara Emond. 20008. Meat Goats. Alberta Agriculutre and Rural Development. Agdex 435/20-1.

6-10. A division fence has been added that split the pasture into two paddocks. Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2002. Pastures for Profit: A Guide to Rotational Grazing. University of Wisconsin-Extension. Madison, WI. 39 pp.

6-11. Land has now been subdivided into four paddocks with permanent and temporary fencing. Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2002. Pastures for Profit: A Guide to Rotational Grazing. University of Wisconsin-Extension. Madison, WI. 39 pp.

6-12. Eight paddocks have been created with temporary fencing based on the farmer's observations during previous grazing seasons. Undersander, D., B. Albert, D. Cosgrove, D. Johnson, and P. Peterson. 2002. Pastures for Profit: A Guide to Rotational Grazing. University of Wisconsin-Extension. Madison, WI. 39 pp.

6-13. The relationship between the height of pastures after being grazed and pasture yield. Source: Porter, G. 1983. Grazing Management for Central Interior Cattlemen. BC Ministry of Agriculture.

6-14. Sheep waiting to be moved to a new paddock. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.

7. Potential Grazing Issues

7-1. Properly trained guard dogs are the most preferred (and effective) guard animals. Source: Tracy Hagedorn, Alberta Agriculture and Rural Development.

7-2. Sheep grazing during dry conditions. Source: Susan Schoenian, Sheep and Goat Specialist. University of Maryland Extension.