CHAPTER 2 ~ GRAZING SYSTEMS

INTRODUCTION

An effective grazing system is the cornerstone of successful pasture management. The number of animals, the size and layout of the farm, production goals, and the amount of management the producer wants to apply are all taken into consideration when planning the use of the pasture and designing a grazing system.

No matter what grazing system is implemented there needs to be a good understanding of what is required by the animals and what is actually available in the pasture. Without this knowledge, it is not possible to design an efficient productive, grazing system. Assessing the amount of available forage or biomass can be done using several techniques, ranging from visual assessment to using specifically designed equipment. Several techniques used together can be the most effective method for assessing the biomass of a pasture, especially when first developing 'an eye' for the process.

Once the available pasture mass has been determined and the requirements of the animals has been estimated, it is important to document the information. The records can then be used to design, plan, and budget the available pasture. A grazing system plan should be somewhat flexible as it is impossible to predict exact pasture masses throughout the season.

This chapter will outline the methods of determining pasture mass and animal requirements, along with an example of a pasture mass budgeting and a planning system worksheet. Paddock design and function will be outlined and explained. Finally, results and examples from research conducted in this region will be presented.

METHODS OF MEASURING PASTURE BIOMASS

Visual Estimate

Producers are accustomed to estimating a pasture's carrying capacity by visual estimates or by 'eyeballing'; a skill that is developed over many grazing seasons. By visually inspecting the pasture with a walk through, the producer estimates how much forage is available in the paddock and how many days the animals can stay. It is important to walk through the pasture rather than rely on a broad visual scan because open spots are not always apparent. This method of pasture biomass determination is very subjective and will only give the producer a rough estimate.

Using a Rising Plate Meter

A rising plate meter is a simple but effective tool in pasture management. It estimates forage cover by measuring pasture height and density. This method can give the producer a more accurate estimate of how much available feed is in the paddock.

The rising plate meter comes in a variety of styles, from a basic design of a disk (which can be metal or plastic) that fits over a meter stick with strings attached (Figure 2.1) to more sophisticated designs with computerized measuring devices. Rayburn and Rayburn (1998) described how to construct a simple weighted meter. In this study, the pasture plate is made from 5.6 mm thick (0.22-inch) acrylic plastic sheeting cut in a 46 cm x 46 cm square (18-inch x 18-inch) square with a 3.8 cm (1.5-inch) hole cut in the center of the plate. A meter stick is inserted into the hole so that the plate's height above the ground is measured when it is set on the sward. The plate has an additional 24 x 3.2 mm (0.13 inch) diameter holes drilled at 7.6 cm (3 inch) square intervals. These holes in the plate allow the use of the plate as a point quadrant for estimating ground cover in thin stands or stubble aftermath or for measuring the occurrence of forage species under the plate.

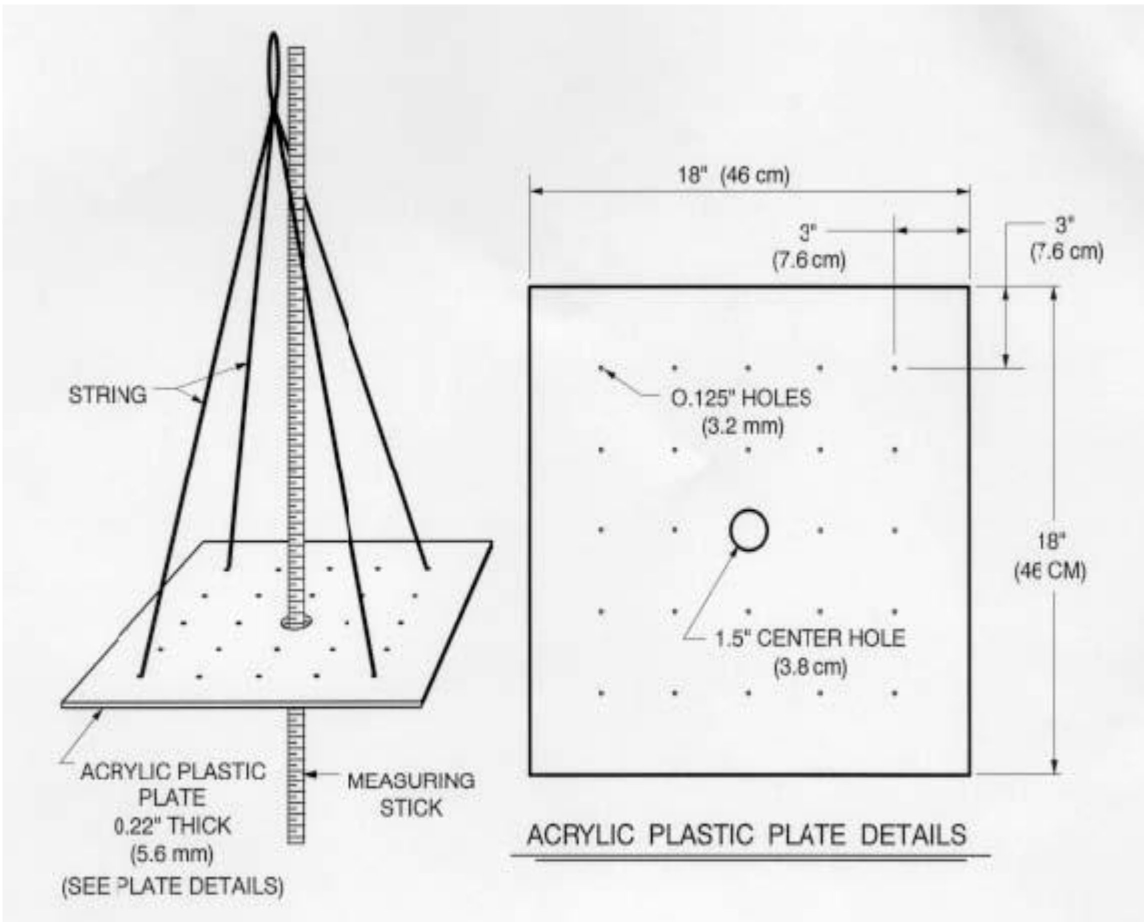

Figure 2.1 A simple design to build your own rising plate meter (taken from Rayburn and Rayburn 1998)

To use the rising plate meter, walk through the paddock and randomly place the tip of the meter stick on the ground and allow the plate to rest on the top of the sward. Record the height at which the plate rests. The more measurements are taken, the more accurate the mass estimation. At least 30 measurements per paddock are recommended (Rayburn and Rayburn 1998).

The rising plate meter has been calibrated on native pastures in Nova Scotia. Firth et al. (2000) tested, calibrated and developed equations for two types of rising plate meters using data collected from several paddocks across Nova Scotia. Table 2.1 shows the results of this calibration work for native pastures in Nova Scotia, comparing the height of the pasture and the corresponding pasture yield at varying times over a season.

Table 2.1 Mean predicted DM yield (kg/ha) of native pastures using a rising plate (Firth et al. 2000)

Plant Height (cm)	Mean Predicted DM yield (kg/ha)		
	May/June	July/August	September/October
5	1440	1350	1370
6	1770	1660	1690
7	2090	1950	1990
8	2390	2230	2270
9	2660	2490	2540
10	2920	2740	2780
11	3170	2970	3020
12	3400	3180	3230
13	3610	3380	3440
14	3810	3560	3630
15	3990	3740	3800
16	4170	3900	3970
17	4330	4050	*
18	4480	4200	*
19	4630	4330	*
20	4760	4450	*

Further testing and calibration of rising plate meters has been done at the Nappan Research Farm (Duynisveld 2003).

The rising plate meter is being used successfully in Australia, New Zealand, Ireland and the United States. With increased research trials, the rising plate meter could become a very effective tool in pasture mass estimation in Atlantic Canada. As with all estimation techniques, it should be used in conjunction with other techniques, and with the producer’s experience and knowledge of the particular pastures and forages.

An example using Table 2.1 to calculate the biomass on a pasture is as follows:

1. The goal is to determine the available biomass in a pasture on June 30th.

2. Using a rising plate meter, the plant height in the pasture is measured 100 times in random locations.

3. Each measurement is recorded and an average height is calculated. For this example use an average plant height of 11.2 cm.

4. Refer to the Plant Height column in Table 2.2 and find the number closest to the calculated average number.

5. Then find the corresponding number in the appropriate month column. In this example the date is June 30th, therefore look under the column marked May/June.

6. The table shows 3170 kg/ha DM is available in the pasture.

Dry Matter Yield by Quadrant Harvest

The accuracy of the visual or 'eyeballing' method and the rising plate meter estimations of biomass can be checked by using DM estimates on 0.25 m^2 quadrants. Mark off 20 x 0.25m^2 quadrants randomly in the pasture. Cut all of the forage near the soil surface and put it into a paper bag. Then dry the samples for one day at 70^oC (160^o F) (Murphy 1994). Multiply the weight (in kg.) of the dry sample by 40,000 to convert the dry weight to kg. of DM yield/ha.

DETERMINING THE BIOMASS AVAILABLE FOR GRAZING

Pasture Entrance and Exit Heights

As discussed in Chapter 1 Plant Growth, in order to maintain a high performing pasture, it is important to manage the grazing duration and rest period. Grazing duration is set by the number of animals, animal intake, size of pasture and amount of available feed. A good way to determine the amount of available feed is to compare the average height of the pasture when the cattle enter the paddock (pasture entrance height) and the average height when the animals leave (pasture exit height).

The following Table 2.2 (taken from Table 2.1) shows the approximate yields of Maritime pastures at different heights at various times during the growing season. The amount of available forage for grazing is calculated by subtracting the amount of forage at the pasture exit height from the amount of forage at the pasture entrance height. An entrance height of about 15 cm and an exit height of 5 cm is a good rule of thumb to follow for a 1 cow/calf pair per acre stocking rate.
It has been found that short, intense periods of grazing are better for forage growth and quality (The Land Conservancy 2008).

The grazing period is so important that if one has to choose between the appropriate exit height and an adequate grazing period, always try to follow the grazing period in order to allow for quick and healthy regrowth. A general 'rule of thumb' is to pasture the animals in a specific area for a maximum of 5 days or shorter in the spring and 8 – 10 days in mid-summer for more uniform plant growth. If you don't reach the adequate exit height within 5 days, you don't have enough animals or the paddock is too big.

Month	Maritime Native Pasture Mass Estimations (kg DM/ha)			
	Plant Height 5 cm	Plant Height 10 cm	Plant Height 15 cm	Plant Height 20 cm
May/June	1440	2920	3990	4760
July/Aug	1350	2490	3740	4450
Sept/Oct	1370	2780	3800	

Table 2.2 Mass estimations of intensively managed Maritime naturalized pasture through the season (kg/ha)

Using Table 2.1 and a pair of boots, a producer can effectively estimate the amount of forage in a paddock. On the leg of a pair of rubber boots, a mark can be made to indicate entrance and exit heights for an average pasture (Figure 2.2). The producer can compare the average growth to the boot marks to easily estimate the biomass of the pasture. The entrance and exit heights will vary with the needs of the species present in the pasture.

Figure 2.2 Boot method of forage assessment

In order to use this method most effectively, the forage estimates should be documented by paddock and compared with more analytical methods, such as using a rising plate meter. There are two additional factors to take into consideration when determining specific paddock entrance and exit heights: plant species and time of year. Different species of pasture plants require slightly different height management (Table 2.3).

Table 2.3 Average recommended management heights

Species	Entrance Height cm. (inches)	Exit Height cm. (inches)	Rest Period Required (weeks)
Tall growing cool season grasses: orchardgrass, smooth bromegrass, tall fescue, timothy, reed canarygrass	20-25 (8-10)	10 (4)	spring 2 summer 4-6
Legumes: alfalfa, alsike clover, landino clover, red clover, birdsfoot trefoil	20-25 (8-10)	10 (4)	3-4
Short growing cool season grasses and legumes: bluegrass and naturalized white clover	10-15 (4-6)	5 (2)	spring 2 summer 4-6

Adapted from Undersander et al. 2002

Adequate rest periods are an essential tool for managing a pasture. The time of year directly influences the duration of the rest period (Table 2.3). Less recovery time is required in the spring than in the hot, dry summer.

Determining Forage Requirements

The forage requirement of an animal is dependent on many factors, including the size of the animal, its stage of production, the quality of the pasture, and environmental conditions. All of these factors are important to consider when budgeting pasture. It is important to know the forage requirement of the animals when designing a grazing system.

The body weight of the ruminant animal is the best predictor of its required forage intake (Blanchet et al. 2003). The following formula can be used to estimate the daily forage requirement of a herd of animals:

(# animals) x (average weight of animals) x (daily utilization rate) = daily forage requirement*

*Blanchet and coauthors (2003) suggest using a 4% daily utilization rate (based on a 2.5 % forage intake, 0.5% trampling loss, and a 1% buffer).

Blanchet and coauthors (2003) also suggest using a balance sheet (Table 2.4) for livestock forage requirements calculations. As an animal is intended to either gain weight, or produce milk or wool, its weight and production will change on a regular basis, requiring monthly forage requirement estimates.

Table 2.4 Forage Requirement Sheet

				Forage Requirements (kg.)		
Kind/Class Livestock	**Number**	**Average Weight (kg.)**	**Daily Utilization Rate**	**1 Day**	**Spring 5 days**	**Mid-summer 8 days**
Beef cow/calf	35	545	0.04	763	3,815	6,104
Herd bull	1	900	0.04	36	180	288
Totals	36			**799**	**3,995**	**6,428**

To achieve the desired production outcome, it is necessary to ensure that the animals are getting the nutrients required. The National Research Council (NRC) publishes tables of animal requirements based on breeds, production system and stage of production. These books are available to read online. Use the book that is applicable to the species you are working with.

The total available forage in a pasture can be determined by using the following formula:

Pasture entrance height – Pasture exit height = total available forage

Then, to determine the length of time a herd of animals can remain on a particular pasture use the following formula:

$$\frac{\textit{Total available forage}}{\textit{Daily requirement of animals}} = \textit{Number of days/hectare animals can remain on pasture}$$

The use of Table 2.2 to predict the DM yield of a native pasture combined with the determination of forage requirements (Table 2.4) provides the producer with a very valuable tool in determining how much land is required to support a particular herd for a set period of time.

A simple log will help with tracking weekly forage estimates (Table 2.5).

Table 2.5 An example of a visual estimates log

Date	Paddock Number	Visual Estimate of days of forage available	Calculated days of forage availability (by DM determination)	Notes
May 31	1	5	3	Cows ran out of forage night before move; moved earlier than estimate
June 3	2	5	4	
June 8	3	5	5	
June 13	4	3	4	

GRAZING SYSTEMS

It is important to review the options for grazing in order to decide which grazing system is best for the situation. Once both the strengths and limitations of available resources have been assessed, the producer can choose which of the three main grazing systems listed below fits their particular farm. Most grazing systems fall under two broad classifications, continuous and rotational grazing (with rotational systems ranging in intensity). These systems are discussed, and it is assumed that controlled grazing is used with every system.

Continuous Grazing

Continuous grazing is a system that has animals grazing on one set pasture for at least six weeks, and can be as long as the entire grazing season (White and Wolf 2000). This system is often used by producers with a relatively large pasture base and low numbers of livestock. Continuous grazing usually results in slightly lower productivity per animal and lower output per unit of land. Due to the inefficient forage utilization that results from this type of system, it is best suited for animals that do not require high maintenance, such as sheep, dry cows, growing heifers, and low-milking ability beef cows.

As with any system, there are advantages and disadvantages to continuous grazing (Table 2.7). Using only one pasture all season long decreases the amount of labour, fencing, and water sources required. The pasture does not need to be monitored as closely and animals selectively graze the most palatable forage, which generally increases gains per animal. However, selective grazing reduces total pasture productivity as some areas are overgrazed while others are hardly grazed at all. Also, because of selective grazing, the pasture can become patchy and vulnerable to drought and weed growth. Forage use can be improved by varying the stocking rate (a "put-take" system) or temporarily fencing off part of the pasture for mechanical harvest ("buffer" system).

Buffer/Put and Take

Buffer, and put and take are terms used for systems for controlled continuous grazing that incorporate ideas from rotational grazing into a continuous system.

Buffer System

The buffer system uses a large pasture with a mobile fence that adjusts the size of the paddock to manage the amount of grass the livestock has access to (Figure 2.3). If the pasture has a large quantity of high quality forage, the mobile fence can be adjusted to keep the animals in a smaller area in order to reduce the amount of forage being wasted. Likewise, if there is a low volume of forage, the fence can be adjusted to allow the animals to graze a larger area.

The buffer system requires less management than a rotational system, but provides greater utilization of the available forage than with continuous grazing. The disadvantage is that it does not give you as much control as with a rotational grazing system.

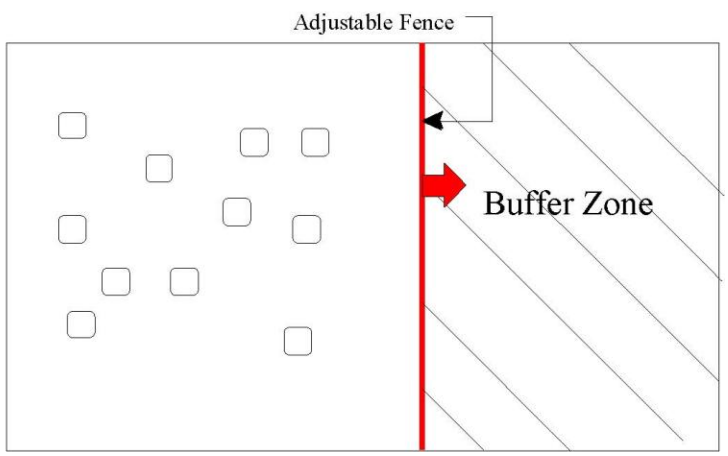

Figure 2.3 Buffer system; the fence can be moved back or forth as more or less forage is required

Put and Take System

A put and take system adjusts the stocking rate in any given pasture to ensure optimum grass utilization (Figure 2.4). For example, in the spring, a pasture may have an abundance of high quality forage. In the put and take system, the stocking rate would be increased in the spring when there is an abundance of high quality forage. Likewise, when the pasture decreases in productivity, some of the animals will be removed so the pasture is not overgrazed.

The advantages to this system are that no extra fence is required and less planning is required than with a rotational system. The major disadvantage to this system is the transportation of animals from pasture to pasture or alternate location when they are removed from the pasture. It also requires closer management of animals than in a continuous system.

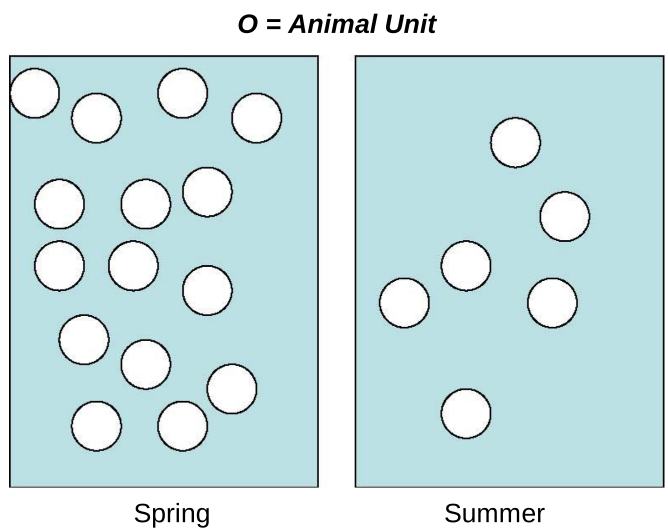

Figure 2.4 Put and take system; adding or removing livestock as required

Rotational Grazing

The most basic definition of rotational grazing is the grazing of two or more paddocks of pasture in sequence, with the main purpose to give pastures an adequate rest period for plant recovery. Adequate rest periods are an essential tool for managing a pasture for productivity. The time of year directly influences the duration of the rest period (Table 2.3). Obviously, two paddocks will not provide an adequate rest period and will stress the plants in use by grazing the regrowth too quickly. Increasing the number of paddocks to at least six will provide the rest periods to maximize production.

In an acceptable rotational grazing system, animals are moved from each paddock after a length of time determined by the rate of pasture growth and sward height. However, this is oversimplified, as there are varying degrees of intensity that can be used to better fit the grazing system's requirements (Table 2.6).

Table 2.6 Types of Rotational Grazing

Type of Grazing	Comments
Rotational grazing	Livestock graze six or more paddocks in sequence; this occurs several times though the season.
Management Intensive Grazing (MIG)	An intensive rotational grazing system in which the grazing period can be as short as 12 hours, allowing much higher forage utilization and providing high quality forage. Most commonly used in dairy cow grazing systems.
Leader-follower grazing	The leader group grazes an area first, usually for a short period grazing the tops of the forage. The follower group grazes directly after the leader group and finishes grazing the paddock to the desired height. The leader group is comprised of livestock with high nutrient/DM requirements, while the follower group requires much less. Examples: lactating dairy cows as leaders with heifers/dry cows as followers; growing steers first followed by ewes with lambs.
Forward creep grazing	A type of leader-follower system used with females with their young. The forward fence is kept high enough for the young to easily travel under it so that they have access to fresh forage, but the mothers cannot access the area.

Adapted from Gerrish and Roberts (1999)

Other types of grazing usually rotationally grazed in this region but do not have to be are:

Type of Grazing	Comments
Mob grazing	A very large group of livestock purposely placed in an overgrown paddock and not removed until it is grazed down evenly. Mob grazing can replace clipping.
Strip grazing	Livestock are given a narrow strip of pasture, enough for 0.5 to one day, with a front and back fence. The forage is of high quality, there is little waste, and utilization rate is enhanced. This system minimizes the amount of time grazing and maximizes the rest period length. Strip grazing is ideal for annual crops such as grazing corn and brassicas as it will minimize wastage. No further grazing is anticipated for crops such as corn, hay fields or brassicas. If re-grazed, it would be a rotational system.
Mixed grazing	Different species of livestock grazing either together or in a leader-follower grazing system; relies on different livestock species selectively choosing different plants or portions of plants to graze. Example: sheep and cattle.

Adapted from Gerrish and Roberts (1999)

Rotational grazing enables the livestock producer to provide the animals with economical, high-quality feed. Like continuous grazing, the management of rotational grazing carries both advantages and disadvantages.

Table 2.7 Advantages and Disadvantages of Continuous and Rotational Grazing

	Type of Grazing	
	Continuous Grazing	**Rotational Grazing**
Advantages	• Low fencing costs • Low daily management • Good animal gain if stocking number correct • Low labour requirements	• More uniform seasonal forage production and quality • More control over animal intake • Higher forage yield and quality results in healthier, more productive livestock • Closer watch on animal health • Effective, efficient manure management • Good ground cover helps control soil erosion and weeds
Disadvantages	• Little control of the grazing intensity and timing • Decreased gains when overstocked • Often results in poor forage utilization • Lower forage production when overgrazed • Less uniform forage quality • Weed proliferation • Selective grazing can result in patchy pastures	• Higher management requirements to coordinate forage production with animal production • Higher fencing and watering costs than for continuous grazing • Higher labour requirements: moving fencing, water sources

The major advantage in a rotational grazing system is the more uniform seasonal forage productivity and resulting increased carrying capacity. Also, the manager has more control over weeds, forage species, animal health and the fertility of the paddock. The biggest disadvantage is the increase in labour required to maintain the system since the pastures will need to be checked and the livestock moved more often. However, once the system has been in place for several weeks, both the producer and the livestock become accustomed to it, and the livestock are easily moved to the next paddock. A side benefit of this system is the livestock will become easier to handle in general, i.e. for weighing, vaccinating, etc. Drawbacks include the initial capital cost of fencing and watering systems.

Rotational grazing also requires additional planning in order to determine the paddock size, position and gate sites, stocking rate, and timing of movement through the sequence. Timing is dependent on a number of things such as the stocking rate and the quality and quantity of forage. However, the key component in determining the movement of animals from one paddock to the next is accounting for the rest period required for grass regrowth. The rest period varies primarily by the time of year but can also vary depending on the type of forage. Typically the amount of time for a paddock to recover in the Maritime region is approximately 15 to 20 days in the spring and about 35 to 45 days in the summer. Pasture masses range anywhere from a maximum yield of 3600 kg/ha in the spring to as low as 2400 kg/ha by the end of fall. Table 2.8 gives estimates of Maritime native pasture masses.

Determining the numbers of animals to be grazed beforehand is also essential information for designing a rotational grazing system. The following is an example provided by Firth (2001) which illustrates how to determine the number of paddocks needed and how often cattle will have to be moved, given a desired number of animals and rate of gain.

Table 2.8 Maritime Native Pasture Mass (kg DM/ha.) Estimations Throughout the Season

Month	**Maritime Native Pasture Mass Estimations (kg DM/ha)**			
	Plant Height 5 cm	**Plant Height 10 cm**	**Plant Height 15 cm**	**Plant Height 20 cm**
May/June	1440	2920	3990	4760
July/Aug	1350	2490	3740	4450
Sept/Oct	1370	2780	3800	

As a general rule, 55 lactating dairy cows or 60 cow-calf pairs will consume 1 acre/day. These are estimates; it is best to determine the actual length of stay as shown in the following example.

Example: To determine the number and size of paddocks required as determined by animal units (AU) and rate of gain.

There are 25 beef cow-calf pairs and the desired gain is at least 1.0 kg/day. A goal of 550 kg/ha with a stocking rate one cow-calf pair/acre has been set. The grazing height entry is 12–15 cm (5-6 in) with an exit height of 5 cm (2 in.).

Step 1: Determine the animal requirements on pasture.

Cow: 600 kg animal x 1.8% utilization rate = 11 kg DM/day required

Calf: 180 kg animal x 3.0% utilization rate = 5.5 kg DM required

Total DM/day/pair = 16.5 kg.

Step 2: Determine how many cow-calf pairs will graze and set the total days per paddock:

Days in paddock = 5

Total number of cow-calf pairs = 25

Step 3: Using the Maritime pasture mass estimations from Table 2.8, determine the total amount of grass available.

In July, 15 cm grass will yield approximately 3740 kg. DM. Using an exit height of 5 cm., this leaves 1350 kg DM. Therefore the total amount of DM available is 3740 kg. – 1350 kg. = 2390 kg.

Step 4: Calculate the amount of DM required per paddock:

(5 days in paddock x 25 pairs) x 16.5 kg. DM/day/pair = 2060 kg. DM required/paddock

Step 5: If 2060 kg./paddock is required to support the desired number of animals for a set time, and approximately 2390 kg. are available per hectare in July, each paddock will need to be: 2060 kg./2390 kg/ha. = 0.85 ha/paddock.

Step 6: The total number of paddocks required for this rotational system would be based on the number of days a paddock is grazed and the rest period required after. In the spring, at least 15 days is required for grass to recover. Therefore, at a 5-day duration in each paddock and 15-day recovery: 15 days / 5 days / paddock = 3 + 1* paddocks in the spring. In the summer, at least 35 days recovery is required: 35 / 5 = 7 + 1* = 8 in the summer.

* In order to ensure the recovery period is adequate, it is good practice to have one extra paddock in your rotation therefore the total number of paddocks required for this system is 8 (Figure 2.4).

However, this calculation produces an estimate: it is important to be flexible and to monitor your pastures and animal health to ensure that your system is providing what is required for your animals. In the spring, the extra paddocks will not be needed for pasture, so they can be harvested for silage or hay, and can enter the pasture rotation later in the season.

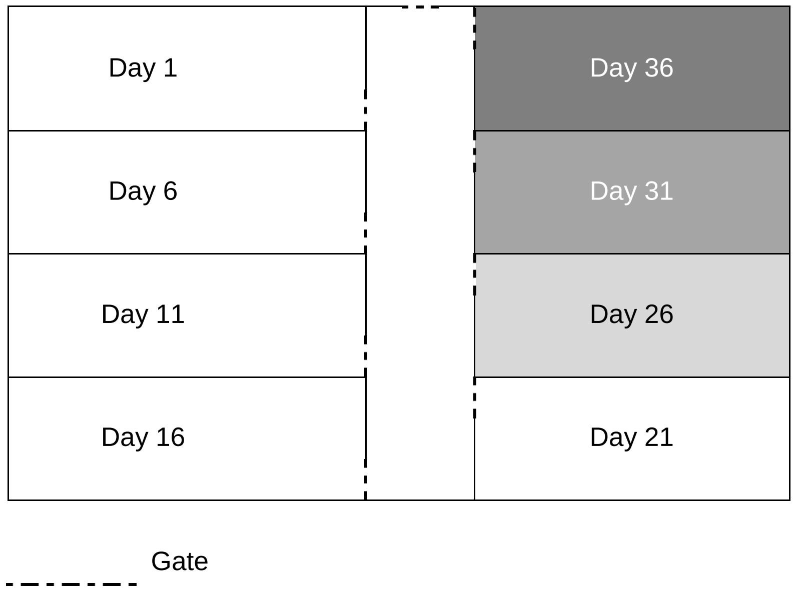

Figure 2.5 An example of a set of eight paddocks in a rotational grazing system. The grayed areas are extra paddocks that should be harvested for stored feed in and used in the pasture rotation when needed.

Designing a Rotational Pasture System

In designing paddocks there are some important factors to consider (Table 2.9). They include topography, soils, forages, water and shade, shape of paddock, paddock orientation, gates and laneways and pasture maintenance (Undersander et al. 2002). The most important asset in designing paddocks is lessons learned from experience and knowledge of the land. Other farmers' experience and advice can provide considerable assistance in fine tuning plans for a grazing system.

Guidelines for paddock layout and design (Bartholomew 2004, Emmick and Fox 1993) to keep in mind are:

- Keep the system as flexible as possible.
- Design on paper first.
- The greater the number of paddocks in a system, the greater the efficiency of forage utilization.
- The best utilization occurs when pastures are no greater than four times longer than wide. The closer the paddock shape is to square, the better. A square shape increases the animals' use of forage.
- All paddocks in the system should be able to produce approximately the same amount of forage so that fewer adjustments need to be made.
- Fencing should be inexpensive and easy to manipulate (electric is both).
- Always give hilly land special consideration. South facing slopes will likely give earlier growth and should be rotated first.

- When slopes are greater than 15%, fence so that livestock will graze on the contour. Paddocks that run up and down steep slopes with the water source at the bottom orientation will have overgrazing at the bottom of the slope and undergrazing at the top.
- Establish laneways on higher, drier land.
- Group plants with similar maturity in the same paddock where possible. Consider varying maturity of some paddocks to better handle growth rates.
- Don't clip unless required to maintain forage quality.
- Allow for extra grazing land close to the paddock system to ensure that there will be extra feed if needed (eg. hayland).
- Place gates in the direction of the natural movement of the herd as they travel to and from the water source. Generally, gates should be in the paddock corner closest to where they need to travel.
- The more accessible the water source - the better: with guidelines of a water source every 500 ft for dairy cattle and 1000 ft for all other livestock.
- Limit livestock access to streams and low banks.

Properly located and constructed laneways and gateways are critical to good rotational pasture management systems. The laneways must be designed to allow for livestock movement directly from one paddock to any other paddock or the barn without moving back through a paddock. Laneways are also used by the livestock to access a water source. Laneways should be built on higher and drier soils and should follow the contour of the land to help prevent erosion (Ohio State University 2008). Livestock will follow the contour rather than walk up and down a hill. The Manitoba Forage Council (2008) recommends laneway length be minimized and the laneways be five to seven meters (16-24 feet) in width. These dimensions will help reduce the amount of damage to the laneway and discourage loafing by the livestock. Blanchet and coauthors (2003) recommend the use of fine textured materials on top of the laneway to help prevent the development of mud holes. Caution: some coarse textured materials may cause injuries to feet of the livestock.

The livestock and frequency of movement are also important to remember when designing laneways. The laneway must be built in accordance with the livestock use and intensity. The greater the frequency and intensity of use, the more durable the lane way will need to be. For example, milking cows may need to move from one area to the barn twice per day while beef cattle will not. (Undersander et al. 2002).

Gates should be located in the paddock corners closest to the barn or the next paddock in sequence. They should be situated so as to lead the animal in the direction you want them to move. The size of the gate is also important to consider as moving large groups of animals through small gates can be difficult (Ohio State University 2008). Gates should be wide enough to allow the passage of farm machinery.

As with all grazing systems, the rotational system has its advantages and disadvantages. However, the rotational system can be incorporated and managed effectively on all types of grazing livestock farms. Table 2.9 discusses potential factors that may be faced when designing a rotational grazing system. It compares suggestions offered by three different resources.

Table 2.9 Paddock Design Factors

Factor	Undersander et al. (2002) recommendations	Blanchet et al. (2003) recommendations	Emmick & Fox (1993) recommendations
Topography	• Separate different slopes into different paddocks. • Fence hillcrest and valley separate from slopes.	• Each paddock should have similar topography.	• Do not combine steep hills and flatlands in the same paddock.
Soils	• Different soils will have different productivity.	• Paddocks should group similar soils.	• Combine similar groups of soils as much as possible.
Forages	• Coordinate different forage growth rates with time of year and soils.	• Including similar forage types helps management.	• Combine similar groups of forages as much as possible.
Water	• Water must be accessible from all paddocks.	• Put a water source no more than 800 ft from where the livestock graze to encourage water consumption.	•Dairy should have water source every 500 ft. •Other animals should have water source at least every 1000 ft.
Shade	• Fence shady and sunny areas separately.		• Unless there is extreme temperature, not needed.
Shape	• Square or rectangular paddocks are not the best choice for hilly and non-uniform land.	• Paddocks should be as square as possible.	• Should be as square as possible.
Orientation	• Run paddocks across the contour.		• Do not run paddocks up and down hills.
Gates and Laneways	• Gates should be located closest to the barn. • Laneways should be placed on higher ground.	• Lanes connect all paddocks to allow for flexibility in forage management.	• Gates located in the corner closet to the barn. • Laneway wide enough to get machinery through as well as livestock.
Maintenance	• Set aside larger open areas for hay-making when pasture is plentiful (spring).		• Clipping should be done if necessary. •Dragging the manure may be required.

Evaluation of Continuous and Rotational Grazing on Native and Improved Pasture for Beef Production

A study demonstrating pasture management techniques to enhance forage yield and to compare animal productivity on native grass and seeded legume-grass pasture mixes was conducted on a community pasture in Cape Breton in 1990 and 1991. The study compared a continuous grazing system on native pasture, a rotational grazing system on native pasture, and a rotational grazing system on an improved pasture using an orchard grass/meadow fescue/white clover mix. Animal production data was collected and general forage quality trends were assessed (Cummings 1991).

Each of the three pasture sites supported approximately the same number of beef cattle at the start of the season. However, as the season progressed, the number of cattle had to be decreased on the continuous and native rotational grazed pastures, but was increased on the improved pasture rotationally grazed.

The two rotational grazing systems resulted in higher animal and forage productivity than the continuous grazing system. The rotational grazing system on the native pasture had higher average daily gains (ADG) and total beef production than the continuous grazing on the native pasture even though the carrying capacity was lower with the rotational grazing.

Rotational grazing on the improved pasture gave higher ADG, forage yield, forage quality, total beef production and carrying capacity than either the rotationally grazed native pasture or the continuously grazed native pasture.

In this comparison of continuous and rotational grazing systems, the rotational system yielded the best animal and forage production.

Final Remarks

The best choice of grazing system depends on the land resources, the livestock and the availability of time and money. Records of animal and pasture measurements and observations will provide valuable information when evaluating your current grazing system or when planning changes. Designing an optimal system can make a farm more productive and profitable.