Factors influencing livestock behaviour and performance

RANGELAND HEALTH BROCHURE 8

BRITISH COLUMBIA

Contents

Citation:

Fraser, D. A. 2004. Factors influencing livestock behaviour and performance. Forest Practices Branch, British Columbia Ministry of Forests, Victoria, B.C. Rangeland Health Brochure 8.

URL: http://www.for.gov.bc.ca/hfp/range/range.htm

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Cattle graze most efficiently when grass is about 15 cm high.

Forage selection

Grazing animals are selective in their eating, and this dietary selection is modified by plant morphology (thorns, thick cuticle, etc.), the presence of secondary compounds, and past experiences. Palatability, preference, and species differences play a role in determining which forages are selected preferentially, secondarily, or not at all.

Palatability is affected by fibre content, bitterness or sweetness, and water content. Simply stated, livestock prefer green material over dry material, and leaves over stems. They will select foods that have the most pleasing texture to the mouth.

Stemmy grass.

Preference is modified by previous experience. Grazing knowledge is acquired at an early age as young animals observe their mothers and other adults. This means that dietary training is possible. In Montana, for example, managers experimenting with sheep to control leafy spurge and tall larkspur have found that trained animals will actually graze these species preferentially once they have acquired the taste.

Young animals learn about grazing and what is good to eat by observing their mothers.

Species differences. There are distinct differences in forage selection among species of herbivores. In general, cattle and elk prefer grass, domestic sheep and pronghorns prefer forbs, while domestic goats and deer prefer woody browse (shrubs). Diet compositions change seasonally as different forages become more or less available, but these herbivores follow the overall pattern. Often by eating a variety of foods, the herbivore maintains a well balanced diet, since deficiencies in macronutrients, micronutrients, protein, or energy in one forage species will often be compensated for by another forage species.

A fertilized crested wheatgrass pasture.

Range management techniques can improve forage quality

Range management techniques can be used to reduce selective grazing behaviour and provide superior-quality forage. A monoculture such as crested wheatgrass is easy to manage because it is uniform and selectivity is reduced; application of fertilizer increases the leaf:stem ratio and water content, therefore making it more palatable and preferable.

Animal unit month equivalencies

An animal unit month (AUM) is the quantity of forage consumed by a 450-kg cow (with or without calf) in a 30-day period. The AUM is the metre-stick we use to gauge forage consumption by herbivores.

One animal unit.

Mammals consume forage in relation to their body weight. Lactating females and young growing animals have high energy requirements.

Mammals consume forage in relation to their body weight, but the relationship is not linear since efficiencies are gained with increases in size. The following table summarizes the animal unit month equivalencies for different sizes and species of herbivores. Lactating females, male cervids growing antlers, and young animals experiencing rapid growth will have elevated consumption rates in order to meet these high energy and protein demands. During winter, when forage/browse is often limiting in quality and quantity, herbivores will often reduce activity levels, consume less forage, and draw upon fat reserves.

In some cases, herbivores, especially horses, will survive periods of low forage quality by increasing their consumption and digestion/passage rates of low-quality forages. Ruminants, because of their four-chambered stomachs, do not have the same capacity to increase their digestion and passage rates and this becomes a major limiting factor. Ruminants may compensate by selecting for a higher-quality diet during periods of scarcity.

Horses have a faster digestion and forage passage rate than cattle and can thrive on poorer-quality forage.

177 ground squrrels are equal to one animal unit.

Table 1 Animal unit (AU) equivalencies according to body weight. Daily intake is in kilograms of dry matter per day. Column 6 takes losses due to trampling, fouling, grazing, and insects into account.

Animal	Weight (kg)	AU equiv.	No. per AU	Intake (kg/day)*	Forage use (kg/day)*
Cow	450	1.0	1	10	13
Cow	680	1.4	0.74	14	18
Heifer	320	0.8	1.25	8	10.5
Bull	770	1.5	0.7	15	19
Horse	600	1.2	0.8	12	15.5
Sheep	55	0.2	5.0	2	2.5
Pronghorn	55	0.2	5.0	2	2.5
Deer	70	0.25	4.0	2.5	3
Elk	275	0.7	1.4	7	9
Ground squirrel	0.5	0.006	177	0.06	0.07
Jack rabbit	3	0.024	42	0.2	0.3

* Expressed in dry matter

A cattle herd during a grazing period.

Moderate slopes along the Beaton River breaks.

Behaviour

Where livestock use has led to site deterioration or conflicts with other resource users, the problems can generally be traced back to a failure to take livestock behaviour into consideration during the initial planning. Grazing animals are creatures of habit, using the same camps (collections of feeding sites that share common drinking, rest, and shelter spots) and home ranges year after year, often leaving as much as 65% of available pasture untouched. Herds will also establish home ranges and will not deviate from them.

Generally, cattle are reluctant to graze on slopes exceeding 15% and, in rolling terrain, will rarely feed at elevations greater than 70 m above water. However, in mountainous parts of British Columbia, experienced animals are known to graze readily on 60% slopes, where they have road and trail access into these areas

Cattle are also limited by horizontal distance from water, rarely grazing further than 2.5 km from it. This leads to the

Steep slopes in the subalpine.

classic bull's eye pattern of grazing where forage use is heaviest at the water source and decreases in concentric circles away from it. Herding can be used to ensure better distribution, but the greater travel distances and rougher terrain will come at the expense of an increase in expended energy.

Tables 2 and 3 are general guidelines for determining stocking rates where minimum livestock management is being employed.

Table 2 Suggested reduction in cattle carrying capacity according to percentage slope

% slope	% reduction in carrying capacity
0–10	0
11–30	30
31–60	60
>60	100 (ungrazable)

A series of terraces in the grasslands zone of British Columbia.

Sheep are better able to utilize more rugged terrain than cattle. Sheep show more reluctance to graze areas having natural cover for predators in the form of bush or topographic relief. They will readily walk from 3 to 5 km for water, but travel distance comes at the expense of energy (weight loss).

Generally, cattle require from 40 – 50 litres of water per day on average, but may require up to 150 litres per day when weather is hot and forage is dry. Sheep require from 7.5 – 10 litres of water per day, while horses require from 60 – 75 litres per day.

Livestock grazing is usually concentrated close to water sources.

Table 3 Suggested reduction in cattle carrying capacity according to distance from water

Distance from water (km)	% reduction in carrying capacity
0–1.5	0
1.5–3	50
>3.0	100 (ungrazable)

Shade and thermal cover

Livestock will seek shade during hot periods of the summer, resulting in disproportional use of forest and streamside areas. Livestock will usually over-use dry southern exposures early in spring and then switch to riparian and shaded areas during hotter times of the year.

Range improvements and grazing systems are often attempts to control livestock behaviour. Fencing, salting, herding, and water development can lead to more uniform livestock distribution. Systems are designed to control timing, intensity, and frequency of grazing on individual plants.

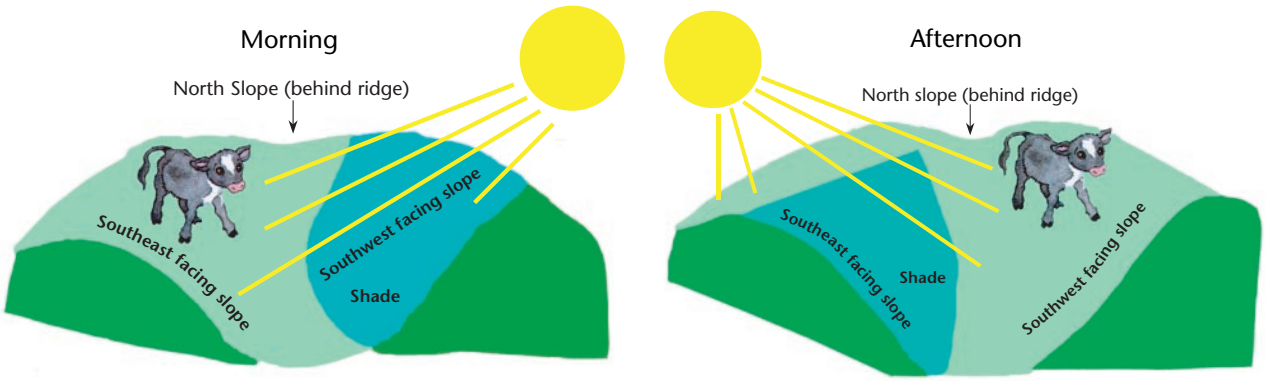

Figure 1 The effect of slope and aspect on livestock distribution. Morning: southeast-facing slope receives the morning sun and will warm sooner in spring and have the earliest growth. Afternoon: southwest-facing slope receives afternoon sun and dries out first as the season progresses.

Cattle resting and ruminating in a streamside riparian area.

A lactating cow with a very large calf in late summer.

An efficient grazer.

Grazing

A number of factors affect the foraging time and diet selection of grazing animals.

Cows that are pregnant or lactating require more food energy than animals that are not. They must therefore spend more time grazing to meet their nutritional needs. Calves will need to spend more time grazing as their mother's milk supplies cease to meet their needs.

The amount and location of preferred food will also affect time spent grazing. The cow takes between 30 and 90 bites per minute and, moving its head from side to side in an arc, can bite continuously for up to 30 minutes. Cattle use their tongues to gather plants into the mouth before shearing of the plants and, as the grass gets shorter, they have to work harder to gather a mouthful. Cattle are at the peak of harvesting efficiency when forage is about 15 cm in height and they can eat up to 70 kg of fresh grass per day. If forage is only 1 cm high, daily intake can be cut to 14 kg of fresh grass. An animal on poor range with short and widely spaced forage plants will have to take more bites, travel farther, and graze longer in order to meet its daily requirements. In doing so, it will have expended more energy in acquiring food.

Voisin, a researcher in France, found that cattle would rarely graze for more than 9 hours in a 24-hour period. Studies in drier regions of the United States, however, show that cattle will, at times, graze for up to 13 hours per day. Cattle will ruminate from 5 – 9 hours per day, depending on the fibre content of the forage they are consuming.

Rumination developed as a predator evasion strategy. According to Voison, cattle experience a sense of well being from rumination. He recommends supplying hay or straw when pastures are lush and green in order to increase rumination time, slow forage passage rates, and pacify livestock.

Cattle ruminating during the heat of the day.

Cattle grazing in fall. Calves have been weaned and cows are well distributed.

A large European breed.

What makes a good grazer?

The speed at which an animal eats will also affect grazing time. Fast eaters can spend more time relaxing in shelter from the elements and predators. Animals that have larger mouths can select larger bites of food and therefore eat faster. Species with smaller mouths, such as sheep, pronghorn, and deer, can be more selective in what they eat.

Certain breeds are better adapted to graze rough topography than are others. Unfortunately, our livestock breeding programs have often selected for animals that do well feeding in a dry lot but not so well on open range. We have selected for docile animals that are easy to handle. These domestic traits unfortunately make for poorer rustlers (foragers) that will not travel far from water holes nor graze rugged terrain. Producers can, however, reverse the trend by selecting animals that show preference for rugged areas while still producing a good calf.

Many European cattle breeds came from areas where annual rainfall was close to 100 mm. Their large body size and superior milk production was suited to an abundance of easily accessible forage. Rangeland conditions and rainfall (20–45 cm) in British Columbia do not supply such readily abundant forage. These may not be the best breeds for our ranges.

Grazing periods

Figure 2 illustrates how grazing, resting, and ruminating times vary seasonally in the northern hemisphere.

Livestock adjust their periods of grazing according to weather conditions and day length. Periods of extreme cold or extreme heat may cause animals to alter their periods of activity. They may seek shelter or shade to maintain their body temperatures with the least possible stress.

Most grazing occurs around dawn and dusk. Cattle may graze through the night during full-moon periods. At higher latitudes, grazing may continue all day as daylight hours shorten. On the other hand, livestock in warmer climates may feed all night in order to avoid mid-day heat.

Changes from normal grazing behaviour can alert the producer that something is wrong. Livestock that are cropping grass very closely and grazing actively during mid-day are probably lacking adequate forage in terms of quantity, quality, or both.

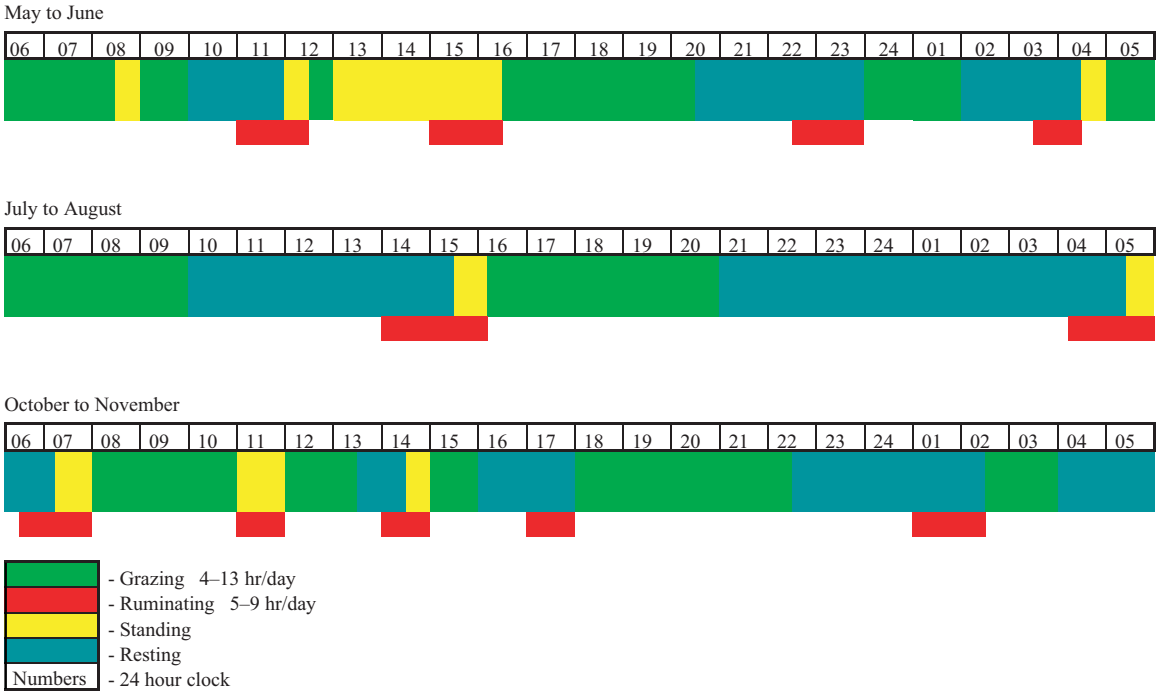

Figure 2 Grazing, ruminating, and resting times in the northern hemisphere.

Cattle are easily spooked by predators, especially bobcats, cougars, and lynx.

Cattle on a daily exploration.

Livestock will often change their behaviour when placed in large herds or onto new range. They will disperse and move through a field rapidly as they compete with other animals in the herd. This can lead to better overall utilization of forage, but can also lead to excessive trampling and lost forage during dry conditions.

If dogs, predators, or unfamiliar people disturb livestock, they will often investigate the intruder and then return to grazing, or begin a new grazing period if they had been resting or ruminating.

It is also common for cattle to go on a daily exploration of a portion of their grazing area. This activity seems to have nothing to do with grazing, but often is linked to the noon activity period, or to the time when they go to water. It is usually during this activity period that cattle will find open gates, move themselves to new pastures, and find new foraging areas.

The manager who becomes familiar with these distinct patterns of grazing, ruminating, resting, standing, watering, and exploring can time livestock moves so as not to disturb the daily pattern. For example, the best time to conduct a livestock move is just prior to major foraging periods, when most of the animals are standing and beginning to move around.

Table 4 summarizes the energy costs of various activities for sheep and cattle. Lactation is the single most costly activity, but time spent grazing and moving (especially running and climbing) also have a significant effect on daily energy expenditure (DEE).

Environmental factors

Environmental conditions affect an animal's daily energy requirements (Table 4). A thermo-neutral zone exists in which an animal can maintain its body temperature without an associated metabolic response. Factors such as temperature, wind speed, and moisture can cause stress by shifting the animal outside of this zone of comfort (or critical thermal environment).

The animal responds behaviourally, physiologically, and morphologically to environmental stresses. Behavioural responses (e.g., seeking shade or shelter from wind) allow short-term modification to a stressful environment. Physiological and morphological responses allow animals to adapt to seasonal extremes, and therefore take longer to express themselves.

Elk resting and ruminating in the shade.

The riparian area has water, shade, and hiding cover.

Behavioural responses

Studies have shown how temperature, wind speed, and precipitation affect grazing behaviour in sheep and cattle. Generally, animals will shift grazing periods and alter total grazing time in order to avoid extremes in heat or cold. Changes in barometric pressure and resulting weather changes will also trigger changes in animal movement and foraging activities. Reduced grazing time is often made up for by an increase in bite rate.

Cattle on range during a late fall snowfall.

During extreme heat, livestock will graze during early morning and late evening, seek shade during the hottest part of the day, and walk long distances to obtain water.

During extreme cold, animals may attempt to minimize energy losses by seeking thermal cover, lying down, orienting their bodies towards the sun, and remaining inactive. Thermal cover, in the form of natural relief or trees, reduces heat loss due to radiation and wind. Research has shown

that sheep lying down experience 20% less heat loss than sheep standing up. Positioning of the body to maximize exposure to the sun also helps to reduce heat losses. The cost of grazing activity may exceed the nutritional value of forage harvested under cold conditions, and animals may compensate by remaining inactive. Feeding periods may also be altered to coincide with periods of maximum sunshine.

Physiological responses

During extremely hot weather, animals lose heat through sweating, panting, and re-radiation. Panting costs an additional 7–25% over resting metabolism, and water consumption must increase in order to replace the fluids lost during this process. Food intake is consequently reduced due to the distention caused by water intake, and overall production declines accordingly. Large animals are capable of increasing their body temperature slightly during the day and radiating this extra heat by night; small animals do not have this luxury.

Animals respond to cold stress by increasing metabolic rates once a lower critical temperature is reached. In order to meet this additional energy demand, they must increase forage intake or burn fat and protein reserves. During cold weather, forage digestibility is reduced and livestock may compensate for this by increasing passage rates and consumption.

Winter grazing of sedge meadows by cattle and horses is common in central and northern British Columbia. Deep snow can be a limiting factor.

Table 4 also lists the energy costs of ambient air temperature and wind speed under dry and wet conditions. In making these calculations it is assumed that animals are in satisfactory body condition and that wind, air temperature, and moisture have additive effects on energy expenditure. With calm and dry conditions, cattle have a critical temperature of –20° C. With calm and wet conditions, cattle have a critical temperature of –7° C. Sheep experiencing dry and calm conditions have

Table 4 A summary of energy expenditure for sheep and cattle experiencing different activities and different climatic factors

Variable	Sheep (45 kg)	Cattle (450 kg)	References
Lactation	No data	26.2 Mcal/day	Sanchez and Morris 1984
Post weaning	1.5 Mcal/day	12.6 Mcal/day	Osuji 1974
Activity			
Standing	4.05 kcal/hr	40.5 kcal/hr	Crampton and Harris 1969
Walking	26.55 kcal/km	265.5 kcal/km	Clapperton 1961
Vertical ascent	29.25 kcal/m	292.5 kcal/m	Clapperton 1961
Walking 10% grade	55.8 kcal/m	558 kcal/m	Moen 1973
Grazing	27.9 kcal/hr	279 kcal/hr	Osuji 1974
Ruminating	10.8 kcal/hr	108 kcal/hr	Graham 1964
Climate			
Air temperature	Mcal/day	Mcal/day	
+35°C	1.56	8.5	NRC 1981
+30°C	1.3	7.3	Collier and Beed 1985
+15 to +25°C	1.25	6.8	NRC 1981
–3°C*	1.25	6.8	Blaxter 1977
–10°C	1.31	6.8	NRC 1981
–20°C**	1.41	6.8	Webster 1974
–30°C	1.53	9.8	NRC 1981
Wind speed	Mcal/day	Mcal/day	
(Dry conditions)	–20°C –30°C	–20°C –30°C	
0 km/hr	1.41 1.53	7.1 9.8	NRC 1981
6 km/hr	1.58 1.7	7.1 10.2	Webster 1974, 1976
13 km/hr	1.65 1.77	7.2 11.0	Webster 1974, 1976
16 km/hr	1.74 1.86	No data	Ames and Insley 1975
26 km/hr	1.77 1.89	7.3 11.6	Ames and Insley 1975
(Wet conditions)		–7°C 5°C –20°C	
16 km/hr	No data	6.8 9.4 11.1	NRC 1981

* Critical temperature for sheep under dry conditions.

** Critical temperature for cattle under dry conditions.

a critical temperature of –3° C. With cool and wet conditions, the DEE of sheep is increased by 0.9 Mcal/day; a wind speed of 10 km/hr would increase the DEE by an additional 0.33 Mcal/day.

Sheep on a seeded pasture.

Morphological responses

The amount of heat loss depends on the gradient between the body core temperature and air temperature, and the insulation provided by hair and tissue. Thicker hair coats and increased deposits of subcutaneous fat reduce body core heat losses during cold weather. This outer coat is shed for a thinner coat during spring. In Table 4, it is assumed that sheep and cattle have winter coats of 100 mm and 30 mm thick, respectively.

Animals accustomed to warmer climates typically have lighter-coloured, more reflective coats. Zebu cattle deposit less subcutaneous fat and commonly have lower metabolic rates and lower productivity than European breeds.

Management implications

Following are general recommendations for consideration by livestock managers.

A. Achieving better distribution

1. Through better herd management
    - herding rather than using passive management
    - moving animals just prior to major grazing periods (times when they are normally standing, exploring, or moving to water)
    - culling stock that do not distribute well (particularly high-ranking animals)
    - moving animals to new areas and holding them there until they imprint
    - training animals to move using whistles, signals, or rewards
    - providing salt or minerals as a reward and not as a free choice

Fence.

Water developments.

Domestic forage seeding.

Mineral lick.

2. Through strategic use of developments
    - fence placement
    - new water development (or by denying access to sources in over-used range)
    - prescribed burning to attract more livestock to secondary range
    - fertilization of domestic forages to give higher leaf:stem ratios
3. Through development of new grazing systems
    - creating separate riparian pastures
    - creating pasture units that are relatively homogeneous
    - utilizing winter grazing areas with no surface water and relying on snow as a water source for cattle

B. Reducing the animal's daily energy expenditure (DEE)

1. By providing access to shelter and shade in the form of trees, natural relief, or cattle shelters in each pasture unit. Shelter from wind becomes even more crucial during wet and cold conditions. Where possible, animals should have access to shelter from wet snow.
2. By reducing disturbances during periods of cold and hot weather in order to allow animals to adapt to stress.
3. By providing adequate watering sites with high-quality water per pasture, allowing animals to expend less energy in travelling to and from water.
4. By grazing pastures to a moderate level in order to reduce the amount of time livestock spend grazing by as much as 2.4 hours per day.
5. By providing free-choice straw on lush pasture to increase the herd's ruminating time. This helps to slow down the forage passage rate through the digestive system and leads to better overall production. The increased rumination time also has a calming effect on the animals.
6. By selecting livestock breeds that are better adapted to our climate, vegetation, and topography. Breeds that are high-volume milk producers need to have access to a high quality/quantity of forage during lactation; this is not always possible on native range, but may be possible if a combination of domestic forages and native range is used. Some breeds and individuals are better rustlers.
7. By separating and weaning calves in early September when forage quality and availability is dropping. This will lead to a substantial drop in DEE for cows, and will allow them to enter winter in better condition.

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