AN EVALUATION OF FOREST GRAZING

IN SASKATCHEWAN

by

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A professional paper submitted in partial fulfillment
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of

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APPROVAL

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ABSTRACT

Livestock grazing of forestland in Saskatchewan has created a number of serious problems and conflicts since grazing began in the early 1900's. Among the major problems are limited enforcement of grazing regulations, excessively long grazing seasons, and limited application of modern grazing management technology. Negative impacts of improper grazing practices and weak administration of policies and regulations on range conditions and wildlife populations are well-documented. However, elimination of grazing from Saskachewan's provincial forests is not a practical solution. The purpose of this study was to investigate and review the issues and problems regarding forestland grazing in the provincial forests of Saskatchewan and develop alternative management strategies and recommendations.

Fifteen specific problems involving livestock grazing of forestland in Saskatchewan were identified. Some were directly related to actual grazing management practices while others involved administrative policy, training of personnel, and management implementation. Each problem was specifically addressed and recommendations were developed. Among the recommendations made were improvement in enforcement of regulations, use of advanced grazing systems, training field staff in range management principles, developing grazing associations, and identifying means of improving wildlife habitat through grazing management practices. It was concluded that despite opposition to grazing on crown lands, good range management and good wildlife management programs can coexist.

INTRODUCTION

Objectives

Livestock grazing has been an accepted use of Saskatchewan forestland for most of the twentieth century (Anonymous 1955). Previous studies have shown that seasonlong grazing systems are detrimental to range conditions and wildlife populations (Blood 1966, Pepper 1972, Thorpe 1978, Rock 1981, Krueger 1983). A number of problems exist with forest grazing as it presently occurs in Saskatchewan (Thorpe 1978, Rock 1981). Elimination of livestock grazing from Saskatchewan's provincial forests is not a practical solution.

There is a definite need to improve the management of grazing and habitat in Saskatchewan's forestlands. It is possible to improve habitat for wildlife under certain grazing systems. My intent is to present a practical strategy whereby the needs of forestry, wildlife and livestock can be met. The solution must also be politically acceptable.

The objectives of this study are: (1) to review appropriate literature, (2) identify major grazing management problems and, (3) present alternative management strategies. The study area is the southern forested region of the province of Saskatchewan.

Biogeography of Saskatchewan

Saskatchewan is located in northcentral North America between 49^0 and 60^0 north latitude and approximately 102^0 and 110^0 west longitude.

It has a cold continental climate characterized by long cold winters and warm summers (Chakravati 1969). Vegetation zones (Figure 1) run in belts from northwest to southeast coinciding with annual isotherms and isohyets (Richards and Fung 1969). The southern edge of the commercial forest coincides with the annual isotherm of 0^0C. Annual precipitation in the forest region is about 40 cm, with a majority of the precipitation occurring during the growing season. The average temperatures for January and July respectively are -18^0C and 16^0C. There are 80 to 100 frost free days during the average growing season. The aspen and mixedwood southern forest region has a Cold "Forest" Climate (Chakravati 1969). The forests of Cypress Hills and Moose Mountain are due to higher altitudes causing a combination of lower temperature and higher precipitation than on the surrounding lowlands.

Descriptions of the southern forested areas of Saskatchewan follow. Plant nomenclature follows Looman and Best (1979). Soil nomenclature follows the Canadian Soil Classification System (CSSC 1978). American soil classification equivalents are given in brackets.

1) The Cypress Hills area (Figures 2 and 3) is best described as a lodgepole pine (Pinus contorta) -- rough fescue (Festuca scabrella) association (Harris et al. 1983). Rough fescue and oatgrass (Danthonia intermedia) dominate well drained level uplands, with shrubby cinquefoil (Potentilla fruticosa) being common. White spruce (Picea glauca) is present on moist, well-drained sites in association with balsam poplar (Populus balsamifera) and red-osier dogwood (Cornus alba). Trembling aspen (Populus tremuloides) is present on dry

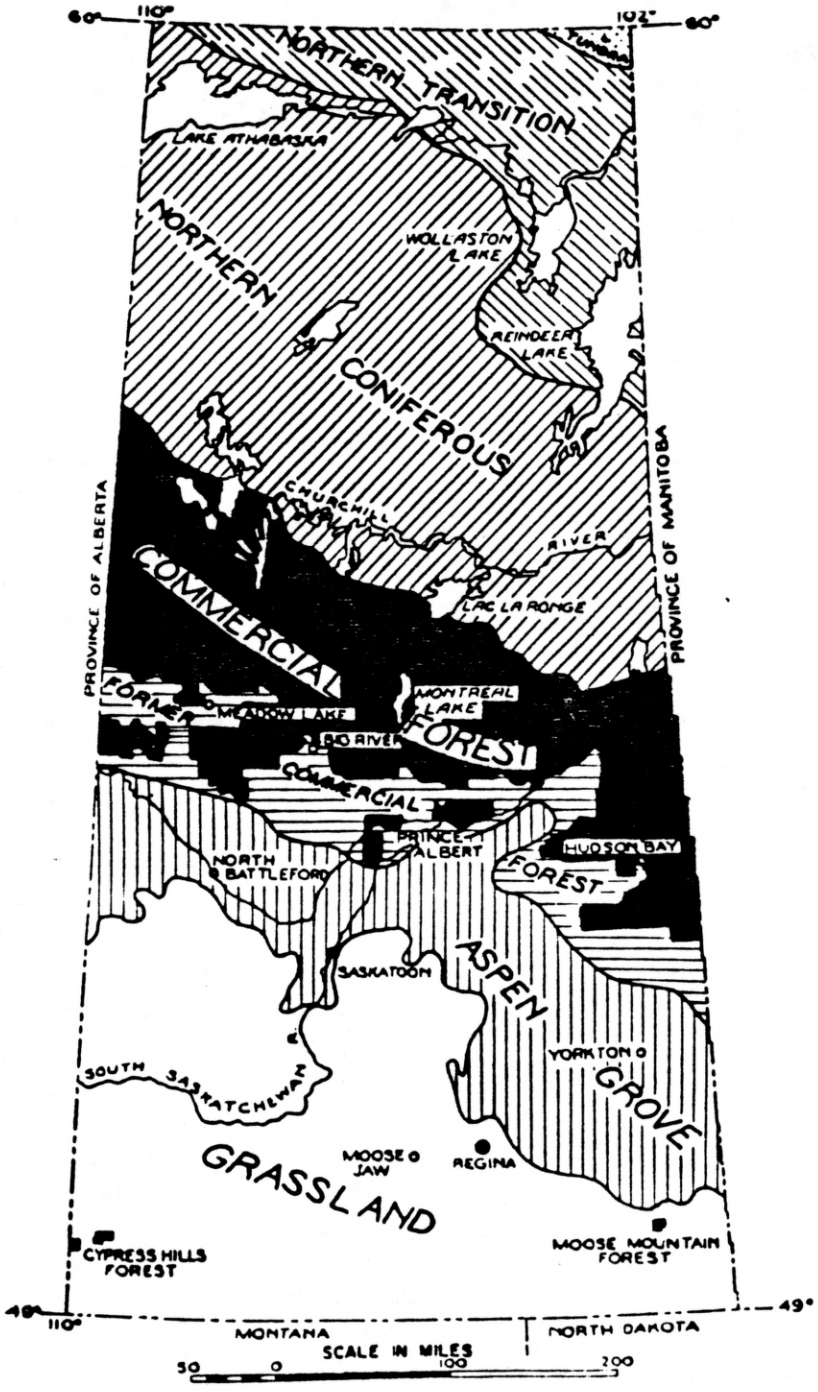


Figure 1. The vegetation zones of Saskatchewan.



Figure 2. Fescue grassland interspersed with shrubby cinquefoil in the Cypress Hills.



Figure 3. Open benchland in the Cypress Hills.

uplands, while lodgepole pine dominates dry, warm, well-drained sites. Shiney-leaved meadowsweet (Spiraea lucida) dominates the understory of lodgepole pine sites. Shiney-leaved meadowsweet and bluegrasses (Poa spp.) dominate the understory on trembling aspen sites. Bluegrasses are common on moist, cool, poorly drained sites. Rough fescue and oatgrass are characteristic of well drained sites. Wheatgrasses (Agropyron spp.) and thread-leaved sedge (Carex filifolia) are characteristic of dry, warm sites. Soils are dark brown Chernozemic (Typic Borolls) under grasslands and dry forest and Luvisolic (Boralfs and Hapudalfs) under cool forest types (Coupland and Rowe 1969, CSSC 1978, Harris et al. 1983).

2) The Moose Mountain Provincial Forest, as described by Stelfox (1979) and Harris et al. (1983), is an aspen forest with interspersed sloughs and moist grasslands (Figure 4). Trembling aspen dominates, with white birch (Betula papyrifera), balsam poplar and ash (Fraxinus spp.) being common. Willows (Salix spp.) surround wet lowland areas. Common understory species are brome grasses (Bromus spp.), bluegrasses, wild sarsaparilla (Aralia nudicaulis), beaked hazelnut (Corylus cornuta), rose (Rosa spp.), western snowberry (Symphoricarpus occidentalis), red-osier dogwood, saskatoon (Amelanchier alnifolia), wolf willow (Eleagnus commutata), gooseberry species (Ribes spp.), and raspberry (Rubus spp.). Sedges (Carex spp.), bulrushes (Scirpus spp.), common cattails (Typha latifolia), and reed grasses (Calamagrostis spp.) dominate slough complexes. Native prairie vegetation is rare, but rough fescue, needle-and-thread (Stipa comata), western porcupine grass (Stipa spartea var. curtiseta, and northern wheatgrass (Agropyron

dasystachum) are present. Soils are black (Udic Borolls and Albolls) and dark gray Chernozemic (Boralfic Boroll subgroups) on uplands and Gleysolic (Aquepts, Aquolls, Fluvents) in lowland areas (CSSC 1978). Black soils were formed under rough fescue grassland; they owe their color to organic matter contributed by fescue (Moss 1932). Gray soils are believed to have originated from black soils which were invaded by forest vegetation and subsequently leached (Coupland and Brayshaw 1953).



Figure 4. An aspen forest in southeastern Saskatchewan.

3) The southern mixedwood forest of Saskatchewan has been described by Kabzems et al. (1976) and Harris et al. (1983) (Figure 5). Fire, land clearing and logging has kept much of the forest in early successional stages. The forest is dominated by trembling aspen, jack pine (Pinus banksiana), black spruce (Picea mariana), white spruce and

balsam poplar in order of significance by area and volume. The understories of deciduous and open coniferous stands are characterized by bunchberry (Cornus canadensis) sarsaparilla, bishop's cap (Mitella nuda), dewberry (Rubus pubescens), and hairy wildrye (Elymus innovatus). Northern wheatgrass and hairy wildrye are commonly found associated under trembling aspen. Isolated natural grasslands of western porcupine grass , needle-and-thread, rough fescue and northern wheatgrass occur. Sloughs are fringed by willows, sedges, cattails, and reedgrasses. Jack pine dominates coarse rapidly drained soils and forms associations with blueberry (Vaccinium angustifolium), lichens (Cladonia spp.), and bearberry (Arctostaphylus uva-ursi). Trembling aspen and white spruce are found on finer, more nutrient-rich soils. Soils are dark gray Chernozemic (Boralfic Borolls) to Luvisolic (Boralfs), with Brunisolic soils (Inceptisols) being common in Nisbet and Fort a la Corne forests.

Ungulate species common to Saskatchewan's forests are moose (Alces alces), elk (Cervis elaphus), white-tailed deer (Odocoileus virginianus), and mule deer (O. hemionus) (nomenclature follows Banfield 1974). Mule deer, once the dominant deer species in the province, have for the most part been supplanted by white-tailed deer. They remain in substantial numbers only in the southwestern portion of the province (Maher 1969 and Anonymous 1980).



Figure 5. A mixedwood grazing area in the Bronson Forest of northwestern Saskatchewan.

Historical Perspective

Government administration of Saskatchewan's forests began with Canada's purchase of Rupert's Land from the Hudson's Bay Company in 1869. Control of crown lands and forests was placed under jurisdiction of the Secretary of State in 1871 and transferred to the Department of the Interior in 1873. In 1877, legislation was passed to allow the creation of forest reserves. In 1894, the Moose Mountain Forest Reserve was created. Additional reserves were not created until 1905, when Saskatchewan became a province. By 1914, Saskatchewan had 6,653 square miles of forest reserves (Anonymous 1955).

The Natural Resources Transfer Agreement of 1930 transferred ownership and control of all resources, including forestlands, to the province of Saskatchewan (Anonymous 1931). The newly created

Department of Natural Resources (DNR) was made responsible for all resources.

During the early part of the twentieth century, settlement, logging and widespread fires reduced the forests of Saskatchewan substantially (Anonymous 1955). The Federal government allowed grazing on forestland, often without fee, in order to remove potential fuel buildup and fire hazard (Harris 1986). Forest areas were further reduced during the 1930s due to an influx of settlers from drought stricken areas of southwestern Saskatchewan. Farms were cleared for agriculture and settlement fires often spread to forestland, taking a heavy toll of timber (DNR Annual Reports 1930-31 to 1960-61, Anonymous 1955). In the southern region of the province, only a few blocks of forestland remain. Their presence is attributed to severe limitations for agricultural purposes (owing mainly to short growing seasons and/or sandy, rocky or poorly drained soils). Only slight limitations for ungulate production and summer grazing have been identified (Anonymous 1955).

The provincial forest system in Saskatchewan is now comprised of the Canwood, Cypress Hills, Duck Mountain, Fort a la Corne, Moose Mountain, Nisbet, Northern (including the Bronson and Divide Forests), Porcupine, and Torch River Provincial Forests (Anonymous 1967) (Figure 6). All forestland is administered by Saskatchewan Parks Recreation and Culture (SPRC).

The DNR's first Annual Report (1930-31) indicated that cattle grazing was occurring on provincial forestland at the time of land transfer from the government of Canada. Following review a decision

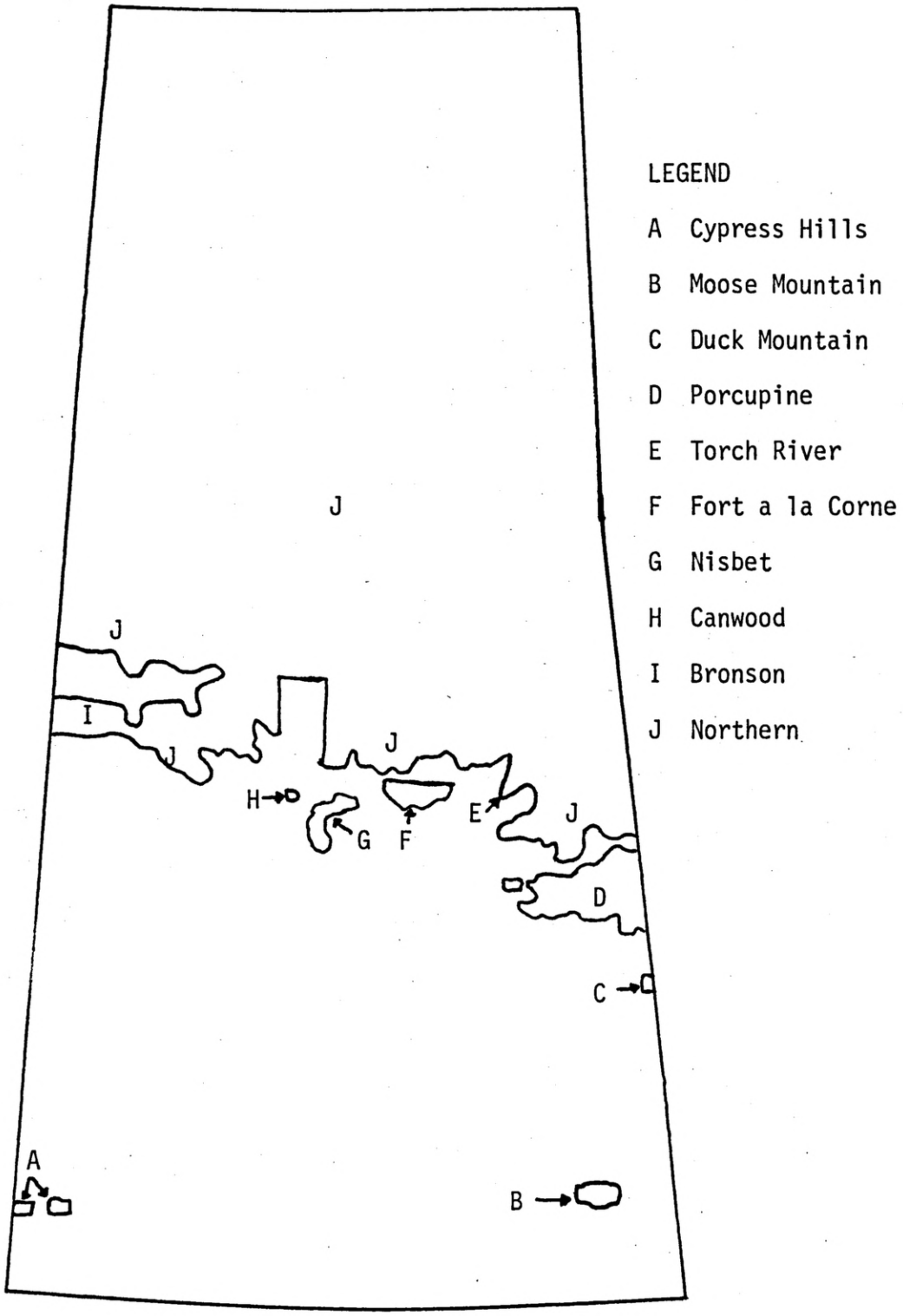


Figure 6. The provincial forests of Saskatchewan.

was made to allow forest grazing and haying to continue in the southern portions of the provincial forest system. During 1931-32, 8,126 cattle, 3,672 horses and 1,263 sheep were grazing on provincial forestland. By 1935-36, their numbers had risen to 13,518 cattle, 1,668 horses and 2,735 sheep. The majority of animals were grazing in four areas: Cypress Hills, Manitou, Moose Mountain, and Prince Albert areas. The 1934-35 annual report acknowledges the practice of spring burning of boundary fire guards and grass meadows. Spring burning had been discontinued by the mid 1950s.

The 1953-54 annual report makes first reference to a provincial range management program (Anonymous 1954). Range surveys and monitoring were carried out during the remainder of the 1950s and 1960s. Annual reports from 1970 and later make no reference to range management.

Recent Research

Two studies of forest grazing were completed in the Bronson Forest of Saskatchewan during the past 10 years. Thorpe (1978) examined the impact of livestock grazing on forest shrubs. Rock (1981) examined competition for food, seasonal use patterns by livestock and wildlife, and the effect of livestock grazing on forage production.

Thorpe (1978) found that livestock grazing was reducing mean stem height of key winter browse species and contributing to longterm changes in understory species composition. He indicated that basing stocking rates on paddocks of several Km^2 in size was a problem. Thorpe recommended basing stocking rates on actual areas of use in order to reduce overgrazing.

Rock's study (1981) made recommendations on alterations to the grazing system in the Bronson Forest. He found that livestock grazing was restricting the population of elk due to direct competition for woody browse species. Rock recommended a 3 month grazing season from June 15 to September 15 and reduction of livestock numbers. He also recommended a proper use factor (PUF) of 40 to 55 percent for forage in this region.

Harris (1986) made a number of recommendations to improve vegetation management in the Cypress Hills area of Saskatchewan. He suggested a deferred grazing system in order to allow rough fescue to set seed each year. Mowing was suggested as a means of controlling shrubby cinquefoil in some grazed areas. The Battle Creek and North Benson areas were noted to be severely over used. Harris recommended elimination of grazing within 100 m of streams. A key elk winter range requiring special treatment was also identified.

Present Situation

During 1986, 12,735 cattle, 5 sheep, and 89 horses grazed within the forest system. The majority of grazing occurs in four areas: Bronson (Meadow Lake), Cypress Hills, Moose Mountain, and Nisbet (MacDowall) Forests. A fee of $3.00 per season is charged for mature cattle and horses grazing in provincial forests. A fee of $3.30 per animal unit month (AUM) is charged for livestock grazing in recreation areas. Animals under 6 months of age are not included in this total, as no fee is charged (SPRC Forestry Branch unpublished information). Present fees have been in effect since 1967. In 1985, SPRC's request for an increase in grazing fees was rejected by the Provincial Treasury

Board and a freeze was placed on fee increases (SPCR Forestry Branch files). New regulations dealing with administration of forest grazing were passed recently (Anonymous 1986). The grazing season now extends from May 24 to October 15 of each year. Permits are renewable on an annual basis, or in the case of term permits, for a period not exceeding 5 years. New permits are issued only on areas of 65 ha or more in size, capable of supporting 0.85 AUM/ha. This is the minimum size and capability perceived as economically viable by SPCR (A. Kosowan pers. comm.).

Permittees are responsible for construction and maintenance of all range improvements. Grazing is under a continuous use system in all areas. Range assessments are not carried out. According to policy, livestock must be branded and ear-tagged before entering the forest. Presently, ear-tagging is required only in Moose Mountain.

Present policy and regulations appear to be adequate, in my opinion, but are not being followed by field staff and permittees. Discussions with SPRC staff indicate that season dates are often ignored by permittees. Meadow Lake Region still allows grazing from May 1 until September 30. Incidents of trespass are common but difficult to detect and prosecute. Cattle are often turned into the forest before legal time and, due to late harvest and difficulty in round-up, remain there until freeze-up. In some instances livestock remain in the forest all year.

My general impression is that field staff regard forest grazing as an unpleasant reality which is unlikely to go away. Forest grazing has become such a strong tradition that it is difficult to enforce

regulations and implement new ideas. Grazed areas are generally regarded as having no value for wildlife.

LITERATURE REVIEW

Many studies have stressed the negative impacts of livestock grazing on wildlife and vegetation (Blood 1966, Mackie 1970, Thorpe 1978, Rock 1981, Whyte and Cain 1981). Negative impacts are generally the result of poor grazing management rather than anything inherently wrong with grazing itself (McNaughton 1979). In fact, most rangelands evolved under grazing pressure from large herbivores (Stoddard et al. 1975, McNaughton 1979). By fitting the grazing management system or strategy to the range or forest site, one can eliminate much of the negative impact often associated with grazing (Heady 1984, Kothman 1984).

Livestock Behavior

Most of the problems associated with grazing can be attributed to livestock behavior (Figures 7 to 10). Livestock are creatures of habit. They tend to use the same areas year after year, often leaving as much as 65 percent of available pasture untouched (Krueger 1983). Livestock herds will establish home ranges and will not deviate from them. Much of their preference for forage types is learned and, as a result, they are highly selective in their feeding. Livestock exhibit a strong preference for green leaves over stems and senescent forage (Kothman 1984).



Figure 7. Livestock remain in open meadows for a majority of the time.



Figure 8. Overgrazing has caused a reduction of forage cover and an increase in bare ground.



Figure 9. Trail caused by livestock travel.



Figure 10. Salting area after 1 season of use.

Livestock will regraze individual plants several times during the growing season, often weakening them. Cattle are reluctant to graze on slopes exceeding 15 percent and, in rolling terrain, will rarely feed at elevations greater than 70 m above water. They are also limited by horizontal distance from water (Van Vuren 1982, Krueger 1983). Livestock will seek shade during hot periods of the summer, resulting in a disproportional usage of forest and streamside areas.

By applying range improvements and grazing systems, one is attempting to control livestock behavior. Fencing, salting, herding, and water development lead to more uniform livestock distribution. Rest-rotation, deferred-rotation, and short-duration grazing systems are designed to control timing, intensity and frequency of grazing on individual plants (Kothman 1984).

Plant Response To Grazing

Range plants are classified according to their response to grazing as decreasers, increasers, and invaders (Dyksterhuis 1946 and 1949). Their responses are complex and depend on many factors including morphology, locations of growing points, phenology, palatability, weather, type of root system, competition from other plants and grazing history (Branson 1956, Stoddart et al. 1975).

According to Dyksterhuis (1949) and McLean and Marchand (1970), decreasers are normally perennials that produce good quality forage and dominate the climax. Increasers are species that increase under moderate grazing use but decrease under prolonged heavy overuse. Increasers are generally shorter subdominant members of the climax

community. Invaders are species that are not members of the climax community. They invade a plant community as the range deteriorates.

McNaughton (1979), McNaughton et al. (1982) and Caldwell (1984) present excellent reviews on the impacts of grazing on plants. Grazing has the following beneficial effects on grass plants (McNaughton 1979):

1) removal of older tissue which is less efficient photosynthetically than young tissue;

2) increased light intensity to lower, younger tissue;

3) increased stomatal resistance leads to conservation of water;

4) increased production of forage

5) recycling of nutrients in the form of urine and dung;

6) trampling aids in the breakdown of senescent forage;

7) growth promoting substances from the saliva of ruminants.

Non-structural carbohydrates (sugars and starches) are used as energy for plant growth and respiration (White 1973). Carbohydrate reserves are necessary for winter survival, early spring growth and regrowth after defoliation. The majority of non-structural carbohydrates is stored in stem bases, stolons, rhizomes, corms and roots. In order for non-structural carbohydrates to accumulate, photosynthetic production must exceed respiration demands. Defoliation removes photosynthetic tissue, causing the photosynthesis/respiration ratio to change. Stored energy must therefore be used to initiate regrowth. Defoliation which removes only some tillers from a plant, while leaving others, is less detrimental because non-structural carbohydrates may be transferred from ungrazed to grazed tillers.

Root growth ceases within 24 hours of defoliation in many grasses and, in most cases, will not resume for 10 to 14 days (Branson 1956, White 1973 and Stoddard et al. 1975). Cessation of root growth places the grass plant at a competitive disadvantage with ungrazed plants (White 1973).

Protection from grazing often does not lead to the benefits one would expect (Johnston 1961, McLean and Tisdale 1971, Anderson and Holte 1981). McLean and Tisdale (1971) estimated that sites in the rough fescue and ponderosa pine (Pinus ponderosa) zones would take 20 to 40 years to recover from fair to excellent condition under complete protection from grazing. They suggested grazing during the dormant period in order to improve range condition. Anderson and Holte (1981) suggested fire may be required to return rangeland to its grass climax once shrubs have taken hold.

Savory (1978) maintains that the main causes of rangeland deterioration are overgrazing and overrest. He defines overgrazing as "grazing during active growth which is both 'severe '(removal of a high proportion of a plant's leaf) and 'frequent' (short intervals between grazing events on the plant), resulting in the eventual death of the plant". Savory (1978) defines overrest as "rest of a perennial plant which is so prolonged that accumulating old material hampers growth and/or kills the plant". Range condition, therefore, declines one plant at a time.

Conifer Seedling Response

Studies in British Columbia (Wallace 1983) and Oregon (Krueger 1983) have shown how grazing and reforestation can be compatible.

Livestock grazing and trampling accounted for less than 5 percent of tree seedling mortality in one study area (Krueger 1983). Coniferous trees were shown to be significantly taller in grazed areas when compared to ungrazed sites (Krueger 1983 and Wallace 1983). This was attributed to the reduction of soil moisture loss through transpiration. Seedling damage did not occur unless livestock were left on a site which was depleted of grass cover (Wallace 1983) (Figure 11).

Kosco and Bartolome (1983) found that brush could be controlled effectively by combined deer and livestock browsing and grazing. This use led to better growth of conifer seedlings than in treatments where either or both species were restricted.



Figure 11. Damage to white spruce sapling caused by livestock browsing.

In mountainous regions, clearcut areas are often seeded to grass-legume mixtures at the time of tree planting in order to reduce erosion. A number of studies have shown this to produce high quality ephemeral grazing without damage to tree seedlings (Krueger 1983, Richmond 1983, Wallace 1983, Quinton 1984).

Grazing Management Systems

Grazing systems are designed to control timing, intensity and frequency of grazing on individual plants and improve livestock distribution (Kothman 1984). In order to be successful, a grazing system must take the nutritional needs of livestock and the phenology and physiological requirements of forage species into account. Grazing systems must be sound economically and ecologically if they are to succeed (Savory 1978).

The old take half, leave half philosophy of range management (Stoddart et al. 1975) appears to be outdated with our better understanding of how plants grow and how defoliation occurs. Proper use factors (PUFs) fail because they do not deal with the problem of repeated defoliation of individual plants. Even if one reduces the PUF to 30 percent, the problem of overgrazing is not effectively dealt with. Under range conditions riparian areas will often receive 100 percent utilization, while upland areas will not receive any use (Van Vuren 1982). With a PUF arrangement, 30 percent of total available forage may have been utilized, but in reality, two groups of plants exist: the overgrazed and the overrested. Both conditions lead to range deterioration (Savory 1978).

A brief description of the more common grazing systems follows.

Primary sources of information are Lewis (1969), Hormay (1970), Shiftlet and Heady (1971), Savory (1978) and Kothman (1984).

Continuous (Seasonlong)

Livestock are turned onto grazing allotments at the beginning of the grazing season and remain there until the season ends. In Saskatchewan, this means from May 24 to October 15 of each year. This system is popular because of its ease of administration. It requires fewer improvements and less monitoring than other systems (Shiftlet and Heady 1971). Stocking rates are generally based on a PUF of 50 percent. Continuous use systems do not deal with the problems of overgrazing and overrest as defined by Savory (1978). The problems indicated by Thorpe (1978) and Rock (1981) are the direct result of continuous grazing.

Deferred

A simple deferred system delays grazing until the key forage species has an opportunity to pass through a critical phenological stage, such as seed set. This has the disadvantage of reducing the length of the grazing season and allowing development of "wolfy" plants. On the positive side, it provides protection for decreaser species, and leads to higher protein levels in the remaining winter forage (Pitt 1986). Stocking rates are normally based on a predetermined PUF.

Two-paddock switchback

Under this system the range is divided into two parts by the construction of a single cross fence (Stoddart et al. 1975)(Figure 12). This allows the producer to concentrate use on one paddock, while

resting the other. Livestock may be grazed on the unit for a predetermined length of time or according to growing conditions. Livestock may, for example, graze paddock A for the first half of the grazing season; then A is rested until the following year. Pasture B would be grazed during the latter part of the grazing season during year one and during the early part of the season during year two. This is the simplest type of rotational system. Time of use alternates yearly.

Deferred-rotation (DR)

This system involves deferment of grazing on several pasture units in a planned rotation as in Figure 13. Additional fencing and water development is required with this system. Producers must also spend more time in monitoring and moving livestock. Reduction of selective grazing and overgrazing is achieved by concentrating more livestock on a smaller area and forcing better overall utilization. Range condition has been shown to improve over time with this system but questions have been raised about livestock gains (Shiftlet and Heady 1971).

Rest-rotation (RR)

Rest-rotation (Hormay 1970) is similar to DR but has the addition of a yearly rest period for each pasture at a point during the cycle (Figure 14). It has the same advantages and disadvantages as DR. The need of allowing time for seed production and seedling establishment on perennial ranges has been questioned by Kothman (1984). Kothman regards the yearly rest cycle as a waste of forage.

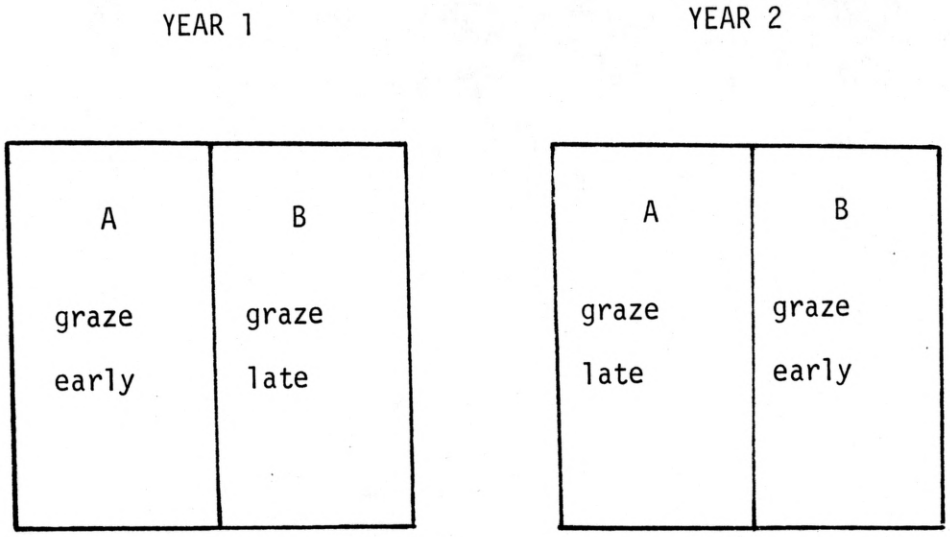


Figure 12. A two-paddock switchback grazing system.

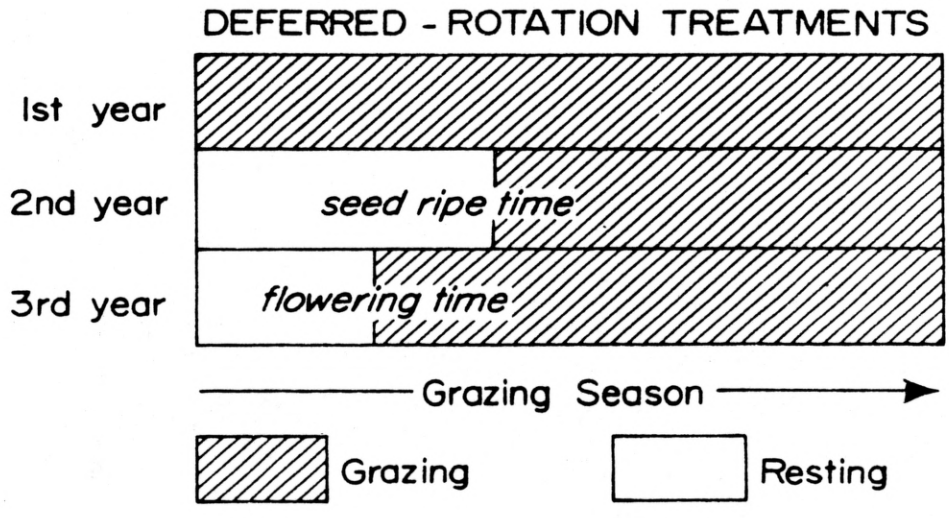


Figure 13. A three-paddock deferred-rotation grazing system.

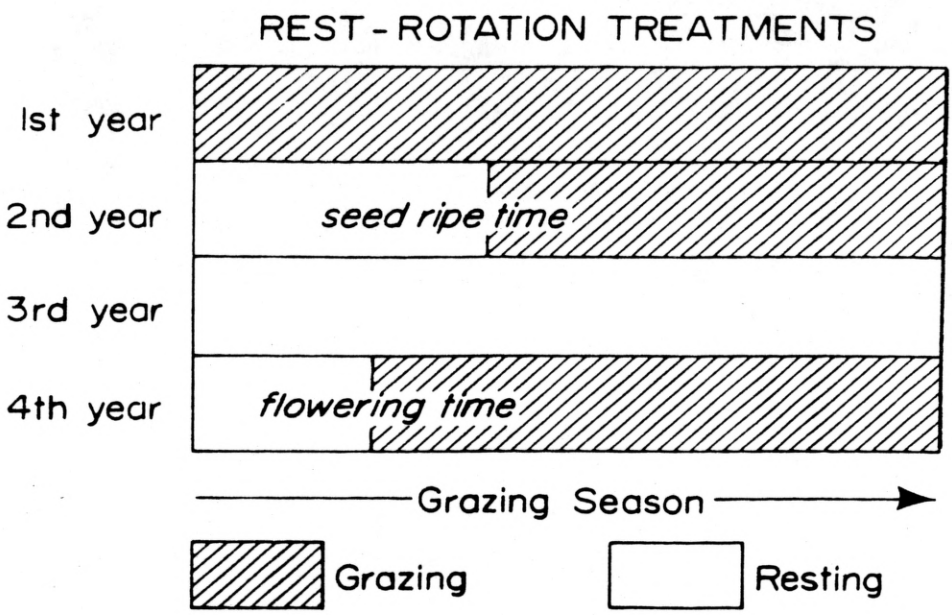


Figure 14. A four-paddock rest-rotation grazing system.

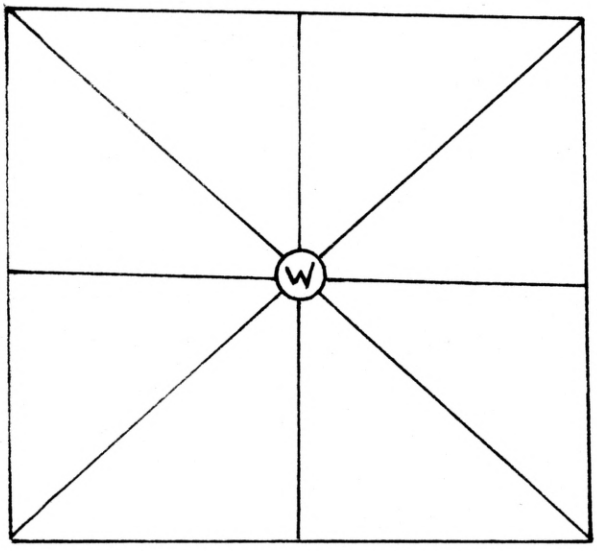


Figure 15. An eight-paddock short-duration grazing system.

Complementary

Complementary grazing systems, involving the use of seeded pastures in combination with native range, have been successful in Canada (Smoliak 1968, Smoliak and Slen 1974). Crested wheatgrass (Agropyron cristatum) provides early, highly nutritious forage and could be grazed from late April until about mid-June. Livestock may then be turned onto native range until mid-September. They are then put onto a pasture of Russian wildrye (Elymus junceus) until freeze-up.

In the forest fringe areas of Saskatchewan, Agriculture Canada recommends the use of Regar meadow brome (Bromus riparius) rather than Russian wildrye (R. Knowles and D. McCartney pers. comm.). Regar meadow brome is easy to establish, competitive, and provides excellent early spring and fall grazing. It is more versatile than crested wheatgrass because the same pasture may be grazed during both spring and fall.

Short-duration Grazing (SDG)

Under this system, numerous small pastures are created, and livestock at high stocking density are rotated through in rapid sequence. The duration of grazing and rest periods are determined based on the rate of plant growth (Figure 15). The goal is to distribute livestock use evenly over the pasture, and reduce occurrences of regrazing on individual plants. Livestock return to the pastures later in the grazing season after plants have had adequate time to grow photosynthetic tissue. Time-control grazing is similar to SDG, but more attention is given to actual plant growth rates, and grazing and rest periods are more flexible. These systems require

intensive monitoring and movement of livestock. They also require additional fencing or herding.

Short-duration grazing systems deal most effectively with the problems of selective grazing and poor livestock distribution. If properly administered, the nutritional needs of livestock and physiological needs of plants should be met (Savory 1978, Kothman 1984).

Livestock Performance Under Various Grazing Systems

A number of studies have compared livestock performance in different grazing systems. Smoliak (1968) and Smoliak and Slen (1974) found that livestock had superior gains on complementary grazing systems. Seeded pastures, however, needed to be fenced and managed separate from native range or cattle would refuse to eat crested wheatgrass.

Walton et al. (1981), in a study of tame pasture in Alberta, found that livestock gains were nearly doubled and vegetation had higher crude protein, calcium, magnesium, and copper on a rotational scheme when compared with seasonlong grazing. Cattle on the seasonlong pasture grazed 2.4 hours per day longer, therefore expending more energy.

Laycock and Conrad (1981), in a study of native mountain rangelands, found no difference in weight gains when comparing livestock grazing seasonlong to livestock on rest-rotation. In this case, good range management was the key to success. Proper salt placement, adequate water development, and fencing all led to better livestock distribution and more uniform utilization of forage.

Stocking rates and utilization levels (30%) were kept low. Van Poollen and Lacey (1979) reviewed a number of grazing management studies and concluded that forage response and production were influenced more by stock density than by grazing systems. They recommend more attention be given to proper stocking rates and PUFs and less to implementation of grazing systems.

Grazing Impact on Wildlife

Julander (1958) indicated that certain conditions must be satisfied for competition between wildlife and livestock to occur: (1) wildlife and livestock occupy the same space; (2) wildlife and livestock eat the same forage plants; (3) food plants are an important source of forage for either wildlife or livestock; (4) food plants are in limited supply or deteriorating in production as a result of combined use.

Elk and cattle are thought to compete directly for forage as they have very similar diets through the southern portions of their range. With the exception of the Cypress Hills population, elk in forested areas of Saskatchewan and Manitoba are considered browsers (Blood 1966, Keith 1977, Hunt 1979). Competition for browse occurs when livestock are left on pastures for too long, resulting in depletion of grass (Rock 1981). Fitzgerald *et al.* (1986) found that cattle preferred to graze in aspen forest over grassland as grass species matured. Raspberry (*Ribes spp.*) and wild rose (*Rosa spp.*) were important browse seasonlong, while trembling aspen was browsed heavily in late summer as its resin levels declined.

Social intolerance, rather than lack of forage, may be the factor

limiting elk numbers on many grazed areas (Mackie 1978). Lonner and Mackie (1983) recommended allocation of areas, rather than forage, for wildlife. They believed that it may be better to sacrifice certain areas to livestock in order to keep other areas exclusively for wildlife. In some environments, better distribution of cattle may displace elk into areas normally inhabited by deer thus complicating the interaction.

Knowlton (1960) found that moose and cattle did not compete for the same forage or space, but Rock (1981) disagreed. Overuse of riparian areas may result in competition for forage and space. Willow retains its leaves longer than other hardwood species, and as a result, becomes a favored food of cattle in early autumn; this leads to competition with moose (Rock 1981). Continued heavy grazing in the Bronson Forest is reducing browse availability for moose (R. Seguin pers. comm.). Presence of cattle may prevent movement of moose between lowland areas during the summer grazing period (Rock 1981).

Deer often benefit from grazing. Heavily grazed meadows are the first to green-up during spring (Rock 1981). At this time deer are facing the increased demands of gestation, early lactation, antler growth, and higher basal metabolism (Moen 1973). These areas provide important highly digestible forage at a critical time of year. During the remainder of the grazing season, deer are often found in areas too rugged for cattle (Mackie 1970). Cattle overgrazing often leads to an increase in woody browse species in grassland situations (Kramer 1973). In forest situations, cattle overgrazing more often leads to a decrease in the forb understory and a decline in the height of important winter

browse species (Sidhu 1965, Thorpe 1978) (Figures 16 to 19).

Cattle grazing may be useful in maintaining pond vegetation in a desired seral stage for waterfowl. Whyte and Cain (1981) recommend, however, that at least one-half of a pond shoreline be fenced in order to restrict cattle use (Figure 20).



Figure 16. An Amelanchier alnifolia which has been hedged by yearly cattle browsing.



Figure 17. Understory in an aspen stand which has been protected from livestock grazing.



Figure 18. Depleted understory in an aspen stand.



Figure 19. Highlining of aspen caused by livestock browsing.



Figure 20. A slough area which has received heavy livestock use.

Waterfowl studies have generally shown rest-rotation as superior to continuous use because birds have undisturbed areas in which to nest and raise their young. Gjersing (1975) and Mundinger (1976) found that ducks responded positively to rest-rotation and deferred-rotation systems. Spring and fall grazing were detrimental to waterfowl due to the removal of nesting cover. Rest and deferment treatments were superior to continuous use in all cases. Rees (1982) recommended rest-rotation grazing in managing a waterfowl refuge. He indicated that Kentucky bluegrass (Poa pratensis) is undesirable as it mats over winter, creating poor nesting cover for dabbling ducks. Grazing and burning should therefore be directed toward limiting invasion by Kentucky bluegrass.

Sharp-tailed grouse (Pediocetes phasianellus) respond best to seasonlong grazing (Yde 1977, Mattise et al. 1982, Nielsen and Yde 1982). Cattle grazing seasonlong create a mosaic of vegetation types due to their uneven use patterns; this mosaic is preferred by Sharp-tailed grouse. Rest-rotation schemes lead to more uniform use of vegetation than does season-long grazing.

Rock (1981) and Hines (1984) found that light and moderately grazed areas supported more Ruffed grouse (Bonasa umbellus) during the summer than heavily grazed areas. Removal of forage was beneficial to broods in allowing easier movement and access to invertebrate foods.

Maintaining forest and range in climax or near climax condition may not be a realistic or desirable goal. Many wildlife species require a variety of habitats, in various stages of succession in order to survive through the year. Deer, for example, require cover for

fawning with food in close proximity. The presence of over grazed meadows may be important to them during early spring, as these are often the first areas to green-up. Elk require areas free of cattle interference due to social intolerance, but they benefit from cattle grazing which removes old coarse growth. Rest-rotation, deferred-rotation and SDG grazing have potential to reduce social conflict by freeing several paddocks from livestock use during each period of the summer grazing period. These systems provide adequate rest and recovery time for forage species at critical times of the year and, therefore, have potential to improve range condition.

Continuous grazing has the advantage of leaving large undisturbed areas to wildlife (Mackie 1978, Lonner and Mackie 1983). Resultant overgrazing and overrest of the range may be unacceptable in the long term (Savory 1978). Lowering stocking rates and reducing utilization by livestock to 30 percent (Laycock and Conrad 1981) does not deal effectively with the problem of selective grazing. Continuous grazing is, therefore, the least acceptable form of grazing system available.

Range Management Benefiting Wildlife

Anderson and Scherzinger (1975) illustrate how livestock grazing, when carefully managed, can be used to benefit elk. The Bridge Creek Wildlife Management area, an important elk winter range in northeastern Oregon, had a history of poor grazing management. Under this management 120 elk wintered there. When cattle grazing was eliminated, the range supported 320 elk, but bluebunch wheatgrass and Idaho fescue plants were becoming coarse and unpalatable. A carefully managed program was implemented, involving livestock grazing from

approximately May 1 until June 15 of each year. This removed coarse growth and allowed sufficient regrowth to occur prior to the end of the growing season. Grazing was distributed to allow maximum area coverage by livestock while keeping utilization at moderate levels. This resulted in the range supporting 1200 elk over winter, and 2.6 times more cattle than had grazed under the original continuous (seasonlong) system; range condition also showed steady improvement.

Demarchi (1973) found that individual bluebunch wheatgrass plants subjected to heavy winter and early spring use had higher crude protein levels than ungrazed plants. Anderson and Scherzinger (1975) also believed that grazing during key periods caused plants to retain higher protein levels over winter.

Pitt (1986) tested Anderson and Scherzinger's (1975) hypothesis by clipping bluebunch wheatgrass during the boot stage, at flowering and at seed set. He found that clipped plants maintained higher levels of crude protein, calcium and phosphorus over winter than unclipped plants. This can have significance in managing winter range for elk and livestock. Pitt (1986) stated that defoliation at these stages will eventually weaken bluebunch plants, so care must be taken in implementing such a plan. Rest-rotation, deferred-rotation, and short-duration grazing appear to create superior winter forage, while giving adequate recovery time for grass plants.

Reardon and Merrill (1976), in a Texas study, found that cattle, decreaser forage species, and white-tailed deer responded better to a 4 pasture deferred-rotation than to continuous use or complete rest. Forage production and range condition showed improvement with both

light continuous grazing and deferred-rotation compared to ungrazed areas. Range condition may actually decline over time in the absence of grazing (Johnston 1961).

Studies in British Columbia (McLean and Willms 1977, Willms et al. 1979, 1980, 1981) have shown that fall grazing or burning of bluebunch wheatgrass range followed by spring deferment of cattle grazing can be used to improve habitat for mule deer. Removal of coarse growth made new growth more accessible to mule deer in spring. Cattle and deer preferred fall burned range over fall grazed range, but both treatments were preferred over the control. By leaving pastures free of cattle during early spring, competition was eliminated.

Single use grazing patterns which eliminate either cattle or wild ungulate grazing, will eventually lead to plant successional changes. These changes are usually contrary to management goals (Jensen et al. 1972). Vegetation can be manipulated by carefully timing use and monitoring utilization levels. Jensen et al. (1972) suggested that livestock grazing on winter ranges should be restricted to early stages of the growing season in order for adequate regrowth to occur.

DISCUSSION

The problems associated with forest grazing are neither new, nor unique to Saskatchewan. A wealth of information on forestland grazing exists. Saskatchewan's forestlands and wildlife would benefit greatly if SPRC would draw upon this information and implement alternative management strategies.

The following problems were identified after personal observations and discussions with SPRC staff:

1) SPRC policies and regulations are not being enforced uniformly;

2) Continuous (seasonlong) grazing systems have led to overgrazing on many forest sites;

3) Range condition and trend are not being monitored;

4) Field staff lack training in monitoring range condition and identifying problems;

5) Grazing season and cattle numbers are relatively inflexible;

6) Indicators of range readiness and condition have not been identified;

7) Livestock grazing can adversely affect coniferous seedlings;

8) Early successional meadows exist as a consequence of fire and logging, but are not being grazed;

9) Natural meadows are being lost to aspen invasion due to exclusion of fire from the forest ecosystem;

10) Administrative time and money is wasted in issuing numerous permits;

11) It is difficult to obtain accurate livestock counts and to determine when livestock are in trespass;

12) A long grazing season may not be economically sound for livestock producers;

13) Producers lack knowledge about alternative grazing systems;

14) Present grazing fees are below market value;

15) Saskatchewan lacks the political will to manage forest grazing properly.

The preceeding points will now be elaborated upon:

1) SPRC policies and regulations are not being enforced uniformly. Cypress Hills and Moose Mountain have the longest history of grazing and also have the best record in terms of following policies. In the remainder of the forest system, SPRC appears to have lost control. Field staff freely admit they have no idea of the number of livestock presently grazing in the forest. The top priority should be to enforce current regulations and livestock quotas.

2) Continuous grazing systems lead to the problems identified by Thorpe (1978) and Rock (1981). Rock's recommendations of reduced stocking rates and overall PUFs of 40 to 60 percent are not acceptable because they do not deal with the basic problems of overgrazing and overrest. PUFs must be designated on an individual species basis (varies from species to species), if they are to be of any value. The problems associated with monitoring PUFs make their use impractical. Introduction of a simple rotational grazing system or SDG system would help to solve the problems of poor livestock distribution, overgrazing and overrest. These systems would require more fencing, but the alternative of continued overuse and decline of range condition is

unacceptable. The photos appearing in this report show areas which are susceptible to invasion by noxious weeds.

Poor distribution of livestock is closely related to continuous grazing. A review of permits indicates that many are issued on large areas which are predominantly forested. One permittee, for example, grazes 231 head of livestock on 77 sections of land in the Porcupine Forest. This area has been held under permit for longer than field staff can remember. In spite of severe overgrazing on portions of the permit area, attempts to improve distribution have not been made.

A permittee in the Bronson Forest operates a simple deferred-rotation by driving cattle to the far extremities of his permit area. As forage is used up, he opens gates allowing cattle to move into adjoining pasture. This strategy makes roundup easier as livestock are near the exit point at the end of the season. Salting can also be used to insure better distribution. Salt should be granular rather than in blocks, and should be placed in containers, rather than on the ground.

In most areas, livestock water at lakes, streams and sloughs. This creates serious overuse problems in riparian areas. Nesting cover for birds is lost, Kentucky bluegrass invades, competition for browse occurs, and streams receive additional silt. It may be necessary, in some cases, to restrict access to riparian areas and to create water access points by fencing.

Harris (1986) recommended elimination of livestock grazing within 100 m of all streams in the Cypress Hills and a shortened grazing season. These recommendations would not be necessary if a simple rotational or SDG system were implemented. SDG would probably allow an

increase in livestock numbers over that presently grazed there (Savory 1978). Careful monitoring and adjustments would be necessary for this to be successful.

3) Range condition and trend are not being monitored. Several exclosures were placed in the Bronson Forest during Rock's (1981) study, but they have not been monitored. Permanent exclosures could be built by district fire squads during periods of low fire hazard at very low cost. Intensive annual sampling would not be necessary, but once established, meaningful information could be obtained when necessary. Forage production studies should be carried out to allow accurate determinations of forest and range site potentials.

4) Field staff lack training in monitoring range condition and identifying problems. Maduram (1973) and Pearson and Sternitzke (1974) outline simple courses which could provide basic training to forest technicians and conservation officers. A three day field and laboratory course in basic plant identification, measurement, and range principles could be implemented. A number of other Canadian sources would provide information relevant to forest grazing in Saskatchewan (Campbell et al. 1962, Johnston et al. 1966, McLean and Marchand 1968, McLean and Pendray 1968, Wroe et al. 1970, and Smoliak et al. 1982).

5) Grazing season dates and cattle numbers are relatively inflexible. SPRC requires the ability to alter season dates and cattle numbers as conditions dictate. Present regulations allow reductions of only 10 percent per year. This may be insufficient in some cases.

6) Indicator species need to be identified for different types of forest-range sites. McLean and Pendray (1968) state that rough fescue,

wild peavine (Lathyrus venosus) and vetches (Vicia spp.) are the best indicators of range condition in forest types of Saskatchewan. Increases of species such as shrubby cinquefoil, pussytoes (Antennaria spp.), fringed sagewort (Artemisia frigida), Canada thistle (Cirsium arvense), and invasion by dandelion (Taraxacum officinale), smooth brome (Bromus inermis), Kentucky bluegrass and annual grasses and weeds are indicators of overuse. Browsing of shrubs by cattle is also an indication of forage depletion (Thorpe 1978 and Rock 1981).

Indicators of range readiness need to be adopted and followed. Cattle should not be turned onto range until forage has reached a prescribed height (15 cm for bunchgrasses and 9 cm for sod and low growing grasses) (McLean and Pendray 1968). Soil should be firm and able to withstand animal weight without damage. Flowering of certain species may be used as an indicator of range readiness in some cases.

7) Livestock grazing can adversely affect coniferous seedlings. Studies in British Columbia have shown this to occur only when grass and forbs have been depleted. Grazing in recently logged and planted areas could be important in eliminating competition and transpiration loss. Seedlings would show improved growth.

8) Early successional meadows exist as a consequence of fire and logging, but are not grazed. Forage from these meadows could provide grazing for livestock for many years while enhancing the growth of conifer seedlings.

9) Natural meadows are being lost to aspen invasion due to exclusion of fire from the forest ecosystem. Prescribed burning could be implemented as a method of preventing this encroachment, reducing

fuel buildup, and improving forage quality. By increasing the amount of palatable forage available for cattle, one can reduce their use of forest types, and therefore their use of browse (Scotter 1980, Fitzgerald et al. 1986). Burning should be carried out to benefit the most important forage species in the individual areas. In most cases burning could be carried out during spring or fall with the aid of district fire squads.

Bailey and Anderson (1978) found that western porcupine grass responded well to spring burning, but declined with fall burning. Rough fescue took 1 to 3 years to recover from burning, depending on season and phenological stage; fall burning was the least harmful. Fall is normally a wet time of year and burning may be difficult in most years. Spring burning of rough fescue can be carried out safely while snow remains in surrounding trees.

10) Administration of forest grazing could be streamlined by elimination of individual permits in favor of grazing associations. Many permits are issued for as few as 5 to 20 animals in the Nisbet, Porcupine and Bronson Forests. Issuing of one permit to a grazing association would reduce administrative time and costs. This would also insure uniform entry and exit dates from the forest. Implementing new grazing systems, with higher stock density would also be simplified because range improvement costs would be distributed throughout the membership. Grazing associations exist and function well in Cypress Hills, Moose Mountain, and a portion of the Nisbet Forest.

11) Moose Mountain has adopted a numbered ear-tag system which has worked successfully, and should be expanded to the remainder of the

forest system. Numbered ear-tags could be issued to grazing associations. All livestock older than 6 months of age would be tagged prior to entry into the forest. Any livestock found without ear-tags would be in trespass. This would simplify the monitoring process.

12) The economics of a 5 to 6 month grazing season needs to be researched. An unpublished study on a PFRA pasture in central Saskatchewan showed that cattle lost weight when kept on native range beyond August 31 (Dr. W. Cates pers. comm.). Lactating cows placed on spring range prior to new growth commonly show poor breeding success (Cook and Harris 1968, Cook 1970).

Studies of weight gains and reproductive success for forest grazing may show that the present season is not economically sound. Forbs, which dominate the understory of aspen forests, do not cure well (Blood 1966, McCaffery and Creed 1969). Grasses in open meadows cure well, retaining relatively high digestible energy (DE), but low crude protein (CP) and phosphorus (Blood 1966, McCaffery and Creed 1969, and Pitt 1986). A long grazing season with continuous use and high stocking rates results in removal of high proportions of this forage. This forces cattle to eat browse, which is low in DE and results in livestock weight losses (Figure 21).

13) Producers need to be shown alternatives to the present system. Complementary grazing systems offer the best possibilities for success in Saskatchewan. With current surpluses of grain on world markets, this may be an opportune time to promote seeding of marginal lands to tame pastures.



Figure 21. Livestock in poor body condition at the end of the grazing season.

14) Present fees for forest grazing are below market value. Comparative fees for Saskatchewan Department of Agriculture (SDA) pastures and grazing lease lands are in the Appendix (Table 2). SDA grazing leases compare favorably with SPRC forest permit areas in terms of land capability and leasee/permittee responsibilities. Permittees operating in provincial forests pay less than one-fifth the present SDA rates for adult livestock, pay nothing for calves, and pay no taxes to the Rural Municipality. This could be viewed as an unfair subsidy to forest permittees. For example, a producer permitted for 30 cows and 30 calves on forestland pays $90 + $2 permit fee for a grazing season. An SDA leasee with the same number of livestock would pay $816 for a season of the same length.

Any attempt at implementing new grazing systems would no doubt lead to strong opposition from producers. A public education program should be implemented to show the benefits of improved grazing management systems. I am not advocating construction of permanent 3 or 4 strand barbed wire fences; clearing of fence-line right-of-ways would create additional access for unregulated hunting activity and all terrain vehicle (ATV) use and the fences themselves would be a hazard to wildlife. I am recommending the use of temporary 2-strand electric fencing which could be moved easily as required.

15) Changes in forest grazing policies must be approved by politicians. This requires an understanding of the basic problems, and a commitment to environmental issues. To date this knowledge and commitment has been lacking.

CONCLUSION AND RECOMMENDATIONS

Major problems are apparent with forest grazing in Saskatchewan, but the opportunity for improvement does exist. Much of the opposition to grazing on crown lands has been generated due to poor grazing management. The public observes denuded or weed infested rangelands and damaged riparian areas and assumes that grazing is harmful and foreign to the ecosystem. Unfortunately wildlife personnel and livestock producers have often been at odds, so that neither group has attempted to understand the other's concerns. It benefits neither wildlife nor livestock when range condition deteriorates. While good range management is not necessarily good wildlife management, the two can often coexist.

With these thoughts in mind, I make the following recommendations:

1) SPRC should begin to enforce regulations and policies uniformly. Livestock numbers should be accurately determined and reductions should be made where necessary.

2) SDG or simple rotational grazing systems should be considered.

3) Rock's (1981) recommendation of a 3 month grazing season throughout the mixedwood forest would require alternative grazing for the remaining 3 months. Producers should be encouraged to develop complementary grazing systems using Regar meadow brome or a combination of crested wheatgrass and Russian wildrye on their own land.

4) The present May 24 to October 15 season would be acceptable in the Cypress Hills with the implementation of SDG or a similar rotation grazing system .

5) Riparian zones need to be adequately protected from overuse. This may be done by implementation of SDG in combination with fencing to allow limited access to water.

6) Grazing season dates should be determined according to the phenological stages of key forage species. This requires greater flexibility in setting season dates.

7) Range condition and trend should be monitored through the establishment of permanent sampling plots.

8) Field staff should be given training in range assessment and range management principles.

9) Administration of forest grazing could be streamlined by introducing grazing associations where possible.

10) Wildlife Branch should identify goals for key wildlife species and attempt to work with grazing associations in order to meet these goals through grazing management.

11) A study of livestock productivity should be implemented in the Bronson Forest. Concrete information about livestock gains and reproductive success is required before other recommendations will be accepted.

12) Livestock producers should be given access to the latest information in grazing technology.

13) Grazing fees on forest land should be brought in line with SDA lease land. SPRC is unfairly subsidizing producers on forest land.

14) Forest grazing and research should be given a higher priority and profile within SPRC Forestry Branch.

The Government of Saskatchewan has taken the approach that multiple use of resource lands is desirable. The type and degree of use which is acceptable to the public depends on the individual area. A serious question which must be addressed, however, is whether one group should be allowed to use crown lands to the detriment of wildlife and other resource users. Class action law suits brought against the Bureau of Land Management (BLM) during the 1970s brought this matter into the public eye in the United States. This type of action is not possible under the Canadian Legal System. Change must occur through political lobbying or by publicly embarrassing responsible agencies and their Ministers. Provincial and Federal agencies need to take their responsibilities for land management more seriously or they may face challenges in the future. A case in point is the Bronson Forest grazing problem. Thorpe (1978) and Rock (1981) clearly identified problems with forest grazing. Their recommendations were, however, ignored for political reasons.

Saskatchewan has lagged far behind other jurisdictions in dealing with its forest grazing issues. Policies, regulations, and recommendations have been ignored for too long. A continuation of present grazing strategies will lead to continued deterioration of grazing land. Clearly, conditions can be improved through co-operation of government agencies and livestock producers. Alternative grazing strategies need to be applied. If SPRC wishes to have any credibility

in the public eye, its Minister must follow the advice of his field staff.

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APPENDIX

Table 1. Numbers of livestock and permits on selected areas of provincial forest during 1986-87.

Location	No. Cattle	No. Horses	No. Sheep	No. Permits
Cypress Hills				
Centre Block	345	0	0	1
West Block	1900	0	0	1
Moose Mountain	1454	0	0	6
Duck Mountain	43	0	0	2
Porcupine Forest	1100	6	0	17
Nisbet Forest				
Shellbrook	378	0	0	2
MacDowall	1030	22	5	25
Remainder	375	0	0	23
Fort a la Corne	218	40	0	13
Northwest Area				
Bronson	3003	0	0	39
Meadow Lake Pk.	415	0	0	11
Remainder	1871	21	0	45
Northern	603	0	0	13
Total	12735	89	5	198

Table 2. Comparative fee structure (Canadian dollars) for grazing lands in Saskatchewan.

Agency	Type	Fee adult $	Fee calf $	Taxes $
SDA	Lease unimproved	3.30/m	8.00/s	4.00/adult
SDA	Community Pasture	.24/d	8.00/s	7.20/adult
SPRC	Forest Permit	3.00/s	nil	nil
SPRC	Prov. Park	3.30/m	nil	nil

Table 3. Fencing costs (Canadian dollars) in Saskatchewan during 1987.

Items	Unit cost $	No./mile	Total $/mile
Conventional Fence			
Posts			
7'	2.70	320	880
8'	6.50	10	65
Wire (12 gauge 440 yards per spool)			
4 st.	40.00	16	640
3 st.	40.00	12	480
Misc.			100
Labor			2000
Clearing	100.00/acre	2	200
Total	3 strand		$3725
	4 strand		$3885
Electric Fence			
Posts			
7'	2.70	105	285
8'	6.50	10	65
Wire (high tensile)			
2 st.	50.00	8	400
Misc.			100
Labor			500
Fencer			100
Total			$1450