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Grazing: a Natural Component of Grassland Ecozone Riparian Systems

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GRASSLANDS EVOLVED WITH GRAZING

Grazing has helped shape and develop riparian ecosystems over thousands of years in North America, through the co-evolution of native plants and grazing regimes. Before settlement, grazing pressure was applied through native herbivores such as deer, elk, pronghorn, and especially bison (Nordin et al. 1997). Other factors such as ice movement, drought, flooding, topography and climate all helped to shape riparian ecosystems.

Bison developed seasonal migration patterns based on forage availability, climate, fire patterns and shelter. Smaller, sedentary herds would typically stay in one region all year round, but the larger herds would migrate (Epp 1998). The summer was usually spent in the mixed grass prairie, moving to the foothills and parklands in winter where food and shelter were in abundance. Though these herds caused considerable disturbance and impacts on riparian systems, they would not return for extended periods of time, creating long rest periods and allowing for the vegetation to recover. Fitch and Adams (1998) describe a natural system to be a grazing regime controlled through season, climatic factors, periodic droughts and fires, followed by varying rest periods.

Grazing, during the period when grasslands were inhabited by large migratory herbivores like bison, was a natural component in the development and maintenance of riparian ecosystems. With the overlap of bison and cattle diets, cattle are a good substitute to mimic the management functions that bison once performed (Peden 1974).

However, since settlement, grazing management has focussed on upland management, rarely considering the needs of riparian areas. Due to overutilization and inadequate rest periods, riparian areas have degraded over time. Negative impacts of inappropriate management have included structurally altered streambanks and shorelines, as well as increased sediment and erosion (Abougendia 2001; Fitch and Adams 1998; Elmor and Beschta 1987; Borman et al. 1999). Learning from the mistakes of the past, land managers now consider either removing livestock from the system (exclusion) or utilizing planned grazing systems which model the natural disturbance-rest regimes of the bison. Riparian systems are dynamic and unique, requiring customized management, although some areas may not be suitable for grazing due to their soil structure and susceptibility to degradation.

GRAZING AND RIPARIAN SYSTEMS

What is a Riparian Zone?

Riparian areas are the transition zones between the aquatic and the upland or terrestrial zone (Thompson and Hansen, 2001). Otherwise known as the green zone along lakes, wetlands, creeks, rivers and areas of increased moisture, riparian areas are characterized by increased water levels, either at or below the surface, hydrophytic vegetation, and hydric soils.

The health of a riparian area is assessed according to its ability to perform a number of key ecological functions. These functions include maintenance and development of streambanks and shorelines;

reduce erosion and sedimentation; decrease water velocities; water storage; aquifer recharge; filter nutrients and contaminants; primary production; and biodiversity. As a result of these key ecological functions, riparian areas provide many public and private benefits. They provide a source of clean water, sustain diverse plant populations, develop highly productive soils, provide fish and wildlife habitat, decrease the risk and damage caused by flooding, and provide areas for tourism and recreation.

Vegetative condition plays a predominant role in determining riparian health (Thompson and Hansen 2001). Vegetation in a healthy riparian area is characterized by diverse populations of deep-rooted, water-loving species such as trees, shrubs, cattails, bulrushes and sedges. These plants provide adequate ground cover, help bind the soil; stabilize streambanks and shorelines; reduce erosion and sedimentation; remove nutrients and trap contaminants, improving water quality; and dissipate water velocities, allowing for infiltration and aquifer recharge. Healthy riparian vegetation also offers habitat for fish and wildlife by providing food and shelter. Without healthy vegetation, a riparian area cannot perform its key ecological functions.

Grazing is Natural:

Livestock exclusion, or fencing, entails the use of a physical barrier to prevent livestock any access to riparian areas. The advantage of exclusion fencing is that it can aid in the rapid recovery of a riparian area, while keeping livestock out of areas that are extremely susceptible to degradation. The disadvantages are that it is very expensive and, at times, impossible. Exclusion may require kilometres of fencing through rough terrain, which may have to be replaced or repaired each year due to flooding and water saturated soils. Furthermore, livestock exclusion may result in the loss of a valuable resource; riparian areas comprise a small portion of the overall landscape (one to five percent), but can potentially produce 20 percent of the summer range (Thompson and Hansen 2001). Apart from economic losses, biodiversity and the overall function of a riparian area may be hindered by the removal of grazing.

Intermediate Disturbance:

Riparian areas function properly through the interactions of diverse groups of deep rooted, soil binding species, maintained through disturbance interactions. Connell (1978) (Figure 1) proposed that species diversity was maximised under intermediate levels of disturbance. At low levels of disturbance, diversity is reduced by competitive exclusion, possibly resulting in the dominance of a particular species, desirable or undesirable. For example, reed canary grass is very competitive, and under exclusion can impede or prevent the establishment of woody species that provide deep binding, bank stabilizing roots. With the introduction of disturbance, and through proper grazing management, woody species can re-establish (Fitch 2004, Personal Communication).

Similarly, high levels of disturbance do not allow for natural succession, thus reducing diversity and the health and function of riparian areas. Natural fluctuations in water levels and water movements (erosion and deposition) may not be enough disturbance to maximise diversity and riparian function. In these cases, proper grazing management is needed to improve riparian function and biodiversity.

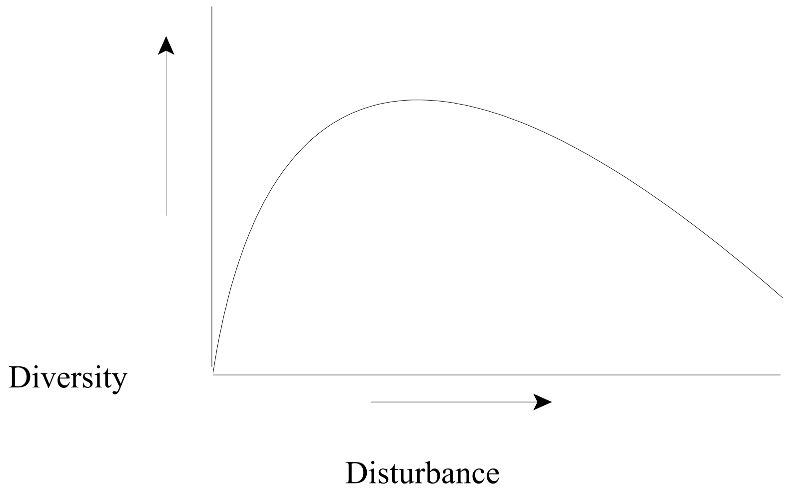

Figure 1: The “Intermediate Disturbance” Hypothesis (based on Connell 1978)

Grazing Can Stimulate Plant Growth:
Proper grazing management can stimulate plant growth, maintain optimal leaf area, enhance nutritive value, remove excessive litter, accelerate nutrient cycling, and manipulate botanical composition (Manske 1998; Manske 2000; Vallentine 1990). Each of these benefits enhance the health and function of riparian areas.

Grazing in riparian areas which have been protected over a long-term can stimulate plant foliar cover (Popolizio et al. 1994). Typically, when a plant is left ungrazed, the leaves become longer, thinner, more erect and with fewer large tillers, reducing their photosynthetic capacity (Briske and Richards 1995). With the removal of some above ground herbage, the remaining leaves are exposed to greater light intensities, increasing their photosynthetic capacity and stimulating growth. Root growth and processes similarly benefit from the removal of excess forage. Increases in light intensity induce root respiration and nutrient uptake (Manske 1998; Briske and Richards 1995). Grazing can also stimulate plant growth through the removal of apical dominance, causing plants to stool and have secondary tillers, increasing herbage yield and cover. After each defoliation, adequate rest periods are needed to allow for nutrient recharge to maintain the new foliage.

A generalized root to shoot ratio for long lived perennial forages on dry land areas is 2/3 of the biomass below ground and 1/3 above ground, with this ratio increasing with moisture availability (Jackson et al.1996; Frank et al. 2001). Thus any disturbance which stimulates above ground biomass will greatly increase the below ground biomass. Stimulating root growth and above ground biomass will improve the soil binding and nutrient uptake needs and capabilities of the plants. A healthy, more robust plant requires more nutrients such as nitrogen and phosphorous for growth.

Idle-itis:

Adequate litter cover serves many purposes: ground cover for moisture retention and infiltration; erosion reduction; nutrient cycling; wildlife habitat; and a food source. In areas of low moisture, such as the dry mixed grass prairie, the removal of litter reduces forage production. In areas of increased moisture, an excess of litter may be a detriment and lead to "idle-itis" or loss of production and diversity due to litter and dominance of a few plant species. For example, in the tall grass and fescue prairie, excess litter can retard growth in the spring, prevent seedling establishment and decrease forage production (Weaver et al. 1934; Laycock 1994). The removal of excess litter by grazing exposes plants to light and warmer temperatures, increasing herbage yield and cover. As highly productive components of the landscape, riparian areas have the ability to accumulate large amounts of litter quite rapidly, thus reducing yield and cover of desired species over time.

Invasive Species:

Grazing can also be used as a control mechanism for invasive and undesirable species, whereas removal of grazing may not improve the competition balance (relationship) for native plants. A study conducted by Cosby (Laycock 1994) found that exclusion grazing on tall grass prairie actually permitted the invasion of undesirable species such as smooth brome and Kentucky bluegrass. On the other hand, selective grazing by livestock can control or eliminate invasive or unwanted species. For example leafy spurge can be controlled by sheep or goats. PFRA-AAFC Community Pastures found a 50% stem density reduction in leafy spurge after implementing a controlled grazing system with sheep (PFRA-AAFC 2004).

GRAZING MANAGEMENT

Grazing management can be used to improve and maintain the health and function of riparian areas if proper grazing strategies are implemented (Popolizio et al. 1994; Boreman et al. 1999; Clary 1999; Clary 1995; Thompson and Hansen 2001; Fitch and Adams 1998). Unique management approaches may be needed for each riparian area, based on the type of system (lentic or lotic), stream type, and the community and habitat type, but each plan should follow the four basic principles of range management.

Balance Supply and Demand:

Balancing forage supply and demand means ensuring that the amount of forage required by livestock does not exceed what the area can supply, while leaving enough residue or carryover to protect the soil, reducing erosion and increasing moisture retention. This is achieved by setting a correct carrying capacity and annual stocking rates. Carrying capacity is the maximum amount of forage that can be removed while maintaining or improving the vegetative stand. Annual stocking rates (the number and types of animals on a given area for a certain length of time – AUM/ha) will vary from year-to-year, depending upon precipitation levels and other environmental factors. In addition, on-site judgements of when to move livestock can be made to ensure adequate carryover.

***Distribution of Grazing Pressure*:**

The theory behind distributing grazing pressure is to ensure that one area within the management block does not receive more pressure than another. To distribute grazing pressure, the manager must not allow livestock to linger or overutilize an area. This can be achieved through many avenues such as salt and mineral placement away from areas livestock normally frequent, water developments, fencing, and herd dynamics and density.

Defer Grazing During Sensitive Periods:
Deferred grazing involves delaying livestock access until certain sensitive periods have passed. In the case of riparian areas, this may be when soils are saturated with moisture and are more vulnerable to trampling, as in the spring. Delaying livestock access may also make sense in the fall, when grasses have matured and are less palatable, and woody species are typically more susceptible to browse. Other considerations may be wildlife; the life cycle of that species must be taken into consideration and grazing should occur at times when impacts are minimal.

Adequate Rest for Recovery:
After being grazed, a plant must have effective rest during the growing season to allow carbohydrate or growth reserves, roots and vigour to be restored. If plants are continuously grazed without allowing time to recover, their health, vigour and productivity are greatly reduced. Eventually these plants may be replaced within the community with undesirable, shallow-rooted species and invasive species.

GRAZING SYSTEMS

A grazing system is key to achieving the above objectives. Each grazing system will be unique and focussed on the needs of that area. An individual system is best implemented on a landscape basis, with special consideration towards riparian areas, along with the previously mentioned grazing management principles. An individual system will generally contain components of the following models, which would be implemented to achieve specific objectives.

Rotational grazing involves the movements of a herd throughout a series of paddocks or fields. This system decreases the amount of time livestock can access each field, which in turn increases the amount of effective rest, reduces selectivity, and improves distribution.

Season long grazing systems are not recommended for the management of riparian areas or uplands. Under this system, livestock remain in a single field or pasture for the entire grazing season. Even if the correct stocking rates are set, this system results in poor distribution, selectivity, and overutilization of favourite species and riparian areas. Because riparian areas supply an abundance of quality forage, and in most cases a supply of water, livestock, especially in the late summer and fall when upland forage is less desirable, loiter and have significant impacts on the riparian area (Marlow and Pogacnik 1986). This is greatly enhanced in a continuous grazing system and allows no time for effective rest, degrading range and riparian condition over time.

Monitoring
To gauge the success of a management plan, a monitoring program must be initiated from initial

development through subsequent years. This provides a benchmark, based on the structure and function of riparian zones and wildlife, and enables the manager to modify the grazing system to improve riparian function. There are approved methodologies available through such organizations as Cows and Fish, Alberta Riparian Habitat Management Society and The Riparian and Wetland Research Program (RWRP) out of the University of Montana.

Defecation:
Management practices should work to minimize loitering, trampling, soil compaction and defecation within the water and riparian area. Proper grazing management reduces the time livestock can access the riparian area and defers access during sensitive periods, distributes grazing pressure evenly, and can improve riparian health and function. Research has shown that management strategies such as the installation of remote watering systems, without fencing, can decrease the time spent in streams by 50-80 percent (Veira and Liggins 2002; Miner et al. 1992). While exclusion fencing eliminates defecation by livestock, vegetative health may diminish, which will affect water quality by reducing nutrient filtering capabilities.

SUMMARY

Grazing ungulates have shaped and developed riparian ecosystems over thousands of years. Though unmanaged livestock grazing has degraded riparian ecosystems, under a properly managed system, livestock can be used to mimic the patterns of grazing ungulates and improve and maintain riparian health and function. Management must be specifically orientated to each riparian area, developing a planned grazing system which follows the four principles of range management, keeping in mind that some riparian areas may not be suitable for grazing. To ensure success, a monitoring program must be implemented based on riparian structure, function and wildlife from the initial stages through subsequent years. This will provide the benchmark needed to determine if management goals have been achieved.

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