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Extension FactSheet

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Livestock and Streams

The Effects of Grazing Management on Riparian Areas

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The Environmental Protection Agency states that agriculture has a greater impact on stream and river contamination than any other nonpoint source. Grazing, particularly improper grazing of riparian areas may contribute to nonpoint source pollution.

This series of fact sheets looks at the issues of livestock and streams and what livestock producers can do to protect this precious resource. In any discussion about managing grazing livestock to decrease nonpoint pollution, it would be helpful to review what is known about the management of grazing in riparian areas.

Although the original grazers were bison, moose, and deer rather than cattle, horses, sheep, and goats; most native riparian plants species re-grow following a period of grazing (Mosley, et al. 1998; Ohmart, 1996).

Photo courtesy of USDA Natural Resources Conservation Service. Rotationally grazing cattle on a well-managed pasture is a good best management practice compared to continuous grazing.

When farmers displaced these occasional roaming grazers with continuously grazing livestock, riparian areas suffered. Provided with limited grazing areas and little stimulus to move from one area to another, continuously grazing livestock trample streambanks, congregate in the shade and cool breezes next to streams, and overgraze the lush vegetation in these fertile areas (Bellows, 2003).

One cannot discuss the effects of livestock grazing on streams without recognizing the interwoven and connected nature of watersheds, riparian zones, streams, and watershed activities. Activities affecting watersheds or riparian zones also affect stream ecosystems directly, indirectly, and cumulatively. Although this series of fact sheets primarily focuses on the riparian areas, it is understated that mismanagement of the land resources in the watershed can have as big an impact on surface water.

What Are the Negative Impacts of Grazing Livestock in Riparian Areas?

Heavy grazing in riparian areas has many effects and can compact the soil, reduce infiltration, and increase runoff, erosion, sediments, and nutrients. Livestock compact soil by trampling it, making paths, or repeatedly congregating in the same areas. This reduces the ability of riparian areas to absorb and hold water, and breaks down streambanks.

Photo courtesy of Jim Hoorman. Continuous grazing leads to overgrazing and soil erosion.

Photo courtesy of Jim Hoorman. Management intensive rotational grazing of dairy heifers.

Vegetation removal leads to higher stream water temperature (Li et al., 1994). Higher water temperatures result due to a lack of shade. Unrestricted livestock will feed selectively on preferred lush forages in riparian areas, reducing the ability of these species to survive or reproduce. This creates bare areas and promotes the growth of weeds. Livestock also transport noxious weed seed and vegetative growth into riparian areas.

Livestock will deposit manure and urine in concentrated areas around riparian areas, especially in hot weather (Bellows, 2003). Manure and urine shed on adjacent pastures or into water bodies can lead to elevated levels of nutrients.

In riparian zones, trampling the streambanks leads to streambank erosion and contributes to sediment yield (Trimble and Mendel, 1995). Fish and aquatic invertebrates (insects) are sensitive to sediment, water temperature, and excess algae and plant growth due to excess nutrients deposited in the stream (Waters, 1995). A general conclusion is that unmanaged grazing leads to overuse and degradation, primarily in riparian areas (Fitch and Adams, 1998).

Can Controlled Grazing Limit Impacts?

Most results for riparian grazing studies suggest that the specific grazing system used is not of dominant importance, but that good management is important, with controlled use in riparian areas (Clary and Webster, 1989).

Research studies show that managed grazing can simultaneously enhance farm productivity, decrease input expenses, and protect the environmental conditions on the farm (Macon, 2002; Herrick et al., 2002; Paine et al., 1999; Berton, 1998). Even governmental agencies and environmentalists, who implicate continuous grazing as a primary cause of riparian degradation, now join with farmers in promoting managed rotational grazing as a way to protect riparian areas (Lyons et. al., 2000; Mosely et al., 1998; Leonard et al., 1997; Elmore, 1992).

Caution should be used when interpreting most past research, because many studies were not experimental with replicated treatments and statistically valid results, rather they are before and after treatments with no baseline or pre-impact data (Larsen et al., 1998). Very little research has been conducted and published for grazing practices in the Midwest and most of the published research gives little indication of the management of the grazing livestock (Mulla and Addiscott, 1999).

Low intensity grazing of pastures that are not fertilized does not usually cause significant nutrient or sediment impacts on surface waters, unless livestock have access to water and/or the riparian buffers (Correll, 1996). Due to efficient nutrient recycling, these low intensity systems are similar in impact to native vegetation and are much better than annual row crop systems. However, pastures that receive heavy applications of fertilizer or stored manure often harm water bodies, and their impacts can exceed those of annual row crop systems. Correll (1996) concluded that rotational grazing reduces the impacts associated with continuous grazing.

In southeastern Minnesota, it was demonstrated that streams with grassy buffers were able to catch and filter eroded sediments better than woody buffers, which had little grass vegetation (Sovell et al., 2000). Researchers found that when grassy riparian areas were continuously grazed, streams had high coliform counts and turbidity. When grassy riparian areas were rotationally grazed, water quality was not significantly different from that measured in ungrazed grassy buffer strips. Rotational grazing did cause coliform counts to rise briefly while cattle were grazing on streambanks but these counts decreased within two weeks after excluding the livestock from the riparian areas. The researchers concluded that rotationally grazed riparian areas may protect water quality as well as, if not better than, some woody buffers. They also found that short-duration rotational grazing of streambanks had only limited and short-term impacts on water quality (Sovell et al., 2000).

Photo courtesy of USDA Natural Resources Conservation Service. Dairy cows grazing pasture leaving 4-inch stubble.

It may be possible to rotationally graze riparian areas that have a high water table and diverse vegetation without harming the riparian zone. Key factors are the length of time or duration of grazing, length of rest periods between grazing cycles, the plant species, the type or species of livestock, the amount of prior riparian degradation, and production objectives.

Can Controlling How Long Livestock Graze Limit the Impacts?

Riparian areas need sufficient rest for critical plant species to re-grow and reproduce to maintain riparian health. Several leading researchers stress that timing and duration of rest periods are more important than specific grazing practices (Leonard et al., 1997; Elmore, 1992).

Stubble height is used to monitor upland pasture conditions and to help make decisions when to rotate livestock. Stubble height can be used as a management tool in riparian areas. The recommended height of forage residues after grazing depends on the environmental conditions (Clary and Leninger, 2000). For example:

- Four-inch stubble will usually maintain plant vigor, trap sediment, and protect soils from compaction when trampled.
- In woody streambanks, moving livestock after they have grazed down to 6-8 inches may be necessary to ensure that they are not feeding on willows or other riparian trees because they lack good forages to feed on.
- Stubble height is not useful on rocky streambanks or where woody vegetation dominates.

Can Grazing at Different Times of the Year Limit Impacts?

The time of year when livestock are allowed to graze riparian areas is critical to maintaining and restoring riparian health. Factors that determine the appropriate time to graze include:

- Riparian soil moisture following rainfall, snowmelt, and/or heavy stream-flows.
- The dominant riparian vegetation and its period of peak growth and dormancy.
- The reproductive characteristics of the riparian vegetation. How and when does it reproduce?
- Freeze and thaw cycles during winter.

Riparian areas should not be grazed when they are wet and most vulnerable to compaction. In the Midwest, this means excluding animals from riparian areas during winter snowmelts and spring rains and not allowing animals in until the soils dry out.

Timmons and Holt (1977) provide levels of nutrient loss from a native prairie in west-central Minnesota that can be used to compare the effects of different grazing levels on nutrient loads in runoff. Depending on the nutrient of interest, 63% to 88% of the average annual nutrient loads were transported in snowmelt; however, concentrations for all nutrients were higher for runoff following rainfall.

Even though Correll (1996) concluded that rotational grazing reduces impacts, he also concluded winter grazing increases impacts. In areas with heavy late fall rains, livestock should be moved out of the riparian area. Timing of riparian grazing is important for preventing erosion and the degradation of soil and water quality (Bellows, 2003).

Timed grazing can be used to protect healthy vegetative growth in riparian areas. Periodic grazing can be used to remove the apical meristem or top portions of grasses and sedges. This promotes vegetative reproduction by stimulating the sprouting of additional tillers (Mosely et al., 1998). Grazing should not occur when annual species are setting seed.

Can Using Different Livestock Limit the Impacts?

Graziers should understand the grazing patterns of animals they manage (Stuth, 1991). Different species prefer different forages and graze them to different heights. Sheep and horses graze close to the ground and prefer lush grasses. Cattle grab and bite with their mouth and tongue and are less specific. Goats are browsers and prefer forbs, shrubs, and grasses. With their small nimble mouths, they can select individual leaves and strip bark off of woody plants. Grazing management practices should be designed to work with an animal's natural preferences (Leonard et al., 1997).

Different livestock also have different herding and camping characteristics. Sheep tend to cause less damage to riparian areas because they do not like to congregate in low-lying areas where they feel vulnerable to predation

Photo courtesy of USDA Natural Resources Conservation Service. Sheep grazing a pasture with fence to exclude livestock from nearby stream.

(Glimp and Swanson, 1994). Cattle on hot days like riparian areas for water, shade, and cool breezes and tend to do more damage because they congregate for long periods of time in riparian areas.

Brush and weed management is the greatest potential environmental benefit that managed grazing provides to riparian areas. Brush removal by cattle maintains grassy buffers that are more effective in protecting water quality and providing fish habitat than are some woody buffers. A research study in Wisconsin is using Scottish Highland cattle in rotational grazing to help control prickly ash, multiflora rose, wild parsnip, and box elder (Shepard, 2001).

In various locations, goats are used to control noxious weeds and non-native brush species in riparian areas, allowing for the growth of plants that provide healthy riparian conditions. Goats are used to control blackberries, multiflora rose, honeysuckle, and many other troublesome plants (Pittroff, 2001; Luginbuhl et al., 2000).

What Are the Impacts from Exclusion?

Deferred rotation grazing led to improvement of aquatic and riparian habitats along three central Nevada streams, but complete rest from grazing allowed the most improvement (Myers and Swanson, 1991).

Streambank soil stability, type and amount of vegetation cover, and quality of pools responded most to changes in grazing management. Complete rest improved channel and water width:depth ratios, channel entrenchment, bank angle, bank undercut, and bank depth. These changes are common, but not universal.

A longitudinal survey showed livestock damage ranging from 0% to 25% of the channel length in grazed reaches (Williamson et al., 1992). They found no statistical evidence that mixed sheep and cattle grazing on streambanks in floodplain streams in New Zealand led to rapid or severe deterioration in channel form, except in small streams (< 6.6 ft wide) under intensive grazing of wet streamside soils.

They found that the dominant erosion mechanism, the undercutting of banks, was largely unaffected by grazing stream margins. The effects of riparian retirement on small streams varied depending on the stability of the stream channel, but were correlated with increased vegetation overhang.

On larger streams with more meandering channels, retirement had comparatively little benefit, because any retirement or grazing effects were rapidly overtaken by channel migration. Williamson et al. (1992) concluded that, in contrast to channelization, grazing appeared only to have a minor effect on channel morphology in the streams they studied, because only very large differences could have been detected as a result of the variability in each reach.

Critical Components of Riparian Grazing Practices

- Combining managed upland grazing practices with good riparian grazing management.
- Installing alternative watering systems and controlled grazing to minimize deposition of manure near streams.
- Adapt grazing management practices to local riparian zone conditions and to the species being grazed.
- Employ long-term rest from grazing riparian areas that are highly degraded.
- Employ short-term or seasonal rest to protect wet streambanks and riparian vegetation that is emerging, regenerating, or setting seed.
- Maintain streambank structure and function by maintaining a healthy cover of riparian vegetation.
- Be flexible in your grazing management and document mistakes so that you can learn from them and avoid repeating them.

(Leonard et al., 1997; Clary and Webster, 1989)

Photo courtesy of Jim Hoorman. Streambank erosion in a continuously grazed pasture.

Summary of Effects of Grazing Management on Riparian Areas

Continuous unmanaged grazing has many detrimental effects on riparian areas that include: soil compaction, increased runoff, soil and sediment erosion, excess nutrients and pathogens transported to streams, vegetation removal, decrease in vegetation species diversity, importation of noxious weeds, and loss of wildlife habitat.

Larsen et al. (1988) suggests using caution when interpreting past research because many studies were not experimental with replicated treatments and statistically valid results, rather they are before and after treatments with no baseline data. Mulla and Addiscott (1999) also states that very little literature has been conducted and published for grazing practices in the Midwest.

With controlled grazing strategies like Management Intensive Grazing (MIG), many of these detrimental impacts to water quality can be minimized or greatly reduced. Riparian areas need sufficient time to rest for critical plant species to re-grow. Allowing livestock to graze for short periods of time when soil conditions were dry was less harmful to the riparian area. On grassy riparian areas, a stubble height of 4 inches needs to be maintained. In woody areas, 6-8 inch stubble heights are recommended, and on sensitive areas, livestock should not be grazed. Each livestock species has different grazing preferences and herding and camping characteristics that should be accounted for in a grazing management strategy.

For more information on the effects of livestock grazing riparian areas see the following fact sheets:

- Understanding the Benefits of Healthy Riparian Areas, LS-1-05
- Negative Effects from Livestock Grazing Riparian Areas, LS-2-05
- Best Management Practices to Control the Effects of Livestock Grazing Riparian Areas, LS-4-05
- Pathogenic Effects from Livestock Grazing Riparian Areas, LS-5-05

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