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Making Riparian Area Protection A Workable Part of Grazing Management

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INTRODUCTION

Riparian areas are recognized as the green area immediately adjacent to water, such as streams, springs, rivers, ponds, and lakes. They are identified by the presence of vegetation that requires large amounts of water during plant growing seasons (Figure 1). These narrow zones of green vegetation make up only a small proportion of the total area of the lower mountain elevations, foothills, and basin areas of the western United States. They serve as a transition zone between the more plentiful surrounding drier land or (upland) vegetation types and aquatic ecosystems supported by a particular source of water. Because of the availability of water, riparian zones are capable of growing three layers of vegetation; I) trees, ii) shrubs, and iii) herbaceous mixtures. This linear mixture of vegetation provides isolated and unique habitat diversity and increased plant production for livestock, wildlife, fish, and recreation within the western landscape.

Riparian zone habitats function in watersheds: I) by filtering sediment transported from adjoining uplands, ii) by stabilizing streambanks and reducing accelerated erosion, iii) by promoting storage of water for release later in dry seasons and, iv) by recharging near-surface aquifers. These functions are why society today demands riparian zone management be considered important when determining future use of public and private lands.

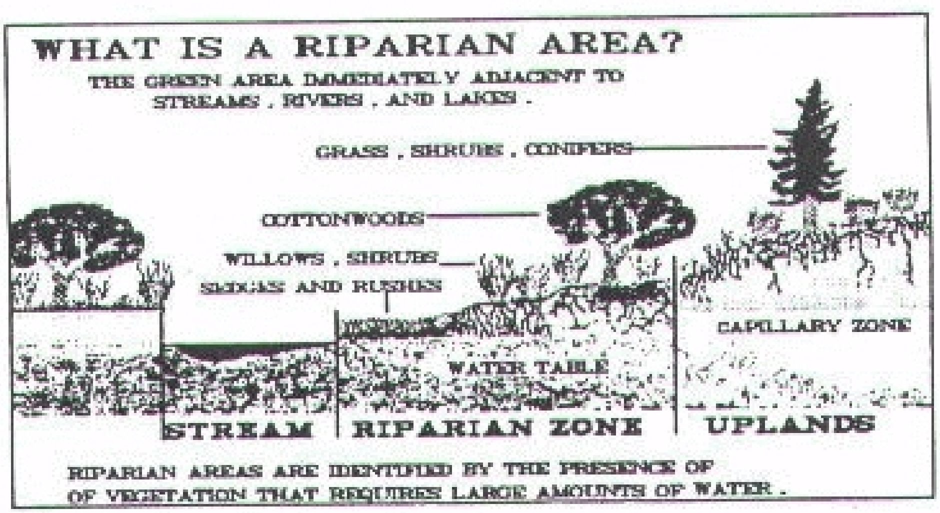

Figure 1. Riparian Zones and Functions (After the Oregon Watershed Improvement Coalition's brochure)

It is clear to the general public that riparian zones act as a sponge, soaking up water during periods of plenty and then slowly discharging it during periods of drought. Free water always near plant roots allows ground cover to increase compared to adjoining upland vegetation types. This increase in ground cover can reduce sediment transport across riparian zones to the water source. A high water table parallel to the water source further allows plants like sedges, rushes, and willows to grow and these form an erosion barrier to moving water like streams. Sedges and rushes are rhizomatous (reproducing by underground stems) and can be more resistant to erosion than grasses with fibrous root systems. Willows add larger roots to soil material making up banks along the water source and may penetrate deeper into the soil profile than grasslike plants when water tables drop. This parallel fringe of sedges, rushes, and willows also acts as a sediment trap by slowing velocity of moving water and allows deposition to occur. Although riparian zone area is small compared to adjoining upland vegetation types, biomass production of these watered areas may be substantially greater. Also, when upland vegetation is dry and has lost much of its nutritional value as forage, in later summer and fall, riparian plants may remain green until freeze up and snow occurs. This added forage diversity can not be ignored when planning for grazing of livestock and wildlife.

HISTORICAL PERSPECTIVE

Ranching has played a significant role in what society now recognizes as the riparian zone resource of the semi-arid western United States. For instance water developments by ranchers has stabilized streambanks and gullies, increased riparian habitat, enhanced wildlife production, and provided higher potential for distribution of grazing animals. These resource improvement practices, although not fully recognized as important by the general public, sustain biodiversity of plant and animal life which were not present before settlement.

Historically, the majority of water stored as snowpack in the central Rocky Mountains runs off the front range in approximately 40 days, leaving wide and shallow stream beds with numerous channels across the more gently rolling basin and plains. Many of these channels dried up during summer months. Ranchers and other settlers developed water by diverting and reducing the power of spring streamflow leaving the mountains. This water, for irrigation was spread over dry land adjacent to the original riparian zones, increasing the availability of green forage and plant cover throughout the adjoining dry vegetation complex. More important, irrigation water that by-passed plant roots became groundwater, eventually returning to the stream and river systems. This return groundwater flow, and reduced stream power during spring, allowed riparian vegetation to encroach wide shallow streanibeds, forming fewer and deeper channels. Also, instream flow conditions were maintained over a greater time period during the dry seasons of summer and fall. Consequently, riparian vegetation has formed continuous stringers from the Rocky Mountains to the Missouri and Mississippi Rivers.

Equally important, ranchers provided off-stream water supplies by drilling wells, developing springs, and building small reservoirs. Improvement practices like these modify distribution patterns of grazing animals. Before ranching, grazing wildlife (buffalo, elk, deer, and antelope) were confined to limited water supplies in streams and springs draining foothills and mountain ranges. At that time, when riparian zones were limited, large numbers of wildlife

were forced to utilize these small areas during dry seasons of the year. In Africa, examples of accelerated erosion and loss of riparian vegetation can now be observed where water distribution follows natural climate cycles. Although livestock replaced buffalo as a grazing animal and other wildlife distribution patterns changed due to settlement, water developed by ranchers provides an opportunity to better manage all grazing animals.

Aware of the importance of water development in the arid west, ranchers supported the construction of dams to provide water required during dry seasons. Control of water by dams further modified streamflow, increasing riparian vegetation below these structures. Also, a shift in use of reservoir water from agriculture to municipalities created urban riparian vegetation like greenbelt and home yard complexes. All along the Rocky Mountains, grasslands of yesterday are dotted with forested areas in towns and cities supporting trees, shrubs, and grasses characteristic of those found along stream systems.

If the truth be known, ranching and its emphasis on water development plays a significant role in conservation of our wildlife, soil, and plant resources. What you see today as riparian zones on the plains and basin regions of the west is not necessarily what existed before settlement. However, stable streams, increased riparian zones, and off stream water supplies now provide the flexibility to better manage land and water for all social needs. The rancher today needs only to capitalize on the issue of managing riparian zones to further support his long record of developing water. This can be accomplished by recognizing the more common impacts to stream systems which cause a decrease in the functions of riparian zones. Once the impacts are recognized then land, water, and user management alternatives exist to let stream dynamics and vegetation heal the riparian zone and maximize desired benefits.

BASIC IMPACTS

Riparian zone condition depends on how well groundwater is maintained near the root zone of water loving plants. This level can change during periods of low streamflow after stream channel conditions deteriorate by down cutting or filling of bottom sediments. Figure 2 illustrates down cutting of a small stream channel.

The top drawing shows a channel condition capable of maximizing water storage. The channel banks have encroached so at low-flow the water column maintains the water table and capillary zone within the reach of roots from water loving plants. The presence of overhanging banks on straight stream segments indicate channel conditions are in equilibrium with the annual average discharge of runoff from the drainage basin. This is in contrast to the bottom drawing where down cutting has occurred. Water stored within the bank aquifer can now drain to the low flow level well below the root zone of riparian plants. This channel condition will not maintain the water storage capability it once had and riparian vegetation will be replaced by upland plant species. In addition, high flow conditions which once spilled over the overhanging banks where flow velocity and force was dissipated over the well covered stream side floodplain is now confined in one deep channel. Confined high flow is now available to further erode the channel banks below the perched root zone. This erosive action will take place until the stream channel becomes wide enough to start establishing floodplains and riparian vegetation within the higher down cut banks.

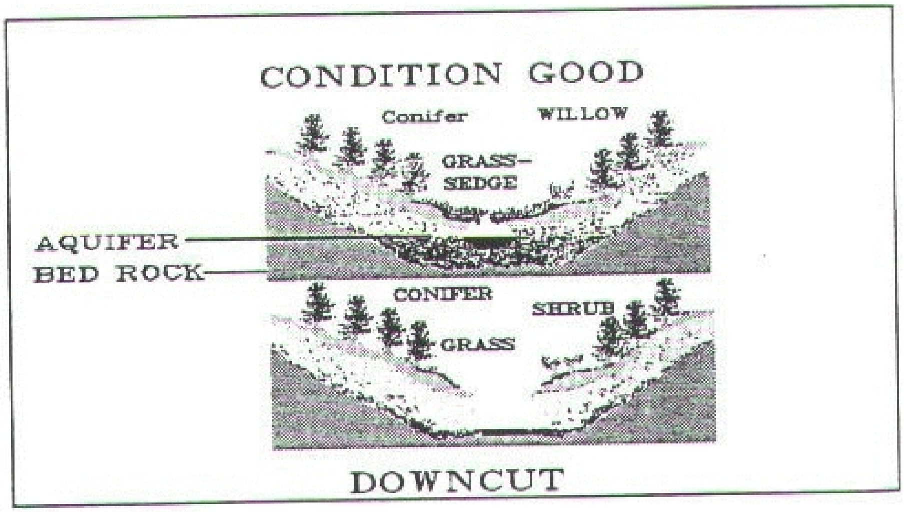

Figure 2. Down cutting of a small stream riparian zone.

Accumulated sediments or larger rock substrate within stream channels also cause deterioration of riparian zones. Affected areas normally occur at the point of transition between steep and flat sections of stream gradients where bedrock controls down cutting and velocity of flow decreases because of reduced channel bottom slope. In addition, streambank failure caused by animal impact during low flow conditions can widen channels. During subsequent runoff periods, substrate can be deposited in these wider sections. This occurs because the wider channel creates lower flow velocity than when overhanging banks existed, and there is not enough power to flush the deposited material downstream. If vegetation is not allowed to encroach on the deposited material then the transport material continues to accumulate causing the channel to become even wider. Channels can fill to a point where during low flow all water is moving below the channel bottom, or smaller and additional channels form (braiding) which can later go dry. Figure 3 illustrates this type of impact.

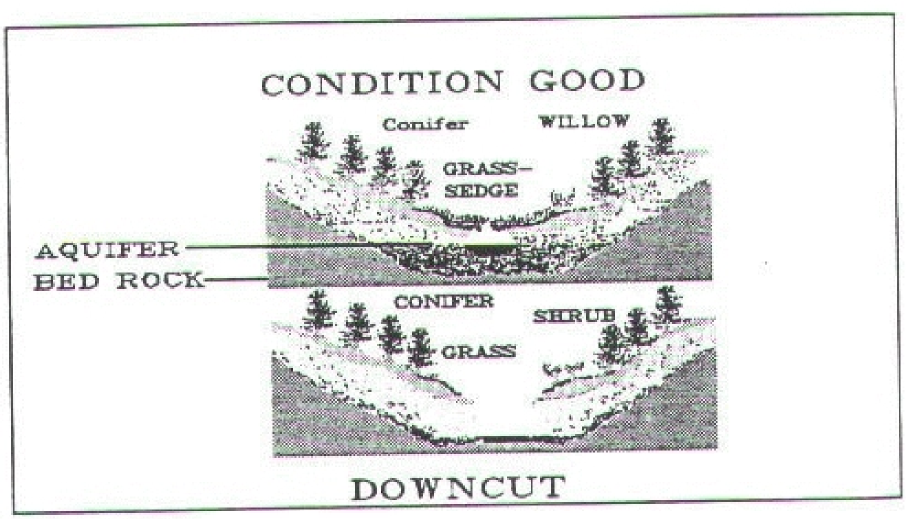

Figure 3. Loss of riparian zone because of channel filling.

Wide and filled stream channels with bottom substrate do not provide riparian and aquatic habitat that is as valuable to wildlife and fisheries as where flow is consolidated into a single channel and overhanging banks exist. The impact, where wide and filled channels decrease riparian zone value, can be reversed by simply managing vegetation along the stream. For example, numerous demonstration\research studies have shown just changing management of livestock grazing alone allows vegetation the opportunity to trap sediment. Plant roots stabilize deposits so banks can build, and eventually the banks confine high flow so bottom substrate is flushed downstream. The stream channel is mature when overhanging banks on straight segments appear. Figures 4 and 5 show this sequence.

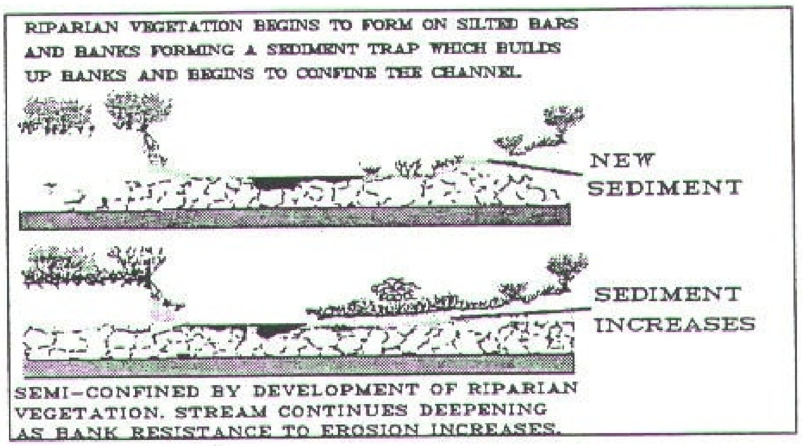

Figure 4. Using sediment and vegetation to build banks and clean channel bottom material from small stream riparian zones.

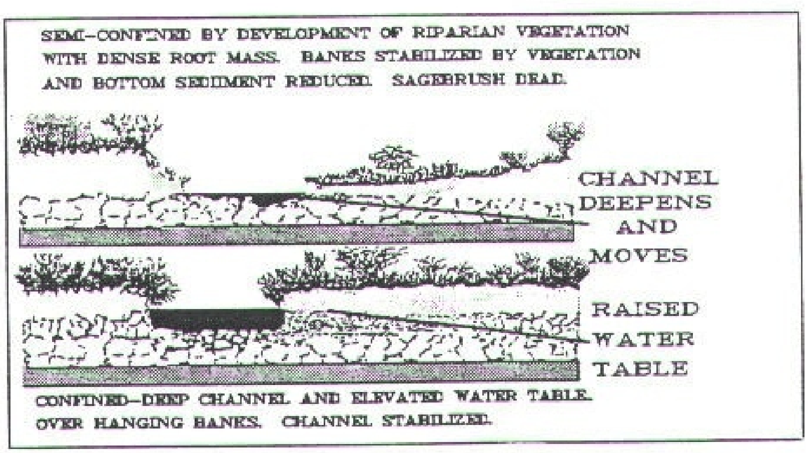

Figure 5. Using sediment and vegetation to build banks and clean channel bottom material from small stream riparian zones (cont.).

STREAMBANK STRENGTH

Streambank strength is related to the type of substrate material deposited and held in place by plant roots. Although there is not a great deal of research proving this point, sand is

considered weak and solid rock strong. Silt and clay are stronger than sand. Substrate angularity provides greater potential for particle interlocking and therefore greater bank strength. Figure 6 illustrates a relative scale of substrate material to evaluate bank strength. Figure 7 shows how angularity and roots can provide additional strength to streambanks. From these illustrations, it is clear that not all streams will react to extreme flow events or user impacts in the same way. If bank material is not strong, then one will expect stream channels to change condition relatively easy. Channel stability will not last long under stress when banks are largely sand or, a small cobble/sand mix.

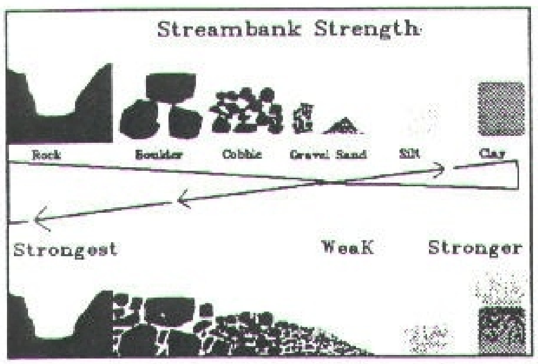

Figure 6. Relative streambank substrate strength.

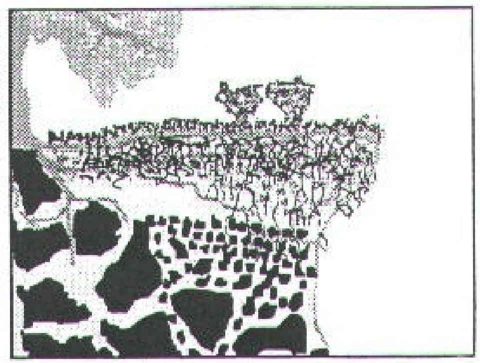

Figure 7. Angularity and plant roots add bank strength.

RIPARIAN ZONE DISTRIBUTION

Numerous attempts are being made to classify riparian zones for western rangeland. Generally these are technical and are not used by the agriculture producer groups to any large extent. However, it is important that the livestock producer realize riparian zones differ in area, water holding capacity, and potential to heal because water and sediment supply vary from high mountains through basin regions of the western U.S. This knowledge can help evaluate where best opportunities exist to change conditions of stream channel segments and adjoining riparian zones and when change is desirable in an area within a given watershed, provides insight towards predicting how fast and what effort will be needed to achieve desired results. Figures 8 and 9 can be used as a general guide to determine where change in riparian zones can lead to increased water storage, riparian zone area, and grazing resources within the general distribution of stream types.

Figure 8 presents a general profile of a stream system from alpine in mountains through basins at low elevations. Water storage capacity within the stream channel and active floodplain of streams can be examined using this profile and near stream soil type materials. Two types of soil material, alluvium and colluvium, are important for storing water along and within stream channels. Alluvium is sediment that is deposited by stream flow parallel to the channel. This material is worked and reworked by the stream as it moves from one location to a next. Colluvium is sediment and rock material that falls or is washed to the stream channel from steeper valley slopes or canyon walls and is deposited at an angle to the stream channel bottom. Alluvium generally consists of smaller soil particle sizes than colluvium and therefore, water

moves in and out of this material slower than it does in colluvial material. Alluvial material is generally deposited in low gradient stream segments and behind natural dams like: bed rock stream gradient controls, rock and wood debris across the channel and floodplain, beaver dams, and within riparian zone vegetation after flood events. Alluvium can build up above bedrock because it is normally deposited on gentle sloping stream segments. The more porous, rock-like material making up colluvium borders stream segments where the gradient is high, flow is confined, and the channel bottom represents bed rock because channel sediment is flushed downstream.

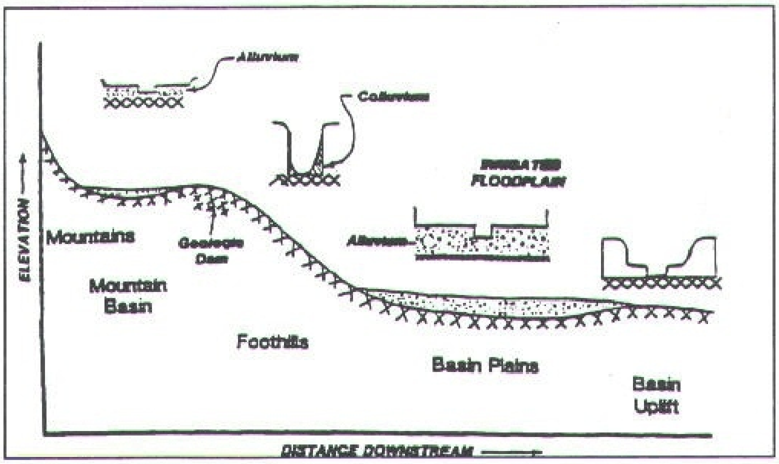

Figure 8. Water storage potential from mountains to basins in the Central Rocky Mountains.

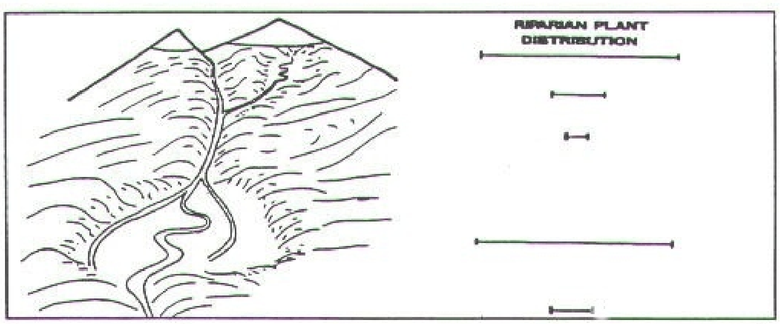

Figure 9. Riparian plant distribution from mountains to basins in the Central Rocky Mountains.

The amount of water storage material available to support stream flow and riparian zones is controlled by the depth bedrock lies under the watershed soil surface. Figure 8 illustrates how bedrock and alluvial/colluvial deposits become shallow with a rise in elevation. There is less water storage capacity within the watershed soil mantle in alpine and sub-alpine than basin regions, yet alpine and sub-alpine regions provide most of the water necessary to maintain late summer and fall streamflow of basin streams. This is because the drainage channel network is

more developed near the top of watersheds. The channel network drains shallow soils over bedrock where little storage capacity is present. The higher frequency summer and fall precipitation supplements snowmelt in mountains and produces surface and groundwater runoff recharge to streamflow. As streams consolidate into fewer channels and enter steep valleys and canyons, little streamside storage capacity exists. However, because bedrock is close to the surface in canyons, narrow riparian zones can be watered frequently by storm events providing upslope groundwater which can move to the stream. After exiting canyons, many deep alluvial deposits along basin streams now have groundwater returning to the channels as return flow from irrigation practices during late summer and fall. This general description for water storage capacity of western watersheds is responsible for the overall distribution of riparian zones now observed as a specialized natural resource.

The general riparian zone distribution of the Central Rocky Mountains is outlined in Figure 9. Riparian plant species are widely distributed within alpine and sub-alpine regions of mountains. Their water requirements are provided by frequent storm events after snowmelt, water harvesting by surface rocks, and a shallow, steep soil mantle over confining bedrock. Riparian zones narrow as runoff is confined to small valley floors along steeper gradient stream segments and along springs flowing from the shallow soil mantle of valley walls. The riparian zones increase in size downstream where geologic or beaver dams have trapped sediment and filled in lakes or ponds along low gradient stream segments.

Streamflow leaving the sub-alpine, after being confined to canyons, support only narrow bands of riparian vegetation along the high gradient streams characteristic of these bedrock corridors, which eventually empty to basin floors. Water required for riparian plants are provided by overbank flow during flood events, groundwater storage in limited alluvium on meander point bars, water harvesting from rock canyon walls during summer storm events, and a porous colluvial soil base next to the stream.

Riparian zones along basin streams are limited to geologic and recent floodplains carved or deposited by the average spring flow regime exiting mountains, canyons, and below water development facilities. Water taken from the stream by diversion reduces streamflow power through low gradient stream segments where deposition of bottom substrate normally occurs. Most irrigation occurs during spring and early summer when the streamflow exiting canyons is at its highest. Diversion lowers the power of the average yearly maximum streamflow and therefore deposition of even more bottom substrates can occur during spring. Spreading the diverted water over lands next to basin streams produces groundwater return flow to the stream. Return flow supports riparian vegetation which stabilizes deposited bottom substrates next to banks. Eventually braided channels characteristic of streams exiting mountain canyons are consolidated to form a single channel supporting a well established riparian zone and deeper channel extending through basin rangelands.

Sediment supply is further supplied to large basin streams from smaller foothill drainage basin systems. These watersheds produce sediment from steep headwaters where vegetation cover is reduced because of the lower average annual precipitation patterns present at lower elevations. Sediment input from these foothill streams increases the rate of building riparian zones and consolidating braided channel configurations of large basin streams. Streambank

strength is increased because sediments supplied by foothill streams have increased silt and clay content and mountain spring flows have been reduced so they are not transported further downstream.

GRAZING MANAGEMENT AND PROTECTION OF RIPARIAN ZONES

Ranching today can take advantage of riparian zone management to further promote low cost water development on grazing lands. Ranching has generally optimized the stabilization of streams on private land. These stable streams can be used to further promote change in riparian zone and aquatic habitat to enhance other income producing ventures like camping, fishing, and hunting. In fact, in the western U.S. these well managed private lands and riparian zones now provide crucial habitat for wildlife during winter. In contrast, much criticism has been voiced that implies ranchers using public land have not been grazing riparian zones appropriately. Most criticism can be focused towards livestock distribution problems and time animals spend on these green line zones. Fortunately livestock distribution can be modified and you as ranchers have many of the tools and knowledge to make this happen.

A common first step in protecting riparian zones to enhance grazing management is to take full advantage of off stream water supplies. These sources were initially developed to take advantage of upland range resources. Now they can be used to reduce time animals spend on streams. When animals are being grazed on streams, place salt on upland sites to better utilize available forage. Spend as much time with your animals as possible, moving them from riparian zones to upland vegetation types. Watch for streambank failure because this reduces your capability to store and manage water and soil. If failure is occurring on straight stream segments, you may be grazing the green line along streams more than you should. If riparian vegetation contains shrubs and trees, graze the system to keep these healthy. Remember diverse root systems of these woody plants may increase bank strength and they certainly provide you with plant diversity to protect animals during periods of stormy weather. Why not review your grazing strategy to see where you can take advantage of riparian forage at special times of the year, but for shorter periods of time. As grazing research data becomes available, it seems to tell us that moderate use maintains the integrity of the stream system. Our challenge then is to strive to meet moderate use of both riparian zone and adjoining upland vegetation forage.

Examples of innovative practices ranchers are now using to achieve moderate use of rangeland to protect riparian zones and maintain grazing operations are as follows:

i) Cattle breeds or crosses are being selected and used that will better range steep slopes and upland areas and reduce time spent on streams. In addition, cattle are being distributed onto rough terrain by drifting small bunches over extended time periods. Drifted animals are then consolidated into small herds which are then moved to separate drainage basins of an entire grazing allotment. They graze their individual drainage basin for the allotted grazing period before being removed. While foraging individual basins, cattle are periodically herded off riparian zones and encouraged to graze uplands. Remaining vegetation is monitored so it is sufficient to curb upland erosion and perpetuate streambank stability.

ii) Spring grazing of riparian zones after snowmelt is taking place on streams where sediment is plentiful to encourage regrowth during late spring and summer. Remaining vegetation is then left over fall and winter to trap sediment the next year. This practice is being used to heal degraded stream channels.

iii) Basin wet meadows and riparian zones are being grazed in late fall and winter after freeze up to minimize hoof action impact to bogs and streambanks.

iv) Small instream structures and rest or deferred grazing are being used in combination on small headwater streams where the stream gradient is low, valleys are wide, and sediment is plentiful. This practice increases the rate of bank building and encroachment into wide channels to restore aquifer recharge for increasing vegetation production.

In summary, ranchers can graze riparian zones and protect stable streams to store water. Potential for increasing and healing riparian zone area changes as streams flow from mountains to basins. Riparian zone area is not confined in alpine regions but is within canyons and cold desert basin regions. In basins, riparian zone area has been increased because of water development. Sediment supply is often limited in mountain regions but is not within foothill and basin streams. Therefore, bank building is slow in mountains and faster in low elevation streams. Areas within streams where natural sediment deposition occurs present best opportunities to heal degraded stream channels. Areas like these occur along low gradient and wide valley stream segments and not in steeper slope canyons and valleys. These watershed locations are also generally used most by livestock. Therefore, periodic herding should be considered as a ranch management option to better utilize upland vegetation resources and minimize time livestock stay on stream side zones. To better facilitate herding, selection for livestock which will use steeper terrain can remain an option.