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Grazing Management in Riparian Areas, 1989

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RIPARIAN AREA MANAGEMENT

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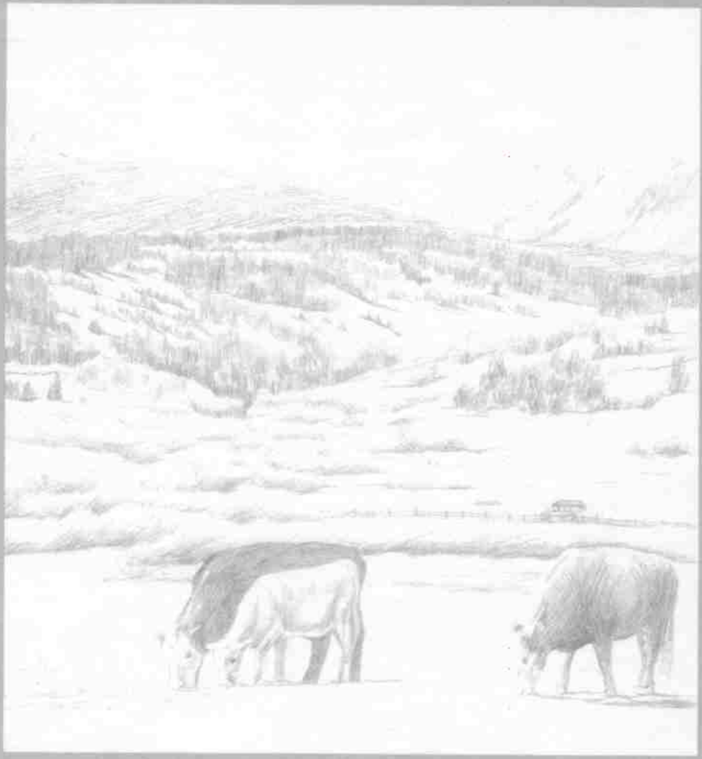

Grazing Management in Riparian Areas

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RIPARIAN AREA MANAGEMENT

Grazing Management in Riparian Areas

by

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Technical Reference 1737-4
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United States Department of the Interior
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TABLE OF CONTENTS

GRAZING MANAGEMENT IN RIPARIAN AREAS

I. Introduction

Generally speaking riparian areas are among the most resilient ecosystems on public land. Depending on condition and potential they usually respond more quickly to changes in management than do drier upland ranges. The purpose of this document is to present information from various land managers and researchers that can be used to guide livestock management in riparian areas utilizing their unique responsiveness to accomplish management objectives. This technical reference is largely based on empirical information because of the small amount of research based information available on successful grazing management in riparian areas. The specific management practices and concepts detailed herein can be used to accomplish management objectives in other riparian areas. This technical reference will be updated periodically as more becomes known about the management of grazing in riparian areas.

The management of livestock grazing in riparian areas is one of the most pervasive and complex issues facing the western rangeland manager today. It is pervasive because the majority of public land is grazed and most non-desert as well as some desert grazing allotments contain some riparian acreage. However, actual riparian acreage is quite limited. Less than one percent of the land managed by BLM (exclusive of Alaska) is classified as riparian acreage. It is a complex issue because: (1) much of the riparian area acreage is privately controlled, (2) riparian areas are often the primary and sometimes the only watering place for livestock grazing arid rangelands, (3) public use of riparian areas is increasing, (4) other resource values are concentrated in and dependent on those areas, (5) grazing affects a number of resources and uses onsite and sometimes off site, (6) the value of properly functioning riparian systems is not widely understood, and (7) traditional management practices are often inadequate and difficult to change. Because of these complexities, the involvement and cooperation of private landowners and ranchers is critical to the success of riparian area management programs.

In the arid, semi-arid west, grazing impacts are concentrated in riparian areas. These impacts have been the focus of much attention in recent years. This attention has come from several sources including professional societies, the research, environmental, and political communities, as well as from public land managers. It is because of this focus, and the commitment of BLM to proper management of riparian areas, that this technical reference has been prepared.

In reviewing the literature and in discussions with range managers, it became apparent that no single grazing management system has as yet conclusively proven to result in consistent improvement of degraded riparian areas throughout the western range. Many varying combinations of sites, resource conditions, and impacts as well as the interaction of many different human perspectives are involved.

The grazing management system designed for an area should be tailored to the conditions, problems, potential, objectives, and livestock management considerations on a site specific basis using the information in this technical reference in an arrangement that will best meet the resource needs.

"From the standpoint of achieving livestock management objectives and minimizing soil, vegetation and water quality impacts, grazing management plans will vary. There is no set formula that will identify the type of grazing system or management plan that will be best for any livestock operation or allotment. Water quality impact will be closely related to soil erosion and sedimentation, associated with vegetation cover and concentration of livestock grazing. The grazing system must be designed on the basis of soil and vegetation capabilities, water quality considerations and livestock and wildlife requirements" (Moore et al. 1979).

II. Compatibility of Grazing in Riparian Areas

Livestock grazing can be a compatible use in riparian areas when managed in harmony with multiple use land management objectives and when the functions of the riparian system (sediment filtering, bank building, water storage, aquifer recharge, energy dissipation), potential of the site and needs of the riparian vegetation guide the development of the grazing management prescription. Grazing must be compatible with the above to comply with the BLM Policy on Riparian Area Management.

Livestock grazing in riparian areas, however, may not always be entirely compatible with other resource uses or the maintenance of other resource values found in these areas. Where soils in riparian areas are unstable, the vegetation complex is fragile, threatened and endangered plants and/or animals are present, the fisheries or recreation values are high, or municipal watersheds are involved, etc., special livestock management prescriptions must be applied. In some cases, the exclusion of livestock grazing may be the most logical and responsible course of action (at least for a time sufficient to achieve a level of recovery and stability which can support grazing in the context of the management objectives).

The compatibility of grazing in riparian areas depends on the extent to which grazing management considers and adapts to certain basic riparian area ecological relationships. Prior to developing grazing management prescriptions for riparian areas, the manager should have some understanding of grazing effects on:

1. Natural functions of riparian ecosystems.
2. Growth, and reproduction of both woody and herbaceous plants on the site.
3. Dependency on riparian areas by other animals (mammals, fish, birds, and amphibians).
4. Hydrologic and geomorphic conditions and processes.
5. Soils.
6. Water quality.

III. Management Objectives, Key Areas and Key Species

A. Management Objectives

Grazing management based only on objectives related to non-riparian areas (uplands) does not usually result in maintenance or improvement of riparian areas present in the same pasture. Therefore, where maintenance or improvement of riparian areas is desired, land use plan and activity plan objectives and management prescriptions must be attuned specifically to riparian area features while considering the needs of the entire watershed. The establishment of specific objectives, description of the desired plant community, and selection of key species should be an interdisciplinary effort carried out in close cooperation with the range user and other interested parties. Objectives should be dictated by the present condition and trend of the riparian habitat in relation to management goals, the resource potential for change, and the importance of other resource values. Major considerations in establishing management objectives include:

1. Vegetation

    a. The ecological site potential.

b. The desired plant community.

1) The health and reproduction of woody plants present should receive equal consideration with herbaceous vegetation (depending on the riparian objectives).

2) The development and/or maintenance of different age classes of the key
plant species on the site to maintain a viable plant community.

3) The complex of vegetation cover necessary to minimize trampling damage and reduce the erosive effects of run-off events.

4) The vegetation structure necessary for wildlife cover diversity.

c. The stabilization of stream banks and elimination of bank hoof shearing.

d. The value of the site for forage production.

e. The amount of vegetation stubble required to trap and hold sediment deposits during runoff events to rebuild stream banks and restore aquifers.[1]

2. Wildlife

a. The improvement or maintenance of the fishery and/or waterfowl habitat.

b. The importance of the riparian community to riparian dependent wildlife and to wildlife species that occur primarily on upland sites but are periodically attracted to riparian areas. In the Great Basin, 79 percent of terrestrial wildlife species are dependent on riparian areas (Thomas et al. 1986).

3. Water

a. Raising the elevation of the present water table.

b. The improvement or maintenance of water quality and quantity or change in timing of flow.

4. Geomorphic

a. The establishment of proper stream channel, bank, and floodplain conditions and functions.

b. The maintenance of longterm adjustment processes which may affect channel/riparian zone conditions. Processes may include gully widening and aggradation, bank, and floodplain development, meandering, etc. (Van Haveren and Jackson, 1986).

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[1]*It should be noted that streamside riparian sites on streams with high gradients and low silt load are more difficult to improve than those with low gradients and high silt load. These differences should be recognized and provided for in the development of the objectives and subsequent management (Elmore pers. commun.).*

5. Other

    a. The aesthetic effect of a good to excellent condition riparian area.

    b. The period of time which is acceptable or necessary for restoration.

    c. The reduction of upland erosion and stream sediment load and the maintenance of soil productivity.

See Appendix F for additional information that can be used in the formulation of objectives.

B. Key Areas

In many allotments, riparian areas are "key management areas" and their condition may indicate whether grazing management is proper for the entire allotment.

As objectives are considered and developed for areas with riparian values, key areas for monitoring must be located in representative portions of the riparian areas as well as in the uplands. These key areas will serve as the location where appropriate monitoring will be conducted and the propriety of management judged. Key areas must possess (or have the potential to produce) all the specific elements contained in the objective(s) because these will provide data for evaluation of management efforts. In many cases, it is appropriate to select the key areas first and then develop objectives specific to each.

C. Key Species

Key species will vary with the potential of each individual site. Key species should be selected which are necessary to the operation of the natural stream functions. The mix of vegetation increases channel roughness and dissipates stream energy. Willows and other large woody vegetation filter larger water borne organic material, and their root systems provide bank stabilization. Sedges, rushes, grasses, and forbs capture and filter out the finer materials while their root masses help stabilize banks and colonize filtered sediments. On sites where potential exists for both woody and herbaceous vegetation, the cumulative effect of plant diversity greatly enhances stream function.

It is essential that the physiological and ecological requirements of key woody species (in addition to key herbaceous species) be understood so that a proper management program can be designed (Thomas, et al. 1979). This includes determining the effects of grazing on the particular growth characteristics of the species involved.

IV. Grazing Management Principles and Concepts

Once objectives have been established, the resource manager, in consultation with the range user and other involved parties, must tailor grazing management to meet those objectives. The following concepts and principles of range management are applicable to riparian areas. However, this section should not be regarded as a cookbook of solutions for every riparian grazing issue. Each component should be evaluated and applied as appropriate on a case-by-case basis.

A. Livestock Preference for Riparian Areas

During portions of the grazing period when air temperatures are hot, riparian sites are usually preferred by livestock over upland sites on arid and semi-arid ranges due to: the presence of water, lush forage and more consistent regrowth than on uplands, cooler air, shade, and relatively flat terrain. Until utilization becomes excessive, livestock don't need to spend as much time and effort in riparian areas to satisfy their daily nutritional requirements as compared with upland range (Skovlin, 1984). In Montana, during August and September, approximately 80 percent of the forage used by livestock may come from riparian sites even though they often comprise less than 4 percent of the total acreage in the pasture (Marlow, 1985). Observations throughout the western range confirm this preference and its effects. See Illustrations 1 and 2.

Riparian areas will usually be overgrazed under passive, continuous grazing. Where used in this document, the term "passive, continuous grazing" will mean grazing throughout the grazing period which is normally uninterrupted and which involves little or no effort to control the amount or distribution of livestock use in an area through salting, herding, or other management practices. Riparian areas may be overgrazed under a program of deferred rotation or rest rotation grazing, even though the allotment or pasture is considered properly grazed and use on adjacent uplands is moderate or light. This preference and resulting use leads to the well documented impacts on streamside vegetation, stream banks, water quality, water table and fisheries etc. summarized by Skovlin (1984). This concentrated use of areas next to water in effect results in the creation of "upland exclosures," and often reduces the effectiveness of the grazing prescription for the uplands (Elmore, pers. commun.).

B. Kind and Class of Grazing Animal

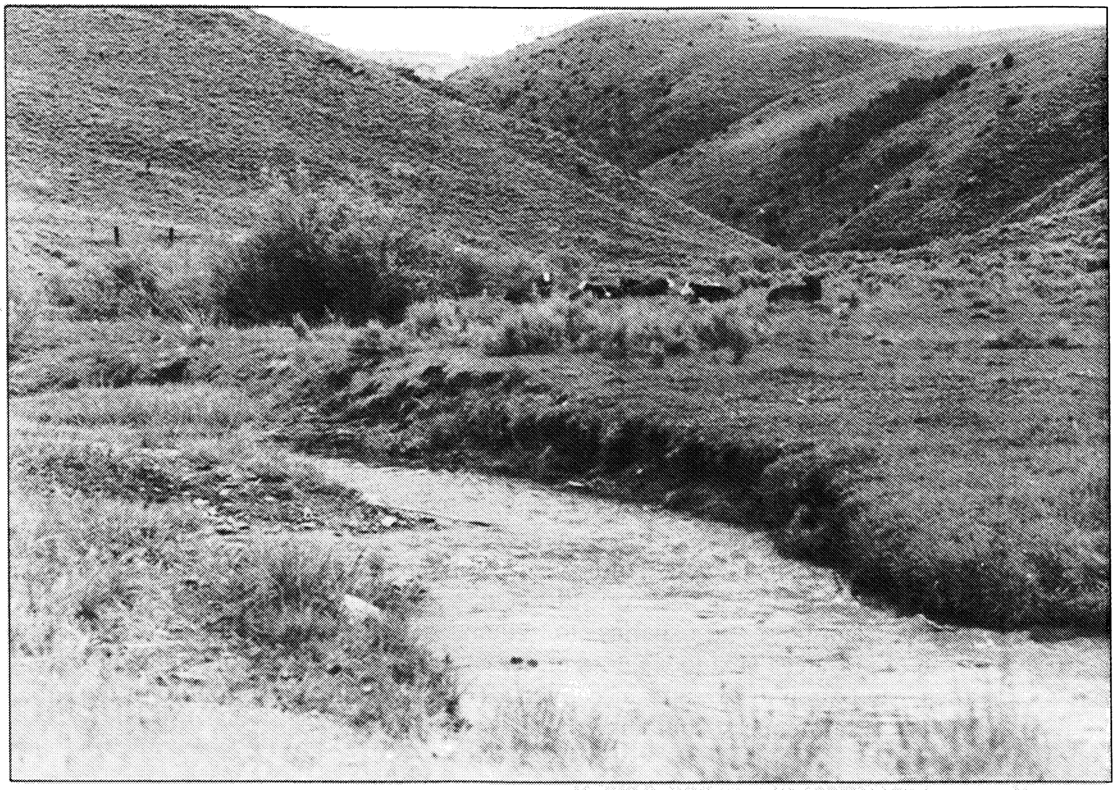
Unrestricted use by cow-calf pairs generally has a more wide-spread impact on riparian areas than use by other kinds/classes of livestock. Cow-calf pairs have a tendency to concentrate and loaf in these areas and at the same time consume grasses, forbs, and woody plants growing in these areas. Yearling cattle, particularly steers, generally tend to be wider ranging and make more use of adjacent uplands, spending less time than cows and calves in riparian areas.

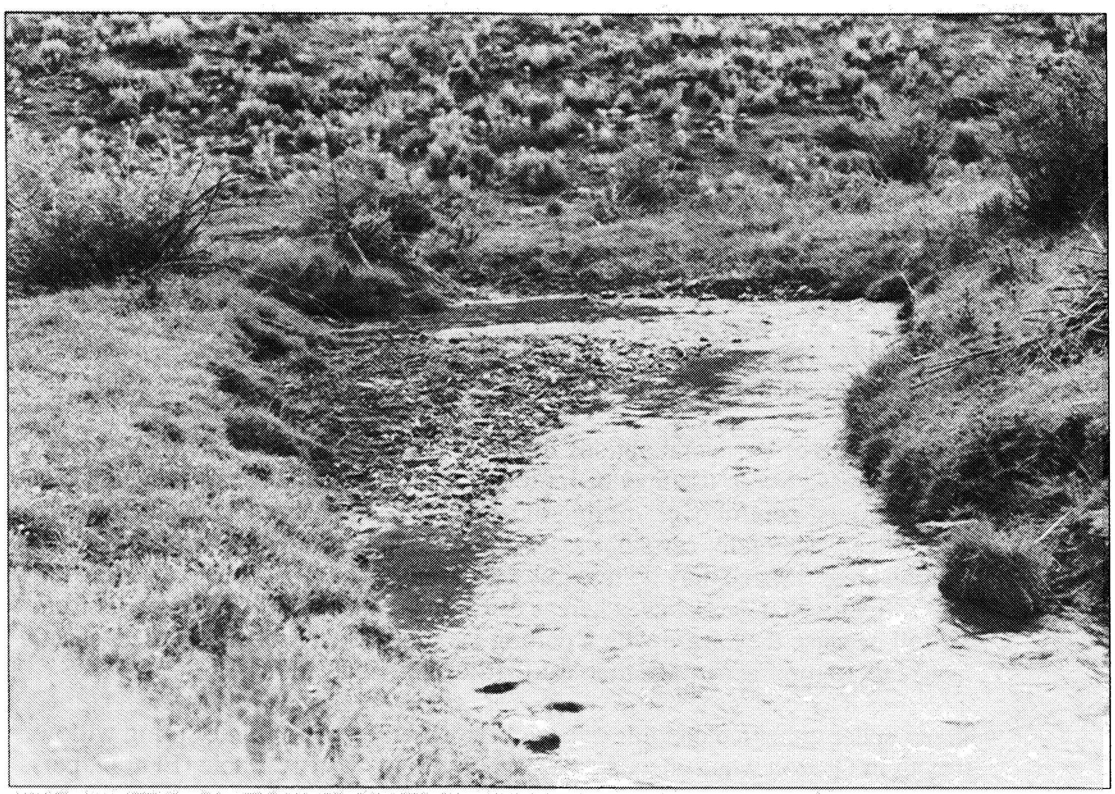
Horse use during the winter in some areas may result in bark being stripped from deciduous trees (Kindschy pers. commun.) However, horses are primarily regarded as grass eaters and generally tend to congregate less than cattle (Stoddart, et al. 1975). The concentration of wild horses on riparian meadows has been reported to result in severe riparian impacts (Platts pers. commun.)

Herded sheep offer several options for achieving proper management in certain riparian areas. Sheep use may be more desirable than cattle use in some areas due to the herders' control over: timing of use, frequency of use, and degree of utilization. Sheep also prefer certain grasses and forbs in lieu of woody species in some riparian areas. Sheep may do less physical damage to herbaceous plants due to their nibbling characteristics, whereas cattle and horses can dislodge plants from the soil because they graze with a pulling motion. When properly herded, sheep cause less trampling damage than cattle (Stoddart, et al. 1975).

Sheep under unherded conditions have been observed to consume spring willow growth in Oregon when adequate herbaceous forage was available (Elmore, pers. commun.). Heavy browsing of young willow growth by unherded sheep has been observed in southern Wyoming during spring, summer, and fall where the herbaceous vegetation was dominated by coarse forage such as sedges and rushes.

Although it is beyond the control of BLM, the selective use of breeding and culling may offer a means of achieving more acceptable use of riparian areas in some cases. Roath (1980) found groups of cattle which possessed certain home





Illustrations 1 and 2. Typical Impacts From Passive, Continuous, Grazing. Note bank hoof shear, lack of vegetation on point bars, encroachment of dry land vegetation, willows well above the channel elevation, heavily hedged willows, presence of only one age class of willow, lack of adequate vegetation for silt filtering and bank protection and the wide shallow stream profile.

range traits: some preferring riparian sites and others preferring upland areas. When riparian forage became scarce, livestock reduced forage intake rather than choosing to move out of the riparian area. If these cattle were culled and replaced with the progeny of others that characteristically made a proportionately greater use of the uplands, benefits may accrue to the riparian sites as well as the rancher. Although other management practices may have more immediate effects, in some instances it may be desirable to discuss this practice with the user when consulting on allotment management planning and grazing practices. Extension livestock specialists are a good source of information about animal characteristics and habits.

C. Season of Use

The grazing use made on riparian areas and upland areas varies during the growing/grazing season in most allotments. Livestock will normally prefer the riparian sites during the hotter-drier months. Less preference is shown for riparian areas during the cooler months when shade is not as important and preferred green forage is available on the uplands.

Soil compaction and damage to stream banks due to hoof action varies with soil type, rock content and the amount of moisture in the soil, which may be a function of season. Riparian areas normally exhibit a longer growing season than uplands due to the influence of soil moisture and the physiology of the plant species dependent on the available water.

1. Winter - This is normally the period of little or no vegetation growth. Winter use is usually the least detrimental to soils (where they are frozen) and to dormant herbaceous vegetation. However, it may be the period of greatest use of browse species by both livestock and wildlife depending on temperatures, snow depth and duration, availability of other feed, animal concentration, forage/browse preference, and the extent of the woody plant community. When grazing is closely monitored and controlled (especially use of woody plant growth), winter can be a season of use with minimal impact. Many riparian areas are unavailable for grazing during a major part of the winter due to snow depth. Winter use can reduce a user's winter feed costs in some areas. In Oregon, this has amounted to as much as $30.00 per head per season (Elmore, 1987). Use during this season, however, also has the potential of removing excessive amounts of vegetation cover, just prior to spring runoff, which is undesirable.

2. Spring - This is the period when cool season vegetation growth begins and peaks. Warm season plants begin growth during the mid to latter portion of the spring season. Spring use normally results in better livestock distribution between riparian and upland areas due to flooding of riparian areas and presence of highly palatable forage (including many annuals) on the uplands. Hoof action can result in trampling of seed and litter into wet soil. On some saturated soils, plants are more easily uprooted by grazing animals than would be possible later in the year. Care must be taken to prevent stream bank hoof shearing and to leave adequate carry-over vegetation for bank protection and silt filtering during spring runoff. Subsequent rest is often required to encourage root growth and other biological activity which will off-set the effects of soil compaction prevalent during the spring season. In southwestern Montana, most bank damage occurs when soil moisture is in excess of 10 percent, which normally occurs prior to late July/early August in arid/semi-arid areas of the west (Marlow and Pogacnik, 1985). The soil moisture content which would minimize bank damage may vary with differences in soil texture.

Spring use provides more opportunity for regrowth and plant recovery than summer or fall use. Regrowth is important in sustaining the important physical functions of a riparian system (e.g. shading, insulation, sediment filtering) as well as buffering the effects of peak runoffs on stream banks.

3. Summer - This is the period of maximum warm season plant species growth and diminishing growth of cool season species. It is usually the period of greatest photosynthetic activity. Upland plant growth will diminish due to reduced soil moisture content. Summer use is generally regarded as the most critical. It usually results in greater utilization of riparian vegetation where free choice grazing is allowed. It is usually the period of greatest stress in the plant community. There is less time for regrowth and replenishment of carbohydrate reserves than with spring use. It has been reported that utilization of willow by livestock (especially in August) often occurs prior to completion of carbohydrate storage and can be quite detrimental to willow growth and regeneration (Kindschy, pers. commun.).

4. Fall - This is the period of cessation of warm season plant growth. Some growth in cool season species may occur where moisture and temperatures are conducive to plant growth. Fall use is usually less critical than summer use because many perennial plants are completing their storage of carbohydrates. Cool season species on the uplands may be productive again, and together with cooler temperatures this results in more livestock use of uplands. This usually shifts some of the grazing pressure from riparian areas. Less soil compaction is probable, but bank damage may be considerable. Heavy fall use can leave streamside vegetation depleted and banks vulnerable to damage during spring runoff.

5. Passive, continuous grazing use, especially when it includes the spring season, is particularly detrimental. It usually combines the negative effects of grazing cited above. It is a major cause of much of the deterioration of riparian areas evident today. Proper management of riparian areas, usually precludes this type of grazing.

   Livestock use should be encouraged when grazing is least damaging to riparian vegetation and soils and when upland vegetation and climatic conditions are conducive to drawing livestock away from riparian areas.

   Changing the season of use, if feasible, is usually one of the least costly approaches for the land manager in achieving improvement in riparian area condition.

D. Distribution of Use

The importance of livestock distribution in the riparian area is illustrated by research done in Idaho, Utah, and Nevada. Platts and Nelson (1985) found that "Livestock were taking an average of 29 percent and as much as 40 percent more vegetation from the riparian sites (wildlife use was trivial) than on the adjacent upland sites. . . . Consequently, although use on the allotments was in the moderate range, use on the riparian sites was in the heavy to severe range." Managing and controlling the attractant features of riparian areas usually increases the use of, and improves distribution in, uplands.

There are many benefits to riparian management when livestock use distribution is controlled. Several options exist for controlling livestock distribution.

1. Fencing is an effective tool in controlling distribution. Fencing can be used in managing riparian pastures by either including or excluding livestock use depending on management objectives. The loss of forage from exclusion fencing may be inconsequential in many allotments. On 365 miles of Oregon streams, the riparian area comprises only 3.5 acres per mile. This equates to 7 AUMs, or 100 cows for 2 days per mile (Elmore pers. commun.). Fencing of water sources at springs/seeps and piping the water to adjacent areas is effective in protecting small riparian areas. However, fencing in some instances may restrict wildlife and livestock movements in an undesirable manner. Fencing results in increased maintenance and management costs.

2. Where it is lacking, water development in upland areas is often a key factor in reducing livestock concentrations in riparian areas. On those watersheds with extremely fragile soils, water development should be approached cautiously where additional livestock use may result in additional soil erosion. Additional upland water development may also result in increased competition for habitat with wildlife.

3. Creating shade and locating rubbing posts and oilers in upland areas where none exist can augment water development and may help to reduce the time livestock spend in riparian areas.

4. Placing salt, hay, grain, molasses, and other supplements only in upland areas away from riparian areas will help improve distribution. It is recommended that except where being used to intentionally localize animal impacts, salt and supplements be placed no closer than 1/4 mile and preferably 1/2 mile or more from riparian areas. Salt and supplements should be located away from intermittent drainages also to avoid potential sedimentation in downstream perennial streams (Riparian Habitat Committee 1982). Proper salting can help control both distribution and utilization.

5. Frequent riding and herding can be an effective practice in controlling livestock distribution in some situations. On some rough or poorly watered ranges, calf crops can be increased by proper herding (Stoddart, et al. 1975) probably because these periodic concentrations improve opportunities for breeding and conception.

6. Use of some pastures during the seasons when uplands contain palatable forage and riparian areas are flooded or are extremely cold can help improve distribution.

7. Planting of palatable forage species on depleted upland areas, can attract livestock away from riparian areas.

8. Bedgrounds and other livestock handling facilities should be located away from riparian areas (Riparian Habitat Committee 1982).

9. Placement of trees and brush on stream banks may discourage use by livestock and also help stabilize eroding banks.

10. Placement of rocks (10" to 20" or larger) along streambanks where cattle trail and cause trampling damage can effectively displace cattle use and promote recovery (Myers, pers. commun.).

11. Prescribed burning of uplands which enhances forage production and palatability may encourage additional use of the uplands.

Proper distribution of livestock can be an effective and economical tool in managing riparian areas. In some areas which are degraded, some rest may be required especially where woody species are part of the management objective.

E. Utilization

Utilization targets or guidelines are a tool that can be used to help insure that long-term objectives are met. Utilization can be monitored annually, or more often, whereas progress in reaching long-term resource objectives such as: bank stabilization; rebuilding of the streamside aquifer; or reestablishment of beaver, fish, or moose habitat can only be determined over a longer period of time. The accomplishment of these long term objectives relates directly or indirectly to the need to leave a certain amount of vegetation available for other uses (soil stabilization, trapping sediment, wildlife cover, or forage, etc.). Utilization monitoring provides a means of insuring that the necessary amount of vegetation is left to protect the site and provide for reaching other vegetation-dependent objectives. Utilization targetscan be used as a tool in controlling the duration and amount of use made in a pasture or parts of a pasture.

The timing, and duration of grazing use must allow for plant growth and development, adequate riparian vegetation stubble and replenishment of carbohydrate reserves necessary for accomplishment of riparian objectives. Where such is not the case, the establishment of utilization targets for riparian key plant species and the management of grazing to insure these targets are met are critical factors involved in proper riparian area management. It should be emphasized that utilization targets in riparian zones will usually be reached much sooner than those in adjacent uplands, unless proper distribution is achieved. Other management tools are required to correct this imbalance. See sections on season and distribution of use.

The establishment of utilization targets requires that the manager know the growth habits and characteristics of the important plant species for which he is managing and how they respond to grazing and browsing. In addition, the manager must know the characteristics, preferences, and requirements of the grazing-browsing animals.

Utilization targets, where used, should be developed for riparian areas and riparian pastures that:

1. Will maintain both herbaceous and woody species (where present) in a healthy and vigorous condition and facilitate their ability to reproduce and maintain different age classes in the desired riparian plant community.

2. Will leave sufficient plant residue necessary to protect banks during runoff events and provide for adequate sediment filtering, and dissipation of flood energy.

3. Are consistent with other resource values and objectives, e.g. esthetics, water quality, etc.

4. Will limit stream bank shearing and trampling to acceptable levels.

Utilization targets must provide for use by wildlife populations. Application of utilization targets together with an analysis of actual use, climatic, and other resource data, can result in the evolution of stocking rates which are compatible with riparian area objectives. In some cases, proper utilization guidelines can only be derived over time though trial and error by monitoring, analyzing, and evaluating the results. Initial results may be different than expected. The manager should not hesitate to make changes in key species or utilization guidelines where required to meet objectives.

Platts (1982) concluded, from studies in Idaho, that on certain riparian habitat groups in good condition, alterations to stream banks and vegetation were apparent when rest-rotation grazing plans called for utilization of 65 percent or more of current annual growth by livestock. Utilization of 25 percent or less of the herbaceous vegetation, resulted in insignificant changes in riparian habitat.

In north central Oregon, summer utilization of the herbaceous riparian vegetation above 40-50 percent results in unacceptable levels of browsing (into the previous years growth) on woody plants in riparian areas (Elmore and Beschta, 1988).

In Southwestern Montana, where summer utilization of herbaceous riparian vegetation exceeded 60 percent (by weight), unacceptable levels of browsing on woody plants occurred (Myers, pers. commun.).

When establishing utilization taregets to ensure riparian area improvement, guidelines should be considered that will provide a margin of safety for those years when production is less than average (Riparian Habitat Committee 1982). This could take the form of reducing the utilization target for both riparian and upland areas to provide additional carryover forage and vegetation necessary for bank protection and sediment filtering.

Due to the variation in riparian sites and management one standard utilization target is not appropriate. However, utilization should be considered (together with regrowth potential) to ensure the presence of vegetation stubble necessary to the operation of natural stream functions or accomplishment of other land use objectives (e.g., residual nesting cover for waterfowl).

F. Timing, Duration and Frequency of Grazing

In a study of 34 grazing systems in operation for 10-20 years in southwestern Montana, Myers (1989) found timing of grazing, duration of use and frequency of fall grazing were important factors in good management. In this study the effectiveness of grazing management involving cattle was judged based on the vigor, regeneration, and utilization of woody species as well as bank stability. Successful systems were defined as those demonstrating good or excellent riparian condition or an upward trend if in fair condition. Results were summarized as follows:

Criteria Used	Successful Management	Unsuccessful Management
1. Time provided for post grazing herbaceous regrowth (average number of days).	35	21
2. Duration of use - total days per season (average number of days).	28	59
3. Fall use duration (average number of days).	21	37
4. Percent of years fall use occurred (average).	31	51
5. Percent of grazing treatments providing residual cover* through rest or regrowth (average).	75	38

*Residual cover was defined as at least 30 days regrowth.

The above data highlights the importance of providing for adequate vegetation vigor and regeneration at the end of the growing season and the apparent critical nature of the frequency and duration of fall grazing treatments.

These factors deserve more attention in the design of grazing prescriptions for riparian areas.

Myers suggest shortening the duration of grazing treatments often prescribed for upland management (60-75 days) to durations of 25-30 days. "Shortening the duration and providing growing season rest in all pastures seems a much better approach. This lessens animal impacts, provides regrowth and allows stock to be more selective in grazing" (Myers, pers. commun.).

G. Livestock Access Points

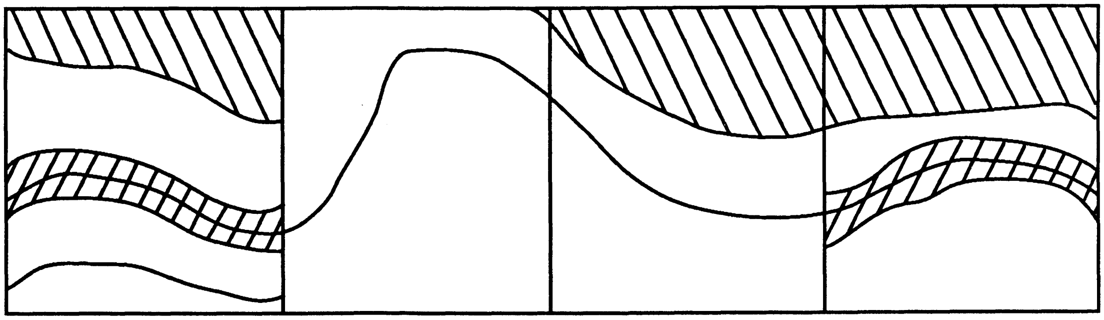
Another tool that may help regulate the timing, duration, and amount of use of riparian areas on some large allotments or pastures that contain adequate stockwater at places other than in the riparian area, is to turn livestock in and initiate grazing at a point most remote from the area needing protection (Gillen, et al 1985).

Gap fencing in conjunction with gullies, cliffs, and other natural barriers can regulate natural trailing or loafing by livestock in some riparian areas.

When rocky areas (natural or manmade) are utilized for livestock water gaps, trampling damage to stream banks and stream beds can be minimized. Narrow water gaps discourage livestock from loafing at the water source.

H. Seasonal and Topographical Aspects of Range Suitability and Carrying Capacity

In most situations where both upland and riparian sites exist in the same pasture(s), portions of each pasture can be *seasonally* unsuitable or unused for grazing because of such factors as wet soils, lack of green forage, length or steepness of slope, distance to or lack of water, and absence of shade etc., as displayed in the following (Elmore pers. commun.):



PASTURE A	PASTURE B	PASTURE C	PASTURE D
USED 5/16-6/15	USED 6/16-7/15	USED 7/16-8/15	USED 8/16-9/15

In pasture A, the corridor along the stream is unsuitable[1] due to saturated soils and some of the uplands are unsuitable[1] due to lack of green forage .

In Pasture C, portions of the uplands are unsuitable[1]due to lack of water and unused due to length and steepness of slope.

In Pasture D, portions of the uplands are unused due to length and steepness of slope and lack of water . Also the stream corridor is of concern due to utilization of willow and bank trampling in excess of allowable limits which may occur during this period.

In pastures C and D, frequent riding and herding of the livestock may increase utilization of the upland and relieve grazing pressure in the riparian areas. This would reduce the necessity of adjusting season of use or numbers of livestock to compensate for heavy riparian area use.

These concepts and others can be used in the analysis of rangeland for determining proper seasonal stocking rates, for developing grazing treatment schedules, for designing and locating fences and water developments, as well as for determining the necessity for requiring specific herding and salting practices.

I. Drift vs. Forced Movement of Livestock

In his evaluations of 30 grazing systems on 44 stream reaches in Montana, Myers (1981) concluded that stock should be moved between pastures rather than left to drift to the next pasture over a period of several days. "In this analysis, riparian vegetative response seemed to be better in allotments where the stock were moved and the gates closed, as opposed to the use of stock drift and simultaneous use of two pastures." Other field personnel also emphasize the need to move the livestock and not expect drift to accomplish the desired movement. Some livestock will stay in a pasture even though there is adequate palatable forage in the next pasture.

[1]*Unsuitable on a seasonal basis.*

To minimize livestock stress and encourage better dispersal, one recommended approach is to open the gate in late afternoon of day one, allow drift on day two, clean the pasture and close the gate on day three (Hagener pers. commun.).

J. Pasture Design

In pasture planning, some authors recommended that as much of a stream be included in a pasture as possible and that streams not be used as fenced pasture boundaries (Myers 1981). "Small stream sections within large pastures cannot be effectively managed." When pasture boundary fences zig-zag across streams, livestock impacts tend to be concentrated near the stream. Cattle tend to concentrate near and trail along the fences resulting in accentuated trampling damage. Also, wire fences across streams tend to be trash catchers and wash out frequently. Myers (1981) recommends trying to center streams within a pasture where possible.

Where the stream must serve as the division line, fencing one side of the stream with watergaps to the stream has been shown to be an effective method for pasture fencing.

Using panels constructed of corrugated metal roofing suspended over the stream, between ends of a fence, has proven effective in controlling livestock movement in Oregon. The panels swing with the flow of water, do not catch trash and are avoided by cattle (Elmore pers. commun.).

K. Management of Small Areas

On small allotments where grazing systems or other intensive management are not practical, improvement in riparian area conditions to meet objectives is still possible. Options should be explored for changing the season and or duration of use to one which will accomplish the objectives or for changing distribution by excluding livestock from the riparian area and furnishing water outside these areas.

L. Compliance and Supervision

Range management in riparian areas must be intensive, because livestock are attracted to riparian areas during certain seasons and frequent supervision is required. Resource managers must work closely with users to insure that alternate water sources are functional, that fences are maintained, that salt and supplements are located as stipulated in the allotment management plan or permit/lease, that essential riding and herding is done, that livestock are in the proper pasture (or area) at the proper time(s) and that the necessary vegetation stubble is left.

"It only takes a few weeks of unauthorized use or overgrazing to set back years of progress in improvement of riparian systems" (Duff 1983). "Compliance with a grazing system is critical. When stock are moved from a management pasture, it is commonplace for a few animals to be overlooked. In one stream, annual use by a few head of unauthorized stock throughout most of the hot season period has nullified positive riparian habitat responses in an otherwise excellent grazing system" (Myers 1981).

M. Key Management Considerations

The proper management of livestock grazing in riparian areas requires a recognition that: (1) grazing management practices which improve or maintain upland sites may not always be good management practice for riparian areas, and (2) passive, continuous grazing is not a viable option to improve deteriorated riparian areas or to maintain a riparian area in good condition.

Grazing management must provide for an adequate cover and height of vegetation on the banks and overflow zones to permit the natural stream functions (sediment filtering, bank building, flood energy dissipation, aquifer recharge, and water storage) to operate successfully.

Many public range users are also concerned about management of riparian areas. Through consultation and cooperation with these range users, needed changes can be implemented that benefit other users of riparian areas. Recognizing operators who have implemented management practices that result in improved riparian area conditions can demonstrate the benefits of good stewardship and help expand good management into other areas. Some of the best salesmen for changing traditional riparian area management practices are those ranchers who have experienced the benefits of proper grazing management in riparian areas.

It is important to gain the understanding and cooperation of all land managers, landowners, users, and the public involved in the management of riparian areas. Workshops and demonstration areas can help promote an understanding and appreciation for the value of properly functioning riparian systems and build support for a sound program.

While riparian areas are uniquely responsive they should not be considered independently of uplands. Upland watershed condition, where runoff and erosion are problems can impair the effectiveness of management in the riparian zone. The rangeland unit must be properly managed as a whole.

V. Grazing Management Practices

The following is a summary of and examples of, certain western grazing management treatments, systems, and concepts that have been reported to be successful in improving certain conditions in deteriorated riparian areas or maintaining good conditions in other riparian areas. Similar results may be expected when these practices are applied under conditions of similar climate and plant growth on streams exhibiting similar functions, character and potential.

A. Grazing Treatments

When riparian areas are managed together with the uplands, it is important to understand the conditions required for achieving success in the management of both. Therefore, in some of the following examples, a general allotment profile is given.

1. Spring Grazing

In the BLM's Prineville District in Oregon, spring grazing has been used to improve riparian conditions on Bear Creek. Bear Creek is located in the high desert of Central Oregon at an elevation of 3,400 feet. Precipitation averages approximately 12 inches per year. Peak runoff normally occurs in mid to late February and summer thunderstorms are frequent. Soils typically are deep and well-drained sandy loam with gravel layers (Elmore pers. commun.).

Under pristine conditions the site was dominated by birch/willow and grass/sedge/rush. It has been grazed by domestic livestock since the late 1800's.

Prior to 1976 (Illustration 3) the area was in a single pasture licensed for 72 animal unit months from April-September.

Illustration 3. Riparian condition on Bear Creek (August 1976).

Under this strategy, streamside vegetation was depleted with low diversity and productivity. Streambanks were unstable and actively eroding. The stream channel was deeply incised and contained medium to high sediment loads. Summer streamflow was often intermittent and low in quality.

In 1976 the BLM decided to rest the area to restore the productivity of the riparian zone.

In 1979 and 1980, after three years of attempted rest, the area was used each year for one week in September. In 1983 juniper trees were removed from the uplands to improve range condition and watershed health. In 1985, a grazing treatment was designed authorizing use from the time of spring runoff (mid February) until April 15 in a three pasture system. Vegetation then regrows through the rest of the year to provide streambank protection against high runoff from summer thunderstorms and runoff the following spring. This regrowth also provides livestock forage for the following year.

Streambanks have stabilized, reducing erosion and sediment production. This increased stability minimized stream channel damage from a major thunderstorm that extensively damaged comparatively poor condition riparian areas immediately downstream of the pasture in 1987. One to two feet of sediment have been deposited in some places within the restored riparian zone.

In 1988 (Illustration 4) the licensed use of livestock forage was increased to 330 AUMs with an additional increase of 24 AUMs in 1989. Permitted AUMs are now nearly five times the forage obtained from the area when grazed under season long use. The permittee has reportedly cut his annual hay bill by$10,000. The riparian zone continues to improve. The resulting

Illustration 4. Riparian conditions on Bear Creek (1988) after implementing a grazing system.

improvement in quality and quantity of streamflow has allowed the reestablishment of rainbow trout.

The principal management objective for the riparian area was to protect streambanks against erosion by high flows during spring runoff and during high-intensity summer thunderstorms through improvement of both the riparian zone and the uplands. The present grazing management meets these two high stress periods for the stream and has improved upland forage condition.

This early season riparian grazing treatment worked well on this site's sandy loam soils. It might not work as well on soils with high moisture content.

Getting the needed recovery on the upland sites was necessary for the total recovery of the area and the increase in the total AUMs allocated for use.

2. Hot Season Grazing Frequency

In the foothill area of southwestern Montana, the frequency of hot season use, July 10 - September 1 (period of heavy use), appears to be a critical factor in the development and maintenance of satisfactory riparian area condition. Studies were made on 44 stream reaches under some 30 existing grazing systems to determine riparian habitat condition using quantity, vigor, and age class of palatable woody species, together with channel stability as indicators of condition (Myers, 1981). The grazing systems evaluated included rest rotation, alternating rest, deferred, and deferred rotation. Most had completed two or three cycles within a 10-12 year period. The area involved is fairly typical in many respects of a sizeable part of the Rocky Mountain Range. The climate is semi-arid. Elevations range from 5500 to 6500 feet. Precipitation ranges from 12" to 16". The green forage season extends through mid-July in the uplands. The growing season averages 90-120 days. Sub-zero winter temperatures are common. Most of the streams studied were small with summer flows of 0.03-0.6 cubic meters per second.

"Grazing systems with hot season use in more than one year out of three or four met riparian habitat goals on only 24 percent of 21 streams. Grazing systems lacking hot season use, or with no more than one hot season treatment in three or four years, met riparian habitat management goals on 90 percent of 20 streams evaluated" (Myers 1981). In this study, utilization data were not available.

Myers typifies the hot season as a period of "desiccation of livestock forage on upland sites, by air temperatures sufficient to require stock to use shade and by greater scarcity of water." The cool season is spring, early summer, fall, and winter. Adequate water and good forage are readily available and temperatures are cool on upland sites during spring and early summer. "During fall and winter, forage is more available on upland south-facing slopes and temperature inversions and snow accumulations discourage stock use of riparian areas."

Summer precipitation keeps forage in the uplands green longer in this area than is the case in much of the Great Basin. This tends to help keep cattle in the uplands and take pressure off the riparian area. The author cautions that "the extended summer green-season may be a key factor in the success of grazing systems in south-western Montana. In areas with hot and dry summers where green forage is largely limited to the riparian area, grazing may have to be more restricted" (Myers 1981).

3. Total Rest

Depending on the riparian area objectives, the tools and finances available, and the time prescribed for reaching objectives, non-use may be the best alternative for realizing the most rapid improvement. Total rest is probably required during the first few years of corrective management of a deteriorated riparian area where the objective is to get woody plant regeneration above the reach of livestock (Davis 1982).

A riparian literature review by Skovlin (1984) showed evidence of:

a. Improved riparian and aquatic habitat following 4-7 years of total non-use.

b. Woody plant (shrub) recovery following 5-8 years of total rest.

c. A doubling of fish biomass following 3-5 years of total rest.

d. Attendant positive responses in birds and small mammals.

On Big Creek in north-east Utah, it was found that a minimum of 6 to 8 years of non-use was necessary to restore a deteriorated stream side riparian area to the point where livestock grazing could be allowed at reduced levels (Duff 1983). Substantial recovery of stream banks and vegetation was observed following 4 years of exclusion of grazing by fencing.

Fencing and fence maintenance is costly and time consuming. Before the manager resorts to total exclusion of livestock grazing, options which could accomplish the same objective(s) should be explored.

4. Late Season Deferment

a. Grazing management that incorporates deferment of use until late season, until restoration of habitat is acceptable, offers a good measure of protection without great expense (Skovlin 1984). An assumption is often made that cattle are leaving the riparian area to use upland range. However, cattle may not leave the riparian areas in every case. "On one of our current study sites in a long glaciated U-shaped valley in Idaho, a late grazing system would help restore riparian quality because cattle move to the uplands in late summer and fall when the cold air pocket forms over the bottomlands. At another study site 15 miles away in a flat broad valley, however, cattle are drawn to the riparian areas during late season because they contain the only remaining succulent vegetation," (Platts and Raleigh 1984).

b. Stream bank damage relates to many factors including soil moisture content, soil type, absence of woody plants and root systems, bank rock content, stock density, and duration of grazing. Stream bank damage due to livestock trampling of wet soils, and where other factors are not controlling may be avoided by deferment of grazing until bank soil moisture content is less than 10 percent. This usually occurs by late July or early August in most of the arid and semi arid western range (Marlow and Pogacnik, 1985).

c. On the Smiths Fork Allotment in the Kemmerer Resource Area of the Rock Springs District in Wyoming, deferred grazing together with good herding and salting practices have resulted in improved riparian and fish habitat in the Huff Creek drainage. The allotment is a 91,000 acre common allotment located 10 miles north of Cokeville, Wyoming. Vegetation ranges from the sagebrush-grassland to aspen-spruce-fir complexes. The growing season averages 70 days ending about September 10. The annual precipitation is approximately 16 inches (averaged for the allotment). Elevations range from 6,200 to 9,000 feet.

The allotment contains several streams, one being Huff Creek. Prior to treatment, Huff Creek was in a deteriorated state. It had changed from a good condition cold water fishery to a warm waterway with severe stream bank erosion and excessive siltation. Willows had been replaced by sagebrush (Smith pers.commun.). Trout populations in 1978 were found to be 36 per mile. During the period 1976 to 1979, two exclosures were built, instream habitat improvement structures were added to one enxclosure and deferred grazing was initiated outside the exclosures. The objective was to protect and enhance habitat for the rare Bear River Cutthroat Trout population. The results were monitored during the period 1978-1984 and reported by the Wyoming Game and Fish Department (Binns and Remmick 1986).

Livestock use in Huff Creek is limited to the period August 15 to September 30 each year. The range rider does an exceptional job of salting on the ridges away from water and keeping the 500 cattle distributed over the entire watershed. He moves the livestock away from the stream every 2-3 days thus reducing impacts in the riparian area (Netherly and Hendersen pers. commun.). Grazing management on other streams in the allotment has been less effective than in Huff Creek due to lack of effective control of livestock distribution. In adjacent drainages the range rider was not successful in achieving the desired use. However, the results on Huff Creek are clear evidence of the response which can be expected when good salting and herding practices are properly applied and livestock distribution is controllable.

As a result of the treatments and management applied in Huff Creek, trout habitat improved at all study stations inside and outside the exclosures by 57 percent. Trout cover increased 214 percent. Bank stability improved except inside the small exclosure. Trout 6 inches and larger increased 300 percent in one exclosure, 92 percent in the other exclosure, and 72 percent in the grazed area. See Illustrations 5 and 6. Field personnel knowledgeable of this study stated that the local grazing associations' and range riders' control of the cattle herd was key to the riparian area improvement outside the exclosures.

B. Grazing Systems[1]

1. Deferred Rotation

a. Based on research at the Red Bluff Research Ranch near Norris, Montana, Marlow (1985) suggests a grazing system which is based on seasonal preference for riparian and upland forage.

In this area, cattle spend most of their time during June and July in the uplands moving to the riparian sites in late July where they graze until October. Bank trampling damage is minimized by deferring grazing until after late July when soil moisture content had decreased to 8-10 percent or less.

A minimum of 3 pastures are required for this system and a 3 year cycle is followed. Stocking rates in the pasture used first are based on forage available on both the upland and riparian sites. Stocking rates on the two pastures used later are based on 20-30 percent utilization of forage on *only* the riparian sites. "Although this may appear to drastically limit the length of time a pasture can be used, riparian zones usually produce 3-4 times the forage upland areas do. The regrowth potential of riparian species is great enough that, during most years, regrazing of the same pasture can occur at 30-40 day intervals until frost.

Consequently, there's little, if any, change in the amount of forage a rancher has available to his cattle in the grazing season" (Marlow 1985).

Cattle are moved to the next pasture when the target level of use is reached. Each pasture receives 2 years of deferment during periods when soil moisture exceeds 10 percent (June-July). The pasture used early the first year is grazed progressively later during the second and third years. See Appendix A for an illustration of the grazing formula.

b. Using riparian habitat as a key management area in conjunction with a deferred rotation grazing system has resulted in improvement in riparian area condition on the Little Sandy Allotment in the Green River Resource Area of the Rock Springs District. This success is a result of sufficient flexibility, use supervision, and cooperation by permittees and the

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[1]*See Appendix A-E for related schematic drawings and grazing formulas.*

Illustration 5. Riparian Conditions in Grazed Area on Huff Creek Below Lower Enclosure (July, 1986).

Illustration 6. Looking Upstream into Lower Huff Creek Exclosure from Grazed Area (July, 1986).

Wyoming Game and Fish Department. This allotment comprises 114,700acres of sagebrush grassland complex and is located 15 miles northeast of Farson, Wyoming.

The growing season averages 135 days ending about September 15. Annual precipitation averages 7-11 inches with elevations ranging from 6,500 to 8,500 feet. The allotment is grazed by 2,500 cattle from May 1 to November 15 using 5 pastures. Herding is employed along with drift fencing to control livestock movement from lower to higher range. Pasture moves are made so as to prevent adverse impacts in the riparian areas, avoiding bank trampling damage and excessive utilization. Sixty percent utilization of key herbaceous vegetation in riparian areas is used as a general rule to prompt pasture moves. One of the lower pastures is always used first each spring due to elevational effects on range readiness and one is used last in the fall. The middle pasture is used twice per season going to and coming from the upper part of the allotment. The upper two pastures are used after seedripe each year alternately one before the other. Riparian areas exist in each pasture. See Appendix B for an illustration of the grazing formula.

The present management has been in effect since 1980. Prior to that time, bank trampling damage was evident, much of the streambanks lacked protective cover, plant vigor was poor, willow reproduction was very limited, and wildlife habitat was non-productive (Smith pers.commun.). Conditions are much improved now. Willow reproduction is apparent, banks are stabilized, plant vigor is improved, and the fish, beaver, moose, and duck habitat is productive again. See Illustrations 7 and 8. (Krosting and Christensen pers. commun.).

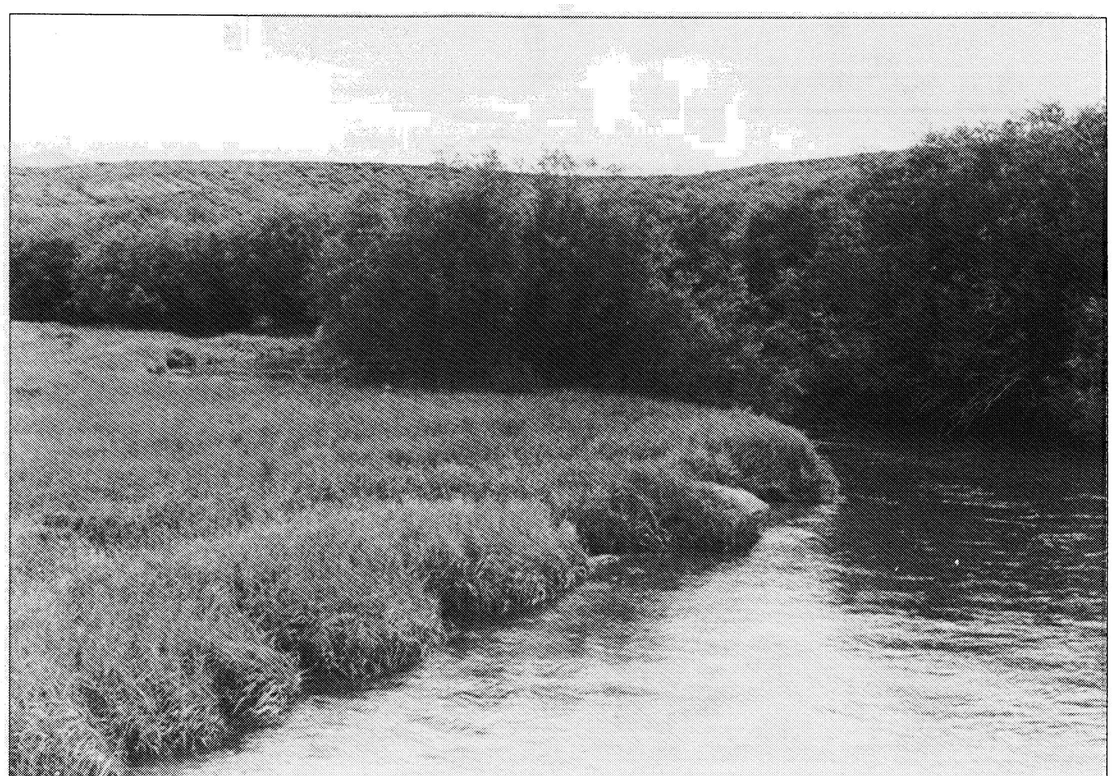


Illustration 7. Riparian Conditions on Little Sandy River in Little Sandy Allotment Following July Grazing Treatment (July, 1986).

Illustration 8. Riparian Conditions on Lander Creek in Little Sandy Allotment (July, 1986).

2. Rest Rotation

The literature reflects much difference of opinion on the value of rest rotation grazing, as previously applied, in the proper management of riparian areas

In a memo to the Rock Springs District Manager dated September 1, 1976, Gus Hormay (1976) discussed grazing management on areas associated with water. He emphasized that each rest-rotation system should be designed to meet the resource needs of each area. The amount of rest as well as stocking rate and season of use in each case should be determined by the manager based on the growth requirements of the vegetation present, all species considered. *Rest-rotation does not dictate heavy grazing under any treatment* (emphasis added).

Following are some reported successes with forms of rest rotation in allotments with riparian areas.

a. On several allotments on the Tonto National Forest in Arizona, rest rotation systems together with proper stocking and management resulted in cottonwood and willow regeneration along perennial streams. These systems incorporated "high intensity, short duration grazing with each pasture receiving spring - summer rest, back to back, two years out of three. In 1978, the Sedow Allotment (34,800 acres) on the Globe Ranger District was placed under this system after the permitted 11,125 animal unit month (AUMs) were reduced to 5,800 AUMs. When the system was initiated, the Walnut Spring area of the Storm Canyon pasture did not have cottonwood or willow between 0.1 and 10.2 cm (0.4 to 4 inches) in diameter. Today, the area supports 650 cottonwoods and 2,275 willows per hectare (1651 and 5778 per acre respectively) in this size class" (Davis 1982).

The elevation in this area is about 5,000 feet above sea level. The vegetation ranges from semi-desert grassland to chaparral-juniper. Approximately 99 percent of the allotment is upland range. The annual precipitation is approximately 19 inches with approximately 60 percent occurring in the winter. The allotment is presently stocked with 430 cattle year long. Utilization did not exceed 50 percent on herbaceous or 60 percent on woody vegetation by key area (Flanigan pers. commun.). See Appendix C for an diagram of the grazing formula.

b. The Superior Allotment (50,900 acres) is another which has responded positively to this same grazing system. It is located at elevations of 2,400-5,200 ft. The vegetation ranges from semi-desert grassland to desert scrub. Approximately 99 percent of the allotment is upland. Precipitation averages approximately 17.8 inches annually with approximately 40 percent occurring in the winter. Temperatures range from 25_ to 115_F. The allotment is stocked with 314 cattle year long. Utilization did not exceed 60 percent by key area for either herbaceous or woody plants (Flanigan pers. commun.). See Appendix C for an diagram of the grazing formula.

c. On the Humboldt National Forest in north central Nevada, a three-pasture rest-rotation system in effect for 12 years has reportedly resulted in improvement in areas of degraded riparian habitat. This system is in operation on the Wilson Creek Pasture Allotment which is comprised of mixed sagebrush - grassland with scattered stands of aspen, and smaller quantities of fir and spruce. The area receives 13-15" of precipitation annually with the majority occurring in winter. The grazing system provides for rest following seed ripe on the upland key species (Idaho Fescue) in the first year, followed by rest from turn out (July 1) to seed ripe in the second year and season long rest in the last year of the cycle. The management has resulted in aspen and willow rejuvenation, stream bank stabilization, and recovery of some of the former fishery (Easton pers. commun.). No utilization was sampled in the riparian area. Utilization in the uplands was in the 35-40 percent range in 1985. See Appendix D for a diagram of the grazing formula.

d. Cooperation from permittees and the U.S. Forest Service, as well as frequent use supervision together with rest rotation have resulted in maintenance and improvement of riparian habitat in the White Acorn Allotment in the Green River Resource Area of the Rock Springs District. This allotment is a 48,500 acre common allotment located 25 miles northeast of Farson, Wyoming. Sagebrush grassland comprises 92 percent of the vegetation complex. Riparian areas along with wet and dry meadows make up another 3 percent of the total acreage. Elevations range from 7,000 to 8,600 feet. The growing season is May 1 to September 30. Annual precipitation ranges from 8 inches at the lower elevations to 10 inches on the higher portion of the allotment. The allotment which was formerly grazed by sheep, is now grazed by 800 cattle from May 16 to October 31 (Krosting and Christensen pers.commun.).

The allotment contains 7 pastures. The lower three pastures are managed under a deferred rotation system while the upper three pastures are grazed under a rest-rotation system. Concern with riparian habitat is focused primarily in the three upper pastures on Blucher Creek. Prior to the change in management (1981), plant vigor was low, bank trampling damage was apparent, willows were the size of garbage cans, and wildlife habitat was in poor condition (Smith pers.commun.). The allotment management plan (AMP) requires herding for maintaining even distribution and control of cattle in each pasture. See Appendix E for a diagram of the grazing formula.

As Illustration 9 shows, riparian values are being improved and maintained under the present management. Most stream banks are stable, willow of all age classes are present, plant vigor is good, and the wildlife habitat is much improved.

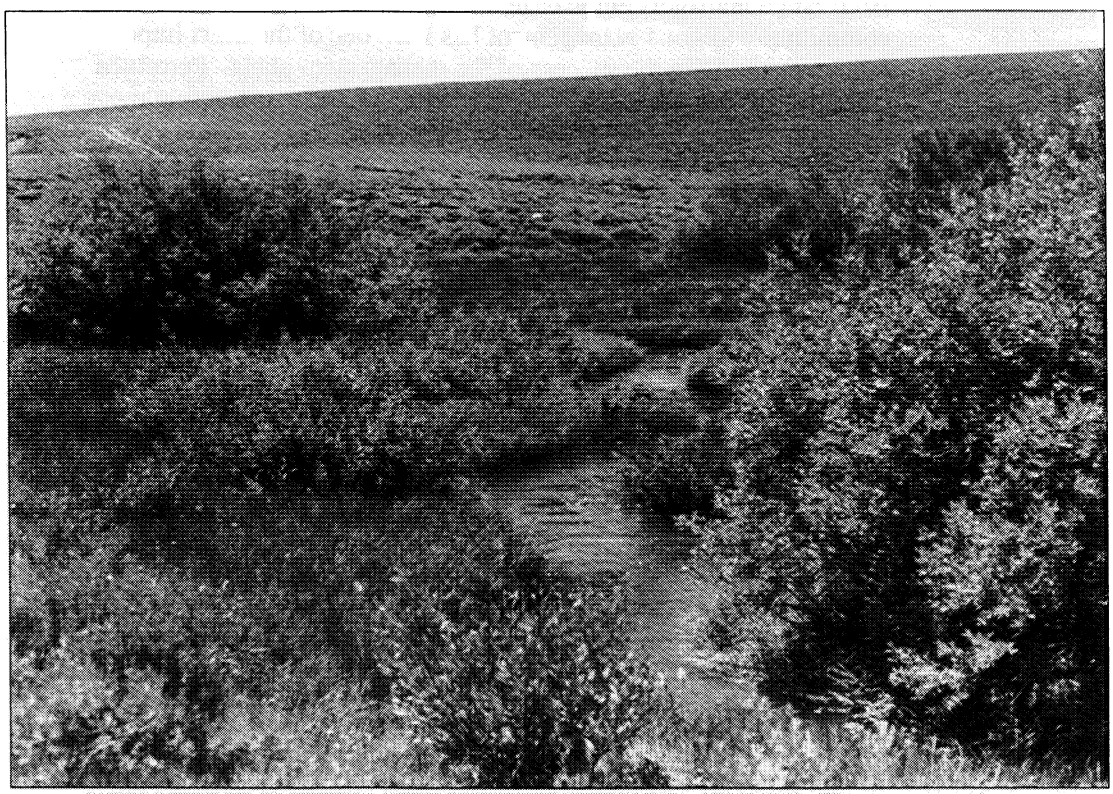


Illustration 9. Riparian Conditions on Blucher Creek in White Acorn Allotment (July, 1986).

There are other allotments in this vicinity being managed intensively under various grazing systems, which contain riparian areas that are reportedly being maintained in good condition (Prospect Mountain and Little Prospect). Both range managers who developed and supervise the AMPs on these allotments share a common philosophy on the key elements of successful riparian management. They state that:

(1) Those involved in the management of the area must understand and agree on the problems and objectives to be addressed.
(2) The users must understand the changes which can occur and how they can benefit from proper management and improvement in riparian conditions.
(3) The users must be involved in designing the grazing system and monitoring the results.

(4) The users must be committed to meeting the objectives through the grazing system.
(5) Grazing management must be flexible enough to permit changes based on experience.
(6) We must learn from our mistakes and not repeat them elsewhere.
(7) Range rest should be employed wherever and whenever possible (as frequently as possible).
(8) Once the management is in progress, the most important element is frequent use supervision (sometimes daily). This is necessary to foresee and avoid adverse impacts, e.g., trampling damage and excessive utilization.

Both range managers emphasize that permittee and BLM involvement and commitment to good management has been one of the most important factors resulting in the success of the management plans. Permittee commitment has taken the form of paying for and constructing range improvements, good herding and salting practices, and in the case of the Little Prospect Allotment, the inclusion of two privately owned partially irrigated pastures in the rotation (Krosting and Christensen pers. commun.)

e. The Forest Service Intermountain Forest and Range Experiment Station conducted research on sheep and cattle grazing and riparian-aquatic ecosystems in moist high mountain meadows surrounded by forests. Preliminary findings were as follows.

(1) Studies of herded sheep use on Frenchman Creek in Idaho showed no detectable change on ranges previously ungrazed prior to the research (Platts, 1981). Utilization in the stream side areas was limited to less than 5-10 percent of the herbaceous forage. The author states, "A rest-rotation grazing system that includes proper herding of sheep to control animal distribution and forage utilization apparently results in insignificant onsite impacts to this type of riparian/stream environment. The rest-rotation system should work well throughout the Rocky Mountain area where animal distribution is tightly controlled" (Platts 1981).

(2) During a 2-year study of cattle use on meadows previously ungrazed by livestock in central Idaho, livestock utilization of herbaceous forage varied from 25-80 percent, and no significant changes were detected in water column, stream channel condition, or fish populations (Platts, 1981). "It is too early to determine if these rest-rotation grazing systems with their different degrees of grazing intensity are compatible with the stream and its fisheries. A minimum of two grazing cycles (six years) will be needed before sufficient trend information will be available.". . . ."A key conclusion evolving during the early stages of the study is that when riparian systems are first grazed, initial adverse impacts will show on the stream banks and riparian vegetation. If this trend remains consistent, it may be possible to detect and correct livestock impacts occurring on good-condition riparian/stream environments before the fishery is affected" (Platts 1981).

Platts, (pers. commun.) indicates that many rest rotation systems have failed to produce the desired results in riparian areas because the utilization levels were too high. He stated that 3-pasture rest-rotation systems are more likely to succeed than season long continuous grazing as long as the utilization is controlled to meet the physiological needs of the plants on site and where the trampling damage to soils and banks is minimized.

f. Rest rotation "seems to work well when precipitation exceeds 15-20 inches per year and is predictably distributed. Both of these requirements are necessary to insure that the rest period will result in soil and vegetation recovery. Deserts don't meet these requirements, since they generally receive less than 8-10 inches of annual precipitation and it is not predictably distributed. Disturbance to desert range caused by a season of *heavy grazing* (emphasis added) may not be repaired by a season of rest. Deserts are well suited to grazing but I do not recommend that deserts be grazed in such a way as to remove more than 50 percent of the current years growth.... The reason for such careful management of deserts is the long time-period needed for recovery" (Busby 1978).

   The timing of precipitation also may be a key factor. In southwestern Montana where most of the annual precipitation (12-16") occurs during the growing season rest rotation has proven successful.

C. Use of Riparian Pasture Management Concepts

The use of riparian pastures should be considered where riparian habitat objectives cannot otherwise be achieved by the grazing management applied to the allotment.

Riparian pastures are normally smaller areas of rangeland containing *both* upland and riparian vegetation which are managed as a unit together to reach certain riparian objectives, as opposed to stream side pastures containing only riparian vegetation or other pastures managed primarily to achieve results in the upland areas.

In the design of riparian pastures, the balancing of forage between upland and riparian areas is important so that forage in the upland sites is not limiting proper distribution or utilization - e.g., provide enough forage in the upland areas of the pasture so that livestock will not be *forced* to the riparian areas to find sufficient forage. It should be noted that forage balance may change with changes in season of use and kind of livestock.

Using 6-10 acre pastures in Idaho, Nevada, and Utah, Platts and Nelson found: "The timing and location of grazing in the specially managed riparian pastures can be controlled much more effectively than in the large allotment pastures, offering an easier way to get the type of grazing needed for compatibility with other resources." (Platts and Nelson 1985).

The use of riparian pastures offers alternatives to the elimination of livestock grazing and the high costs of fencing the boundary of riparian areas. The authors conclude: "By experimenting with different types of riparian and upland range, different sizes and shapes of pastures, and different ratios of riparian forage to upland forage, it may be possible to efficiently graze riparian vegetation without damaging this sensitive zone[1]. Special management pastures would need to be larger in mountain meadow ranges than the ones we used to better match benefits derived from improved riparian and fish habitat with the costs of fencing. The influence of a cattle herd's home range on grazing use will need careful analysis; pastures may have to be larger than a herd's home range in less productive range

[1] *This may not be practical in many cases due to cost.*

types. When the fencing of narrow streamside corridors or the elimination of livestock grazing from the allotment are the only alternatives available for maintaining productive riparian and fishery habitats, the cost of special management pastures may not seem exorbitant" (Platts and Nelson 1985).[2]

D. Holistic Resource Management

Holistic Resource Management (HRM), as developed by Allan Savory, with its associated grazing practices, is being used to improve general range conditions and riparian area conditions on the Deseret Land and Livestock Company ranch in north central Utah. This ranch includes approximately 201,000 acres of private land and 15,600 acres of public land with elevations ranging from 6,000 to 8,700 feet. Vegetation varies from irrigated hay land and sagebrush grassland at lower elevations to the aspen-fir complexes at the higher elevations. The growing season is 60 days. Precipitation varies from 10 to 22 inches depending on elevation. The grazing season is variable depending on snow but has been extended in some years from April 1 to January 1.

A range conservationist who formerly worked on the ranch reports that prior to implementation of HRM much of the rangeland on the ranch was in a deteriorated condition (Secrist pers. commun). Many sagebrush filled gullies were present in the lower elevations. These drainages flowed muddy water and only during snow melt or following heavy rains. Riparian herbaceous vegetation was absent in most drainages including Saleratus, Negro Dan, Stacy Hollow, and others. No willows could be found in these drainages.

A program of HRM was initiated on the ranch in 1979. The objective was to make a profit while improving the health of the range. Since evidence exists that grazing animals were originally part of the ecosystem, livestock were chosen as the tool to accomplish the objective. Cattle, sheep, and buffalo are managed to control the timing and duration of grazing as well as animal impact.

Flexibility in time control has been achieved by grouping animals into large herds (from 1,300 yearling heifers to 3,500 pairs and 6,000 yearling steers) and creating more pastures through fencing. Three different cattle herds and 6 bands of sheep use 100 different pastures on the ranch. Depending on range conditions as well as vegetation and economic goals, pastures are used 1 to 3 times per year. The majority of pastures are only used once per year. Stock density (animals per acre) has ranged from 0.5 to 3.5 depending on pasture size. Time in each pasture is determined by how fast plant growth is occurring. Where growth is rapid, pasture moves are frequent. Where plant growth is slow, the livestock stay longer in each pasture. Where plants are dormant, livestock are moved when forage is lacking and animal performance begins to suffer. Time in each pasture has ranged from 3 days (during rapid growth) to 100 days (during dormancy). During the growing season the grazing animals are moved from pasture to pasture in an attempt to graze a given plant severely only once and then allow it to recover from the effects of defoliation before it is grazed again. Yearling cattle and sheep are moved by herding. The 3,500 pairs are trained to move from pasture to pasture by responding to a whistle.

Animal impact is gained through herd effect: (1) hooves breaking up soil crusts and incorporating manure, litter, and seeds into the soil surface, thus enriching the soil and providing for increased ground cover, (2) adding urine (urea) to the soil,

[2] *Riparian pasture management is an option to consider in achieving riparian objectives in certain allotments. It should not be considered a panacea.*

(3) creating hoof print seedbeds and pockets for collection of litter and precipitation where seeds are compressed in mineral soil, and (4) pruning plants by grazing, trampling, crushing, etc. to stimulate new growth. Animal impact when properly managed is very important to the health of these rangelands. The herd effects mentioned and particularly the hoof print seed beds, result in improved microsite conditions for the germination of seed and establishment of seedlings which can be the weakest link in the natural function of many range ecosystems. New plants result in additional path ways for water to get into the soil reservoir where it is stored, purified, and slowly released into riparian areas.

The manager believes that this method of grazing results in an increase in ground cover which in turn will result in an increase in water infiltration thus improving the range as a whole, including riparian areas. Moisture enters the soil profile in the uplands (rather than flowing over the surface) and then migrates through the soil to the drainages thus restoring some of the natural hydrologic function to the watershed. Riparian vegetation re-establishes in the drainages serving as a silt trap which raises the water table. Moisture moving from the uplands to the edges of the sharp drainages results in sloughing banks which are then colonized by riparian vegetation. As this healing process continues the bottom of the drainage rises in elevation thus deepening and widening the riparian aquifer. As a result, riparian vegetation expands into the edges of the uplands and sagebrush is "flooded out". Evidence of this can now be seen on the ranch. In the drainages mentioned earlier, and others, riparian vegetation is established in the drainages and is expanding into upland areas adjacent to the bottoms. Clear water is flowing year-round. Willows have established themselves where not seen previously. The streambed in one drainage has increased more than six inches in elevation. Gully banks are slumping and being vegetated by riparian plants. Sagebrush is dying as the riparian areas expand. See Illustrations 10, 11, and 12.

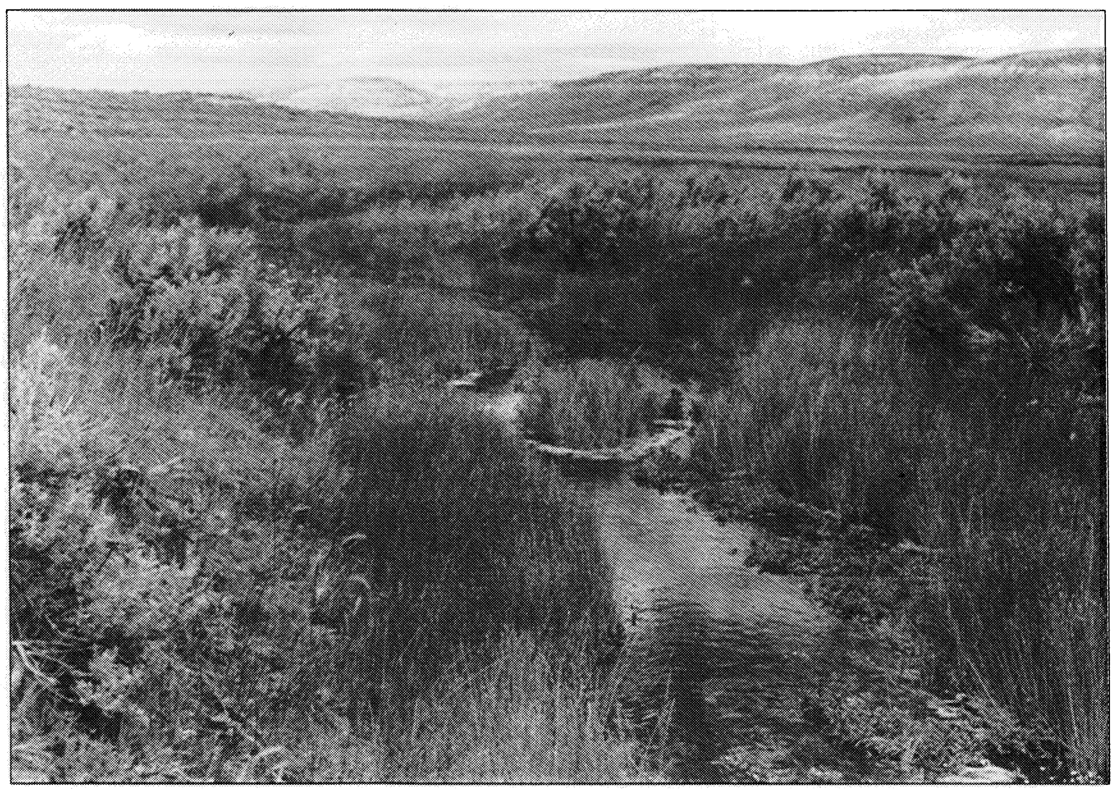


Illustration 10. Stacy Creek on Deseret Ranch (July, 1986). This was a dry wash with no sedges or rushes present 6 years ago. It is now a perennial stream.

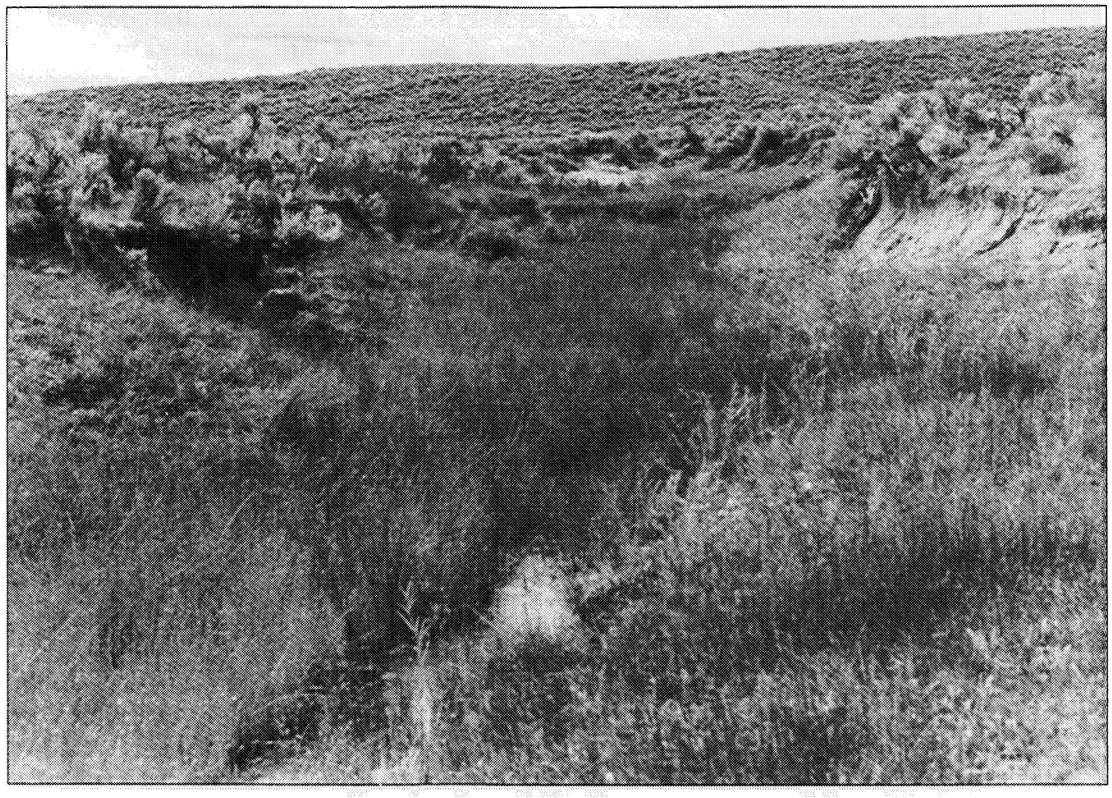


Illustration 11. Negro Dan Creek on Deseret Ranch (July, 1986). Formerly a dry wash this drainage is now stabilized by sedges and rushes and flows water year-round. Note young willows to right of stream.

Illustration 12. Upper Reach of Negro Dan Creek (July, 1986). Riparian vegetation has colonized former sagebrush filled draw. Note dead sagebrush stems.

Although precipitation has been above normal for the past four years with two years being record years, the changes mentioned above occurred while stocking on the ranch was significantly increased:

	1979	1986	
Cattle	4,500	10,460	
Sheep	12,000	10,000	(approximate)
Elk	350	1,500	
Buffalo	0	230	

The number of animal units marketed or harvested (cattle, sheep, elk, moose, deer, and horses) has increased from 5,000 in 1979 to 9,500 in 1985. Additionally, though precipitation and runoff has been far above normal of late, the additional ground cover in the uplands and the improvement in the riparian habitat has prevented significant erosion damage on the ranch (Simonds pers. commun.).

VI. Learning From Experience

Internal BLM information and the literature contain very little documentation of successful grazing management in riparian areas. There is an urgent need to publicize our successes as well as to identify and document the conditions under which certain systems don't work. Grazing prescriptions designed to properly manage riparian areas they should be monitored and evaluated regularly. Managers should not hesitate to make changes in grazing treatments and take some risks where the present management is not achieving objectives especially where other alternatives exist.

We must document our successes and failures in order to learn from our efforts. Before and after photos (with backup data), showing the effects of management are particularly valuable in documenting results and should be mandatory in any riparian area monitoring plan. Documented successes should be publicized through presentations at professional society meetings, meetings of the livestock community, conservation group meetings, internal workshops, and in professional and popular publications.

Personnel in every field office should document both the successes and failures resulting from efforts to improve riparian conditions. It is important that pretreatment resource conditions be documented to provide a basis for interpretation of results. This will provide a basis for avoiding past mistakes and a "spring board" for exploration of other options.

VII. Cardinal Rules for Management of Grazing in Riparian Areas (and for action planning)

A. The grazing management designed for an area must be tailored to the conditions, problems, potential, objectives, public concerns, and livestock management considerations on a site specific basis.

B. Grazing must be managed to leave sufficient vegetation stubble on the banks and overflow zones to permit the natural functions of the stream to operate successfully.

C. Alternatives to passive continuous grazing must be identified and implemented.

D. Grazing prescriptions should take advantage of seasonal livestock preference for uplands.

E. Rest from the livestock grazing should be employed whenever possible and appropriate.

F. Those involved in the management of the area including the livestock user and the involved public should understand and agree on the problems and objectives to be addressed, as well as understand the changes which can occur, and how they can benefit from proper management and improvement in riparian conditions.

G. The livestock user should be involved in designing the grazing system and monitoring the results.

H. All parties involved should share the commitment to achieve the management objectives.

I. Grazing management must be flexible enough to accommodate changes based on need.

J. Once management is in progress, frequent use supervision is essential by the parties involved.

K. Mistakes should be documented and not repeated.

L. Management successes should be used to promote good riparian area management elsewhere

APPENDIX A

Three Pasture Deferred Rotation System Based On Seasonal Preference

	Pasture A	Pasture B	Pasture C
Year 1	Graze first third of grazing season (stocking rate based on entire pasture)	Graze middle third of grazing season (stocking rate based on riparian zone forage base)	Graze last third of grazing season (stocking rate based on riparian zone forage base)
Management Objective	promote livestock production; utilize all forage in pasture	protect stream banks; maintain livestock production	begin stream bank improvement; maintain livestock production
	B	C	A
Year 2	Graze first third (stocking rate based on entire pasture forage base)	Graze middle third (stocking rate based on riparian zone forage base)	Graze last third (stocking rate based on riparian zone
Management Objectives	promote livestock production; utilize all forage in pasture	continue stream bank improvement; maintain livestock production	begin stream bank improvement; maintain livestock production
	C	A	B
Year 3	Graze first third (stocking rate based on entire pasture) forage base)	Graze middle third (stocking rate based on riparian zone forage base)	Graze last third (stocking rate based on riparian zone
Management Objectives	promote livestock production; utilize all forage in pasture*	continue stream bank improvement; maintain livestock production	improve stream banks; maintain livestock production

*Improvements in upland range condition, which have occurred during the rest periods, produce more forage for livestock. (from Marlow 1985).

APPENDIX B

Grazing Formula for Little Sandy Allotment - Deferred Rotation (All Dates Are Approximate)

Jensen Meadows Pasture July 16 - August 15	Mountain Pasture August 16 - September 15
Elkhorn Pasture July 1-15 September 16-30	
Reservoir Pasture May 1-June 30 November 15	Dry Sandy Pasture October 1- November 15

Year One

Jensen Meadows Pasture August 16 - September 15	Mountain Pasture July 16 - August 15
Elkhorn Pasture July 1-15 September 16-30	
Reservoir Pasture October 1- June 30	Dry Sandy Pasture May 1-

Year Two

This cycle is repeated every two years

APPENDIX C

1. Grazing Formula for Sedow Allotment - Rest Rotation (Modified Santa Rita Grazing System)[1]

	YEAR ONE			YEAR TWO			YEAR THREE		
Pasture	* June-Sept	Oct-Jan	Feb-May	* June-Sept	Oct-Jan	Feb-May	* June-Sept	Oct-Jan	Feb-May
A	▨					▨			
B			▨				▨		
C				▨					▨

▨ - Grazing Treatment ☐ - Rest Treatment

* *Growing Season*

2. Grazing Formula for Superior Allotment - Rest Rotation (Modified Santa Rita Grazing System)[1]

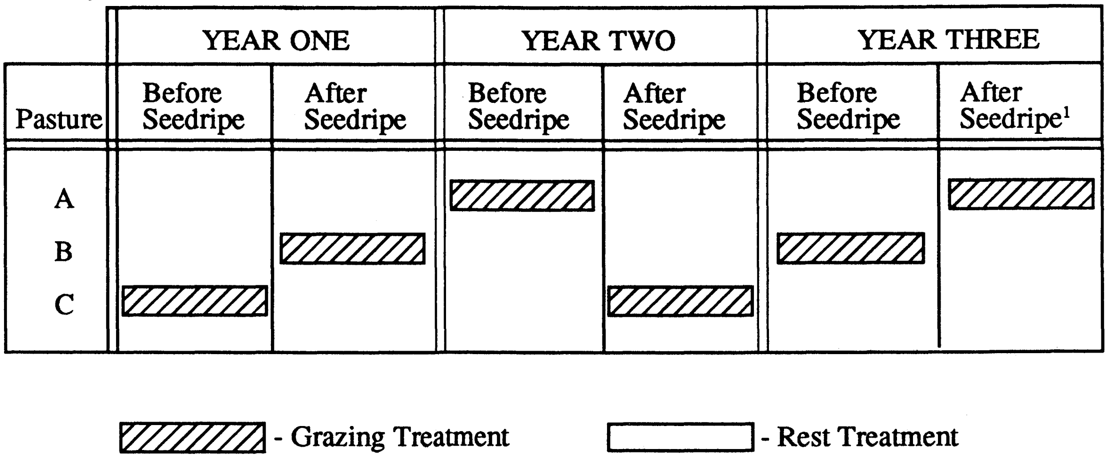
	YEAR ONE		YEAR TWO		YEAR THREE	
Pasture	May-Oct	Nov-Apr	May-Oct	Nov-Apr	May-Oct	Nov-Apr
A	▨			▨		
B		▨			▨	
C			▨			▨

▨ - Grazing Treatment ☐ - Rest Treatment

[1]*Based on "The Santa Rita Grazing System" (Martin 1978).*

APPENDIX D

Grazing Formula for Wilson Creek Pasture Allotment



[1]Seedripe is about August 15

APPENDIX E

Grazing Formula for White Acorn Allotment (upper 3 pastures)

	YEAR ONE		YEAR TWO		YEAR THREE	
Pasture	After Flowering	After Seedripe	After Flowering	After Seedripe	After Flowering	After Seedripe
A			▨			▨
B		▨			▨	
C	▨			▨		

▨ - Grazing Treatment   □ - Rest Treatment

APPENDIX F

I. Indicators of High Quality Riparian Habitat.

Riparian areas are the most important wildlife habitat type. Following are indicators of quality habitat which can be considered when designing management objectives for riparian area management in the Great Basin, and similar areas, including the Great Plains, and toward which grazing management practices can be designed. These factors can also be used as indicators of quality habitat for other species as well.

A. Fish Habitat

Platts et al. (1977) indicate the following are indicators of good fish habitat in the Great Basin (these are also good indicators of bank stability).

1. Adequate vegetation canopy to maintain acceptable water temperatures for the fish species involved.

2. Well vegetated stream banks which will minimize soil loss and trampling damage.

3. On 50 percent or more of the stream bank, and especially on outside bends of streams, overhanging vegetation (within 1-2 feet of water surface) is needed for fish cover.

The authors acknowledge that individual sites possess limitations which may preclude accomplishing all the above. However, the type, density, height, diameter, and age class of vegetation needed for good fish habitat should be included in the management objectives.

In designing grazing systems to improve fisheries, a fisheries biologist should be consulted to insure the treatments are tailored to the site specific resources present.

B. Waterfowl Habitat

Mazzoni, et al. (1977) made several recommendations for management of waterfowl production habitat in the Great Basin.

1. Manage for native plant communities where possible. Where this is not practical, manage for introduced species best adapted to the site that give the greatest density with the tallest and most erect growth form.

2. Ideally, areas managed for production should contain 1/3 open water and 2/3 marsh vegetation.

3. Fence critical areas or place salt, water, and supplements for livestock away from critical production areas. Where fencing is impractical, islands or artificial structures are recommended.

4. Where maximum nest density and nesting success is desired, manage for high erect growth forms in 80 acre or larger blocks. These areas should be ungrazed until the vegetation begins to mat.

5. Several years of non use may be required to promote homing, larger clutches, and earlier nesting of waterfowl species.

6. Most nesting starts before current years' vegetative growth is useable for nesting. Grazing should be managed to provide for increases in residual nesting cover which will carry over for the following year. This carry over should be comprised of a combination of abundant ground litter, as well as erect and recumbent vegetation. These characteristics help deter predation and provide ideal temperature and moisture conditions for a good hatch.

7. Grazing formulas which prescribe deferred grazing in areas with good residual vegetation from the previous year provide maximum benefits to nesting waterfowl (Mazzoni et al. 1977).

In a study of rest rotation grazing and waterfowl production in Montana, the following suggestions were made. Cattle should be moved from the pasture and gates closed at the end of the early treatment (spring and summer grazing) to provide for residual cover and regrowth. Grazing of these or other rested pastures with residual cover should be delayed the following year until incubation is complete (Gjersing 1975).

II. Willow and Cottonwood Stand Regeneration and Management

Although the following do not specifically relate to grazing management some are indirectly related and may prove useful in planning for proper management.

A. Willows - Pillmore (1983) reported the following findings on willow:

1. Bare soil with moisture above or at the surface and temperatures above freezing are required for germination.

2. The duration of seed viability is short (6-7 weeks).

3. For survival, seedlings require continuous high soil moisture availability.

4. Willows can tolerate 2-4 weeks of flooding but no more than 200-400 mg/l of total dissolved solids.

5. Willows can only tolerate 2-4 weeks of moisture stress and require "that the water table be within 12 feet of the surface" (Pillmore 1983).

There are many species of willow native to the western rangeland. Habitat preference and growth form vary widely.

B. Cottonwoods

Cottonwoods usually don't regenerate naturally in existing stands until the overstory has declined due to harvest or death. This is due to competition for moisture and light. The best conditions for seed germination are moist gravel, sand, or silt exposed to full sun.

"Soil disturbance or exposure is usually necessary to achieve sprouting or reproduction from seed" (Beeson 1983). Seed viability is short lived. A constant supply of moisture is essential during the first few weeks of seedling growth to ensure survival.

Cottonwood seedlings frequently appear following high runoff and silt deposition in conjunction with peak seed dispersal (Fenner, et al. 1985).

Studies on cottonwood in north eastern Colorado indicated that although the most important factor in cottonwood regeneration was water management, livestock grazing and fire are beneficial in controlling competition from herbaceous vegetation during the period of the summer when cottonwood seed was disseminated and seedling growth was likely (Crouch, 1979). The author found that if the area contained inadequate forage, grazing was likely to result in loss of seedlings.

The author makes the following recommendations to ensure stands are maintained in vigorous condition. "There should be a number of age classes of cottonwoods, with an age separation of not more than 5 years between individual groves. To obtain this result, the manager will need to provide suitable site conditions to assure a good stand of seedlings at 5-year intervals. Such a stand, once established, will require protection from browsing or other damage for up to 5 years" (Beeson 1983).

Additionally, cottonwoods can stand flooding for only 7-16 days, can tolerate only 200-400 mg/l of total dissolved solids, are capable of living under only 2-4 weeks of moisture stress, and can survive when the water table is within 20 feet of the soil surface (Pillmore 1983). Some streams in Colorado with much greater concentrations of dissolved solids support cottonwoods.

Willow, cottonwood, and aspen sprout from stumps and roots. Livestock, especially cattle, annually consume this reproduction when "overgrazing" during summer and fall is allowed. Beaver play a natural role in stimulating suckering and sprouting. If good beaver habitat is to be maintained, it is essential that stumps be protected from summer cattle use for 3 to 5 years following cutting by beaver (Kindschy pers. commun.). For an exhaustive treatment of aspen ecology and management see USDA (1985).

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The management of livestock grazing in riparian areas is one of the most complex issues facing the western rangeland managers to day. This Technical Reference assembles information from various land managers, authors, and researchers that can be used to guide livestock management in riparian areas using their unique responsiveness to accomplish management objectives. This Technical Reference discusses implications of grazing in riparian areas, how to establish management objectives, and lays out grazing principles and concepts. It also provides examples of grazing management practices that have worked in various regions.

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