Compatibility of Livestock Grazing Strategies with Fisheries

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Abstract.—Livestock grazing strategies and techniques have been developed for upland ranges to increase plant and litter cover, encourage growth of favorable plant species, improve plant species composition, increase plant vigor, and protect soil from erosion. These same objectives must be met when using the riparian area for livestock grazing. Grazing strategies have been preliminarily evaluated here with respect to their compatibility with the requirements of the stream-riparian zone and a productive fisheries. A better understanding of management strategies with respect to their stream-riparian compatibility should help fishery specialists work more closely and effectively with range conservationists in rangeland management.

Livestock grazing strategies and related techniques have been developed to increase forage production, increase plant and litter cover, encourage growth of desirable forage plants, improve range condition, improve plant species composition, decrease soil erosion, and increase plant vigor on grazed lands (Holcheck 1983). Although these strategies should also benefit the fisheries in streams that flow through grazed lands, more information is needed to determine if the objectives are actually being met in stream-riparian systems (the complete stream and its surrounding riparian habitat) and whether they benefit fishery resources (the "fishery" refers to the fish and their complete habitat). Literature that reports evaluations of the compatibility of different grazing strategies with fishery resources is lacking (Meehan and Platts 1978).

Holcheck (1983) reported that, although grazing strategies have been a major focus of range research and management, range specialists still lack specific knowledge of the conditions under which individual grazing strategies give best results. This observation also applies to the status of fisheries research and management. Holcheck (1983) also found little difference in cattle performance (e.g., weight gains) and diet quality between the different grazing strategies (e.g., season-long continuous versus rest rotation). With little clearcut advantage from specialized grazing strategies on upland rangeland sites, there is little economic incentive for managers and users to change from one strategy to another. Therefore, economic benefits from grazing strategies designed to improve stream-riparian zones as well as fisheries must be demonstrated.

This report reviews the ability of current grazing strategies to meet fisheries needs based on the information in the references cited and on personal observation. The evaluation draws heavily on the experiences of the author. Also, the grazing strategies are evaluated based on the commonly used stocking rates and grazing intensities used on today's allotments. Obviously, one cow grazing a large allotment at 1% utilization under any selected grazing strategy would be compatible with fisheries needs. This report, however, evaluates each strategy as commonly used. This report concentrates on the northern Rocky Mountains and the Great Basin, but should have application in other areas. Range specialists and land managers might evaluate some of these strategies differently; I see no problem with this but present this report as a beginning that will be subject to refinement.

Fishery needs are viewed as the major objective in the evaluation of each livestock grazing strategy. The management goal is assumed to be that any strategy should attain or maintain all the affected range types (especially riparian) in a condition that will meet the needs of all other beneficial uses. However, the allocation of resources for combining the needs of all the different uses sometimes means that full productive capacity for any one resource may not always be achieved.

Grazing Strategy Development

Gifford and Hawkins (1976) showed that current grazing strategies failed to significantly increase plant and litter cover on watersheds. They also stated that grazing strategies appear to benefit only certain plant species. It is possible, then, that one plant species will increase in density while another will decrease. The net result may well be no change in watershed protection. Gifford and Hawkins' (1976) findings have application in stream-riparian management. Plant density and species composition changes have affected many stream-riparian systems in the western USA. A prime example is the historic reduction in stream canopy overstory along many western streams (Platts and Nelson, in press).

Historically, range managers have not distinguished between the different plant community types on the uplands from those of riparian ecosystems and have typically subjected both groups to the same grazing management strategy. This management approach is still commonly used and has caused serious fisheries problems because of the disproportionately heavy use of stream-riparian zones by livestock. Rangeland researchers and managers have had difficulty developing grazing strategies that counter the unbalanced animal distribution patterns that develop when livestock concentrate in stream-riparian zones. Holcheck (1983) noted that for any grazing strategy to work it must be tailored to fit the needs of the vegetation, terrain, class or kind of livestock, and the particular ranching operation involved. Today's range and fisheries specialists must tailor grazing to fit the needs of streambanks, stream channels, water quality, and streamside vegetation. If the riparian area is the key to productive fisheries, then the grazing strategy must meet the needs of the key vegetation species, whether they be ungrazable brushy species or palatable grasses.

Specialists have progressed slowly in evaluating grazing strategies with respect to fisheries' needs, and our understanding interrelationship is so far rudimentary. Information and sound conclusions require time to attain, but managers must make decisions daily using the best information available. They do not have the luxury of waiting years for research to find a definitive solution. This report evaluates commonly used grazing strategies based on present limited data.

Options for Strategy Development

Seven major options are available when developing grazing strategies that incorporate fisheries compatibility. To be successful, combinations of the following options are usually required:

(1) control of grazing frequency (includes complete rest);
(2) control of livestock stocking rates;
(3) control of livestock distribution;
(4) control of the timing (season) of forage use;
(5) control of livestock kind and class;
(6) control of forage utilization;
(7) artificial rehabilitation rangeland fisheries.

Controlling animal stocking rates has been the principal option used, but controlling numbers alone has had only limited success on stream-riparian zones. Rest is built into strategies such as rest-rotation to improve plant condition, and deferred strategies use the timing of forage use to enhance plant vigor and seeding success. The control of the the kind and class of livestock can be highly successful but is seldom used. The artificial rehabilitation of rangeland fisheries should be a last-resort option. Natural rehabilitation under proper stewardship should receive first consideration.

Evaluation of Selected Grazing Strategies and Techniques

Each grazing strategy or technique is evaluated with respect to how its use relates to potential impacts on fishery productivity (Table 1). The range profession does not list or define some of the strategies used in this report; what they do define, they call systems. Problems, benefits, and fishery compatibility are outlined and rated for each grazing strategy (Table 2). Ratings range from 1 to 10, with 1 indicating little or no fishery compatibility and 10 representing complete compatibility with fishery needs. Grazing strategies are evaluated based on their effect on amount of streambank vegetation used, control of animal distribution, effects on streambank stability, ability to maintain brushy species, control of seasonal plant regrowth, and the ability of a stream-riparian habitat to rehabilitate while under the influence of the strategy.

The descriptions of the more commonly used grazing strategies are derived from the works of Kothmann (1974), Gifford and Hawkins (1976), and Holcheck (1983). The definitions used by Kothmann (1974) are used in this report whenever possible. These researchers' work was also used to identify certain problems and benefits. Interpretations on corridor fencing, riparian pasture, rest, rest rotation, double rest rotation, and seasonal preference as related to fisheries needs were taken from Platts (1981, 1984), Platts et al. (1983, 1985), Platts and Wagstaff (1984), and Platts and Nelson (1985a, 1985b, 1985c, 1985d). The grazing strategies were rated (Table 2) using information available in the previous citations and unquantified experiences of the author. This rating guide will need to be reviewed and refined over time, but for now it is something for specialists to work with.

Grazing strategy definitions listed by Kothmann (1974) are used in this report. Kothmann does not define many of the commonly used strategies, so definitions from Holcheck (1983) and Gifford and Hawkins (1976) were used whenever possible. However, any definition will be changed to meet a new definition that appears in updated versions of the range term glossary or the "Glossary of Aquatic Terms" published by the Western Division of the American Fisheries Society.

Table 1.—Potential effects of grazing on aquatic and riparian habitats that should be considered when grazing strategies or grazing related techniques are evaluated.

Stream banks

(1) Shear or sloughing of stream-bank soils by hoof or head action.
(2) Water, ice, and wind erosion of exposed stream-bank and channel soils because of loss of vegetative cover.
(3) Elimination or loss of stream-bank vegetation.
(4) Reduction of the quality and quantity of stream-bank undercuts.
(5) Increasing stream-bank angle (laying back of stream banks), which increases water width and decreases stream depth.

Water Column

(1) Withdrawal of streamflow to irrigate grazing lands.
(2) Drainage of wet meadows or lowering of the groundwater table to facilitate grazing access.
(3) Pollutants (e.g., sediments) in return water from grazed pasture lands, which are detrimental to the fisheries.
(4) Changes in magnitude and timing of organic and inorganic energy (i.e., solar radiation, debris, nutrients) inputs to the stream.
(5) Increases in fecal contamination.
(6) Changes in water column morphology, such as increases in stream width and decreases in stream depth, including reduction of streamshore water depth.
(7) Changes in timing and magnitude of streamflow events from changes in watershed vegetative cover.
(8) Increases in stream temperature.

Channel

(1) Changes in channel morphology.
(2) Altered sediment transport processes.

Riparian Vegetation

(1) Changes in plant species composition (e.g., brush to grass to forbs).
(2) Reduction of floodplain and stream-bank vegetation, including vegetation hanging over or entering into the water column.
(3) Decrease in plant vigor.
(4) Changes in timing and amounts of organic energy leaving the riparian zone.
(5) Elimination of riparian plant communities (i.e., lowering of the water table allowing zeric plants to replace riparian plants).

Continuous Season-Long (Cattle)

Continuous season-long grazing (cattle) for this report is grazing a particular pasture annually throughout the complete vegetation growing season. Kothmann (1974) defines continuous grazing as grazing of a specific unit throughout a year or for that part of a year during which grazing is feasible. Under the continuous season-long strategy, livestock congregate and linger on riparian streambank areas because of the presence of succulent forage,

Table 2.—Evaluation and rating of grazing strategies based on the author's personal observations, as related to stream-riparian habitats.

Strategy	Level to which riparian vegetation is commonly used	Control of animal distribution (allotment)	Stream-bank stability	Brushy species condition	Seasonal plant regrowth	Stream-riparian rehabilitative potential	Rating
Continuous season-long (cattle)	Heavy	Poor	Poor	Poor	Poor	Poor	1[a]
Holding (sheep or cattle)	Heavy	Excellent	Poor	Poor	Fair	Poor	1
Short duration-high intensity (cattle)	Heavy	Excellent	Poor	Poor	Poor	Poor	1
Three herd — four pasture (cattle)	Heavy to moderate	Good	Poor	Poor	Poor	Poor	2
Holistic (cattle or sheep)	Heavy to light	Good	Poor to good	Poor	Good	Poor to excellent	2-9
Deferred (cattle)	Moderate to heavy	Fair	Poor	Poor	Fair	Fair	3
Seasonal suitability (cattle)	Heavy	Good	Poor	Poor	Fair	Fair	3
Deferred-rotation (cattle)	Heavy to moderate	Good	Fair	Fair	Fair	Fair	4
Stuttered deferred-rotation (cattle)	Heavy to moderate	Good	Fair	Fair	Fair	Fair	4
Winter (sheep or cattle)	Moderate to heavy	Fair	Good	Fair	Fair to good	Good	5
Rest-rotation (cattle)	Heavy to moderate	Good	Fair to good	Fair	Fair to good	Fair	5
Double rest-rotation (cattle)	Moderate	Good	Good	Fair	Good	Good	6
Seasonal riparian preference (cattle or sheep)	Moderate to light	Good	Good	Good	Fair	Fair	6
Riparian pasture (cattle or sheep)	As prescribed	Good	Good	Good	Good	Good	8
Corridor fencing (cattle or sheep)	None	Excellent	Good to excellent	Excellent	Good to excellent	Excellent	9
Rest rotation with seasonal preference (sheep)	Light	Good	Good to excellent	Good to excellent	Good	Excellent	9
Rest or closure (cattle or sheep)	None	Excellent	Excellent	Excellent	Excellent	Excellent	10

[a]Rating scale based on 1 (poorly compatible) to 10 (highly compatible with fishery needs).

drinking water, gentle terrain, shade, and vegetation. These areas usually receive excessive use even under light stocking rates (Platts and Nelson 1985c). Operating costs are minimal because fencing is minimal and stress to livestock due to gathering, trailing, and changing pastures is reduced. This grazing strategy is seldom compatible under commonly used forage intensity and seasons of use because too much pressure is exerted on riparian plants and streambanks (Platts et al. 1983, 1985; Platts and Nelson 1985b).

Holding (Sheep or Cattle)

The holding strategy, as used in this report, calls for holding grazing animals for long periods or under heavy stocking rates on a selected area. It differs from the closed herding definition used by Kothmann (1974), which relates primarily to the spread of a herd while grazing and the handling of a herd in a closely bunched manner to restrict the natural spread of the animals when grazing. The holding strategy is different because it is more contained and often used during waiting periods until conditions become right to move animals to other areas. Examples include holding on private pastures, use of U. S. Forest Service administrative pastures, holding on lower elevation meadows until higher elevation areas are ready for grazing or breeding pastures, and holding on areas until transportation to another area can be arranged. This strategy is usually not compatible with fisheries because season and proper use receive little consideration. When sheep are forced to concentrate (i.e., are held) on stream-riparian areas, they adversely affect these environments in much the same way as cattle (Platts 1981).

Short Duration-High Intensity (Cattle)

This strategy calls for rotating high intensity use over short periods. Kothmann (1974) defines this as any system of grazing management that uses a stocking density index greater than two. The stocking density index is the reciprocal of the fraction: land available to the animals at any one time divided by the land available to the animals for the entire grazing period. This strategy is sometimes called rapid rotation grazing (Steger 1982). It is sometimes used in a wagon-wheel arrangement with several pastures radiating outward, like the spokes of a wheel, and served by a central water supply. Regardless of the design, each paddock or pasture is given a short period of intensive grazing under high animal stocking rates followed by a longer period of rest for recovery.

To be successful, this strategy often requires ranges that receive adequate season-long precipitation or irrigation for plant regrowth. The grazing use probably places too much grazing and mechanical pressure on brushy species and streambanks. The initial expense (mainly fencing) to develop the pastures is high.

The strategy does result in better animal distribution, which results in more even pasture use, and it has been successfully applied on flat upland grassland types (Steger 1982). Stocking rates can often be substantially increased in comparison to corresponding rates under continuous season-long grazing. This short duration-high intensity strategy places livestock in the riparian stream habitat over intervals spanning the entire grazing season.

Three Herd-Four Pasture (Cattle)

This strategy closely resembles deferred rotation. It calls for grazing each pasture continuously for a year, and then each pasture is given 4-months of nonuse. With four pastures, nonuse can be staggered so that it occurs in each pasture during each period of the year by the end of the 4-year cycle. Livestock are allowed to graze the streambank forage over all periods of the year. Thus, early grazing can cause streambank shear and late grazing can eliminate vegetation needed to buffer high stream flows and ice erosion.

Better plant production has been obtained with this strategy on uplands where adequate precipitation occurs during the entire year. However, constant grazing pressure on brushy plant species occurs during the year of continuous grazing. The 4 months of rest allows some rehabilitation, but only one rest period every 4 years may be insufficient for fishery needs.

Holistic (Cattle or Sheep)

This strategy, often referred to as the Savory grazing method (Savory and Parsons 1980), is difficult to define because it is largely in the mind of the beholder. The strategy is usually thought of as heavy stocking and frequent movement of animals dependent upon the growth cycle of the plants. The strategy is similar to short duration-high intensity; the major difference is that the holistic grazing method must include daily planning and flexibility to obtain the desired animal performance through the dimensions of time, number, and space (Steger 1982). The timing of grazing and rest is supposedly keyed to plant and soil environmental conditions and needs. Neither the holistic nor the short duration-high intensity strategies have been adequately tested on stream-riparian zones to draw many conclusions. Supposedly, the hoof action and mechanical disturbance of soils will improve infiltration, decrease overland flow, and promote better riparian zones by reducing peak stream flows. But there is no proof that this is true for riparian areas.

One excellent feature of the holistic strategy is that the livestock operator is forced to think about management options and possible responses and to provide daily supervision. Most grazing techniques do not require this degree of sophistication. However, the operator will still have difficulty determining needed forage use, forage timing, and animal movements because these have to be keyed to imprecisely defined environmental conditions requiring intensive training and more of the operator's time than is usually available. Livestock hooves can churn the soil, break the surface soil capping, trample ground litter, disturb soils for increased soil porosity, and encourage seedling establishment. Such conditions do not necessarily meet the needs of maintaining streambank stability, streambank morphology, channel form, and brushy vegetation.

Although this strategy has been credited for improvement of some upland range types (Savory and Parsons 1980), there is insufficient information to determine if this is true. Most allotments on public lands are too small and homogeneous to provide the options needed to make this method work. Success has been gained on some large ranches where needed options are available.

Deferred (Cattle)

This strategy delays pasture grazing until the more important forage plants develop seed or attain desired regrowth. Kothmann (1974) defines this strategy as the use of deferment in grazing of a management unit, but not in a systematic rotation including other units. This strategy calls for the discontinuance of grazing on various parts of a range in succeeding years, allowing each part to rest successively during the growing season to permit seed production, establishment of seedlings, or restoration of plant vigor. The strategy requires more fencing and cattle movement than the continuous season-long strategy. The deferred late grazing period and higher animal stocking rates may remove vegetation needed to protect streambanks from future ice and water scouring. Early grazing may increase streambank shear.

The periods of nonuse do provide opportunities to improve plant vigor and cover for the preferred grazing plants, and more even animal distribution occurs over the complete pasture than in season-long grazing. This strategy can be especially effective where considerable differences would normally exist between the consumption of different plant species and accessibility of plants to be grazed. The deferment adds periods of nonuse that can improve the capability of the vegetation to protect streambanks from erosion. To be successful, a sufficient amount of herbage needs to remain at the end of each grazing treatment, especially at the end of the late grazing period, for fisheries needs.

Seasonal Suitability (Cattle)

This strategy restricts the use of vegetation to a specific season (Kothmann 1974). The range or allotment is partitioned into pastures based on vegetation types, plant condition classes, or accessibility conditions. The best pasture, from a livestock nutritional standpoint, is selected for use for each season of the year. This strategy has application in those rangelands having high elevation differences or different randomly distributed precipitation patterns. The strategy is sometimes called the "best pasture system."

Higher fencing cost and increasing need to move animals from pasture to pasture to fit seasons of use raises costs. Also, the riparian habitat could be selected as the "best pasture" and therefore could receive levels of use detrimental to fisheries habitat. This strategy does not account for the need to decrease streambank erosion and protect brushy species, and the "best pasture" selection may require higher animal stocking rates per unit area at critical plant growing periods or periods when streambanks are most susceptible to shear.

Selected nonuse periods could allow degraded streambanks and riparian vegetation some time to recover from past damage, but because each pasture may be grazed every year, this programmed nonuse may not be adequate. Riparian areas, because of their nutritional content, would probably receive heavy grazing under this strategy, and fisheries habitats would therefore decline.

Deferred-Rotation (Cattle)

Rotation is an orderly sequence of use when some or all subdivisions (pastures) are both grazed and deferred during the same grazing season or calendar year. Kothmann (1974) defines deferred-rotation grazing as any strategy having a stocking density index greater than one but less than two, which provides for a systematic rotation of the deferment among pastures. Steger (1982) states that under deferred-rotation strategies, half or more of the land in the system (strategy) is being grazed at any given time, and the time a pasture is grazed equals or exceeds the period of rest. In this strategy, at least one pasture is deferred during part of the grazing season, and this deferment is then rotated among pastures (a minimum of two and frequently four pastures) in succeeding years. This strategy is commonly used to graze one pasture during the early part of the grazing season and then graze the remaining pastures during the late part. The following year the pasture use sequence is altered so the early grazed pasture last year is deferred to late grazing this year.

This strategy requires additional fencing and cattle movement. It calls for alternate year (under the two-pasture design) early livestock grazing when streambanks may be susceptible to shear damage, and for every other year late when plant regrowth may be needed to protect streambanks from ice and flood scour. In some cases the livestock manager can have the option of controlling use levels on critical areas. Because of the deferment, vegetation has the opportunity to store carbohydrates and set seed every other year. The strategy provides some control of animal distribution.

This strategy does provide some nonuse during some critical streamflow and plant growth periods and thus may increase streambank plant cover. Over 2 to 4 years, however, each pasture is grazed over the complete grazing season providing the possibility of streambank shear and vegetational mat elimination.

Stuttered Deferred-Rotation (Cattle)

This strategy is similar to deferred-rotation in that one pasture is deferred for part of the plant growth period; this deferment period is rotated among pastures in succeeding years. Under a two-pasture design, the deferred-rotation strategy grazes one pasture early one year and another pasture late, and then the pattern is reversed the following year. In the stutter, the sequence calls for use of one pasture early the first 2 years, and use of the other pasture late the following 2 years, taking 4 years to complete the cycle.

Fisheries compatibility is similar to deferred-rotation except that the two successive years of early grazing on one pasture and late grazing on the other pasture may give brushy species some relief. Because of the deferment, vegetation has the opportunity to store carbohydrates and set seed every other year. The strategy provides some control of animal distribution.

This strategy does provide some nonuse during some critical streamflow and plant growth periods and thus may increase streambank plant cover. Over 2 to 4 years, however, each pasture is grazed over the complete grazing season providing the possibility of streambank shear and vegetational mat elimination.

Winter (Sheep or Cattle)

Winter grazing is a form of seasonal grazing. Grazing occurs only during winter conditions, and to be successful, streambanks should be frozen and all riparian plants must be dormant. Rangelands must receive only light snowfall to allow livestock access to the forage. Heavy grazing can eliminate the streambank vegetational mat needed to prevent soil erosion due to winter-spring floods or ice events and to transfer grazing from grasses to shrubby species, unless controlled.

Winter grazing can eliminate or reduce supplemental winter feeding. Frozen streambanks are more resilient to mechanical damage minimizing streambank shear. Carbohydrates have returned to the root system, prior to the grazing season, providing the opportunity to increase plant vigor.

Rest-Rotation (Cattle) - Commonly Three or Four Pasture

The rest-rotation strategy calls for a multipasture design where each pasture receives at least 1 year of complete rest during each grazing cycle. This is an intensive system of management calling for extensive fencing and animal movement whereby grazing is deferred on various parts of the range during succeeding years, allowing the deferred part complete rest for 1 year. Two or more management units are required. Kothmann (1974) defines rotation grazing as a strategy of pasture use embracing short periods of heavy stocking followed by periods of rest for herbage recovery during the same season. It is generally used on tame or cropland pasture. Kothmann does not define rest-rotation.

The fishery habitat rehabilitation gained from the rested year may be nullified by the higher use that occurs on each of the grazed pastures. Also, during each grazing cycle, livestock will have grazed the streambanks during all seasons of use. In 1 year out of each 3-year grazing cycle, assuming a three-pasture design (but it could be any number), the streambank vegetation is grazed late and the cover necessary to buffer erosion from floods and ice is reduced. In 1 year out of each 3-year grazing cycle, streambanks are grazed when soil moisture is high (usually in spring or early summer), and shear damage can result (Platts and Nelson 1985a).

The year of rest (assuming a three-pasture strategy) gives plants and streambanks the opportunity to rehabilitate from past damage. In 2 years out of the 3-year grazing cycle, the vegetation is left on the streambanks to help buffer any water and ice erosion. In 2 years out of each 3-year grazing cycle, livestock are not grazing streambanks during the early grazing periods when shear potential may be high. Streams that have a high natural rehabilitative rate can recover during the rest period, but those streams that do not have this high potential may continue to degrade. This strategy appears successful on stream-riparian habitats where the channel is maintained and controlled by vegetation. This usually only applies to ephemeral channels.

Double Rest-Rotation (Cattle)

In this strategy, the pasture with the highest riparian and stream values receives twice the rest that would normally be applied during a commonly used rest-rotation grazing cycle. In a three-pasture design, the pasture with the highest stream-riparian values is rested continuously for 2 years and then grazed early or late the third year, then rested 2 years and grazed early or late the third year. Thus, it takes 6 years to complete the cycle.

Benefits usually exceed those from the commonly used three-pasture rest-rotation strategy because the stream-riparian habitat has 2 years in a row, instead of one, to rehabilitate from any applied stress. Brushy species have 2 successive years of twig growth before grazing occurs again.

Seasonal Riparian Preference (Cattle or Sheep)

This strategy, as defined for this report, requires that concerned riparian stream values are in pastures that can be grazed during the season that is most compatible with fishery needs. Kothmann (1974) defines seasonal grazing as grazing restricted to a specific season. Unless closely managed, streambanks can still receive shear stress and late season grazing can reduce the vegetation needed to minimize flood erosion; also, it is difficult to determine seasonal preference because seasonal climatic conditions vary from year to year. The strategy does allow livestock to graze streambanks during their most shear-resistant period and when brushy species would receive the least use. Managers must have a good data base or experience to be able to determine the preferred period of use.

Riparian Pasture (Cattle or Sheep)

This technique may be a separate strategy or be used as part of or in combination with another strategy. Similar to the seasonal riparian preference strategy, the riparian pasture places the selected stream-riparian habitat, or portions of this habitat, within one or more pastures (Platts and Nelson 1985d). Unlike the seasonal preference pasture that becomes a working pasture within the grazing cycle, the timing and use of forage within the riparian pasture is set strictly to meet previously determined riparian stream objectives. The pasture can be grazed or rested on any given season or year depending on stream-riparian needs.

This strategy usually requires even more fencing, maintenance, and livestock movement than rotational or deferred strategies. Without effective control of animal numbers and animal distribution, the riparian pasture can lead to unbalanced animal distribution and disproportional forage use in the remaining pastures during certain parts of the season.

This strategy allows forage use and timing to be set to match the productivity of the stream-riparian habitat while allowing a much simpler and more economical grazing strategy to be used in the surrounding upland pastures. As the riparian vegetation regains its vigor and productivity, available forage for livestock use can often be increased under this strategy.

Corridor Fencing (Cattle or Sheep)

In this technique, all the stream-riparian habitat, or required portions thereof, are fenced to try to obtain rest or the application of a desired grazing method.This strategy requires extensive fencing, which increases operating costs while usually eliminating livestock forage within the corridor. Corridor pastures are usually too small and narrow for proper grazing under a pasture concept. Corridor fencing allows onsite stream-riparian habitat to rehabilitate while allowing grazing targets to be met on the uplands using simpler grazing strategies.

Rest-Rotation with Seasonal Preference (Sheep)

This strategy is the same as that used with rest rotation grazing with cattle, except with sheep the herding allows riparian habitats to be grazed during periods and intensities of least impact. The livestock operator must move sheep into different pastures as determined by the rest-rotation requirements and, in turn, graze riparian zones at selected times. The rest period gives riparian plants and streambanks the opportunity to recover from past use (Platts 1981).

With good herding and compatible sheep stocking rates, this grazing strategy can meet the needs of both the riparian and upland habitats. Because sheep are grazers that usually prefer slopes and upland areas, they naturally tend to graze streambanks less than cattle do. This strategy can be successful and has been found to produce no significant adverse impacts to fishery habitats (Platts 1984).

Rest or Closure (Cattle or Sheep)

This strategy calls for complete rest (some areas may not be suitable for grazing), or the allotment or selected pastures therein are to be ungrazed until stream-riparian habitats improve to meet fisheries management objectives. Kothmann (1974) defines rest as a period of deferment included as part of a grazing system. Rest is usually thought of as a period of time equaling or exceeding one complete year of nonuse. Rest eliminates all forage use by livestock, so livestock producers could be impacted financially.

Complete rest usually allows riparian stream habitats to immediately move toward their potential productivity, with fisheries products increasing in value (Platts et al. 1983; Platts and Nelson 1985a). This allows degraded allotments, pastures, and stream-riparian habitats to regain the productivity needed so that they can then be placed under suitable grazing strategies.

Discussion

In the past, no commonly used livestock grazing strategy was capable of maintaining high levels of forage use while rehabilitating damaged streams and riparian zones (Meehan and Platts 1978; Platts 1981). The main reason for this was the fact that range management practices combined different vegetative habitats, including the riparian, into one management unit. Another reason was the natural attraction of livestock, especially cattle, to riparian zones. Presently, no grazing strategy exists that will function under all situations, but with present knowledge, some strategies can produce good results under the right conditions.

The most promising grazing strategies for maintaining or rehabilitating riparian-stream systems are those that include one or more of the following options:

(1) including a riparian pasture within a grazing allotment or operation to allow riverine-riparian ecosystem to be managed separately from the uplands;

(2) fencing streamside corridors to allow stream-riparian habitats to rehabilitate;

(3) changing the kind of livestock (from cattle to sheep on certain ranges) for better grazing compatibility with rangeland types;

(4) adding more rest to the grazing cycle;

(5) reducing intensity of use on streamside forage;

(6) controlling the timing (often season) of forage use so grazing occurs during periods most compatible with riverine riparian ecosystems;

(7) managing grazing programs as specified and required in properly prepared allotment management plans or other proven management guides, therefore giving full consideration to riparian management objectives.

In reference to item 1, in our seven small experimental riparian pastures where cattle numbers were controlled to achieve desired forage use of the riparian vegetation, the utilization of upland forage normally exceeded that of the streamside forage by an average of about 13% — just the opposite of the typical allotment pasture (Platts and Nelson 1985c). Because they are usually drawn to moist sites, cattle will often override the grazing strategy if pasture size is too large for animal control. Also, no grazing strategy is going to work for stream fishery needs if there is not a set amount of vegetation left at the end of the growing season to buffer future ice and flood flows.

With item 2, range and fishery specialists have attempted to solve problems by fencing stream-riparian habitats. Standard cost for two 30-m corridors is about $3,750 (USA) per stream kilometer, with $38 to $125 maintenance costs per stream kilometer per year. About five animal unit months of forage are lost per stream kilometer fenced (Platts and Wagstaff 1984). Fencing streamside corridors is a last resort, but it may allow those grazing strategies that are working well in the uplands, but not in the riparian zone, to be compatible over the watershed as a whole.

In item 3, there is opportunity, especially in the higher elevation areas, to change the grazer from cattle to sheep on those allotments where sheep grazing is more compatible. In two Frenchman Creek study sites, which have been grazed by sheep under a programmed three-pasture rest rotation strategy since 1967, I can find no incompatibility of this strategy with fishery needs (Platts 1984). Proper herding, forage use, and timing of forage use can make this strategy completely compatible with fishery needs.

Item 4 calls for adding more rest to the grazing cycle. Holcheck (1983) has stated that the benefits from rest in one pasture may be nullified by the extra use that occurs on the remaining grazed pastures. Our studies (Platts and Nelson 1985a, 1985c) tend to support his statement when use of the riparian forage is heavy. However, a three-pasture rest rotation strategy can leave a vegetative mat on the streambank on 2 out of every 3 years, 1 year during early grazing and the other during the rested year. A double rest rotation grazing strategy (1 year grazing, 2 years rest) has been successfully used on high elevation pastures (Platts 1984).

Items 5 and 6 need much more study because the proper grazing of streamside vegetation requires tight control of animal distribution. In many areas it is not desirable or economically feasible to fence every streamside corridor to create corridors or riparian pastures (Platts and Wagstaff 1984). Therefore, grazing strategies that have better control over intensity and timing of forage use in riparian areas must be developed. Winter grazing, types of rest rotation strategies, and deferments that allow protective mats to be maintained on the streambank during critical runoff periods show promise, but again, more analysis is needed.

Item 7 calls for proper management of allotments, rangelands, or pastures, as required under the guidance plans. If grazed lands cannot be managed properly, as plans require, then no grazing strategy is going to work.

Fishery specialists, working closely with range specialists, must analyze each grazing plan with respect to its compatibility with fishery resources. Each plan must then be further evaluated to determine how well it meshes with basic and complete watershed needs. The stream and the watershed function as a unit. If the grazing management is not conducive to good watershed conditions, good stream conditions will also not exist.

Once they have deteriorated, many stream-riparian habitats are difficult to rehabilitate and need special management. In many situations, the stream-riparian habitat must be considered the key area for rangeland or pasture management. Livestock grazing under proper strategies with controlled intensities, timing, and animal distribution can permit grazing use of riparian stream ecosystems and foster acceptable results. This move toward better rangeland management could easily give society the highest rate of return for time and money expended.

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