50%) or the lower end of the heavy range (51-75%), whereas streamside vegetation was more frequently in the heavy use range (76-100%).

The chief goal of a specialized management strategy (one that is more sophisticated than continuous grazing) is to maintain or improve livestock performance while improving or maintaining rangeland conditions by controlling the numbers, type, and distribution of livestock. All but one of the study areas are being managed with some sort of specialized management strategy. These studies, however, indicate that none of the grazing systems have controlled livestock distribution in such a manner as to promote a balance between streamside and upland vegetation use. As a result, evaluation of range condition in upland vegetation may show a positive result due to moderate grazing over most of the allotment, whereas continued heavy to severe grazing pressure in the streamside corridors may be having precisely the opposite effect. Consequently, range management decisions based upon overall pasture use may result in inappropriate watershed management decisions and failure to effectively manage for multiple use.

We believe grazing to be a valuable use of rangeland resources that can enhance esthetic as well as economic values. However, it should be balanced with other equally valid uses of western rangelands, such as enjoyment of productive aquatic and streamside ecosystems and their combined resources. Cattle usually graze riparian areas more heavily than the uplands, which necessitates the riparian areas being monitored and managed separately. We hope this information will help point out the need for more effective grazing strategies that stop continued degradation of western streams. Among the strategies that show promising results in our studies are winter grazing under certain conditions; separate riparian pastures through which animal distribution, timing, and intensity can be controlled; total closure of extremely vulnerable areas through stream corridor fencing; and strategies that provide for longer rest periods (such as double rest-rotation) or deferred grazing that allows a protective vegetative mat to be maintained on the streambank during critical runoff periods.

Big Creek in the Wyoming Basin Province. Heavy grazing to the right and light grazing to the left of the fence.

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Will the Riparian Pasture Build Good Streams?

William S. Platts and Rodger Loren Nelson

Since the mid 1930's, improved range management practices have steadily enhanced the deteriorated rangelands that existed at that time. Although overall rangeland conditions have continually improved, riparian range sites (lands supporting vegetation that requires free or unbound water or moist soils) have not necessarily followed suit. Many riparian areas remain in a deteriorated state because they fail to respond favorably to the management strategies being applied to the allotment. Certain classes of livestock graze riparian zones more heavily than they do the uplands—the nonriparian portion of the range. Consequently, management strategies designed for allotments that contain a variety of range types may not effectively control animal distribution on the lusher, wetter sites.

Today's popular grazing strategies (rest-rotation, alternate, deferred) were developed primarily to increase the production and vigor of upland grasses, and were not developed primarily to improve riparian vegetation. These grazing strategies have developed a steady improvement in upland range, and this would be an opportune time to initiate a similar trend on riparian sites. Until such improvement is achieved, there will continue to be conflicts between range users with respect to how the public range should be managed.

Our livestock-fisheries studies were designed to test commonly used grazing strategies on riparian-stream systems and to develop grazing strategies that are more compatible with such zones. One strategy being considered is a special riparian pasture, which is a small pasture within an allotment that is set aside to be managed independently to achieve a specific vegetational response. The pasture includes the riparian-stream corridor along with a portion of the uplands. We believe that this approach may have promise under certain grazing situations.

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The Stolle Guard special management pasture.

Study Area and Methods

The 15 study areas were located in Idaho, Utah, and Nevada in 3 widely separated hydrographic basins. These sites provided the broad geographic distribution and the diversity of geo-climatic, vegetational, and grazing conditions needed to determine differences in patterns of vegetational use between upland and riparian range sites on managed allotments. The study sites were used to evaluate grazing strategies, timings, and intensities of forage use for a specific livestock class (predominantly cattle). The surrounding allotment was managed by the respective Forest Service District Ranger or BLM Area Manager as specified by their land use plans.

Most of the commonly used grazing strategies, such as rotation, rest-rotation, deferred, and continuous, or season-long, are being used on one or more of the study areas; thus, the study sites represent the effects of commonly used grazing strategies on riparian areas. Seven of the Idaho sites (Table 1), scattered through the southern portion of the Idaho batholith, functioned similarly to special management pastures, allowing comparison with the surrounding allotment management.

The basic design of each study area involved the stratification of an 1,800-foot riparian-stream reach with 181 equidistant transects placed at 10-foot intervals. The special use pastures were constructed around the central 60 consecutive transects comprising 600 feet of stream. The 2 adjacent control areas of 600 feet each were used to evaluate the forage utilization under allotment management. Streamside vegetation use was visually determined immediately after the grazing season along each transect line and compared with the adjacent upland forage utilization. The upland use was determined visually by the range conservationist responsible for the allotment. Tested against estimates obtained using the electronic capacitance meter, our method of estimation was found to be reliable (±5% of averaged means).

The Lower Frenchman Creek special management pasture immediately after grazing ceased.

Grazing Patterns on the Conventionally Managed Allotment

Livestock were taking an average of 29%, and as much as 40% more vegetation from the riparian sites (wildlife use was trivial) than from the adjacent upland sites (Table 2). ("Adjacent" means sites next to the riparian zone and within 0.25 mile of the stream). Consequently, although use on the allotments was in the moderate range, use on the riparian

Table 1. Forage use under rest-rotation grazing on streamside and adjacent range (within 1/4 mile of stream) in experimental pastures within the Southern Idaho Batholith.

Pasture	Early grazing			Late grazing		
	Streamside	Adjacent range	Difference	Streamside	Adjacent rangé	Difference
			——Average Forage Use, Percent——			
Upper Stolle	71	82	-11	84	76	+ 8
Guard Stolle	56	69	-13	74	92	-18
Cougar Stolle	68	90	-22	66	61	+ 5
Lower Stolle	46	63	-17	83	92	- 9
Upper Frenchman	57	80	-23	60	60	0
Lower Frenchman	69	83	-14	69	80	-11
Horton Creek[1]	62	70	- 8	65	70	- 5
Average	61	77	-15	73	76	- 4

[1]Data 1980-82, other sites 1979-82.
Eight of the study sites, four in the Columbia Basin, two in the Lahontan Basin, and two in the Bonneville Basin allowed a comparison between streamside and upland forage use under Forest Service or BLM management (Table 2).

Table 2. Comparison of forage use (percentage) on streamside and adjacent upland portions of typical grazing allotments.

Study area	Analysis period	Grazing system	Forage use	
			Streamside	Adjacent upland
Columbia Basin				
Johnson Creek	(1976-82)	RR	66	NA
Elk Creek	(1976-82)	RR	58	19
Bear Valley Upper	(1976-82)	RR	75	52
Bear Valley Lower	(1977-82)	RR	68	61
Lahontan Basin				
Gance Creek	(1979-82)	D	64	31
Tabor Creek	(1979-82)	C	69	41
Bonneville Basin				
Upper Big Creek	(1979-82)	C	83	47
Lower Big Creek	(1979-82)	C	80	53
Average			72.2	43.4
Difference				+29%

NA = Not available
RR = Rest rotation
D = Deferred
C = Continuous

sites was in the heavy to severe range. Mean differences were generally greatest in the Lahontan and Bonneville Basin, possibly because streamside vegetation was far more palatable than upland vegetation and differences in the grazing season. Vegetation use in the Idaho mountain meadows showed less difference, possibly because of less difference in the palatibility between the forage and the amount of moisture on the 2 types of range.

The grazing principles intended to maintain high plant vigor and favorable species composition in the uplands may not produce similar results in the riparian zone because of the imbalanced use. The improving trend expected in the uplands, therefore, may not occur in the riparian sites, which may continue to deteriorate. Some grazing strategies, therefore, require modification to obtain a better balance between upland and streamside use. We believe the riparian special management pasture may encourage this balance on certain allotments.

Grazing Patterns on Special Riparian Pastures

The experimental pastures used to evaluate different grazing strategies were set up like a special riparian management pasture. The experimental pastures contained a riparian-stream zone and extended from both sides of the stream into the adjacent uplands. The experimental pastures were 6 to 10 acres in size; in operational use special management pastures would probably have to be larger and longer to be economically feasible.

In the experimental pastures, wherein cattle numbers were controlled to achieve a certain forage use, utilization of upland range forage normally exceeded the utilization of the streamside forage by an average of 10% (Table 1), just the opposite of the typical allotment pasture. The relatively small size of the experimental pastures placed all of the forage within the cattle's potential home range, thereby encouraging a more balanced use of available forage than found within the typical allotment. In addition, the ratio of riparian range forage to upland range forage (approaching 50/50) was many times higher than would normally be found in most allotments, so the uplands could have received the heavier use in the cattle's search for variety; also, all salting was done in the uplands. Cattle did have to go to the riparian zone to water because there were no upland watering sites.

Cattle grazing the Upper Stolle special management pasture under a rest-rotation strategy.

In his studies in the Blue Mountains of Oregon, Bryant (1982) found that neither salting nor alternate water sources away from the riparian zone appreciably influenced livestock distribution.

On our study sites, the timing seemed to influence the utilization of vegetation in streamside areas. In the allotment areas, mean utilization (not proven significant) of streamside forage averaged about 13% greater. This relationship is certainly not yet conclusive, but we believe it demonstrates the tendency of cattle to avoid wet streamside zones early in the season. In drier riparian sites more early use (just after plant readiness) can occur in the riparian zone, especially under season-long grazing, when cattle will not move to the uplands until the riparian forage has been heavily utilized.

Bryant found in the Blue Mountains of Oregon that throughout most of the summer grazing season cattle favored the riparian zone but during the latter part of the grazing season they favored the upland vegetation.

In our small special management pastures, late cattle grazing did not necessarily shift more forage utilization to the streamside zone, but there was a 12% greater overall utilization of the streamside zones under late grazing compared with early grazing. Other factors, though, must be considered in the decision to graze early or late, such as the greater susceptibility of streambanks to hoof shearing during the early grazing period before banks have dried out, and the fact that late grazing can eliminate the vegetative mat needed to protect the streambank soils from the following high water flows. 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.

Conclusions

Our studies show that, on conventionally managed allotments using rotation, rest-rotation, deferred, and season-long continuous cattle grazing strategies, cattle graze riparian range types more heavily than the uplands. Fencing streamside corridors to exclude grazing is expensive (possibly the new electric fences may solve some of this problem) and a large amount of forage is lost. Special management pastures will also be expensive, but the forage can be efficiently utilized. Furthermore, eliminating grazing from certain allotments is not sociologically, economically, or politically acceptable; in certain situations, therefore, we must turn to some other alternative. The special management riparian pasture is a promising alternative.

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. 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 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.

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Control of Big Sagebrush by Aerial Application of 2,4-D

Steven W. Cussins

The application of 2,4-D to control sagebrush is an important management tool to improve Wyoming rangelands. Big sagebrush *(Artemisia tridentata)* covers 270 million acres in the Western U.S., and Wyoming has approximately 37 million acres dominated by sagebrush.

Advantages of spraying big sagebrush are erosion control, increased moisture availability, and increased forage value. Erosion is reduced by increased basal cover of grasses, whereas with burning, there is an increased chance for erosion. The moisture availability is increased to understory plants by reducing competition from sagebrush. Through spraying, there has been an increase in forage production for livestock as well as for wildlife.

2,4-D is usually applied by air from fixed-winged planes or helicopters. Recommended rates are a maximum of 2 pounds per acre, usually applied in a total volume of 2 gallons of No. 2 diesel or water used as a carrier. Lower amounts may be applied for a lower percent control, and higher rates are not economically feasible.

Selection of an area to be sprayed should include the following criteria:

1. Sites with an adequate grass understory.
2. Sites at higher elevations where there is adequate precipitation.
3. Sites with a sagebrush canopy cover of 15% or greater.
4. Sites with deep soils found in swells producing thick stands of brush.
5. Sites that are not critical wildlife habitat.

The sagebrush shown in the first photo is located in the Bighorn Mountains of Wyoming. Big sagebrush *(Artemisia* tridentata) cover is dense with a low forage production. The second photo represents the same area after spraying, showing a 200 to 300% increase in production of grasses (Alley 1955). Forbs showed a decrease after spraying, but 2 to 3 years following spraying, showed an increase.

Studies of wildlife use on sprayed sites were conducted for big game animals and upland game bird species. Antelope, deer, and elk were studied. Antelope were least benefited by

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