PROCEEDINGS

1984 PACIFIC NORTHWEST RANGE MANAGEMENT SHORT COURSE

RANGE WATERSHEDS, RIPARIAN ZONES AND ECONOMICS: INTERRELATIONSHIPS IN MANAGEMENT AND USE

OREGON STATE UNIVERSITY
CORVALLIS, OREGON

FOREWARD

The Pacific Northwest Range Management Short Course had its conception in the 1960's. It has been held each year with only a few exceptions. Coordination and conduct of the short course has been the responsibility of the Extension Range Management Specialists at the University of Idaho, Washington State University, and Oregon State University with various locations rotated among the three states. The 1984 short course was at Pendleton, Oregon, January 25-27, and attracted about 185 participants.

The role and importance of range watershed and riparian zones has increasingly been recognized in the past 10 years. This recognition brought about the devotion of research and development monies and effort to address a number of questions in the western United States. Extrapolation of research results and application of practices from ongoing projects often is limiting because each watershed with its soils, vegetation and associated riparian zones is unique. However, the principles uncovered and the development of management philosophies based upon repeated observations of similar responses provide a sound base from which future progress will be made.

Few, if any, resource management activities can be treated outside of their economic contexts. This was the rationale for integrating into the program the economic perspectives so important in analyzing management impacts and results.

The short course contained a total of 19 presentations divided into three subject sessions. Four of the presentations were not developed into written papers for these proceedings. The topics and authors were selected specifically to address the conditions found in Washington, Oregon, and Idaho. It was intended that treatment of the subjects be complete but not exhaustive in the sense that recommendations for problem solving be practical and useful. Only time can tell whether that objective was met.

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OF THE RESOURCES

AN ECOSYSTEM CLASSIFICATION FOR INTERMOUNTAIN RIPARIAN AREAS

A. H. Winward 1/

Introduction

Riparian areas normally make up only about 1-4 percent of any one geographic region. There has been a tendency to overlook the value or importance of these areas, perhaps because of their small size. As we look more closely at the riparian resources and their special needs for management, documentation of their importance has been surfacing in nearly every western state. In Oregon, Roath and Krueger (1982) found that livestock obtained 81 percent of their herbaceous forage from less than two percent of an allotment. Also in Oregon, Kauffmen et al. (1981) inventoried 81 species of birds in a two mile section of stream in Union County. In Colorado, Bailey and Neidrach (1965) found that over half of the 438 species of birds of that state reside and use the riparian area, at least seasonally, even though these areas cover only about three percent of the state.

Riparian area values are also significant to fisheries, to certain wildlife species, and to numerous recreationists. Based on relative size riparian areas are probably more important to more users than any other ecosystem.

I have been asked to discuss ecosystem classification in riparian areas. As with other riparian efforts, the classification generally has taken a back seat to work on upland types. Only in the past decade has there been a concerted effort to treat riparian areas as distinct and unique entities, different enough from surrounding upland types to require their own type of classification.

Policies and direction for classifying riparian areas on public lands have included lumping them with upland types or, at best, separating them into the broad range type units of "dry meadows," "wet meadows," or "browse shrub" (USDA 1982). The vigorous interest that has now developed provides an opportunity for us to fine-tune our classifications. I will show how we can develop riparian vegetation units at several levels of intensity. I will emphasize the finer levels that can be classified because these can form the basis for broader units through an agglomerative effort, i.e., using the finer "cells" to develop each successively larger "cell."

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The Riparian Classification

What type of ecosystem classification system is most useful in the riparian setting? On public lands, a system based on ecological features such as vegetation composition and soil and/or other site features may be best suited over one designed merely on use-oriented features such as forage production or wildlife habitat values. Normally several uses become important on any one riparian area. In order to make best use or best combination of uses on these lands it is therefore appropriate to have a classification based on ecological criteria which, ideally, could serve as the basic classification for all users.

Another valuable attribute of a riparian classification system is to have several levels of intensity. The lowest level in the classification could be used for detailed project work, such as willow reestablishment or monitoring of bank stability. These small units could be grouped systematically to form larger units for such things as range allotment inventories or wildlife habitat evaluation. Even larger, more inclusive grouping could be developed to use as analysis areas in Land Management Planning or capability areas for the broad Resources Planning efforts. Level of classification used would depend on ones needs or on the dollar and people power available. The important aspect of this hierarchial approach is that in the grouping or lumping process one can keep track of what smaller units have been clustered together. Also, the land manager can select the level of detail required for any particular management situation.

Developing the Classification

In the Forest Service we have initiated a stratification effort called the Land Systems Inventory (LSI). Soil scientists, geologists, and hydrologists have been involved in stratifyiing each Forest into unique land units. There are several levels of hierarchy in this system ranging from very broad national units to narrow, site specific units. One of the intermediate scale units, the "Landtype Association," is a subdivision based primarily on landform, geology, vegetation, and general climate. As an indication of scale there are approximately 15-30 Landtype Associations on a National Forest. These Associations are named after descriptive features, e.g., "Boise Front Alluvials" or "Upland Dissected Granitics." A particular creek or river may flow through several of these Landtype Associations with each segment of the associated riparian area encompassing its own environmental features. These riparian units could be mapped or treated separately since their environmental features would be distinct. This could be considered a rather broad type of classification of riparian areas.

Along with the LSI effort, we also have individuals working on a more refined riparian area classification. Here vegetation composition and on-site environmental characteristics such as water table or soil structure are emphasized. The units we classify are termed community types, i.e., areas with similar vegetation composition. Unlike the concept of habitat typing as often used on upland vegetation in the

Western U.S., community types are not tied to undisturbed or "climax" vegetation. Instead, they are named after repeating units or stands of vegetation present on the area at the time of sampling--disturbed or undisturbed. There are several reasons for using this approach, the main ones being the absence of unaltered vegetation in riparian areas and the relatively short-term natural stability of vegetation in the riparian zone even in absence of human influences.

Community types (ct's) are named after the most prominent or characteristic species in the community. Examples include the beaked sedge (Carex rostrata) ct or the cottonwood/Kentucky bluegrass (Populus angustifolia/Poa pratensis) ct. Stands of these types can range from a few square feet to several acres in size. Commonly an acre of riparian area encompasses a mosaic or complex of 1-3 different ct's. In any one meadow or mile of stream it is not uncommon to find 5-10 different ct's each represented in several separate stands. These "patches" of ct's often form concentric bands around lakes or ponds or may form long linear types along streams or rivers. Sometimes they appear as a complex of types without obvious reason or pattern. Other times they form distinct ecological patterns with the environment--primarily the water table.

Admittedly it takes effort and training to identify these small units along a meadow or streamside. Normally, specially trained individuals develop the classification and keys to the community types. Managers or user groups then use the keys and determine which types they have to work with. As in other vegetation classifications, one needs to have an adequate background in plant taxonomy, especially for the sedges (Carex spp.) and willows (Salix spp.) which we have often ignored in past land management efforts.

Thus far we have identified over 50 riparian community types in Idaho and western Wyoming. We expect to identify another 30+ as we expand our efforts into Utah and Nevada. We are also in the process of developing management alternatives for each of the types we have identified. Many of these types are widespread with occurrences in several states. Others are much more specific both geographically and within riparian areas.

Now we need to make the tie or connection between these refined classification units (ct's) and the larger units in the LSI. I mentioned that some ct's are broad ranging, i.e., found in most western states. They also may have rather broad ecological ranges within riparian areas; consequently, they can be found on a diverse set of environmental situations. For example, the beaked sedge ct may be found at the lower elevations on large, relatively flat, meadow situations or it may occur as narrow stringers along stream courses at higher elevations. Management requirements for these two settings may be quite different. In order to help alleviate this sort of complication, one can relate the ct to the LSI Unit in which it occurs.

In this way, e.g., the "Beaked Sedge - Boise Front Alluvial Association" would be identified separate from the "Beaked Sedge - Upland Dissected Granitic Association." Using this approach we can separate land units based on the broad features of landform, geology, and climate and on the more refined features of vegetation composition, water table, soil texture, etc. These units of classification are the most refined types that we presently have ability to define. They are ecological in that they are based on all aspects of the environment. In addition, they can be lumped to form larger units as necessary without losing identity of the refined components. This approach now fits the needs mentioned earlier.

Where LSI units are not available, one could relate a certain ct to the appropriate soil series or soil family as per Soil Taxonomy. This likewise would provide refinement for broad ranging ct where necessary. Current direction in the Forest Service Manual identifies units where both abiotic and biotic characteristics are used to identify and name classification units as "Ecological Types" (USDA 1983).

Potential Uses of the Classification

Some of the advantages for using the described classification system include:

1) It provides a relatively permanently based system for stratifying the landscape.

2) It provides a medium for communication, making management decisions, and coordinating resource uses.

3) It encourages emphasis on management of ecosystems rather than individual resources.

4) It allows flexibility in selecting the level of detail required for any particular management situation.

5) It is a relatively easy approach requiring identification of a limited number of plant species.

6) One can use this classification approach to extrapolate predicted results of our management efforts within a common landform system.

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USE OF COLOR INFRARED PHOTOGRAPHY IN STREAM HABITAT INVENTORIES

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INTRODUCTION

Increased budget cuts and lower work force ceilings have placed heavy restrictions on public land agencies for the completion of management activities. These cuts have been particularly restrictive in the amount of funds available for field inventories needed for planning and Environmental Impact Statements. However, federal guidelines, State laws, and requirements by the public land users for detailed information in decision making, has increased.

The use of low level color infrared photography was employed to meet the above needs for riparian and stream inventory for the Two Rivers EIS in the Prineville District of the BLM. The project encompassed approximately 192 miles of stream on the John Day and Deschutes River in Central Oregon. Contracts for the project were handled through the Environmental Protection Agency in Las Vegas, Nevada.

Total contractural costs for the photography was $15,000.00 with $4,000.00 of this sum contributed by the Oregon Department of Fish and Wildlife.

Photos were taken at a scale of 1:2000 (1" = 166.6 ft.) and were over exposed 1/2 f stop to obtain water penetration. The film used was Kodak 2443 color infrared taken at an exposure of f 5.6 at 1/550 of a sec. Flying time was restricted between 11:00 AM and 1:00 PM for maximum sum azimuth to help reduce tree and terrain shadows. Late June was selected as a compromise date for water clarity and vegetative growth. Analysis of photos transparencies was completed using both a Bausch and Lomb and a home made light table.

TECHNIQUES

Ten ground truthing plots were established prior to the aerial photography with an attempt to represent all habitats. Each plot consisted of a 1/10 mile (528 ft.) stream segment which was classified for aquatic and riparian habitat. Plot markers consisting of 2' x 10' white cloth sheets were placed at the start of each transect. A 2' x 2' sheet of cloth was also placed at the center of each riparian plot to aid in scale determination and location on the photos. Each plot was then recorded on a 7 minute U.S.G.S. topographic map.

The stream habitat inventory profile (Illustration I) was used for both ground truth plots and photo interpretation. Estimates were made for cover and percent of shade, bank condition, stream bank stbility, channel stability, and sedimentation of the streambed.

Riparian vegetation was sampled on a 200 foot long transect consisting of 4 evenly spaced 11.7 foot radius plots (Illustration II). Trees and shrubs were identified and recorded by condition, approximate age, height, crown density and percent ground cover. Measurements of plant height and crown diameter were taken for each plant and recorded on the target sheet, according to scale (Illustration II). The riparian recording system was originally developed for ground inventories by the Oregon BLM and adopted to this project.

RESULTS

Photo interpretation was accomplished by locating and interpreting the first ground truth plot. Comparison was then made with this analysis and the ground truth ratings recorded on the stream habitat inventory and the riparian habitat rating forms (Illustration I & II). The maintenance of a 5 percent agreement level between the photo interpretation and the ground truth plots was set as the paramater for quality control.

The photo interpretation was done by ¼ mile stream segments and then summarized by grazing allotments. Acres of riparian habitat by condition class were recorded by measuring the length and width of each type. The system revealed an accurate assessment of riparian condition, total habitat acreage, stream condition, and base data for future trend. Over exposing the film to obtain water penetration allowed analysis and mapping of stream bottom composition within spawning areas for salmonid species.

The total savings, in comparison to conventional stream surveys, was estimated at $30,000.00. This included the photo contract, ground truthing and photo interpretation.

STREAM HABITAT INVENTORY PROFILE
(This form to be used for field inventory or photo interpretation)

Stream ______________________ Date __________ Surveyor(s) __________ State __________ Dist. ________

Planning Unit ______________________ Site No. ______ Length of Stream Surveyed ______________

Field Survey ______________________ Aerial Photograph ______________ (Check one)

Stream Cover (% Shade)	80%+	4	60 - 80%	3	40 - 60%	2	40% or less	1
Stream Bank Condition (% Bare Soil)	5% or less	4	6 - 15%	3	16 - 25%	2	25% or more	1
Stream Bank Stability (% Bank Damage)	0 - 10%	4	20% or less	3	40% or less	2	41% or more	1
Stream Channel Stability (% Channel Movement)	5% or less	4	6 - 10%	3	11 - 15%	2	16% or more	1
Sedimentation of Streambed (% Silt)			10% or less	3	11 - 25%	2	26% or more	1
Column Totals	[____]		[____]		[____]		[____]	

Stream Condition Rating for Length of Stream Evaluated - (Enter total score in appropriate space)

Excellent 17 ____ Good 14-16 ____
Fair 10-13 ____ Poor 5- 9 ____

SUMMARY (Last page of inventory for each stream)

Field Inventory Total Number Stream Sites ______
Stream Condition Rating No. Miles: Excellent ____ Good ____ Fair ____ Poor ____

Photo Interpretation Total Number Stream Miles Inventoried ______
Stream Condition Rating No. Miles: Excellent ____ Good ____ Fair ____ Poor ____

A. <u>High Stream Cover</u> (June - September; 11:00 am - 5:00 pm, MDT) — Rating

	Rating	
80%+	4. ____	Excellent
60-80%	3. ____	Good
40-60%	2. ____	Fair
Less than 40%	1. ____	Poor

B. <u>Stream Bank Condition</u> — Rating

	Rating	
No negligible use/damage; vegetation 1/ well-rooted; sod intact; very little, if any erosion from vegetation areas, less than 5% bare soil showing.	4. ____	Excellent
Some use/damage, vegetation generally well-rooted; sod mostly intact; soil showing in places (0% to 15% bare soil showing overall); some surface erosion evident.	3. ____	Good
Use or damage close to sod; vegetation shallow-rooted; moderated surface erosion (16% to 25% bare soil showing overall).	2. ____	Fair
Heavy to severe use/damage; vegetation generally cropped to sod; considerable soil showing (over 25%) with sod damage serious; active surface erosion a serious problem.	1. ____	Poor

1/ Primarily grasses, sedges and forbs.

C. <u>Stream Bank Stability</u> — Rating

	Rating	
<u>Bank Stable and Undamaged</u> - Partial or no evidence of bank damage; 90-100 percent of bank area free from use/damage. Little or no unnatural bank erosion or sloughing present.	4. ____	Excellent
<u>Bank Damage 20 Percent or Less</u> - Banks 80 to 90 percent free from use/damage. Some erosion and sloughing but fully recoverable after a season of rest.	3. ____	Good
<u>Bank Damage 40 Percent or Less</u> - Banks having received 20 to 40 percent damage from use/damage. Moderate to heavy bank erosion and sloughing during season(s) of use, and which continues during no use period(s). Conditions will not allow natural stability recovery of banks to a level greater than 60 percent stability.	2. ____	Fair
<u>Bank Damage Excessive</u> - Banks exhibiting greater than 40 percent damage. Severe bank damage and accelerated erosion and sloughing is present over virtually the entire bank surveyed. No evidence of bank recovery visible, and erosion is consistent.	1. ____	Poor

D. <u>Stream Channel Stability</u> — Rating

	Rating	
No negligible lateral channel movement and bank erosion (cutting) (5%), scour, or changing channels.	4. ____	Excellent
Some lateral channel movement and bank erosion (5 to 10%), minor channel scour or changing channels within stream bed.	3. ____	Good
Frequent lateral channel movement (10 to 15%), moderate channel scour or channel change within stream bed.	2. ____	Fair
More than 20% lateral channel movement and bank cutting, changing channels and severe scour evident, and source of extreme sedimentation.	1. ____	Poor

E. <u>Sedimentation of Stream Bed</u> - Percent of fine sediments (particles sand size and smaller) covering stream bottom (wetted parameter) materials. — Rating

	Rating
Less than 10%	3. ____
10 - 25%	2. ____
More than 25%	1. ____

Riparian Vegetative Inventory

1. Vegetative Communty ______
2. Location ______
3. Stream ______
4. Examiner ______ 5. Date ______
6. Community length ______ width ______ acres ______

7. Vegetative Species & Height						8. Utilization			Canopy Hits			
Woody Species	under 4'	4'- 10'	10'- 20'	20'- 30'	30'- +	Slight- light	Moderate	Heavy	under 4'	4'- 10'	10'- 20'	> 20'
Grass/ Sedge												
Forbs												
Rock												
Bare Ground												
Persistent Litter												
Non-persis tent lit.												
Total												

L	W	RM

9. Cover Composition

	%	Acres
Shrub/Tree	___	___
Grass/Sedge	___	___
Forb	___	___
Rock	___	___
Bare Ground	___	___
Persistent litter	___	___
Non-persistent litter		___
	100%	Total

10. Avg. Canopy Closure ______ %

11. Canopy Distribution
Scattered ___ Clumped ___ Solid ___

12. Canopy Potential % of Potential
High ___ Medium ___ Low ___ ______

13. Vegetative Trend ↑ ↓ ↔

14. Vegetative Succession
Early ___ Middle ___ Late ___ Climax ___

15. Riparian Habitat Quality
Poor ___ Fair ___ Good ___ Excel. ___

16. Remarks

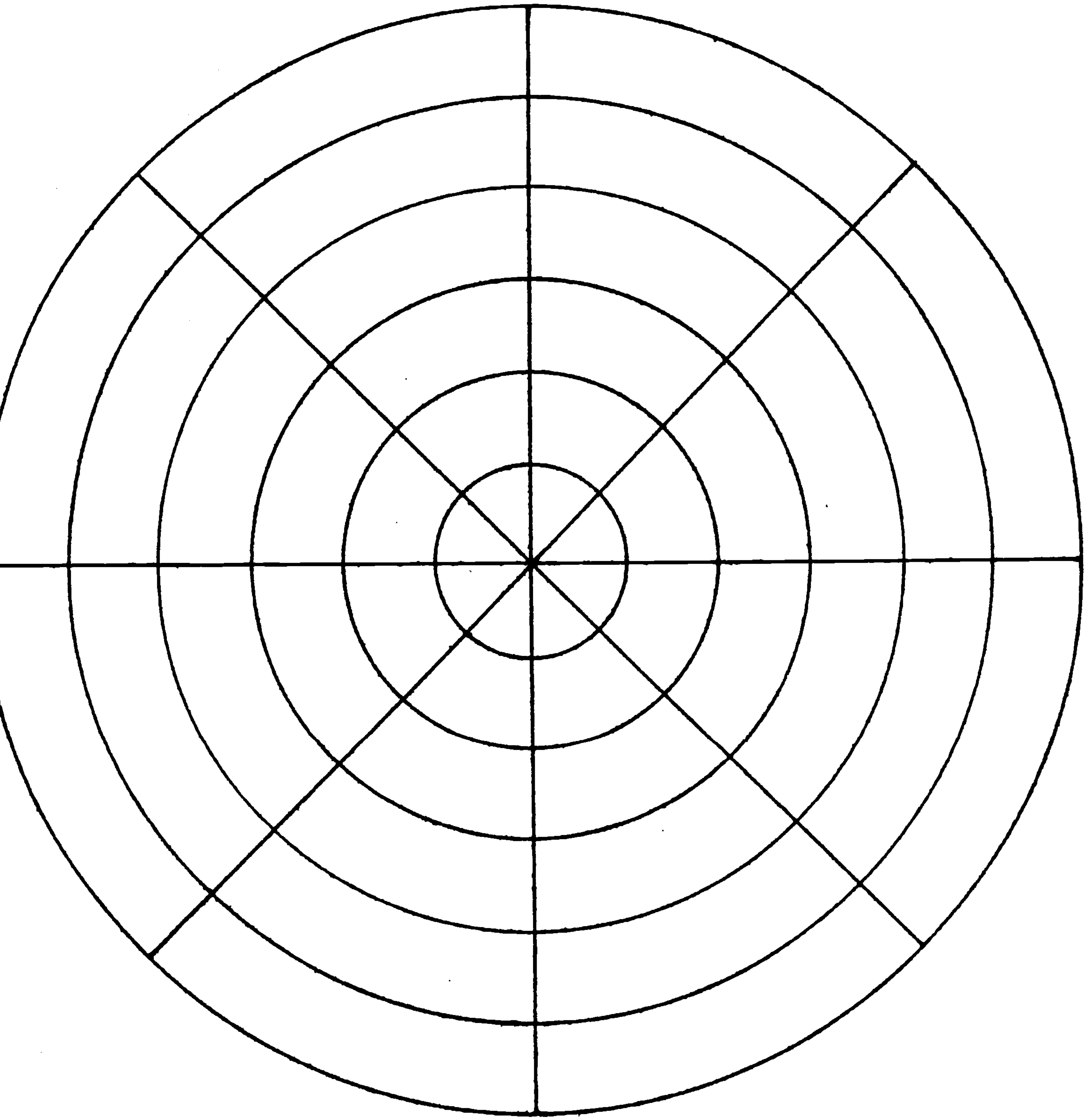
Photo # ______ # of snags ______
Animal Species Observed - ______

Date ________________

Stream ______________

Transect No. __________

Plot No. ______________



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RIPARIAN MONITORING USING LARGE SCALE COLOR INFRA-RED AERIAL PHOTOGRAPHY IN SOUTHEASTERN OREGON

Jean Findley

Abstract

Large scale color infra-red aerial photography is being used by the Bureau of Land Management in Vale, Oregon, to monitor effects of management on selected riparian habitat. Approximately 130 miles of stream have been photographed at a scale of 1:2000, with repeat photography to be acquired on a five to ten year cycle. Measurements are made to determine existing cover of perennial woody and herbaceous vegetation in the riparian zone. Changes in cover over time will determine subsequent management actions. Other measurements including bank and stream channel stability/instability also may be made.

Introduction

The importance of riparian habitat for a variety of multiple-use values is receiving increased attention throughout land management agencies (Thomas et al., 1979). Historically, serious conflicting uses on riparian areas have resulted in degraded condition due to a variety of reasons, the most obvious of which in Southeastern Oregon is livestock grazing. Current efforts are underway to improve the condition of these areas through management systems and exclosures.

Much of the past riparian inventory data has been limited to one-time estimates which have often been too gross to make evaluations concerning change. In addition, little is known about potential communities and successional stages in these zones. Management systems designed and implemented to improve riparian habitat are often not accompanied by adequate documentation of changes.

Purpose and Plan

The intense interest in and controversial status of riparian communities has created the need for a detailed method that accurately records baseline data and assesses subsequent changes within those communities in a timely manner. Use of large scale color infra-red aerial photography in the Vale District of the Bureau of Land Management appears to meet this need satisfactorily. The focus of Vale District's riparian monitoring effort centers on changes over time (trend) in ground cover of the perennial woody and herbaceous components of the riparian zone.

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Release of existing shrubs as well as the establishment of new plants following changes in management are also monitored with the use of large scale photography. The basis for alterations in grazing management will be made on the results of changes in total riparian shrub and/or herbaceous cover in subsequent years. The portions of streams selected for photography are key areas which have been chosen to represent conditions along the entire stream stretch.

Initial flights of portions of all streams identified for riparian management and monitoring were completed in 1983. A schedule for future flights has been developed so that these streams will receive repeat photography on a five to ten year cycle. The intent of the district is to make this project part of the annual work plan so that approximately the same number of miles will be flown yearly. Each stream was evaluated for its potential to respond to management, and the schedule developed on these projections.

In the course of routine range and wildlife work, these streams and rivers receive frequent inspection. If field personnel note unexpected responses either in decline or improvement of habitat beyond what has been projected, the schedule will remain flexible so that photographs can be obtained more quickly than scheduled originally to support present management or to suggest the need for change in management. Such a situation occurred in 1983 on Willow Creek in the Northern Resource Area. The first set of repeat photographs was acquired a year earlier than scheduled on stretches of that stream.

Location

The Vale District is located in the southeastern portion of Oregon in the Owyhee Uplands and Blue Mountain Provinces. Elevations range from 1600 to 8200 feet. Topography varies from deeply-dissected canyons with steep slopes along the Owyhee, Whitehorse and upper portions of the Malheur Rivers to low rolling hills and gently sloping valleys along the other major rivers. These rivers and their perennial tributaries provide highly productive riparian habitat. Predominant perennial woody vegetation consists of willow species with associated cottonwood and quaking aspen in localized areas. Higher elevation riparian areas also support mock orange and red osier dogwood. Herbaceous vegetation consists predominantly of perennial grasses and sedges with scattered perennial and annual forbs.

Photo Acquisition

Large scale color infra-red photography was acquired in 1979 at a scale of 1:1000 on 22 miles of stream in the district. Due to budget limitations and after an initial evaluation of the project, the scale for photography taken in subsequent years was changed to 1:2000. The smaller scale was determined to be satisfactory for the district's monitoring needs and permitted additional miles of stream to be flown. Selected frames of critical or key areas are enlarged each year to a scale of 1:1000.

Data were lost due to a technical error in 1980, but 45 miles of stream were flown in 1981, 30 miles in 1982, and 37 miles in 1983 to complete the initial data base. Repeat photography on 25 miles of stream flown in 1979 is scheduled for acquisition in 1983. White T-formation markers are placed at both ends of the stream stretch to designate the study area prior to photographing. Streams are flown the third week in June between 1000 and 1400 hours. Both contact prints and transparencies in a 9" X 9" format are received by the district. Overlap for stereo coverage is included in the project specifications. Cost per mile, including analysis discussed below, is approximately $325.

Photo Analysis

On each photo, study area boundaries are predefined. Vegetative cover within these boundaries will be compared in subsequent years. An electronic planimeter is used to measure the amount of shrub and tree cover and herbaceous species cover in the delineated riparian zone. Measurements are repeated three times and an average taken. Only riparian shrub and tree species are measured; more xeric species such as sagebrush, bitterbrush, and juniper are not measured. Individual shrub species can be delineated using the 1:1000 photographs, but individual species identification is difficult on the 1:2000 scale photos. However, monitoring of individual riparian species is not critical in evaluation of the impacts of management. Intensive ground-truthing can thus be avoided, although the opportunity remains using selected enlarged frames to identify individual species and to make detailed ground checks on key areas.

The Vale District has contracted with the Environmental Protection Agency (EPA) in Las Vegas, Nevada, to analyze sections of streams photographed from 1982 to 1984. District personnel have begun analysis of streams flown in earlier years. As major environmental statements requiring input of district personnel are completed in 1984, the analysis effort may be concentrated in the district after that date.

Other methods for photo analysis have been considered. Linden and Concannon (1981) had selected frames from the 1979 flights digitized using a scanning microdensitometer. Their subjection of the data to an interactive digital image analysis computer system yielded an accurate separation of riparian from non-riparian vegetation. Individual species identification was attempted with less, but promising, success. Should costs for delineating herbaceous and shrub cover separately become excessive in the future, the computer system may be used to make the gross separation between riparian and non-riparian vegetation.

An electronic video system, Measuronics System II, developed by Measuronics Corporation, Great Falls, Montana, also shows promise for interpretive work. Two video cameras bring two different images into the same scale and then overlap them on a single video screen for comparison. The areas of overlap of particular interest can then be defined using polygons of various sizes. The system can digitize the polygons, store the information in the memory of an attached computer, and perform various calculations, including area, on the polygons. In addition, the system can detect 256 shades of gray, making density slicing of riparian vegetation possible on a limited basis.

Discussion

One of the major benefits of large scale photography is that one need not rely on samples of the photographed population for information: the entire population as photographed is spread before the examiner. Either the population in total or several frames can then be selected for sample analysis at a desired level of intensity without the problems of over or under sampling that so often occur in field inventory and monitoring situations. Any initially unsampled photos become a permanent record which may be sampled at a later date as more data are needed. Likewise, sampling individual frames for changes can be done at the examiner's leisure, often during inclement weather or during non-field months. Qualitative assessments can be made from one year to the next to determine the need for more detailed studies. Photos can be carried to the field for additional checks.

The district fisheries biologist is directly involved in the project as changes affect fisheries habitat, and the recreation planner has expressed interest in changes in high-use recreational areas. The photos are valuable when working with ranchers who can quickly observe changes from one year's photographs to another. Also, if other data needs become apparent, such as changes in stream channel or cutting of stream banks, a permanent record is on hand of the baseline year as well as changes in following years. Cuplin (1978) details procedures for measuring such additional parameters. Again, the examiner has the benefit of selecting his sample from the population photographed and over a time-frame of several years.

Summary

Because of the critical values of riparian zones and conflicting uses on these areas, a method has been selected by the Bureau of Land Management, Vale District, in southeastern Oregon to monitor riparian habitat using large scale color infra-red photography. Key areas along streams selected for riparian management are flown and photographed at a scale of 1:2000 with overlap for stereo coverage. From a predetermined area on each photo the amount of tree, shrub, and herbaceous cover of riparian species is measured. The initial photographs of these areas provide the baseline data to which all subsequent years will be compared. Repeat photography will be acquired on a five to ten year cycle. Management decisions regarding changes needed in grazing management or other uses will be made on comparative cover values from the baseline to subsequent years. Acquiring the photographs is reasonably quick, and a permanent record is on hand in the district files for a variety of analyses should the need arise. Analysis of cover values may be done accurately by district personnel at any time, and the photographs provide excellent qualitative comparisons between years if time becomes limited to make more detailed quantitative studies.

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A METHOD FOR PREDICTING RIPARIAN VEGETATION POTENTIAL OF SEMIARID RANGELANDS

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Abstract.--Predicting the potential of riparian areas to recover after protection from livestock is difficult because examples of pristine riparian communities have generally been destroyed by excessive grazing. This paper describes a method for predicting riparian site potential of streams and reservoirs in semiarid climates such as southeastern Oregon. The method is based on physical characteristics of stream and reservoir riparian zones, such as extent of water level fluctuation, persistence of flow, scouring, and soil type. These factors have been organized into keys for field use. Predicting the potential of riparian sites is essential to set priorities for the expenditure of funds to enhance and monitor those sites.

INTRODUCTION

In recent years, most rangeland managers have come to recognize the importance of riparian vegetation associated with streams, reservoirs, and springs. In semiarid rangelands, riparian areas are distinct from the drier upland vegetation. Consisting of grasses, forbs, sedges, woody shrubs and trees, riparian vegetation is often the only green succulent vegetation available during the summer. These areas are an oasis for wildlife; 280 of 360 terrestrial wildlife species in southeastern Oregon use riparian zones more than any other habitat (Thomas et al. 1979). Riparian vegetation is of critical importance to trout species in desert streams because the vegetation provides escape cover, helps lower summer water temperatures through shading the stream, and retards streambank erosion that can result in siltation of spawning gravels and rearing areas (Phillips 1971). Riparian areas are also focal points for human recreational activities. Excessive grazing in riparian areas conflicts with these other uses, degrading fish and wildlife habitat and lowering water quality and aesthetic appeal.

Detrimental effects of grazing on fish and wildlife habitat provided by riparian vegetation have been well documented (Platts 1981), and rangeland managers are now attempting to come to grips with this problem. As a result, many biologists have been involved in inventories to determine the present habitat condition of riparian areas. Most soon realize, however, that the present habitat condition cannot be meaningfully assessed without first knowing the ecological potential of the various sites, that is, what would be the climax plant community under pristine conditions? Answering this question is generally not possible because a long history of grazing and other disturbances have eliminated most examples of the pristine community. Yet, knowing the pristine community is essential, not only to assess the present habitat condition, but to select riparian areas that have the greatest potential to respond to protection from livestock grazing.

The purpose of this paper is to share a system we have developed for predicting the ecological potential of riparian areas associated with streams and reservoirs in semiarid rangelands. Our system is based on observations of riparian areas that have been protected from livestock grazing for many years by fencing or by natural barriers such as rough terrain and slope. For example, many riparian areas were fenced in the 1960's during the Vale project, a multimillion dollar range improvement program. We observed that some protected areas responded almost immediately while others did not, even after many years of protection. Based on such observations we identified the important physical characterisitics that determine the potential of streams and reservoirs to support riparian vegetation. The pristine and recovered riparian communities we studied to identify these characteristics were located in southeastern Oregon, but the principles may be applicable to similar semiarid rangelands elsewhere.

STREAMS

Bowers et al. (1979) have divided streams in southeastern Oregon into three distinctive zones; boulder, floodway, and pastoral (Fig. 1). The boulder zone is found in the headwaters of

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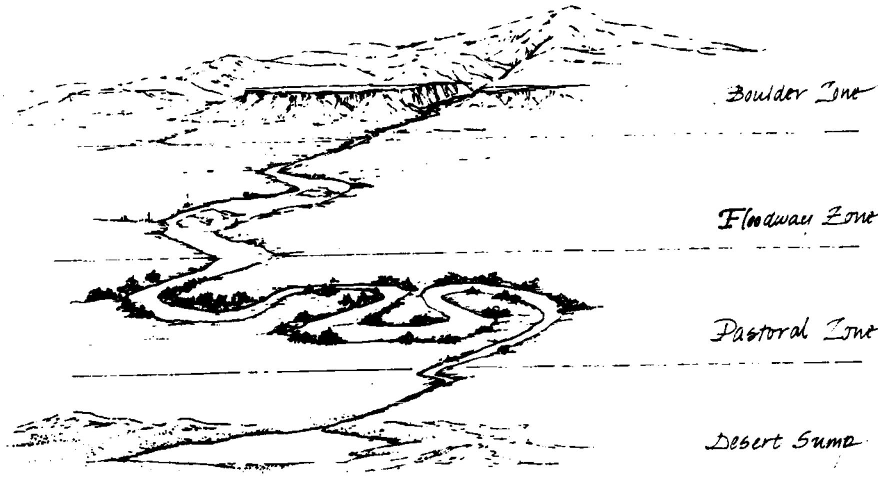

Figure 1.--Physiographic characteristics of southeastern Oregon streams (from Bowers et. al. 1979).

streams that typically originate in steep mountains. Water flowing at high velocity down gradients greater than 8% has carved narrow channels through V-shaped gorges. The stream channels and banks are composed almost entirely of coarse gravel, rubble and boulders. The floodway zone begins where the gradient and water velocities gradually decrease. Here, the streambanks are composed of much finer material and are more vulnerable to erosion than in the boulder zone. The streams flow through braided channels that often shift and form gravel bars. Beaver frequently dam streams in this zone causing further meandering and braiding that greatly expands the riparian zones. The best quality trout habitat is often found in this zone, but at the same time, these areas are the most severely impacted by livestock because of their accessibility. Occasionally, the floodway zone of a stream is confined by narrow vertical walled canyons. Such streams are severely scoured during spring freshets, when debris can be lodged six meters or more above the canyon floor.

The pastoral zone includes the lower reaches of the streams where water flow is sluggish and the streambed is composed primarily of silt and sand. Streambanks are composed of fine textured soils and are generally lined with trees. The upper reaches of the pastoral zone and the lower sections of the floodway zone are often flood irrigated for hay and crop production. The streams eventually flow into larger river systems or sometimes onto a desert playa where they disappear underground or evaporate.

Physical characteristics determine the capacity of each stream zone to develop a riparian vegetation community. The most important physical factors are the extent of water fluctuation and persistence. Soil type is another influencing factor but the stream gradient and flow regime generally dictate the soil composition. Many southeastern Oregon streams are intermittent, flowing only in the spring and early summer. The boulder and floodway zones of such streams retain water in the soil substratum only long enough to support a few plant species such as herbaceous sage (Artemisia ludoviciana), flannel mullein (Verbascum thapsus), various sedge or rush species; (Juncus, Scirpus, Carex) and limited shrub or coyote willow (Salix exigua). Low gradient, intermittent streams are dry by mid-summer except for isolated pools. These pools are surrounded by densely rooted sedges, grasses and forbs, but very few woody plants. Perennial streams in the boulder zones support a narrow band of willow, mockorange (Philadelphus lewisii), chokecherry (Prunus virginiana) and scant herbaceous vegetation that can take root in the rocky streambanks.

The most productive and diverse plant communities are found in the lower reaches of the floodway zone (Figs. 2 and 3) and in the pastoral zone. Decreased gradient and water velocity result in deposition of finer silt and gravel ideal for herbaceous plant growth and moderate annual stream flows disturbs areas that create seedbeds for woody plants. The riparian community might be composed of thinleaf alder (Alnus tenuifolia), Pacific willow (Salix lasiandra), coyote willow, black cottonwood (Populus trichocarpa), clematis or virginsbower (Clematis ligusticifolia), woods rose (Rosa woodsii), mockorange, and a dense stand of robust sedges and forbs. At elevations greater than 1500 meters, the dominant tree species is often quaking aspen (Populus tremuloides) rather than cottonwood, alder or tree willow.

An interesting phenomenon occurs in the floodway zones of streams that undergo opposite extremes in water level fluctuations. Streams confined by narrow, vertical walled canyons are often severely scoured by spring runoff which destroys rigid woody plants (Fig. 4). Pliable herbaceous plants survive on the canyon floor but trees and shrubs persist only at the fringes of the flood plain. Conversely, the same herbaceous plant community may dominate streams where almost no water fluctuation occurs. These streams are fed by voluminous springs and are often lined by densely rooted mats of grasses, forbs and sedges. One possible explanation for the lack of woody plants is that many species, such as willow, are ecological opportunists that rapidly invade disturbed areas. Without significant fluctuations in water level to produce minor scouring of streambanks, herbaceous plants thrive and preclude establishment by woody species.

Occasionally, desert stream drain through alkaline soils, resulting in riparian soil pH's that few tree and shrub species can tolerate. The riparian

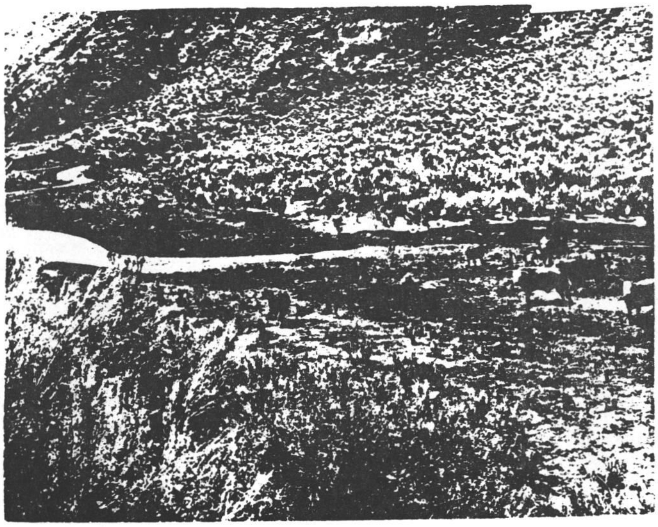

Figure 2.--Cattle concentrate all summer at high potential riparian sites on Willow Creek, a floodway zone stream near Vale, Oregon. In this pasture all woody vegetation is browsed to ground level.

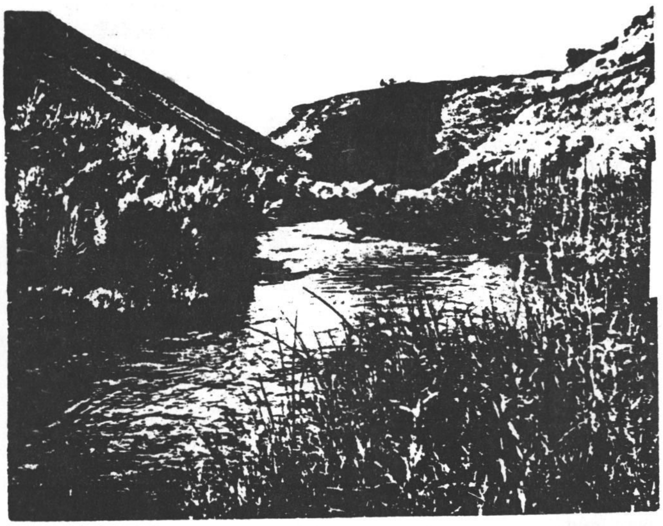

Figure 3.--An adjacent pasture on Willow Creek achieved rapid succession of riparian vegetation after only one year of protection from cattle use. Many young willows are present in the lush herbaceous growth along the stream.

community is restricted to alkali bullrushes (Scirpus sps.), black greasewood (Sarcobatus vermiculatus), silver buffaloberry (Shepherdia argentea), saltcedar (Tamarix gallica), and other salt tolerant species.

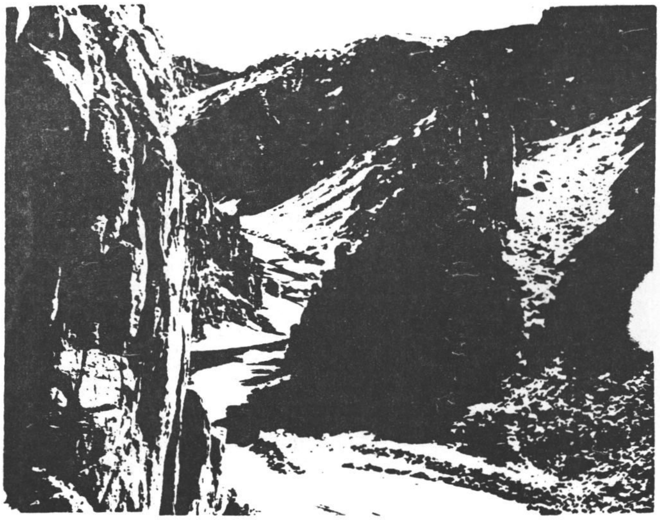

Figure 4.--Owyhee River Canyon normally is severly scoured by high volumns of water during the spring snow melt. Woody vegetation is uncommon.

RESERVOIRS

To achieve better livestock distribution on public grazing lands, thousands of stock ponds and reservoirs have been constructed in southeastern Oregon. The vast majority, however, go dry during the summer, leaving only a small number that have the potential to support riparian vegetation. The main factor influencing plant communities around reservoirs is water fluctuation. The evaporation rate in southeastern Oregon is greater than one meter a year, and when drawdown exceeds one meter vertically and six meters horizontally, most riparian species do not receive enough subsurface moisture to survive (Fig. 5). The most dense and diverse riparian zones are associated with reservoirs that have only minor fluctuations in water level and gently sloping shorelines (Figs. 6 and 7). The riparian community around such reservoirs might include tree and shrub willows, cottonwoods, meadow grasses, rushes, and sedges. These sites are ideal for planting exotic species including Chinese elm (Ulmus parvifolia), Russian olive (Elaeagnus angustifolia), and Siberian peashrub (Caragana arborescens), where such introductions do not threaten the native flora. Some springfed reservoirs that undergo almost no water level fluctuations support few woody plants. Competition from densely rooted herbaceous species, which pioneered site succession, may prevent invasion by shrubs and trees. Padgett (1982), however, attributed the dominance of herbaceous plant communities in marshy riparian zones to insufficient soil aeration for growth of woody plants.

Soil type is another factor that influences riparian communities around reservoirs. Extremely rocky shorelines limit the riparian zone to a narrow band of willow, cattails, bullrushes and herbaceous species. Riparian zones with highly alkaline soil support only salt tolerant species.

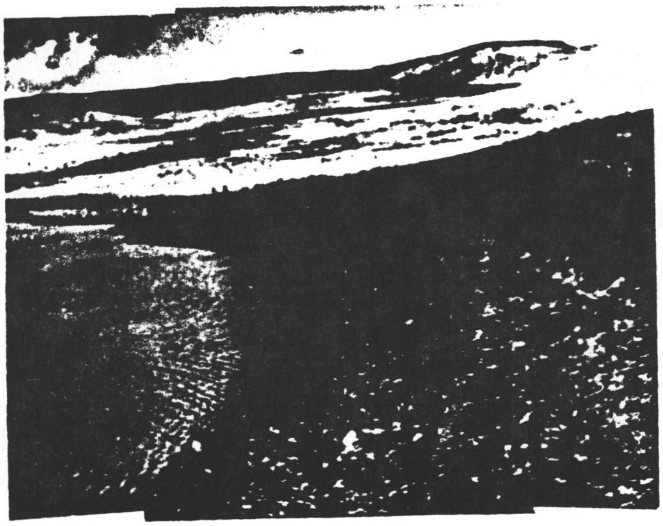

Figure 5.--Twin Springs Reservoir has been fenced since 1966. A general lack of soil, and extreme fluctuation in water level because of evaporation loss precluded extablishment of riparian vegetation.

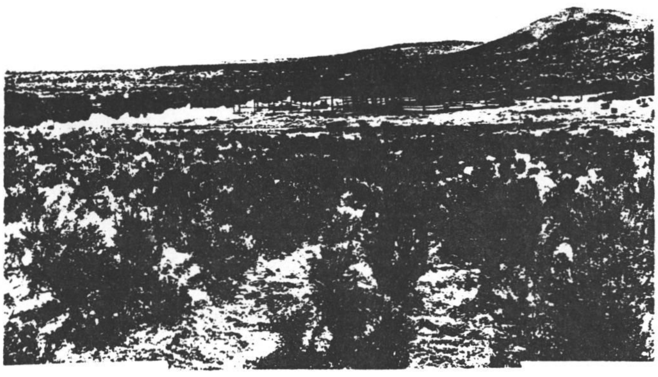

Figure 6.--Kane Springs Reservoir before exclusion of cattle, September, 1964.

Figure 7.--Dense riparian vegetation at Kane Springs after six years of protection from grazing by cattle. Russian olive in foreground were planted in 1965. Background shrubs are predominately wild rose.

APPLICATION

Physical factors influencing riparian potential have been organized into keys for field use (Tables 1 and 2). These keys identify the plant species most commonly associated with stream and reservoirs of certain physical characteristics. The characteristics assessed for streams are persistence of stream flow, extent of water level fluctuation, stream gradient, and type of soil. For example, Willow Creek (Figs. 1 and 2), a perennial floodway zone stream with fine textured soils undergoes minor fluctuations in water level and has the potential to support a dense and diverse riparian community of trees, shrubs, and herbaceous species (see Table 1; 7b). The reservoir shown in Figure 5 has almost no potential for a riparian zone because of extreme fluctuations in water level and a rocky shoreline (see Table 2; 3a).

After using the keys to predict the potential riparian community of a stream or reservoir, an investigator can then more accurately classify the present condition of the riparian habitat. For example, Willow Creek (Fig. 2) can support dense and diverse riparian vegetation, but the present community has been reduced by grazing to closely cropped herbaceous species and is classified in poor condition. The wide gap between the potential and present riparian community along Willow Creek indicates the high potential of this stream for recovery if protected from grazing (Fig. 3). In contrast, a severely scoured stream like the Owyhee River (Fig. 4) has only a limited capacity to respond if protected from grazing. These keys enable an individual with limited botanical knowledge and experience to predict the potential plant community, classify the present community condition, and make intelligent management decisions.

TABLE 1

Key for Assessing Riparian Vegetation Potential of Streams

1a. Stream flow intermittent

- 2a. Water not in soil all year...Mullein, low sagebrush, biscuit root.
- 2b. Water in soil all year.
  - 3a. Stream gradient less than 1%; dry in mid-summer except for isolated pools...Dense mats of sedges, grasses, and forbs around pools; few or no woody species.
  - 3b. Stream gradient greater than 1%...Herbaceous sage, mullein, sparse willow and other shrubs.

1b. Stream flow perennial

- 4a. Stream flow does not vary seasonally (springfed)
  - 5a. Soil highly alkaline...Alkali bullrush, greasewood, buffaloberry, salt cedar.
  - 5b. Soil not highly alkaline...Densely matted sedges, forbs, grasses, cattails; few or no woody species.
- 4b. Stream flow varies seasonally
  - 6a. Water level fluctuations extreme; severe scouring common...Vegetation limited to sparse stands of grasses, forbs and sedges; woody plants found only in areas protected from scouring.
  - 6b. Water level fluctuations moderate
    - 7a. Soil extremely rocky; gradient generally greater than 5%...Narrow band of willow, mock oragne, chokecherry, sparse stands of grasses and forbs.
    - 7b. Soil fine in texture; gradient generally less than 5%...Tree willow, cottonwood, alder, aspen (above 1500 m), dogwood, mock orange and other shrubs, dense stands of grasses, sedges and forbs.

TABLE 2

Key for Assessing Riparian Vegetation Potential of Reservoirs

1a. Water level of reservoir unstable

2a. Water level fluctuates more than one meter vertically and six meters horizontally so that majority of basin is dry by mid summer.

3a. Shoreline soil extremely rocky...No vegetaion.

3b. Shoreline soil fine in texture; bottom gradient less than 5%...Sparse sedges and watergrasses.

2b. Water level fluctuates less than one meter vertically and six meters horizontally so that majority of basin is moist all year.

4a. Shoreline gradient exceeds 20%.

5a. Shoreline extremely rocky...No vegetation.

5b. Shoreline soil fine in texture...Narrow band of shrub willow, cattail, bullrush, grasses and forbs.

4b. Shoreline gradient less than 20%.

6a. Shoeline extremely rocky...Narrow bank of cattails, bullrushes, grasses, sedges and forbs; a few shrub species possible.

6b. Shoreline soil fine in texture...Tree and shrub willow, cottonwood, alder, rose, and other shrubs, diverse and densely rooted grasses, sedges and forbs. Suitable for planting exoitic species such as Chinese elm and Russian olive.

1b. Water level of reservoir constant (springfed)

7a. Soil highly alkaline...Alkali bullrush, salt grasses and other salt tolerant species.

7b. Soil not high alkaline...Densely rooted sedges, forbs and grasses, few or no shrubs or trees.

MANAGEMENT IMPLICATIONS

Today, land managers are much more aware of the critical importance of riparian habitats to fish and wildlife. However, it is our responsibility as biologists to identify for them the riparian areas that have the greatest potential to recover if protected. We are applying the principles outlined above to advise our range managers on riparian management decisions. For example, we recently determined that several reservoirs scheduled for fencing had little potential to support riparian vegetation because of water level fluctuations, so we recommended reservoirs with higher potentials. Based on our riparian inventories we selected critical stream habitats from which livestock should be excluded and recommended no changes in grazing systems for streams with low potentials. We were also asked by our range managers to predict the response of riparian communities to grazing systems that reduces or eliminates grazing during the hot summer months when most of the damage occurs (Fig. 8). We set specific goals for riparian community response under these grazing system and designed a monitoring system to determine if the riparian goals were being met. Identification of riparian potential is the foundation of our riparian monitoring procedure and is essential for making all riparian management recommendations and decisions.

Figure 8.--Excellent reestablishment of willows has occured along Pole Creek near Juntura, Oregon, where yearling cattle have been grazed from mid March through May for the past five years.

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A LINE-INTERCEPT METHOD FOR MONITORING RIPARIAN VEGETATION TREND

Robert R. Kindschy 1/

Objectives

Many riparian ecosystems within the northwestern United States are experiencing a new management thrust to enable recovery of ecological productivity. A means to quantitatively measure and document vegetative change is presented which can assist managers in determining trend.

Successional trend may be quantitatively documented utilizing a permanent line-intercept transect. Data analysis will include the following for each and every segment of the transect:

1. Percentage of transect occupied by plant species or type.
2. Number of individual occurrences of plant species or type.
3. Average size of individual occurrences of species or type.

Successional advancement will normally be indicated by:

1. Increases in woody riparian vegetation (willow, alder, etc.).
2. Increases in wetland perennial grasses and sedges.
3. Decreases in upland woody plants (sagebrush, rabbitbrush, etc.).
4. Decreases in soil barren of vegetation.
5. Apparent changes of vegetation as shown in photographs.

Optional data may be gathered to document changes in the cross section of the stream and water quality characteristics. Although this data may provide additional insight concerning the successional process, specialized equipment and skills are necessary for water quality studies.

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Methods

Selection of the site for monitoring is important. The riparian habitat should be examined and one or more areas identified where present vegetation is representative of a successional sere or stage less advanced than the site potential. Crouse and Kindschy discuss a method for site potential identification within these transactions.

1. Select a point of beginning and set a permanent marker stake (rebar or equivalent). Measure 10 feet in the direction opposite of the intended transect and drive a steel fence post. This post, and an identical post 10 feet beyond the terminal end of the transect, will assist in later relocation of the transect.

2. Project transect across the riparian community, preferably at right angles to the stream. Affix the measuring tape to the steel post with a wire or strong cord so that measurement 0.0 falls over the marker stake. Stretch tape from the point of beginning to the terminal fence post. Set a marker stake at the last tape point, normally the 100.0 foot mark.

3. Photograph transect site from both ends. Additional photos up and down the stream from the point of transect crossing are recommended.

4. (Optional) Measure a cross sectional segment of the stream channel. This is accomplished using a surveyor's rod at set intervals (e.g. 1 foot) along the transect tape. A cross section diagram can be drawn from this data.

5. (Optional) A fisheries biologist, or other qualified specialist, measures the characteristics of the stream including: stream flow, fish species present and abundance, benthic organisims, temperature, pH, conductivity, and other water quality criteria.

6. A line intercept transect is run along the entire transect tape length from the point of beginning to the end (usually 100 feet, but may vary with site). A plumb-bob is recommended to mark the crown intercept along the tape. If two workers are available, one may identify the intercepts while the second records the data. A single worker may effectively record intercepts on a micro cassette tape recorder for later analysis. It is important to be able to account for each and every segment of the intercept upon totaling; non-vegetated segments are recorded. Analysis of these data will provide the following:

   A. Percentage of transect occupied by a plant species or barren.
   B. Average size of intercepted plant or barren segments.
   C. Number of occurrences of a species or barren segments.
   D. Statistical analysis capabilities of data.
   E. Ability to draw a cross sectional diagram of transect.

7. Line intercept transect is then used as a baseline to include nearby riparian trees and other important woody vegetation. Worker notes the measurement along the tape that is 90° from the tree and records figure on the field notes sketch; he then tapes the distance to the tree, which is also recorded. The greatest crown diameter of the tree is measured and a second measurement is made at right angles to the first. The crown area may then be calculated using the formula:

$$\frac{(\text{Length X Width})\ 3.14}{4}$$

The height of the tree is measured using a tape or through triangulation using an abney-type hand level. The number of trees measured is a matter for individual judgement.

8. A brief narrative is written from the field notes. The amount of vegetative use by wildlife, insects or livestock should be noted. Any evidence of past flooding or scouring should be recorded.

9. Data is summarized, analyzed and filed.

10. The procedure is repeated in the future. Comparison of data from prior studies determines vegetative trend.

Results

A sketch of the transect line, as shown in Figure 1., will be valuable in documenting changes in the stream and generalized vegetative communities. Trees near the line are identified by recording the measurement along the tape opposite the tree plus the right angle distance to the tree. These measurements also enable relocation of the transect position if the point of beginning or ending stakes should be lost through erosion or vandalism.

Data analysis shown in Figure 1. was accomplished through the use of a programmable calculator. The beginning point and ending point of each segment for a component are entered. Output data are the number of segments (N), total accumulative length of segments (Σ), average length of segments ($\bar{x}$), and the standard deviation of the lengths (S). A program for the Texas Instruments TI-59 programmable calculator (with print cradle) is available from the author. These data should prove useful for future comparisons to assist in interpretation of successional trend.

Graphic display of the data provides the researcher and the land manager with a quick and clear comparison of data. Figure 2. utilizes a "pie graph" to portray the percentage of the total transect occupied by the various components.

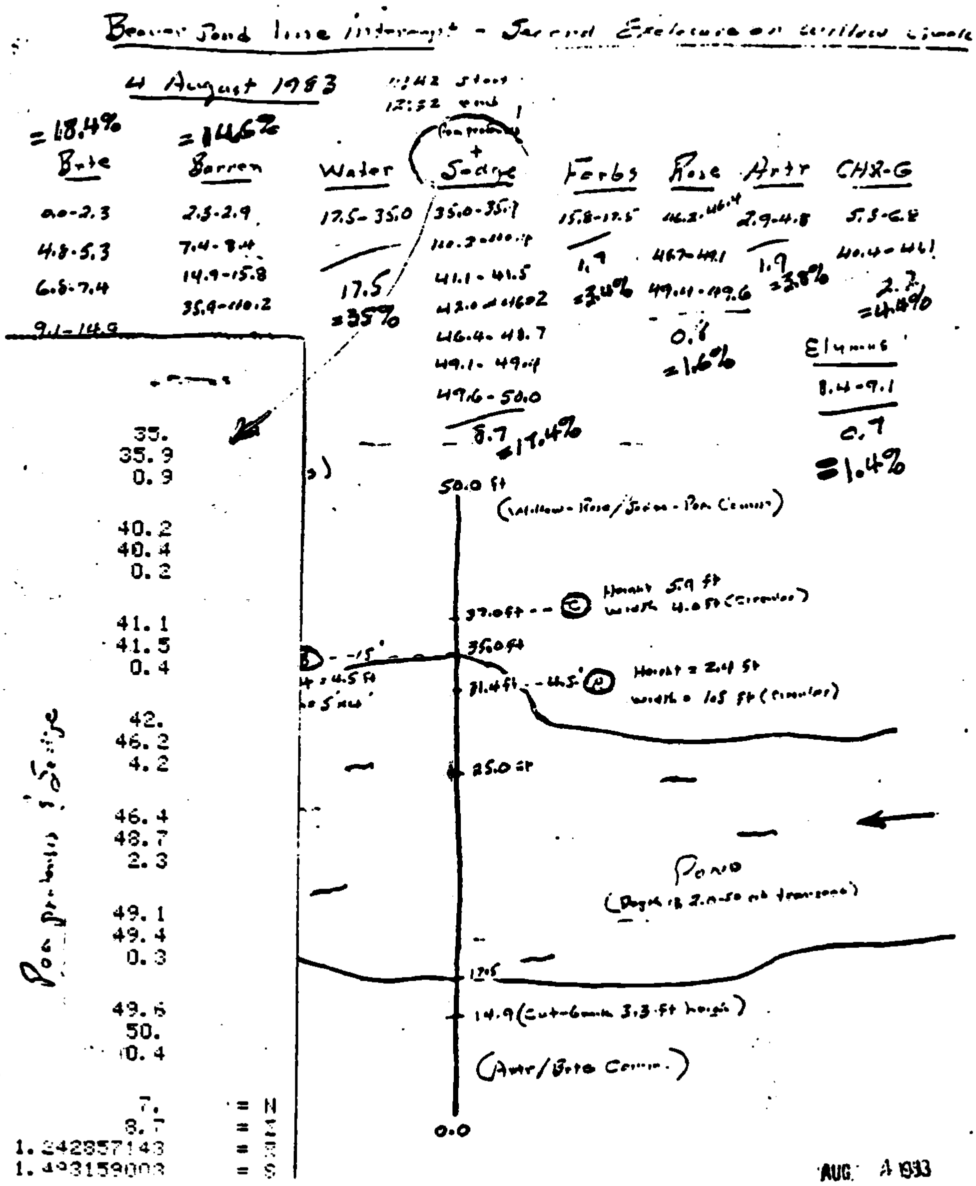

Figure 1. Field notes from a beaver pond transect includes a sketch of the transect with pertinent measurements, location of adjacent trees, intercept measurements by category, and a printout of intercepts for the bluegrass sedge community.

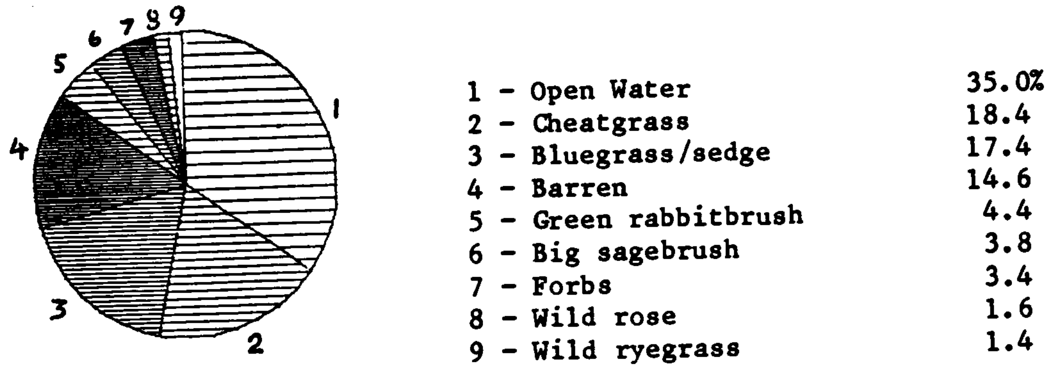

Figure 2. Pie graphs are excellent to show the percentage of the transect occupied by the various vegetative communities.

Bar graphs (Figure 3.) and trend lines (Figure 4.) may be used to compare changes in the amount of individual components over time.

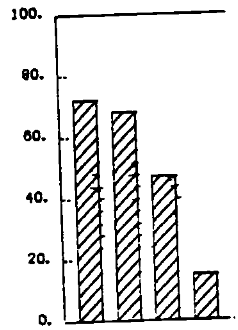

Figure 3. Bar graph illustrating the percent of ground barren of vegetation during four consecutive periods.

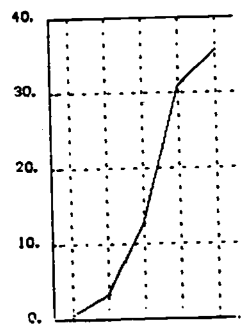

Figure 4. Trend line graph illustrating the amount (in feet) of willow cover during five consecutive periods.

Cross sectional diagrams (Figure 5.) of the entire transect also convey an instant picture of vegetative occurrence, location and, when compared among years, trend. Vertical structure may be shown through scale adaptation. Such diagrams are rather laborious to draw by hand. Use of various colors to identify individual components assist in interpretation of data.

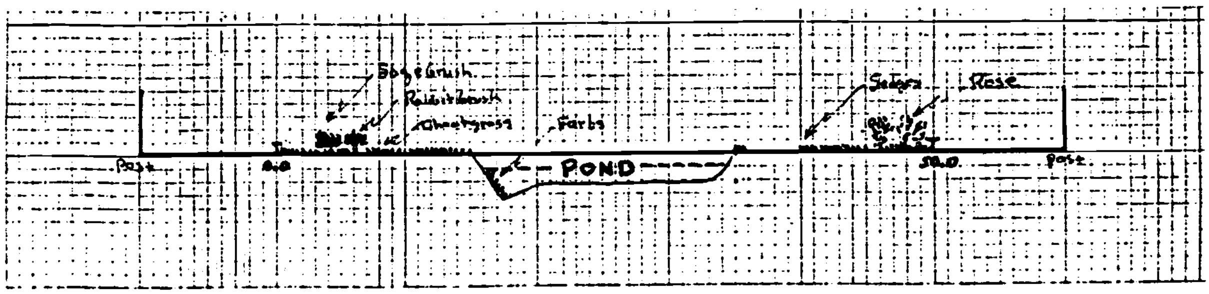

Figure 5. Cross-sectional diagram of a 50-foot line intercept across a beaver pond. Each square represents 1 foot horizontally and vertically.

<u>Summary</u>

A procedure utilizing a modified line intercept transect will provide quantitative and qualitative data for documenting vegetative changes in riparian communities. Data will be usefull to managers for determining achievement of ecological trend objectives.

SIGNIFICANCE OF RANGE WATERSHEDS TO THE NATURAL AND HUMAN ENVIRONMENT

INFILTRATION AND EROSION: IDENTIFYING POTENTIAL HAZARDS IN THE RANGELANDS OF OREGON

John C. Buckhouse

Introduction

Upland watershed management, sediment production and erosion control are fascinating subjects. During the past several years the watershed research through the Department of Rangeland Resources at Oregon State University has investigated many of the relationships which exist on eastern Oregon rangelands.

Identifying Hazards

We initially quantified potential sediment production from rangeland which we had classified into broad ecological groupings. These "ecosystem" classifications corresponded roughly to the "FRES" grouping of the USDA Forest Service (U.S.D.A. Forest Service 1972). An interesting pattern quickly developed (Buckhouse and Gaither 1982, Gaither and Buckhouse 1983). A hierarchy of sediment potentials ranging from units of kilograms per hectare produced by a single high intensity ($\approx$7 cm) 30-minute simulated convectional storm to thousands of kilograms per hectare became evident (Figure 1).

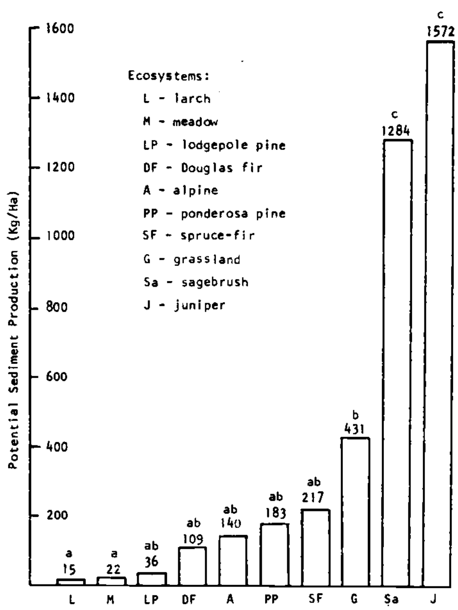

Figure 1. Potential sediment production in 10 Blue Mountain ecosystems. Different lower case letters indicate differences in statistical significance (P<0.10).

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Meadow and forested communities (particularly the deciduous western larch forests) produced the least sediment. Mountain grassland systems were intermediate, followed by sagebrush steppe classifications. Invading juniper communities produced the most potential sediment. It became obvious that as biomass at the ground surface increased, infiltration rates were increased, overland flows were decreased, and potential sediment production were decreased.

A refinement of the ecosystem classification involved a more detailed look at ecological classification employing the Daubenmire Habitat Type concept (Daubenmire 1952). We found that this increased ecological resolution was helpful in further quantifying hydrological parameters including potential sediment production (Buckhouse and Mattison 1980).

It seemed we were on the right track so on our next attempt we tried to further refine our ecological classification scheme to include subspecies of the big sagebrush taxa. This tool used alone proved to be a disappointment since we were unable to demonstrate consistent differences among the *Artemisia tridentata* subspecies. The *wyomingensis* subspecies sites tended to be lower in water's infiltration, higher in overland flows of the water and higher in potential sediments produced than were *vaseyana* and/or *tridentata* subspecies. However, these trends were statistically significant at only two of the four geographic locations we sampled (Swanson 1983). We were, however, able to explain the processes more fully when we looked at certain soil structural types. We found that platey and/or vesicular soil structure was very detrimental to high infiltration rates. Further analysis revealed that medium and coarse sand and organic ground cover were positively correlated with infiltration rate, while fine sand was inversely correlated. These three variables accounted for some 43% of the observed variation noted in the infiltration rates. Interestingly, the factors associated with potential soil loss were related but not necessarily identical. As organic ground cover and coarse fragments increased, soil loss decreased. As the clay and silt fractions increased, soil loss increased. These four variables accounted for some 47% of the variation noted in potential soil loss (Swanson 1983).

Range Improvements

Frequently I am asked to respond to the hydrologic character of a site following range improvement. The literature and our watershed work in Oregon all agree that any disturbance to the site will cause a decline in the rate of water's infiltration into the soil. The degree of disturbance dictates the severity and longevity of the decline.

With decreased infiltration rates, one would assume an increase in overland flows and therefore an increase in potential soil losses.

This, however, has not always been what we observed (Buckhouse and Bolognani 1982). Under certain instances we observed a decline in infiltration rate following the improvement practice coupled with reduced soil losses. I believe this perplexing, apparent dicotomy can be explained by the vegetation success (or lack of success) following the practice. While it is true that the mechanical and physical affects of range improvement and temporarily bare soils deçreases infiltration rates, if the seeded or released vegetation does well, it may form sufficient retention/detention dams to actually retain the water in contact with the surface for a longer period of time. The rate has been reduced but the total time of soil/water contact has been increased and therefore total amount of water which has infiltrated is increased.

CONCLUSIONS

Erosion Hazard Identification

It can be concluded that:

(1) Great differences in erosion and infiltration potential exist among broad ecological classifications.

(2) Ecological refinement, such as Habitat Typing, is helpful in identifying potential hydrological hazards.

(3) As biomass and soil protection improve, the erosion hazards decrease. These vegetation improvements can usually be expressed as increased "range ecological condition class". However, there are cases where a lower condition class had more biomass and more soil surface protection.

(4) Sagebrush subspecies within the Artemisia tridentata taxa alone were not sufficient to identify erosion hazards. Additional information such as soil platyness, viscosity, organic matter, and particle size must also be evaluated.

Erosion Prevention or Acceleration Following Range Improvements

The degree of soil loss which is experienced from a given site seems to depend upon:

(1) The degree of disturbance associated with the particular practice in question. As the degree of disturbance increases, the rate of water uptake into the soil is lowered.

(2) The success of the "catch" of seeded or released vegetation. If biomass has been increased, soil losses may be decreased. However, if the success is poor, soil losses may be greatly increased.

(3) The amount of time that has passed since the improvement practice was implemented. Infiltration rates moderate with time. Freeze-thaw, wet-dry, and growth cycles all serve to ameliorate the initial decrease in infiltration rate. In addition, vegetation is time dependent. If the stand continues to improve and thicken, it has positive hydrologic effects for both infiltration and sediment reduction. If the stand declines over time, the opposite is true.

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LIVESTOCK PRODUCTION POSSIBILITIES ON STREAMSIDE MEADOWS

Martin Vavra

The importance of riparian ecosystems has been well documented in recent years (Johnson and Jones 1977; and Johnson and McCormick 1978). Also well documented is the effect of cattle grazing on riparian vegetation. Krueger (1984) stated riparian zones were focal points of cattle grazing activity. In most cases riparian zones accounting for 2-3% of a pasture, produced 20% of the forage which received 80% use. In the Blue Mountains of eastern Oregon Gillen et al. (1984a) observed that cattle showed a high preference for meadow communities. Fifty percent of the cattle on the area studied were located on 5% of that area. Forage utilization was 75% on meadows but only 10% on uplands. Gillen et al. (1984b) also found unrestricted season long cattle use continually removed forage growth as it occurred so no increase in standing crop on meadows was noted. Cattle use on riparian meadows was evident even after herbage levels decreased below the physical limits of grazing.

Many riparian meadows are being utilized season long by cattle. The potential to produce beef from those meadows is decreased and perhaps due to poor distribution decreased on the pasture as a whole. Roath (1980) observed when little forage was available riparian zone grazing by cattle depressed animal gain and preconditioned cattle to later physiological disorders like pulmonary emphysema. Developing grazing programs for the controlled use of riparian meadows by cattle would benefit cattle production and distribution, and benefit wildlife (Kaufmann et al. 1982).

Data presented in this paper are the result of many studies (Berry 1982, Holechek et al. 1981, Holechek et al. 1982a, 1982b and 1982c, Holechek and Vavra 1982, Vavra and Phillips 1979 and 1980). Partial funding was by the Pacific Northwest Forest and Range Experiment Station, Forest Service under PNWFRES Project 1701, entitled "The Influence of Cattle Grazing Methods and Big Game on Riparian Vegetation, Aquatic Habitat and Fish Populations." Studies were conducted on two different stream systems, Meadow Creek on the Starkey Experimental Forest in the Blue Mountains and Catherine Creek on the Hall Ranch in the Wallowa Mountains. Each will be discussed separately.

MEADOW CREEK

Data in Table 1 indicate the percentage cover of selected species found in riparian meadow communities on the Meadow Creek Study Area and the composition of cattle diets. Species composition of diets reflect forage availability. Forage class consumed within grazing period and year indicates a shift to increased grass consumption during the fall period (Table 2). Freezing temperatures and frost are common during the September 15 to October 15 grazing period on Meadow Creek particularly on the meadow pastures. Generally, frost affects forb and shrub leaves more severely than grass leaves. Frosted and dried forb and shrub leaves are probably less palatable than grasses. Also, forbs would be at maturity in fall and probably drying without frost. The major grass constituent of the diet, Kentucky bluegrass remains green and growing (hence palatable and available) as long as soil moisture and temperature are favorable.

Table 1. Selected plant species in diets of cattle grazing a riparian meadow and percent cover of those species (three year average)

Species	Percent cover [1]	Percent in diet
Kentucky bluegrass	21	12
Sheep fescue	6	8
Small fruited bulrush	5	8
Spike bentgrass	2	8
Idaho fescue	4	8
Other grasses & grasslikes	29	36
Forbs	13	12
Snowberry	8	6
Other shrubs	12	2

[1] From Ganskopp (1978)

Nutrient quality of the diet of cattle grazing the riparian meadow was not superior to nutrient quality of the diet of cattle grazing upland pastures (Table 3). A comparison of livestock production (average daily gain) from various pasture types in the Meadow Creek area is presented in Table 4. Differences between average daily gain on the meadow and each other pasture management type are presented in Table 5. From the standpoint of livestock production there is no advantage or disadvantage to delayed use of the Meadow Creek riparian meadows under most conditions. However, cattle restricted to south facing slope grasslands did not gain as well as meadow grazed heifers in 4 years out of 5 during the late summer period. Fall gains favored the meadow grazed heifers in 3 years out of 5. Late summer and fall performance of cattle on the grassland is dependent on precipitation adequate to initiate regrowth during these periods (Holechek et al. 1981 and Holechek et al. 1982a).

Table 2. Forage classes in diets of cattle grazing a riparian meadow on the Starkey Experimental Forest

	1976		1977		1978	
	Late summer[1]	Fall	Late summer	Fall	Late summer	Fall
Grasses	75	86	72	85	72	86
Forbs	18	12	14	10	18	12
Shrubs	7	2	14	5	10	2

[1] Late summer, August 15 - September 15 and Fall, September 15 to October 15.

Table 3. Digestible energy (DE) and percent crude protein (CP) in diets of cattle grazing the grassland, forest and riparian meadow on the Starkey Experimental Forest

		DE (Mcal/lb)			CP (%)		
		Grassland	Forest	Meadow	Grassland	Forest	Meadow
1976	Late summer	.93[1]	.91	.86	11.0[1]	11.7	9.5
	Fall	.88	.80	.91	9.3	10.6	9.3
1977	Late summer	.73	.90	.87	7.2	9.4	8.0
	Fall	.86	.79	.73	8.4	9.1	7.7
1978	Late summer	.83	.86	.85	7.0	9.3	8.5
	Fall	.76	.86	.84	9.1	9.7	8.1

[1] National Research Council requirements for 1.1 lb. average daily gain for a yearling heifer are 1.0 Mcal/lb intake and 8.8% crude protein.

Table 4. Average daily gain (lb) of yearling heifers grazing various plant community types on the Starkey Experimental Forest.

	1976		1977		1978		1979		1980	
	Late summer	Fall	Late summer	Fall	Late summer	Fall	Late summer	Fall	Late summer	Fall
Meadow	2.18	.29	1.01	.35	-.09	1.63	.26	.35	1.35	1.63
Grassland[1]	.90	1.26	.22	.60	-.88	.62	1.87	-.55	.82	-1.01
Forest[1]	1.12	.93	1.59	-.02	-.82	1.19	1.47	.59	1.73	.48
Rest rotation[2]	1.54	1.23	1.57	.68	.33	.79	1.28	.96	1.08	- .08
Seasonlong[2]	1.39	1.46	.11	.58	.66	1.21	1.35	.75	1.13	.05

[1]Cattle restricted to specific plant community and excluded from riparian meadow.

[2]Standard fencing with various plant community types including the riparian meadow available.

Table 5. The difference in average daily gain (lb) of yearling heifers between meadow and each plant community type on the Starkey Experimental Forest. [1]

	Late summer					Fall				
	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
Grassland	-1.28	-.79	-.11	+1.61	-.53	+ .97	+.25	-1.01	-.90	-2.64
Forest	-1.06	+.58	-.73	+1.21	+.38	+ .64	-.37	- .44	+.24	-1.15
Rest rotation	- .64	+.56	+.42	+1.02	-.27	+ .94	+.33	- .84	+.61	-1.71
Seasonlong	- .79	-.99	+.77	+1.09	-.22	+1.17	+.23	- .42	+.40	-1.58

[1] A negative number indicates inferior average daily gain on that plant community compared to the meadow.

Therefore, in dry falls cattle can be expected to gain better on the riparian meadows than on grasslands. Cattle usually restricted season long to south facing slopes or shallow soiled pastures similar to the grassland in this study would benefit the most from special late season use of riparian pastures.

HALL RANCH

On the Oregon Agriculture Experiment Station's Hall Ranch exclusion of meadows associated with Catherine Creek as special use pastures has been practiced since 1960. Presently meadow grazing occurs during late August and early September by cow-calf pairs. Typical grazing season weight changes in cows is presented in Figure 1 and average daily gain of calves is presented in Figure 2. The Hall Ranch grazing scheme provides for utilization of ponderosa pine dominated uplands early in the grazing season, then as forage matures on these sites cattle are moved to the riparian meadow pasture. Increased weight gains in cows and calves is possible with this practice. In 1983 cow-calf pairs were weighed on range in June and again in August just prior to pasture changes. At this time the herd was split in two equal groups based on cow age. Half the herd was turned into an upland pasture that was previously ungrazed in 1983, while the other half was turned into the riparian meadow. Cow-calf pairs were again weighed when utilization of the meadow reached desired levels and pasture changes were to be made. From June to August cows actually lost weight; (Table 6) not uncommon for lactating cows on range (Figure 1). Calf gains were similar to other years' weight gains on the Hall Ranch. Calves grazing the riparian meadow gained .9 lb more per day than calves grazing the upland pasture. During the 20 day grazing period this amounted to 18 lb per head more beef produced from the riparian pasture. Cows on the riparian meadow gained weight while cows grazing uplands continued to lose weight. Weight losses on cows grazing uplands (-2.14 lb per day) are not greater than expected for lactating cows at that time of year.

Table 6. Cattle weight changes (lb) and average daily gains (lb) on the Hall Ranch during 1983

		Calves		Cows	
		Wt. change	ADG	Wt. change	ADG
6/14 to 8/23	Upland[1]	139	1.97	-77	-1.09
	Upland	144	2.06	-57	- .96
8/23 to 9/12	Upland	21	1.03	-43	-2.14
	Meadow	39	1.93	14	.68

[1] Primarily ponderosa pine - pinegrass - Kentucky bluegrass communities.

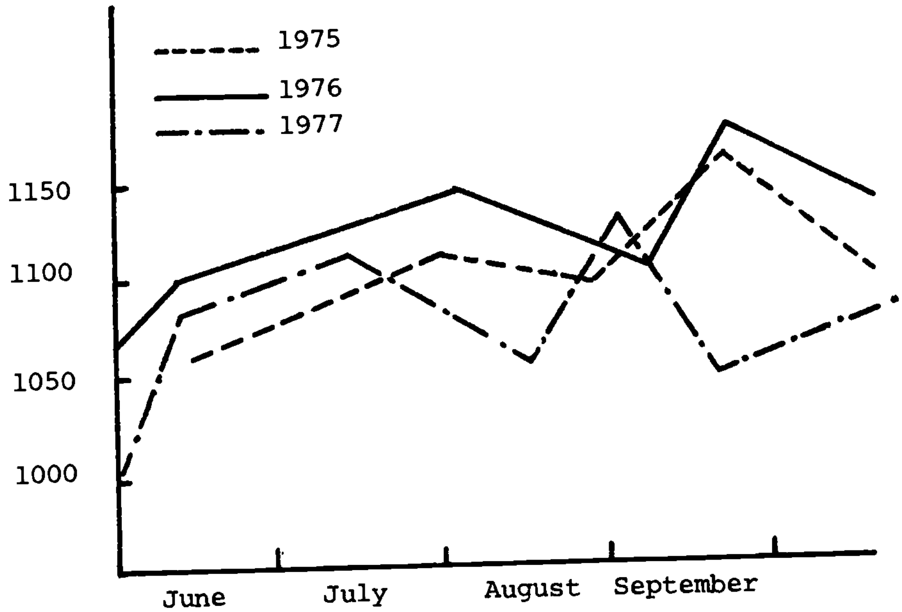

Figure 1. Cow weights (lb) for the summer grazing seasons. Data from Vavra and Phillips 1980.

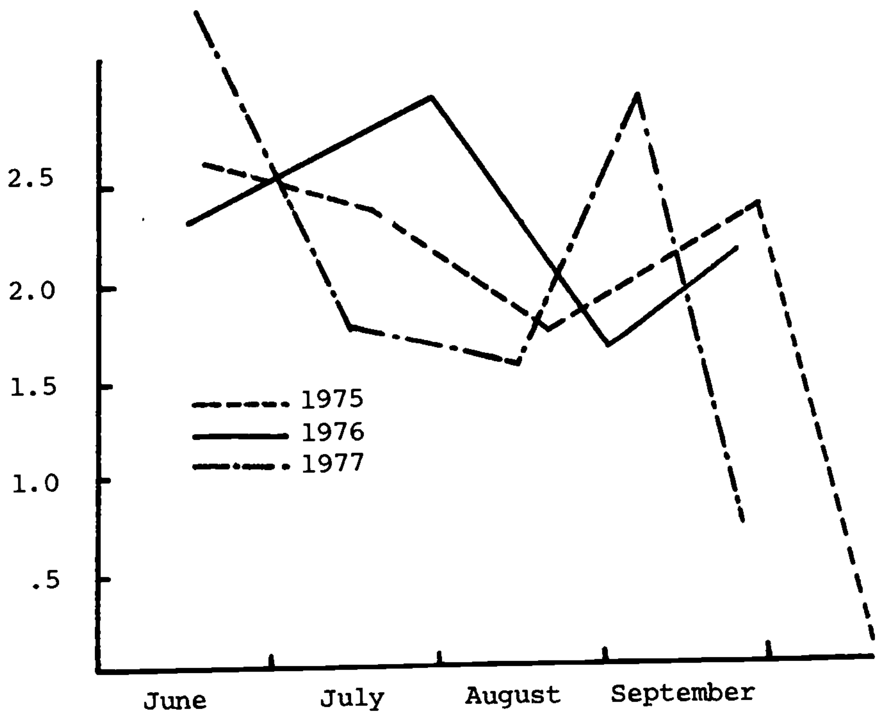

Figure 2. Average daily gain (lb/day) of calves for the summer grazing seasons. Data from Vavra and Phillips 1980.

DISCUSSION

Data from the Hall Ranch indicate a clear benefit to cattle from riparian meadow deferment. Meadow Creek data are less clear. Fencing riparian meadows and deferment of grazing probably will not greatly improve beef production on Meadow Creek but if done for "other" reasons fencing and deferment would not decrease beef production. A look at plant communities on both areas provides possible guidelines to use in predicting beef production potential of riparian meadows in late summer.

The Hall Ranch meadow has large acreages of Kentucky bluegrass dominated grassland communities and mesic communities dominated by sedges; all highly preferred by cattle (Kaufmann 1982). The study meadows on Meadow Creek were dominated by stands of Douglas-fir/snowberry and Hawthorn/snowberry communities. These plant communities indicate more xeric conditions and hence decreased forage quality late in the summer. Cattle gains on the Meadow Creek meadows were still superior to even more xeric grasslands (Table 5) in most periods studied. Therefore, I think the potential for increased beef production during late summer and fall on riparian meadows compared to adjacent upslope areas is dependent on the community structure of both the riparian meadow and the adjacent upslope pastures.

Beef production potential on riparian meadows can be evaluated by the plant communities present and their specific acreage on the meadow. A late summer inspection of the area in question observing plant phenology on the meadows and upslope would also assist in estimation of potential beef cattle production. Minimum practical size for grazing of meadows also must be addressed. This decision would have to be made on a case by case basis, but probably should provide at least 3 weeks of grazing for cattle.

Even if beef cattle production does not benefit from riparian deferment other considerations may make fencing feasible. For example, deferment of grazing to late summer allows ground nesting birds the opportunity to nest and fledge their young (Kaufmann et al. 1982). Plant cover is also maintained during early season, important if the area is used for fawning or calving. Deferment would also allow most plants to complete their annual growth cycle and create less impact on plant physiolgical functions.

Fencing riparian meadows may also enhance the ability to manipulate cattle grazing on adjacent uplands. As Krueger (1984) and Gillen et al. (1984a) pointed out, cattle given access to riparian meadows seldom venture into upland areas. Restriction of cattle from meadows should provide better distribution throughout the pasture and more uniform utilization. Holechek et al. (1981) developed a grazing system on the uplands surrounding the Meadow Creek meadows which restricted cattle to either south facing slope grasslands or north facing slope forested pastures depending on forage quality of each. Grasslands provided higher quality forage early in the grazing season and again in late summer and fall if adequate late summer moisture occurred to stimulate regrowth on the grasslands. Forests were grazed during mid and late summer. Cattle managed in this manner will out perform those allowed free choice of both community types. In 1982 cattle so managed were 25 pounds per head heavier at the end of the grazing season than those allowed free choice of both communities Vavra (1984) and in 1983 18 pounds heavier (Vavra and Bryant 1984)[1]. Integration of riparian meadow use in late summer or fall should also improve the system.

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IMPORTANCE OF PUBLICLY OWNED RANGELAND

TO THE OREGON CATTLE INDUSTRY

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During the summer and fall of 1983 a survey of Eastern Oregon livestock operators was conducted by Oregon State University with support from the United States Forest Service (USFS), the Bureau of Land Management (BLM) and the Oregon Cattlemen's Association. General characteristics of dependent rangeland livestock operations in Malheur, Lake, Klamath, Umatilla, Union, Wallowa, Crook, Deschutes, Jefferson, and Wheeler Counties were developed from survey results.

Ranchers were contacted by mail and/or telephone in a random manner. All of the interviewed operators held either a BLM license or a USFS permit. A total of 154 usable questionnaires were completed, of which 150 were solely cattle operations and four were either sheep or cattle/sheep operations.

Data obtained through the summary may be stratified by herd size, by county or county groups, by type of enterprise or by type of ownership. For the purpose of this paper, data are presented by counties with the exception of the mideastern counties of Jefferson, Deschutes, and Wheeler which are presented as a group due to small sample size.

Aggregate Characteristics of the Sample

In Oregon, there are approximately 1,474,280 animal unit months (AUMs) authorized for livestock use by the BLM and the USFS. In the ten counties covered by this survey, a total of 272,636 paid AUMs were represented. Of this total, BLM permits accounted for 187,171 AUMs of 20.7 percent of the total BLM authorized use in Oregon. USFS permits accounted for 62,281 AUMs or 11.0 percent of the total USFS authorized use in Oregon. The remaining 23,184 AUMs were attributable to state and/or other lands. The number of brood cows reported by the 154 ranchers surveyed totaled 64,857 head.

Forage Utilization

Forage usage data by counties are presented in Tables 1 through 8. Forage usage data by herd size categories will be

Total Percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Malheur County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM	.8	.8	2.0	54.0	62.7	44.9	45.8	45.4	41.4	32.0	2.7	1.5	28.9
Forest Service													
State			1.2	3.4	2.6	.7	.7	.7	3.5	8.6	7.2	2.2	2.5
Deeded Range	4.4	4.4	15.8	29.4	26.1	49.2	45.2	44.3	40.2	38.2	11.6	9.0	27.1
Deeded Meadow				5.7	5.5	3.2	3.2	3.3	4.2	4.3	5.6	5.8	3.4
Deeded Irrigated Pasture	.4	.4	.3	1.3	1.3	1.9	5.0	5.0	4.2	2.5	1.4	1.3	2.1
Deeded Aftermath	.4	.4	.3						5.8	14.4	42.2	19.3	6.6
Rented Range													
Rented Pasture													
Hay	94.0	94.0	80.4	6.2	1.8			1.4	.7		29.4	61.0	29.3
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Lake County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM	6.5	2.1	1.3	44.5	57.7	55.6	48.1	33.2	35.4	27.0	2.1	7.7	25.7
Forest Service					1.2	10.2	15.8	19.5	16.5	.8			4.8
State	7.1	7.2	9.9	6.4	9.1	2.4	2.4	2.5	2.8	2.3		.8	4.5
Deeded Range	1.9	1.6	1.8	8.6	10.3	7.6	10.0	16.7	20.3	12.7	4.2	2.7	7.7
Deeded Meadow	.7	.7	.7	.7	3.3	5.1	6.2	9.9	8.9	5.5	1.8	1.7	3.5
Deeded Irrigated Pasture				3.7	17.8	19.2	17.4	18.1	14.8	10.1	2.9		8.1
Deeded Aftermath	.8								2.1	20.8	61.4	13.2	8.5
Rented Range													
Rented Pasture													
Hay	83.1	88.4	86.3	36.2	.6					20.8	27.6	73.9	37.2
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total Percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Klamath County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM				1.2	26.1	13.6	6.7	8.1	7.7	8.6			5.8
Forest Service		6.5	6.5	6.2	10.5	14.8	20.1	20.1	20.4	7.6			9.3
State													
Deeded Range	6.4	6.5	6.5	8.1	25.7	34.1	34.2	33.0	23.6	10.9	7.3	6.4	16.7
Deeded Meadow				2.7	18.8	19.2	17.7	17.7	17.6	9.6	5.5		8.9
Deeded Irrigated Pasture				7.9	18.6	18.2	21.3	21.2	18.5	9.1	2.4		9.6
Deeded Aftermath	3.2								12.2	54.2	64.6	4.1	10.9
Rented Range													
Rented Pasture													
Hay	90.5	87.0	87.0	73.8	.2						20.3	89.5	38.8
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total Percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Jefferson/Wheeler/Deschutes Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM	1.3	.23	.23	16.8	24.5	27.9	16.3	8.5	4.5	9.8	16.1	11.9	11.3
Forest Service					3.1	15.0	18.1	18.5	22.6	6.4			6.5
State													
Deeded Range	16.9	1.4	4.3	45.3	57.4	45.1	33.7	31.8	25.1	22.3	26.7	15.5	26.5
Deeded Meadow				2.5	2.6	.76	8.3	8.3	5.3	4.6			2.6
Deeded Irrigated Pasture	6.4			.17	6.6	11.3	23.6	32.9	41.3	32.1	17.9	16.0	14.5
Deeded Aftermath	1.5								1.2	9.9	24.6	21.4	4.6
Rented Range													
Rented Pasture													
Hay	73.9	98.4	95.4	35.3	5.9					15.0	14.7	35.2	34.0
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total Percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Crook County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM			1.7	19.1	25.9	27.7	21.3	10.9	7.0	5.6	6.9	3.8	11.3
Forest Service					2.7	9.1	16.6	17.5	11.4	.4			5.2
State					.2	1.6	1.6	1.6	1.8	1.9	2.1	2.0	1.1
Deeded Range			.1	51.1	62.7	49.1	47.4	55.7	48.1	44.5	52.4	21.7	36.7
Deeded Meadow					.2	1.1	1.1	1.1	1.2	1.2	1.4		.6
Deeded Irrigated Pasture				1.1	8.3	11.3	12.0	13.0	12.5	18.4	13.6	12.3	8.6
Deeded Aftermath	3.0	3.0	3.0	1.5				.3	17.9	28.0	21.8	10.8	7.0
Rented Range													
Rented Pasture													
Hay	97.0	97.0	95.2	26.7							1.9	49.5	29.6
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total Percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Wallowa County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM				.27	.61	.59	.59	.59	.70	.91	.19		.37
Forest Service	5.5		5.3	18.0	34.4	35.9	32.8	30.2	35.8	45.9	22.7	12.7	23.0
State													
Deeded Range				29.8	40.0	45.0	53.4	56.0	54.1	40.2	42.6	21.8	31.9
Deeded Meadow				3.5	9.8	9.8	9.8	9.8	8.3	10.7	7.7		5.8
Deeded Irrigated Pasture					14.9	8.8	3.4	3.4	1.1	1.4			3.0
Deeded Aftermath	5.7									.91	13.0	46.5	4.9
Rented Range													
Rented Pasture													
Hay	88.8	100	94.7	48.4	.29						14.0	19.1	31.1
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Umatilla County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM							1.2	1.2					.19
Forest Service					1.8	19.5	28.2	29.0	31.9	15.7			10.1
State													
Deeded Range	6.2	7.2	29.0	58.3	87.4	71.0	59.9	58.8	56.0	65.2	58.1	44.3	49.7
Deeded Meadow						1.2	2.4	2.5	2.7	1.3			.81
Deeded Irrigated Pasture			4.3	7.0	7.9	8.0	8.0	8.2	9.0	5.4	1.4	1.3	5.0
Deeded Aftermath	26.0	11.4	12.4	18.2	1.6					12.0	27.4	31.1	11.8
Rented Range													
Rented Pasture													
Hay	67.8	81.5	54.3	16.5	1.4	.28	.34	.35	.39	.38	13.2	23.3	22.3
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Total Percentage of the Herd's Roughage Needs Met by Various Sources Per Month: Union County Permit Ranchers.

Forage Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	TOTAL
BLM				.26	.38	.58	.82	.82	.82	.51	.22		.39
Forest Service						11.9	26.8	26.8	26.8	7.1			9.2
State											9.9	29.3	3.0
Deeded Range			16.7	23.4	70.1	65.2	50.0	50.0	50.0	68.8	35.8	16.7	38.5
Deeded Meadow					9.0	2.3	2.3	2.3	2.3	2.5			1.9
Deeded Irrigated Pasture					20.0	20.0	20.0	20.0	20.0				9.4
Deeded Aftermath	8.6	8.6	8.6	9.2						21.1	41.6	7.6	7.8
Rented Range													
Rented Pasture													
Hay	91.4	91.4	74.7	67.2	.55						12.5	46.5	29.8
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

available in a forthcoming OSU Extension Service Special Report (August 1984).

Lake County exhibited the highest overall degree of public land dependency with an average annual dependency rate of 35.0 percent. Malheur County was second with an overall average annual rate of 31.4 percent.

The southeastern counties of Malheur, Lake and Klamath displayed the highest dependency on public land forage supplies in the months of May (62.7 percent) and June (54.7 percent). In May, 56.7 percent of these three counties forage needs was provided on BLM land. Forest Service land provided 1.7 percent and state and/or other lands provided 4.3 percent of total May forage needs. In June, the percent of forage provided on BLM land dropped to 47.0 percent while Forest Service lands contribution increased to 6.3 percent.

Moving further north to the mideastern county of Crook and the combined county group of Wheeler/Deschutes/Jefferson, the peak months of dependency occur one month later in the year [June (40.3 percent), July (37.5 percent)]. In June, BLM land provided 27.8 percent of forage needs, Forest Service land 11.5 percent, and State and/or other lands slightly less than one percent. In July, the percent of forage provided by U.S. Forest Service lands increased to 17.2 percent while BLM land contribution dropped to 19.3 percent.

Again, as the geographical location of the counties moves further north, the peak months of dependency on public lands occur later in the year. In the northeastern counties of Wallowa, Union and Umatilla, the highest levels of dependency occur in July (30.8 percent) and August. In July, U.S. Forest Service lands contributed 30.0 percent of the samples' livestock forage needs while BLM land contributed only .8 percent. In August, U.S. Forest Service land while BLM contribution remained at .8 percent.

Conclusions/Forage Dependency

Taking a look at the county forage usage percentage tables it becomes apparent that it is not relevant how much forage is produced on an annual basis, but how available the forage is at various times in the grazing season. In other words, the value of the forage is determined by the need at a point in time, rather than over an extended period of time. For example, increasing the amount and availability of public land forage to ranchers in Union County in the month of May would be of little significance (see Table 8). However, increasing the amount available in the summer months would be expected to have significant impact on Union County ranching operations.

Thus, the point that needs to be emphasized from an economic point of view is that the value of an AUM is not constant across months (time) or space (location). Value is a function of when and where, as well as how much, forage is available to domestic livestock.

General Characteristics

Along with forage usage data, information about ranching operations also was obtained. Table 9 lists these various optional characteristics by counties.

Two relationships stand out in the referenced table. First, there appears to be an inverse relationship between calving rate (calves weaned versus cows on hand at beginning of calving season) and extent of public land dependency. Lake and Malheur Counties which exhibit the highest degree of dependency on public lands (35.0 percent and 31.4 percent) also exhibit two of the lowest calving rates (83.4 percent and 81.9 percent, respectively). On the other hand, Union and Umatilla Counties which are the least dependent on public lands report the highest calving rates (88.3 percent and 91.8 percent, respectively). Wallowa County is the exception in this case ranking third with respect to dependency on public lands but showing the second highest calving percent of 89.1 percent.

Also apparent is an inverse relationship between weaner weight (at time of sale) and the extent of public land dependency. Again, Malheur and Lake Counties show relatively light weaning weights, 479 and 641 pounds, respectively. Umatilla County, however, displays the heaviest weaning weight of 576 pounds. Union County is an exception to the apparent relationship exhibiting both a low degree of dependency on public lands and a light weaner weight of 427 pounds.

Although these two relationships appear to fall out of the data, a causal relationship is not necessarily implied. Many other factors may play significant roles in determining calving rates and weaning weights. Such factors may include marketing strategies, herd management practices, cattle type, range type and condition in general on both private and public lands. However, it appears that as public land dependency increases the average total cost per unit of sales also increases.

SUMMARY SHEET

County	Number of Rancher's Surveyed per County	Average County Herd Size	Average Permitted Paid AUMs	Exchange of Use	Average Permitted Paid Forest Service AUMs	Exchange of Use
Malheur	35	393.1 (281.87)	2122.0	114.8	0	0
Lake	28	439.0 (390.20)	2242.5	184.1	395.9	29.5
Klamath	15	334.4 (261.74)	280.5	57.0	307.0	23.0
Union	7	324.0 (201.69)	16.4	6.4	318.8	0
Umatilla	9	320 (155.20)	27.8	7.1	222.3	15.6
Wallowa	17	250.9 (350.91)	81.8	0	770.7	31.8
Jefferson, Deschutes, & Wheeler	15	449.5 (465.41)	1570.0	117.1	240.2	0
Crook	24	322* (343.9)	721.3	39.3	508.7	3.7

* excluding 2 large operations

SUMMARY SHEET (continued)

County	Average Cow Culling Weight	Average Bull Culling Weight	Average Replacement Rate	Average Cost of Hay Raised	Average Cost of Hay Bought	Average Percent of Hay Raised
Malheur	979.1 (73.80)	1512.6 (218.94)	15.3% (4.59)	$34.31 (13.15)	$67.50	94.67% (11.34)
Lake	1010.2 (118.95)	1490.0 (188.90)	15.7% (5.6)	$41.54 (17.15)	$68.33	97.30% (6.75)
Klamath	1005.4 (84.42)	1662.5 (166.37)	19.88% (7.51)	$39.38 14.24	$66.00	96.21% (7.51)
Union	985.0 (48.48)	1590.0 (184.39)	15.3% (3.0)	$38.14 (15.84)	$65.00	94.45% (13.61)
Umatilla	1067.5 (105.07)	1711.0 (151.25)	16.10% (6.68)	$49.78 (13.48)	$79.50	63.95% (41.88)
Wallowa	1021.1 (78.49)	1427.0 (286.08)	15.56% (5.58)	$47.31 (10.92)	$61.00	50.51% (40.31)
Jefferson, Deschutes, & Wheeler	959.2 (66.40)	1396.6 (299.69)	16.0% (4.05)	$48.29 (13.35)	$59.00	83.89% (26.74)
Crook	993.83 (109.24)	1488.0 (170.38)	18.8% (12.37)	$49.71 (7.11)	$75.00	92.28% (16.03)

SUMMARY SHEET (continued)

County	Average Permitted Paid State AUMs	Exchange of Use	Average Permitted Paid Other AUMs	Exchange of Use	Average Calving Rate 1982	Average Weaner Weight	Average Yearling Selling Weight
Malheur	154.3	37.3	2.8	8.5	83.4% (10.70)	479.0 (78.01)	697.0 (309)
Lake	232.1	58.9	91.0	0	81.9% (9.56)	461.5 (60.63)	727.5 (78.05)
Klamath	0	0	0	0	81.4% (14.7)	476.4 (31.51)	672.40 (76.54)
Union	35.7	0	0	0	88.32% (8.0)	427.3 (73.52)	643.6 (139.84)
Umatilla	2.2	2.2	0	0	91.8% (6.13)	576.3 (47.44)	789.4 (75.86)
Wallowa	0	0	0	26.2	89.1% (9.09)	509.0 (85.10)	768.0 (94.09)
Jefferson, Deschutes, & Wheeler	28.3	0	0	0	84.7% (9.98)	477.7 (49.78)	751.2 (64.44)
Crook	61.0	0	0	0	88.3% (8.27)	468.9 (30.12)	718.2 (97.22)

BRIDGING THE MANAGEMENT GAP

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(This is a condensation and interpretation of Dr. Thomas' remarks. Editor, T. E. Bedell)

The multiple use concept for federal lands was legalized in 1960. What managers have been trying to accomplish was integration, but it was termed multiple use. This could not really be practiced until land use planning was done and this was not mandated until both the Federal Land Policy and Management Act and the National Forest Management Act were passed in 1976. When the multiple use concept was first introduced, it was assumed that conflicts could be avoided.

That turned out not to be the case. As a people, we can view conflict and the ability of the resources to support us in different ways. Can we, or if we can, should we make a bigger resource pie? Or, should we merely reallocate or subdivide the current resource pie in different ways? These are vastly different perspectives requiring compromise.

Land use planning, whether in the riparian zone/watershed context of this short course or whether focused on other resources, holds the key to rational use. More knowledge through research about consequences of various management actions will be necessary. However, even more knowledge will not necessarily overcome political inertia because that depends upon who is in charge of policy and regulations within and among the agencies involved. Custom and tradition or "business as usual" are strong factors which have to be recognized and dealt with in positive ways.

The principle of equity with public land resources should be addressed. Who wins and who loses, or who gains and who pays are matters not easily reconciled when brought to the local level. In the time and space microcosm in which each individual functions, there may necessarily always be unresolvable inequity.

In that light, the only solution lies with cooperatively setting management objectives which are based on verifiable research results and on solvable problems. The management gap will best be bridged that way.

LIVESTOCK GRAZING AND THE RIPARIAN ZONE

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Riparian zone management as related to grazing by domestic livestock receives a large amount of attention. Little doubt exists that poorly controlled livestock distribution can have profound effects on vegetation, streambanks, streamflow, water table characteristics, wild fauna of all types, recreation, and aesthetics. My purpose is to briefly review recent research contributions, primarily from Oregon.

Riparian zones are those areas associated with streams, lakes, and wet areas where vegetative communities are predominately influenced by their association with water. Thus, they obviously will surround perennial streams and lake/reservoirs, but also will be along ephemeral streams and in other water run-in areas. Native wet and semi-wet meadows are examples where water table effects can greatly affect quantity and quality of vegetation and dependent fauna. Grazing animals, whether domestic or wild, affect a number of things. Although for research purposes, effects on specific ecosystem components, eg. streambanks and adjacent vegetation may be compartmentalized, in fact, they are usually not separated. Animals graze, walk, run, stand, mill around, lie down, defecate and urinate. All have different effects, yet all are intertwined. The effect of defoliation may be studied, but the animal had to stand near the plant in order to have the grazing effect. Therefore, the pressure of its weight can have effects on soil compaction under specific soil moisture conditions and no effect under other conditions.

Riparian zones definitely are ecologically more complex than upland areas. Therefore, any single management practice can have different effects on different plant communities. In the western states there are approximately 4 million acres of meadows associated with riparian zones; 52% are federally owned and 48% privately owned. These areas are commonly 1-2% of a grazing allotment, provide 3 to 16 times as much forage as on adjacent uplands, are exposed to domestic animal stocking rates 5 to 30 times those of adjacent uplands, and may provide as much as 80% of all the forage actually grazed from an allotment. Average stocking rates on federally owned riparian influenced areas are 1.2 acres per AUM, but they are 50% higher (.8 acre per AUM) on the privately held land. No data exist to show whether privately held meadows are more vegetatively productive.

Riparian zones possess a number of attributes that are conducive to their occupation by large numbers of animal species. Thomas (1979) stated that of the 378 terrestrial species known to occur in the Blue Mountains of Oregon, 285 are either directly dependent on riparian zones or utilize them more than other habitats. The major attributes relate to plant community structure, the available vegetation to be grazed, topography, and microclimate. As an example, forage plants are green longer, therefore, maintain higher nutritive value longer. A high percentage of the riparian plant species appear to be preferred by grazing animals. Since there is more plant biomass, at least when not overgrazed, it takes animals less time to get their daily intake. There generally is more plant regrowth. Use on riparian areas is confounded by the effects of slope amount and length, but generally not much by aspect. The primary exception is less use on north slopes in the autumn. Preferred species on a 40% slope one-half mile from level were grazed only one-half as much as on a 20% slope the same distance from the level (Glendening, 1944). Microclimate factors relate to temperature, primarily shade in summer and cold air movement in spring and fall.

Livestock or wildlife grazing of riparian areas, if not carefully controlled, can (1) change waterfowl and other bird species composition benefiting some and harming others as the vegetation changes, (2) increase small mammal diversity but decrease their abundance of total biomass and (3) decrease diversity and abundance of invertebrates (Skovlin, 1981).

Because each riparian system is unique, the results of any research study also are unique to that system. Consequently, extrapolation of results can be hazardous without some means of verification.

<u>Streambank Effects</u>

Livestock certainly can impact streambanks and directly affect their erodability. However, as with any other grazing animal related impact, the effect itself is strongly influenced by the numbers of animals and the time spent on riparian zones. Not all studies give similar results. For example, on Meadow Creek in northeastern Oregon, Buckhouse (personal communication) found that 5 continuous years of seasonlong use resulted in significant increase in bank loss when compared to no grazing, occasional, (1 or 2 years) seasonlong use, and late season grazing. Other grazing schemes were not significantly different after 5 years of use. At the same time, Buckhouse et al. (1981) stated that overwintering processes associated with high water and ice floes were agents that were at least as important in streambank erosion as the perturbations associated with livestock. Hayes (1978) in the Idaho batholith felt that rest rotation grazing did not significantly alter channel movement in meadows and in fact degradation during spring discharge along ungrazed streambanks was significantly greater than along grazed streambanks.

Kauffman et al. (1983a) studied effects of August and early September grazing at 3.3 acres per AUM on the banks of Catherine Creek in northeastern Oregon. In their study, grazed areas had significantly more streambank loss compared to areas not grazed (27 cm mean annual loss as compared to 9 cm). Because the exclosure design limited access to the creek as compared to the pre-experiment conditions, they felt the observed effects were more a result of meters of accessible streambank per AUM than they were of the stocking rate per se. Catherine Creek is a rather active stream and the banks do erode regardless of grazing. High water and ice floes cause a great amount of disturbance but there were no differences between the grazed and ungrazed areas during the 10½ month nongrazed period. Bank undercutting was significantly less in grazed areas and there was more bank sloughoff in the grazed areas during the grazing period but not thereafter.

Conclusions from these studies suggest each stream systems' complexity. Cattle grazing at moderate to light stocking rates can cause streambank loss. Not studied were the effects of these losses on the stream itself or on the productivity and stability of whole riparian areas themselves.

Vegetation Effects

Effects on riparian area vegetation from different durations and intensities of grazing are not clearcut at all. Generally, intensities of grazing are more important than grazing systems as an influence (Skovlin, 1981). Volland (1978) found when Kentucky bluegrass was rested from grazing annually, that it improved productivity for the first 6 years. Thereafter for the ensuing 5 years, the productivity declined. This suggests high adaptability of the bluegrass to grazing under a scheme other than deferment.

Because the ecology of riparian areas is complex, vegetation responses also can be expected to be different. Kauffman et al. (1983b) found large differences in cattle use depending upon the riparian communities. Species composition changes may also be expected, eg. a decline in timothy when grazing ceased. Species diversity declined in the short term after grazing ceased. Because environmental factors would be different without grazing over time, it is possible for species diversity to improve, but that could not be measured in their study. Forage production will be a function of year effect and relative species abundance.

Woody plants often are cited as being especially sensitive to cattle grazing. Kauffman et al. (1983b) felt that woody plant succession was probably being retarded even by late season grazing. When considering that herbaceous plants may be declining in palatability during late season, whereas, shrubs may not be making quite as rapid a decline, it would follow that some shrub use could occur. Kauffman et al. (1983b) pointed out that their observations and others cited by them were inconclusive, but generally suggested that late season grazing use of shrubs would not be detrimental when sufficient herbaceous vegetation was available in the riparian zone. Roath and Krueger (1982) found on Camp Creek that use of shrubs was quite different in successive years.

Kauffman et al's. (1983b) recommendations were that as long as approximately 10 cm of herbage growth height occurred, there would be no grazing of shrubs except those that are highly palatable. When stubble height is less than 10 cm, a definite shift in preference to the less palatable shrubs will be likely to occur.

Another effect of grazing not often measured is that of phenological stage. Ungrazed moist and dry meadow plant species started growth later in the spring and matured later. Considerable litter build up can occur when riparian plant communities are ungrazed. Such litter accumulations probably keep soil temperatures cooler later in the spring (Kauffman et al., 1983b).

Gillen (1984) made an extensive study of seasonlong (June-October 15) and an early-late (June-July versus August-October) grazing system along the main stem of the John Day River in east central Oregon. The riparian zones were not separated from the uplands. He found an average of 75% utilization of vegetation in the riparian area but never more than 16% use of the upland vegetation at any time. This verified Roath and Krueger's (1982) earlier findings. Stocking rates were roughly equivalent but the stock density in the early-late pastures was twice as much. Since cattle preferred riparian areas regardless of season, the amount of forage left at the end of the season in October was very little different regardless of grazing management practice. During the early period, cattle used the areas primarily as a forage source, however, as the summer wore on, other factors appeared to influence livestock. The study suggested that cattle ate all they could. No regrowth opportunity was allowed in either the early grazed or the seasonlong pasture. Kentucky bluegrass was well adapted to either grazing strategy. Over the season at large, forage production declined to lower levels in the riparian areas as compared to uplands. Most of the cattle remained on the meadows to suggest less daily intake and, therefore, less daily performance. Another possible result could be higher susceptibility to acute pulmonary emphysema, since some research points toward a preconditioning effect of energy intake restriction in late summer range (Elliott, 1975).

Another study in the southwestern Blue Mountains of Grant County, Oregon, documented cattle behavior and effects on vegetation (Roath and Krueger, 1982). This was a U.S. Forest Service allotment in which the riparian zone consisted of 1.9% of the total area but produced 21% of the total forage (11 times as much on a unit area basis). Dominant herbaceous vegetation was Kentucky bluegrass which over the duration of the study tolerated 72-76% annual utilization. Roath and Krueger (1982) found a high preference for meadows by most cattle but, interestingly, did observe that certain cattle consistently stayed out of the riparian areas on the uplands regardless of weather and forage conditions. This suggests something about home range phenomenon. Gillen (1984) found home range phenomenon also, but not a preference for upland. Roath and Krueger (1982) also noted that as forage on the riparian zones became limiting, cattle would move off the zone to a limited extent. The effect was a delayed one. Gillen (1984) did not find this effect.

Roath and Krueger (1982) determined that willows were definitely preferred in relation to their availability (an average over 2 years of 35% eaten compared to 23% available). The converse occurred with alder where an average of 49% was removed, whereas, 59% was available. Shrubs such as rose, snowberry, and currants were eaten in approximately the same proportions as they occurred. Shrub use in the Roath-Krueger study was related both to availability and the relative preference of the grasses. For example, they found examples of both high shrub use and poor herbaceous condition and low shrub use and favorable herbaceous regrowth during late season grazing.

Management can have positive effects on cattle behavior and preference. As examples, Gillen (1984) found a rank preference order of riparian zone over sites which had been logged and seeded over grassland sites. Some variation occurred dependent on the forage species seeded in the logged areas. However, if the season of use could be early, then the grassland sites would be preferred. This would suggest that management of time in terms of both season and duration can have a beneficial effect. Gillen's recommendations for improving cattle distribution to alleviate impacts on riparian areas in a forested setting included seeding logged areas to forage species, placement of salt close enough together vertically in terms of elevation, development of trails especially to obtain use on slopes exceeding 10%, and using an aggressive riding strategy. Gillen concluded that a grazing system *per se* will not affect meadow use if such use is already high. Grazing systems are probably more important in maintaining riparian ecosystem health than as a means to rehabilitate streamside vegetation (Skovlin, 1981).

Conclusions

In order to achieve clear-cut objectives which enhance riparian area vegetation and soils, stream stability, and other faunal considerations, grazing by cattle will have to be managed more carefully than it has been in the past. Most riparian areas tend to be highly resilient. Unless disturbances are very severe, whether from cattle grazing or other perturbations, riparian areas should maintain themselves in a more or less static condition. For example, it has been 20 years since the Fish Pasture on Camp Creek in the Malheur National Forest of Oregon was fenced. Cattle were excluded for four years and then allowed to graze at a moderate level in late season. Conditions continue to improve since 1968.

All of these studies point to the need for clear objectives to be formulated. Since each riparian situation is part of a whole system, managers need to carefully assess a number of factors before they can make a prescription. Some of these factors are: (1) how badly damaged is the situation? (2) how rapidly is restoration desired? (3) if grazing by livestock is to be excluded, at what point can it be used in habitat manipulation? and (4) what are the critical values for recreation, fisheries, and other wildlife habitat uses (Skovlin, 1981)? With accurate answers to these questions, applying one or more of several approaches has a high probability of success.

The alternatives to be considered have to be evaluated in light of management objectives. Some alternatives are: (1) do nothing, (2) improve livestock distribution for greater upland use within the existing system, ie. reduce use on riparian zones, (3) change season and/or time of use, (4) implement specialized grazing seasons or systems for restoration of riparian zone and improved distribution in the upland, (5) rest entire grazing unit for 5 years or until target levels of recovery in riparian zone have been achieved, (6) fence meadow flood plain for controlled use of entire riparian zone environment and consequently the uplands, (7) fence streamside corridor for complete habitat preservation and provide access to water where needed, (8) combinations of two or more of the above solutions, (9) revegetate with woody cover and apply 5 and 6 or 7 or (10) eliminate grazing.

If some overriding concern dictates an elimination of grazing, then at least all options would have been considered. Most objective observers have seen both good and poor examples of livestock management in relation to riparian zones. Tools generally exist to correct poor management. Livestock control is one main tool. Nothing but good will result when approached positively.

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COMPATIBILITY OF LIVESTOCK GRAZING STRATEGIES WITH RIPARIAN-STREAM SYSTEMS

William S. Platts

INTRODUCTION

The chief goal of any specialized livestock grazing management strategy is to maintain or improve livestock production, while simultaneously maintaining or improving rangeland conditions. This is primarily done by controlling the numbers, kind (cattle or sheep), class (calves, steers, cows), and distribution of livestock. Commonly used grazing strategies, however, were principally developed to achieve these goals on non-riparian grasses and forbs (Heady 1975). Therefore, the application of these strategies to enhance riparian habitats has generally been unsuccessful.

Meehan and Platts (1978) and Platts (1981) were unable to identify any widely used livestock grazing strategy that was capable of maintaining high levels of forage use while rehabilitating damaged streams and riparian zones. One reason was that range management practices historically combined different vegetative habitats into one management unit. Another reason is the natural attraction of livestock to riparian zones. Range managers have had difficulty developing grazing strategies that improve the unbalanced animal distribution pattern that develops when livestock are free to preferentially concentrate in riparian zones. Therefore, special management of riparian and stream habitats has been difficult to achieve.

Better riparian management is important because streamside vegetation and streambanks provide habitat for terrestrial insects, which are an important part of the fishes' diets. Streamside vegetation provides direct organic material to the stream, which makes up about 50 percent of the stream's nutrient energy supply for the food chain (Cummins 1974). The stream detritus formed from incoming terrestrial plants is a principal source of food for aquatic invertebrates that eventually become food for fish (Minshall 1967). Streamside cover also provides cover, which may be the most fragile and important element affecting a fishery.

Some researchers including Holcheck (1983) have found little difference in cattle performance and diet quality between the different grazing strategies (season-long continuous versus rest-rotation). This reduces the economic incentive to change from a poor riparian grazing strategy to one that would be more beneficial to the riparian habitat. The political, social, or economic considerations do not always give environmental concerns proper weight in the decision-making process. Holcheck (1983) found that during the last 5 years grazing strategies have been a major focus of range research and management, yet we still lack an analysis of the conditions under which individual grazing strategies give best results.

This report addresses commonly used grazing strategies with respect to how they affect riparian-stream conditions and, in turn, the fishery, and offers some preliminary solutions. Methods used in these studies are described in Platts and others (1983).

GRAZING STRATEGIES

Continuous (Summer-fall)

The continuous grazing strategy allows the same area (pasture) to be grazed annually and at the same time throughout the grazing season. In the Intermountain Region this is usually from about June 15 to November 1. Because livestock selectively graze preferred plants and streamside zones more heavily than the remainder of the range, these preferred areas are generally overused with this strategy.

Our research on Tabor Creek, Nevada, (Platts and others, in press) and Big Creek, Utah, (Platts and Nelson, in press a) showed that once sites were released from cattle grazing, the quantity and quality of the riparian vegetation dramatically improved, streambanks became more stable, and stream channels became narrower. These improvements resulted in a deeper water column and more cover; thus, more favorable conditions for fish survival resulted. On Tabor Creek, termination of grazing reversed the degraded condition and streambanks rebuilt themselves. Vegetative cover overhanging the water column was 11 times greater in the released area than in the grazed area. The continuous strategy that calls for annual summer and fall grazing can reduce streambank cover during the following winter and spring, exposing the soils directly to ice flows and floods. These two studies demonstrate that under heavy continuous grazing in summer and fall, streamside zones will be degraded. We presently have five study areas that historically used the continuous cattle grazing strategy at moderate to high intensity, and none suggest that this management scheme is compatible with the riparian-fishery habitat. The reduction in cattle stocking rates necessary under the continuous grazing strategy to counter the attraction of cattle to riparian zones would probably make the strategy uneconomical.

Continuous (winter)

Our Otter Creek study of winter and limited (mainly non-use) spring continuous cattle grazing was initiated 4 years ago. Because of the short period of time since initiation of the study and inherent differences between grazed and ungrazed sites, it is difficult to conclusively evaluate winter grazing effects at this time. Because the sites have inherent differences, a time series analysis of changes that occur on the sites must be used for comparison, rather than to determine differences between sites. The information so far suggests that winter continuous grazing (December 20 to February 28) is reasonably compatible with aquatic and riparian habitat needs (Platts and Nelson 1983b). Little change has been observed in the ungrazed sites with respect to the grazed sites, except that willow is beginning to re-establish itself in the ungrazed site. Winter grazing under these circumstances is compatible with good channel morphology and streambank stability, possibly because the streambanks are frozen during most of the grazing season, leaving them less susceptible to trampling, and the forage is harvested during the plant dormancy period.

Continuous (holding)

Our Horton Creek study site has been grazed by sheep under a holding strategy (similar to season-long continuous, with some summer rest) since the late 1890's. Since the closure of an adjacent sheep driveway in the 1960's, the holding strategy now includes grazing sheep on the meadows in late spring until higher elevation pasture lands are ready, and grazing again in early fall while awaiting shipment. Under the holding strategy, Horton Creek within the grazed area became 4 times wider, one-fifth as deep, and had 15 times greater streambank alteration. The quality of the riparian habitat decreased in the grazed area as compared to the lightly grazed area (Platts 1981). Like cattle grazing, heavy sheep grazing under this type of a continuous grazing strategy is not compatible with healthy riparian-fishery habitat.

Deferred

Deferred grazing strategies delay the grazing season to some pre-selected time, such as waiting until seeds of the key species are mature. Holcheck (1983) found that vegetation response under deferred grazing was superior to season-long continuous grazing in the Blue Mountains of Oregon. Deferred grazing shows some promise because it is reported to work best where considerable differences exist between the palatability of plants and the convenience of areas for grazing (Holcheck 1983). If this is so, deferred grazing offers promise for balancing grazing use on the the preferred streamside zones with use on the less palatable upland vegetation. Deferred (in a two-pasture strategy) also offers the opportunity for seed production every other year and increased plant vigor.

We have only one area under study where deferred grazing is the strategy presently being used, and at this time we are capable of making only preliminary interpretations. In the Gance Creek study area, we believe that the previous season-long continuous strategy was not favorable to the riparian-stream habitat. More time is needed to determine if the deferred (early first year, late following year) strategy will correct this situation.

Rotation

Rotation grazing, like deferred, requires the movement of livestock from one area or pasture to another. Rest-rotation grazing allows one area or pasture to receive a scheduled amount of rest from grazing, usually for one year, while the remainder of the pastures support the grazing use.

Sheep

Our two Frenchman Creek study sites have been grazed by sheep under a three-pasture rest-rotation strategy since 1967. After 8 years of study we see no significant changes in trends of any of the environmental factors measured. The stream and its riparian zone were in a healthy condition and no significant changes were observed between the grazed and ungrazed pastures. Good management (proper herding, intensity, and timing) is the probable reason for the maintenance of the high-quality stream habitat. Herding allowed light forage use on streamside zones after the banks had dried out. This strategy could be useful throughout the Rocky Mountains and Sierra Nevada.

Cattle

Cattle, which are usually not herded, use riparian forage at higher rates than upland forage (Platts and Nelson in press b). Holcheck (1983) stated that the benefits from rest in a rest-rotation strategy may be nullified by the extra use that occurs on the grazed pastures. Our studies tend to support his statement when use of the riparian forage is heavy. A three-pasture rest-rotation strategy can, however, leave a vegetative mat on the streambank on 2 out of every three years; 1 year during early grazing and the other during the rested year. The condition of the vegetative mat during ice flows and floods greatly influences the stability of the streambank.

A double rest-rotation grazing strategy (1-year grazing, 2-years rest) was used with good success on pastures surrounding our Johnson Creek, Idaho, study site (Platts 1981). Good riparian habitat conditions were maintained. The single rest-rotation strategy (1-year's rest out of three) appears to be successful if grazing intensity of riparian zones can be maintained below 25 percent (Platts 1981). This is not always feasible with many of the commonly used grazing strategies because it would call for drastic cuts in stocking rates. In the Idaho study areas, where cattle were grazed under a rest-rotation strategy in high-elevation meadows, the use of streamside forage was 8 to 12 percent greater than on adjacent range. Consequently, if the goal of the range manager was to graze the allotment at moderate grazing intensity, the streamside zone could easily receive heavy use. The grazing on the Otter Creek, Utah, exclosure study area is really an alternate-year rotation grazing system wherein the two pastures are grazed during alternate years (Platts and Nelson 1983b). It appears that these sites have improved since grazing was changed from the continuous grazing strategy.

Our interpretation of the effects of rest rotation grazing on streambank stability and morphology is preliminary at this time because change from such effects usually occurs slowly over time (Platts 1981). We introduced three-pasture rest-rotation cattle grazing into pristine pastures to examine the process of bank alteration (soil loss and vegetative condition). At the 65% to 80% use level, differences in streambank stability between grazed and ungrazed ranges began soon after cattle began grazing. After 3 grazed years and 1 rest year, grazed streambanks were more altered than ungrazed streambanks, but not to the detriment of the fish populations. As the study continues, it will be determined whether rest-rotation grazing under selected grazing intensities will be compatible with or deleterious to streambanks to the extent that the fisheries will be affected.

Strategy plus Riparian Pasture

A special riparian pasture is a small pasture within an allotment set aside for management to achieve a specific vegetational response (Platts and Nelson in press c). The pasture includes the riparian-stream zone and a portion of the uplands. Grazing in the specially managed riparian pastures can be controlled much more effectively than in the large allotment pastures, offering an easier way to obtain the proper grazing needed for compatibility with other resources.

In our seven rest rotation experimental pastures (which function similarly to riparian pastures), 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 about 13 percent -- just the opposite of the typical allotment pasture discussed previously. 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 if cattle search for variety in their diet; also, all salting was done on the uplands. Cattle did have to go to the riparian zone to water because there were no upland watering sites. 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.

Strategy plus Corridor Fencing

Range management practices historically combined the different vegetative habitats into one management unit where all vegetation was treated alike. Range and fishery specialists have attempted to solve this problem by fencing riparian areas along streams to exclude livestock grazing. Fencing (two 100-foot corridors) costs about $6,000 per stream mile, with $60 - $200 maintenance costs per stream mile per year, and about 12 animal-unit months lost per stream mile fenced (Platts and Wagstaff in press). An increase of 47 fisherman days per mile per year would be required to balance the cost of fencing if recreational fishing were the only factor considered in an economic evaluation.

It has been well demonstrated that fencing stream corridors degraded by livestock grazing allows these corridors to rehabilitate into productive systems (Platts and Nelson in press a) and Platts and others (in press). The problem is the cost of fencing and loss of forage that accompanies this option. Therefore, it is a last resort but in some situations it may be the only effective solution.

DISCUSSION

At the present time, there is no commonly used grazing strategy that works in all situations. The strategy applied must be suited to the environmental needs of the resources within the allotment or pasture. It has been demonstrated that streamside forage can be overutilized under most of the common grazing strategies. Any system that excessively overgrazes one pasture or area in order to rest another can cause problems with other resource uses.

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

1. The inclusion of the riparian pasture as a separately managed resource.

2. Fencing streamside corridors.

3. Changing the kind of livestock (from sheep to cattle on certain ranges).

4. Adding more rest to the grazing cycle.

5. Reducing intensity of streamside forage use.

6. Controlling the timing of forage use.

These options require a change in management and will cost more money. On many allotments or pastures they may not be socially, economically, or politically acceptable. Therefore, the need continues to improve existing grazing strategies and develop new ones that are more compatible with riparian-stream habitat.

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RANGELAND EROSION

A QUESTION OF MEASUREMENT

by

Hugh Barrett

Today Keith Wadman and I are going to discuss rangeland erosion, a subject raised this morning by John Buckhouse in an excellent presentation.

John made a point that I would like to reiterate - riparian zones are a part of a watershed system and reflect the relative balance or stability of that system. Only by viewing an entire watershed from its crest to its mouth or discharge point can we hope to address the long term stability of that system - if that is possible.

In any discussion of soil erosion, whether on rangeland, forest land or in stream corridors, it is important to differentiate between the two major catagories of soil erosion - geologic and accelerated.

Without distinguishing between these, we are risking very costly and often futile attempts at erosion control.

Geologic erosion is a natural process in which a delicate balance exists between the rate of soil removal and the rate of soil development. With all other factors being equal, vegetation is responsible for maintaining this balance by reducing the impact of raindrops and retarding soil transport.

Accelerated erosion, on the other hand, occurs when this delicate balance is disturbed and soil loss exceeds the rate of soil development. This is commonly attributed to the activities of man. If we consider geologic erosion to be a process of soil maintenance, then accelerated erosion is a process of soil depletion.

Losses through soil erosion are not limited to the mineral fraction of the soil mantle but obviously include other constituents necessary in maintaining a healthy, productive and protective growing medium. Accompanying the soil particle in its displacement are certain amounts of organic material, nutrients and bacteria.

Whether erosion results from the action of wind or water - two things occur - the soil particle is detached (by raindrop impact in the case of water erosion or by saltation in the case of wind erosion), and secondly, the soil particle is transported from the site.

Let me reiterate that vegetation and its litter play a vital role in reducing the impact of raindrops or wind blown soil particles, and by decreasing the distance of transport.

A loss of this physical protection by whatever means exposes the soil surface to the unrelenting forces of nature.

Under this condition, not only is the rate of soil loss increased but because of soil crusting, which often occurs with the loss of organic matter, infiltration rates are reduced, runoff is increased and seedlings of protective vegetation find establishment difficult.

As things get worse, a spiral of lowered plant production, decreased plant vigor and diversity, reduced infiltration, and increased erosion ensues.

The soil surface is <u>the</u> point of vulnerability in the full completion of the hydrologic cycle. That is not to say that the hydrologic cycle would cease without soil, it would only be a lot more rapid and not nearly so complex. Soil's role in the hydrologic cycle is to capture and hold moisture for use by vegetation with any surpluses going to ground water recharge or maintaining surface flows.

With the deterioration of soil conditions in a watershed, and the rapid runoff and sedimentation that can occur, stream channels experience higher peak flows and decreased duration of flow. These wide fluctuations often cause severe stream channel erosion. The habitats or habitat elements of many life forms that depend on the stream are destroyed and often havoc and economic loss are created through downstream flooding.

We understand the process of erosion to a fair degree. We have made the connection between vegetation and soil stability and there is little question that accelerated erosion has serious on-and-off site effects.

But on rangeland, we have not been able to quantify soil loss with a great deal of accuracy.

Rainfall simulation has given us an idea of the amounts of loss we can expect from intense thunder storms but should we put all our eggs in the high intensity-low frequency basket in our manipulation and management of sites?

What of snowmelt, rain on snow or rain on frozen ground events? How extensive is the problem of subsurface compaction. We know that on cropland, plowpans will perch soil moisture and result in concrete ice conditions in the upper part of the soil profile. In the Palouse, soils in this condition "melt" during spring thaw and become slurry that is easily transported by gravity or rain.

A preliminary review by Soil Conservation Service in Oregon indicates that subsurface compaction may be rather extensive on rangelands.

In the semi-arid rangelands of the intermountain west, where precipitation ranges from 5 to 16 inches per year, soil development is slow. The tolerance of these soils to loss must be determined with a high degree of accuracy so that treatment alternatives can be selected that best meet the needs of the site.

This tolerance limit, when compared with measured erosion rates will go a long way in identifying critical rangeland erosion and those areas where limited money and manpower can best be spent.

We must also determine that link between soil and productivity or between soil loss and loss of productivity.

In conclusion, today we have the "luxury" of contemplating, measuring and decrying soil loss because we in this nation live in an age of "surpluses" (really just poor distribution but lets pretend surplus).

Soil loss fills the horizons of some today, but beyond our horizons, and whatever fills them, looms our final problem - the general loss of the productive capacity of our environment.

SOIL EROSION ON RANGE WATERSHEDS
A QUESTION OF MEASUREMENT

Keith Wadman[1/]

Accelerated soil erosion has long been recognized as a serious problem on many of our Eastern Oregon rangelands. This erosion is often quite visible and is characterized by a loss in range health and productivity, an increase in runoff, which causes higher stream peak flows and reduced low flows, and an increase in sediment loads that clog and damage streams and rapidly fill reservoirs.

The Soil Conservation Service has for many years been involved in a comprehensive program to reduce soil erosion in critically eroding areas. Considerable accomplishments have occurred, but because of the size of the problem, and the limited assistance available only a small overall reduction has been achieved.

In recent years the SCS has been placed under increasing pressure to develop a method that would quantify soil losses on rangelands. This information was needed so that we could relate actual soil loss with its associated damage within the watershed and to document how various rangeland improvement practices affected soil losses.

Our traditional method for measuring range health has always been by determining range site and condition. This technique does a good job of describing the condition and apparent trend of a rangeland but does little to quantify soil losses. Other attempts to measure soil erosion include the SCS ocular estimate and the BLM Soil Surface Factor methods. Both of these methods subjectively estimates soil erosion by evaluating such factors as plant pedestalling, surface pavementing, apparent soil movement, gully and rill formation and flow patterns. But while these methods provide a good indication of what is occurring at a specific location neither method provides quantities of soil being lost.

The Universal Soil Loss Equation is a tool that the Soil Conservation Service and others have used successfully to measure soil erosion on cropland. It was developed using a great deal of test data and provides an accurate measurement of soil losses on farmed soils. Because of our pressing need to be able to predict soil losses on rangeland and because other tools were not adequate for this purpose the SCS decided several years ago to adapt the USLE for use on rangelands. It was recognized that the USLE would need to be modified before it would provide accurate information on rangeland soils. This testing has begun in several areas but much work is left to be done.

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Some recent studies have indicated that there may be a direct relationship between range condition and soil erosion. If these studies are correct and if a procedure can be developed that will measure this relationship, it may be possible in the future to determine soil erosion rates by simply determining range site and condition.

An opportunity to field test the hypothesis that there is a relationship and to study soil erosion in greater detail exists as a part of the "Oregon Rangeland Erosion Target Area Program". This target area was selected for emphasis under a program developed as a result of the Resources Conservation Act (RCA) passed by Congress in 1977.

The target area includes the Oregon Counties of Wheeler, Grant, Jefferson and Crook. Its purpose is to improve the condition of the range watersheds and to determine the effects of conventional range improvement practices on them. Appropriate studies can be initiated to help accomplish these objectives.

A field trial is scheduled to begin this summer that will measure any relationship that might exist between range site, condition and their effect of soil erosion. This study is being developed in cooperation with Oregon State University and will be monitored by them.

The study will be a field testing of USLE to determine whether it is accurately estimating soil erosion on rangelands. Other data will be collected and analysed for their relationship to the USLE including:

1. Range Site and Condition.

2. Soils.

3. Slope; aspect.

4. Percent Utilization.

5. Foliar Cover.

6. Soil Surface Factors.

7. Simulated storm runoff quantities.

Our objective is to improve USLE as a working tool for measuring erosion on rangelands and to better understand the relationships of range health and improvements on soil losses.

The watershed surrounding any stream is a major factor in determining the condition of that stream. Many of the problems that we recognize within the stream channel itself are often just symptoms of a watershed in need of treatment.

MANAGEMENT OF THE RANGE WATERSHED

FIFTEENMILE CREEK RIPARIAN RECOVERY, WASCO COUNTY, OREGON

Jim Newton
Oregon Department of Fish and Wildlife
The Dalles, Oregon

Fifteenmile Creek is a small Columbia River tributary typical of a number of other small streams in North Central Oregon. The stream heads in the Mt. Hood National Forest just east of Mt. Hood. It flows northeast out of the timbered higher elevations before circling north through the dryland wheat country southeast of The Dalles.

The Fifteenmile Creek watershed encompasses 239,000 acres (Wheeler, 1975). Approximately half of the watershed is within oak/pine and fir forest ranging in elevation from 120 feet at the mouth to 6,525 feet on Lookout Mountain. The lower half of the basin is dominated by dryland cropland and open range. The average annual precipitation ranges from 10 to 45 inches in which about 80 percent occurs from October to March. The state engineer reported in the Fifteenmile Creek Basin Report that the basin annually produces approximately 149,000 tons of sediment. (Wheeler, 1975).

Historically Fifteenmile Creek supported populations of resident trout, steelhead and probably salmon. The tangle of riparian vegetation along its banks was prime habitat for upland game birds, furbearing animals, nongame wildlife and big game animals. However, during the past one hundred years this stream has felt the increased presence of man within the watershed. Valley bottoms were cleared and water was diverted for crop production. Increasing livestock numbers, combined with cultivation, fire and herbicides reduced or eliminated streamside vegetation. Peak stream flows increased in correlation with acres of dryland cropland cultivated and acres of forest harvested. As peak flow increased stream bank erosion became a common occurence.

Annual erosion prompted landowners to construct new stream channels so field erosion would be reduced and fields would be more regularly shaped to ease cultivation and irrigation. This practice resulted in a reduction of overall stream length and an increase in stream gradient. Unfortunately the shorter, steeper, unvegetated channel was also plaqued with annual erosion problems aggrevated by increased peak flows.

Wheeler, C.L. 1975. Fifteenmile Creek Watershed . Preliminary Investigation Report. State of Oregon, State Engineer. 24 pp.

The consumptive use of water from the basin, combined with a lack of riparian vegetation resulted in lower summer stream flow with elevated water temperatures. At stream mile 3.0 on May 31, 1975 the water temperature soared to 84° F., which is generally lethal for cold water fish species. By the mid 1960's the lower 20-25 miles of Fifteenmile Creek would no longer support trout or steelhead production. Extremely low summer flows, elevated water temperature, and heavy siltation made this stream reach inhospitable for desireable fish species.

In 1964 the Fifteenmile Creek watershed was ravaged by one hundred year - frequency flood. Following the flooding the Soil Conservation Service worked with private landowners to solve the flooding and erosion problems. The accepted corrective techniques at that time were to straighten the channel to speed the passage of flood waters and to remove streamside vegetation to prevent potential debris jams and associated problems. However, following the implementation of these practices many landowners discovered that the improved creek channel required repairs after each winter's high flows. In accuality the straightned channel accelerated stream velocity and this increased destructive force scoured gaping holes in adjacent cropland.

A second one hundred year frequency flood hit Fifteenmile Creek in 1974. Landowners again sought assistance to repair the damage and prevent future reoccurrences. The Wasco County Soil and Water Conservation District launched a search for funding assistance; while the Soil Conservation Service in cooperation with the Oregon Department of Fish and Wildlife and other agencies, evaluated the extent of the damage and considered acceptable remedial measures.

The various agencies agreed the best methods for stream channel stabilization were to slope vertical cut banks and seed with a grass mixture, armor vulnerable sites with rock riprap, construct rock check dams to reduce stream velocity, and fence the stream corridor to exclude livestock and encourage revegetation.

Proposed corrective practices were discussed with affected property owners. Their response was almost completely favorable. Some individuals indicated that they had become so frustrated with the annual attempts to stem the erosion that they were willing to try anything.

Shortly after the evaluation and preliminary planning was completed the soil and water conservation district received a federal small watershed restoration fund grant of more than $700,000 for corrective measures on several Wasco County streams. The program required no monetary committment from the property owners, since federal funding provided for all equipment, material and labor costs. The landowner's only obligation was to grant a temporary easement to permit construction activities on his property.

Private contractors under SCS supervision started the stabilization work during the spring of 1974 and the work was completed in 1975. Following completion of bank sloping and riprap placement, sportsmen from The Dalles Chapter of the Association of Northwest Steelheaders applied a grass seed mixture to more than ten miles of streambank in an attempt to speed the revegetation of exposed soil.

Sportsmen, Boy Scouts and several landowners also planted hundreds of trees and willow cuttings to hasten bank stabilization and stream shading. Table I summarizes the stabilization practices implemented on Fifteenmile Creek during this project.

Table I
1974 Fifteenmile Creek Project

Cubic yards riprap	Feet of livestock fence	Gradient control structures
70,371	82,482	22

Following the completion of the stream corridor fencing the problem of maintenance began. The landowners had no written obligation to maintain the sixteen miles of new fence, the stream fence crossings or the fenced livestock water access points. However, the ability of the stream corridor to revegetate was dependent upon protection from livestock grazing and trampling. Some of this maintenance burden has been undertaken by Oregon Department of Fish and Wildlife employees and members of sportsmen clubs in The Dalles. These individuals have assisted with needed fencing repairs during the spring months when normal farm operations are so demanding on the time of farmers and ranchers. This arrangement has not only led to some dramatic vegetative recovery and has helped to improve landowner-sportsmen relationships.

The level of stream corridor recovery seen along Fifteenmile Creek where streambank sloping, seeding, rock placement and fencing was provided has been phenominal. This demonstrates what sound conservation measures can accomplish. Unfortunately there are also several sites where these conservation practices were installed but, due to continual livestock grazing, vegetative recovery has been severely retarded or non-existant.

Where stream corridor fencing has been maintained, the growth of trees, shrubs and grasses has been dramatic. In these livestock exclosures, young alder and willow now form continuous bands from 15-20 feet high. Some young cottonwood trees now reach 30-40 feet high. Where vegetative growth has been accelerated with fertilizer and irrigation the stream disappeared beneath a complete tree canopy within five growing seasons. Grasses, sedges and rushes have effectively armored previously erodable banks. This ground cover has not only protected streambanks, but has stimulated the natural bank rebuilding process. The vegetation traps silt and sediments carried by high stream flow, which in turn has provided better growing conditions for additional vegetative growth.

In the years since the Fifteenmile Creek stabilization project was completed there have been several periods of moderately high winter flow. These freshets have caused only minor erosion in areas where there has been good cooperative maintenance of streamside fencing. However bank erosion has continued to be a problem along stream reaches where fencing was not provided or where it has not been maintained. Rock riprap has helped to reduce erosion in some of these areas, but it is readily apparent that a long-term solution to this problem is dependent upon revegetation of stream banks.

The Department has not had the opportunity to fully evaluate the response of fish and wildlife to this project. However, observed improvements in instream and streamside habitat should eventually result in increased fish and wildlife production. These habitat improvements include dramatic changes in the channel confiquration. Natural processes have started to re-establish a desireable pool-riffle ratio, where previously the only pools were associated with temporary rock check dams. The stream width has been gradually narrowing, with a corresponding increase in average water depth and hence improved cover for fish. This confiquration combined with the recovery of riparian vegetation will act to reduce maximum summer water temperatures and potentially increase low summer flows. Overhanging vegetation provides a source of organic food material for aquatic insects, which in turn are an important food source for fish.

Reports from landowners indicate that the range of trout in Fifteenmile Creek has expanded downstream five to ten miles in the last five years. This improved distribution may be directly attributable to reduced summer water temperatures and increased aquatic insect production.

The evaluation of the response of wildlife to the project is also incomplete, but field tours of the recovering stream corridor have shown that upland game birds, waterfowl, furbearers, nongame wildlife and an occassional deer have already discovered this narrow ribbon of desirable habitat. Continued vegetative recovery will result in further habitat improvements for all terrestrial wildlife.

This stream stabilization project has been successful in the treatment of eight to ten miles of stream channel. However this result has been totally dependent upon cooperative landowners and in some instances other individuals who have worked to speed streambank revegetation. The cooperative interactions between agencies, landowners, and sportsmen has also been a significant aspect of the overall project. Without this level of cooperation and sincere interest in the resources, the final outcome would have been questionable.

The problems found on Fifteenmile Creek are not unique, rather there are many streams around the state with similar problems. Restoration practices used on this stream should produce similar results on other degraded streams.

EVAL-- A COORDINATED AND COMPREHENSIVE APPROACH TO RANGE MANAGEMENT

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Abstract
The Oregon Range and Related Resources Evaluation project (EVAL) is an effort to implement known range management techniques and evaluate their impacts on range and related resources. Results obtained will have wide application throughout much of the western United States and will be useful in developing federal, state, county, and private resource management plans. Resource managers will benefit through increased knowledge concerning the economic and environmental welfare of the natural resource base. The EVAL process includes installation of range practices on both private and public lands. The resulting information will be used for economic and resource analyses.

EVAL was established in 1976 and conceived as a 10-year project. Initially the study was designed to investigate the impact of five levels or intensities of range management strategies on 18 range and related resources. Due to funding problems, however, only forage, water, and economic resources are being analyzed. The project has been extended 1 year, through 1986, to accomplish data summaries, analyses, and prepare a final report.

The lead agency for EVAL is the USDA Forest Service including the National Forest System, State and Private Forestry (which provides the funding for the cooperating agencies and the private landowner sector), and Forest Service Research. Cooperating agencies and groups include: USDA Soil Conservation Service, USDA Agricultural Stabilization and Conservation Service, United States Department of the Interior Bureau of Land Management, Oregon State Department of Fish and Wildlife, Oregon State Department of Forestry, Oregon State University Extension Service, and private landowners.

The EVAL Project encouraged private landowner cooperation by paying approximately 75 percent of the costs to implement range management practices on 22 ranches.

The forage and timber resources were inventoried on the base property of each cooperator by the USDA Soil Conservation Service and Oregon State Department of Forestry. A Coordinated Resource Plan was then prepared to incorporate the recommended range and forest management opportunities. With the full involvement of the private landowner, management options and strategies were selected and a Long Term

Agreement was prepared. This document formalized the cooperative agreement between the landowner and the Forest Service and specifies the range management practices to be installed and the estimated costs, cost share, and time schedule for work to be completed. The agreement also indicates the landowner's responsibility within the EVAL project to provide cost information on the installation of each range practice and annual actual use records for each pasture included in the agreement. It also grants project personnel access to the private land.

A mixture of range management strategies are established on 338,000 acres of public and private land with a total investment in range practices of approximately $1.8 million. EVAL is now in the final year of data collection. The last 2 years will be used to complete data summaries, analyses, and the final report.

THE ECONOMICS OF RANGE INVESTMENTS:

PUBLIC AND PRIVATE PERSPECTIVES

by

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Introduction

A rangeland improvement project or practice may produce a variety of impacts. Effects of a project may include changes in forage quantity and quality, changes in wildlife habitat, differences in the costs associated with livestock use of an area, and/or aesthetic changes. When faced with the decision of undertaking a project or instituting a management change, the decision maker may initially consider analyzing all of the potential impacts before reaching his or her decision. Such an approach, however, quickly and, in some cases, unnecessarily complicates the decision making process.

This paper will first discuss how a management problem may be approached differently by different decision makers. The attributes of a project important to one group of decision makers may not enter the analysis of the same investment by a second group of decision makers. The ideas developed in this first section of the paper will then be applied to a rangeland setting. A hypothetical management proposal will be presented, and the results of an analysis of that proposal by a federal land management agency will be contrasted with the results obtained by a totally different analysis conducted by a livestock operator involved in the project. The paper concludes with a brief discussion of the implications of the differing analytical procedures and results for the federal land manager.

Problem Identification

Several points argue against considering all of the attributes of a project in the decision making process. First, not all of the attributes will be of relevance to the decision maker. For example, significant improvements in big game winter range may result from a particular range improvement. However, the private investor, whose sole direct benefits from the project may be in terms of increased livestock revenues, may not deem the resultant wildlife habitat improvements of any importance in deciding to undertake the project.

The second argument against considering all of a project's impacts is based on practical grounds: it may be difficult to identify all of the changes resulting from a project. This may be of particular significance in the natural resource field. Modifying one component of a system will probably have some effect upon the other components of that system. It may therefore be desirable to establish boundaries in the decision making process: we will identify impacts up to a certain level in the process.

Related to the problem of identification of a project's impacts is the problem of quantification of the impacts. Stream quality may improve as a result of a project, but by how much? Quantification of environmental changes is anathema to many resource specialists. However, before the decision to commit funds is made, the extent of the resulting benefits should be known. If, for a given level of investment dollars, habitat improvement would be slight in one area and moderate in another, quantification of these impacts may result in the investment being made in the project with the greater net return.

One final problem remains in considering the multiple impacts of a particular project. How does one compare a change in wildlife habitat with a change in ranch income? To include both of these impacts in an analysis, the decision maker must make assumptions on the relative values of the different elements of the problem. These value judgments may be either implicit (e.g., we aren't going to be concerned with wildlife (or ranch income)) or explicit, with rigorous economic methods employed to reduce all problem components to a common measure (e.g., dollars). As anyone with experience in land management is aware, the relative value assignments made by the federal land manager may not be readily accepted by the public.

It is therefore important that the public land manager and representatives of various interest groups realize that there will probably be differences in the decision analyses that each group conducts. The relative importance of the different resource outputs may differ, the decision regarding which impacts should be considered may differ, and the quantification of changes in the included impacts may differ. The remainder of this paper will consider a hypothetical situation in which an allotment management plan initially proposes a 60 percent reduction in allowable livestock use in order to enhance watershed productivity. Mitigating measures are then proposed which restore livestock use to its pre-AMP levels, at an increase in investment and operating costs to both the federal agency and to the affected permittee. The results of an analysis of the investment obtained by federal benefit-cost procedures will then be compared with the procedures that the permittee might perform.

Federal Perspective

The paper written by Dr. Obermiller, and included in these proceedings, deals with the conceptual elements involved in the economic investment analysis conducted by the federal land management agencies. Further detail is presented in an Extension Service publication available from Oregon State University [Lambert]. There will therefore be no discussion of the theoretical basis or of the calculations underlying public benefit-cost (B/C) analysis. The values of the resource outputs used in the following example are those used by the Bureau of Land Management (BLM) in Oregon in 1983. The interested reader should refer to either Obermiller's paper or the Extension Service publication for explanations of how these values are derived and what they represent.

Ranch Perspective

The attractiveness of a particular investment opportunity to a permittee will depend upon how well the investment fits the management objectives of the individual rancher. With the possible exception of some small, noncommercial ranches and of some larger outfits that may serve as income sinks for tax purposes, a cattle ranch is a commercial enterprise. In order to survive as a commercial enterprise, a primary objective of the operation has to be to remain economically viable. This viability requires that ranch revenues from sales must exceed the costs of production over the long run.

This primary objective of economic viability immediately distinguishes the cattle ranch from the federal land management agency. The ranch is not a social agent; the ranch's purpose is not to provide the greatest amount of good to the largest number of people. This is not to say that the ranching industry does not impart economic benefits to other segments of society: many local communities in the Western United States rely upon the continuing prosperity of the ranches in their area. It is probably safe to assume, however, that maintaining the economic health of their local communities is not the management objective of many ranch operations.

There has been considerable discussion in the agricultural economics literature attempting to identify the management objectives of range livestock operators [Smith and Martin; Rodewald and Bostwick]. Management objectives mentioned have included maintaining the ranching lifestyle, avoiding financial ruin, maximizing profits, and retaining the ranch in the family for future generations. Each of these objectives may result in totally different responses of different ranch managers in the face of a management decision. In the example examined here, it will be assumed that the ranch manager will operate to maximize profits over the 50 year planning horizon we will be using. His or her decision to adopt the proposed investment will thus require that the total returns to the investment will exceed the total costs associated with the proposal. Long-run profit maximization was chosen as the objective for both its ease of specification and its common usage in economic analysis. It also is consistent with the overall goal of firm survival: that revenues from livestock sales exceed the costs of production over the long run.

Range Investment Analysis: An Example

Cost and production data was available for a medium-sized ranch in Eastern Oregon. The current capacity of this ranch, in terms of forage and feed supply, is approximately 470 brood cows.

The grazing season commences in May, when the animals are turned out onto deeded rangeland for a month. The stock is moved into privately leased pasture in June. Approximately one-fourth of the herd is moved into a Bureau of Land Management allotment on July 1, where they remain through the end of September. Deeded range and aftermath grazing end the grazing season, and the herd is on ranch-produced hay from about December through April depending, of course, upon the severity of the winter.

In the current example, it is assumed that the BLM has determined that grazing pressure in the ranch's summer allotment is too great. The nonlivestock resource values of a hypothetical riparian area running through the allotment are determined to be producing at below their potential levels due to livestock use within the allotment. It is therefore recommended that livestock use be reduced by 60 percent from 382 AUMs to 153 AUMs.1/

This reduction in allowed use will have an adverse impact upon the permittee's operation. As will be developed in more detail in the discussion of the model presented in a following section, the overall impact of this reduction will be a decrease in the ranch's capacity from 468 to 431 cows. It is therefore proposed that investments be made in the allotment which will accomplish two objectives: (1) mitigate the adverse impacts of the proposed grazing reduction upon the permittee; and (2) ensure that the riparian zone receives the intended protection.

Three actions are subsequently proposed to accomplish these objectives:

(1) Increase early season forage availability on 1,030 acres from 9 acres/AUM to 3 acres/AUM by seeding to intermediate wheatgrass. This will allow permitted use to return to the 382 AUMs utilized prior to the reduction. Additionally, three miles of fence are considered necessary for the proper use of the seeded area.

(2) Two water developments are proposed, one within the seeded pasture and one on a native range site.

(3) Twelve miles of fence are proposed to completely exclude livestock from the riparian zone.

The costs of the range improvement program are listed in Table 1.

1/ The extent of this reduction and the values of the forage increases resulting from the subsequently proposed improvements are hypothetical. The purpose of this example is to contrast public and private economic analyses of range improvements, not to present biological response data from field experiments.

Table 1. Range Improvement Program: Costs.

Year	Activity	Per Unit Cost	Total Cost	% Federal	Costs by Year	
					Federal	Permittee
1	Seed 1030 acres	$ 25	$25,763	50	16,631	16,631
	Fence 3 miles	2,500	7,500	50		
2	Maintain 3 miles fence	200	600	50	300	300
3	Fence 12 miles	2,500	30,000	100	33,300	3,300
	Develop 1 spring	2,000	2,000	50		
	Construct 1 reservoir	4,000	4,000	50		
	Maintain 3 miles fence	200	600	50		
4-50	Maintain:					
	15 miles fence	200	3,000	90	2,850	450
	1 spring	100	100	50		
	1 reservoir	200	200	50		

Benefits from the range improvement program are assumed to be noticed in the avoidance of the reduction in livestock use, increases in the productivity of the riparian area, thus improving fish and game habitat, and improvements in the amenity values of the riparian area and the native range areas, thus resulting in increased visitor use.

Economic Efficiency Analysis: Agency Perspective

The changes in resource outputs resulting from the range improvement program are listed in Table II. Utilization of forage by livestock will increase 229 AUMs each year. This represents the difference between the stocking rate with the projects (382 AUMs) and the level allowed if the investment were not made (153 AUMs). It was also assumed that recreational use would increase in the allotment following the repair to the riparian area. The magnitudes and years of the occurrence of these increases are also listed in Table 2. The values per unit of each of these outputs are listed in the bottom row. Each additional AUM of livestock use is estimated to provide $7.70 in benefits, each additional hunter day provided is valued at $15.12 and so on.[2/]

The results of three economic efficiency analyses are presented in Table 3. The total benefits are compared to the total costs, both private and public, of the improvements. Total benefits are compared to just the federal monies expended for the projects, and the livestock benefits are compared to the permittee's share of the costs. The projects are seen to fare poorly in the analyses. The present value of the 50 year stream of total costs exceeds the present value of the total benefits at both the low four percent and at the eight percent discount rates. The internal rate of return of slightly over two percent shows that only at this very low discount rate does the present value of benefits equal the present value of the costs.

The same interpretation applies to the remaining two analyses. Using the Bureau's $7.70 average value of each AUM generated by the project, the livestock benefits-permittee costs analysis results in an internal rate of return of 7.4 percent. The project appears somewhat more favorable when subjected to a modified internal rate of return analysis, yielding a 9.34 percent rate of return. For reasons beyond the intended scope of this paper, the modified internal rate of return is the more favored analysis for financial decision making from the perspective of the private investor. It is this figure that will be compared with the investment analysis conducted by the permittee in this hypothetical example.

To summarize the federal analysis of the projects, it would appear that the proposed mitigation investments should not be undertaken. From the national economic efficiency standpoint, where total benefits

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2/ These values represent those used by the BLM in 1983 in Oregon in their B/C investment analysis procedures.

Table 2. Change in Benefits Resulting From RIP: Social Perspective.

Year	Livestock Forage (AUM)	Deer Hunting (HD)	Angling (AD)	Nonconsumptive Recreation (RD)
1	229			
2	229			
3	229			
4	229	110	10	6
5	229	120	20	12
6	229	130	30	18
7	229	140	40	24
8	229	150	50	30
9	229	160	60	38
10	229	170	70	48
11	229	180	80	60
12	229	190	90	74
13-50	229	200	100	90
Value/Unit	$7.70	$15.12	$7.56	$4.32

Table 3. Rangeland Improvement Project: Economic Efficiency Analysis, Agency Social Perspective.

Total Benefits - Total Costs

	Present Value (Benefits)	Present Value (Costs)	B/C Ratio	Internal Rate of Return
4%	106262	126775	0.84	2.11%
8%	54322	92229	0.59	

Total Benefits - Federal Costs

	Present Value (Benefits)	Present Value (Costs)	B/C Ratio	Internal Rate of Return
4%	106262	78591	1.35	7.44%
8%	54322	58989	0.92	

Livestock Benefits - Permittee Costs

	Present Value (Benefits)	Present Value (Costs)	B/C Ratio	Internal Rate of Return	Modified Internal Rate of Return
4%	37853	27622	1.37	7.40%	
8%	21564	22621	0.95		9.34%[a/]

a/ Safe rate = 7.5%, Risky Rate = 10.0%.

are compared with total costs, the B/C ratio is below one for all discount rates higher than 2.11 percent. However, from the permittee's perspective, assuming that the $7.70 per AUM value used by the Bureau accurately estimates the average value for each AUM generated by the project, the investment may represent a beneficial undertaking. We will now contrast this conclusion with the results which the private investor might undertake.

Private Perspective

An equilibrium, known life dynamic programming model was constructed to estimate the income effects of undertaking the hypothetical investment.[3/] The model was initially solved under the conditions of the initial AUM reduction. Optimum herd size was thus obtained for the ranch following the reduction, and net revenues per year were calculated over the 50 year planning horizon of the investment. Although 50 years may be an unreasonably long planning horizon for the ranch operator, it was chosen to ensure consistency with the long planning horizon used by the Bureau in its analyses.

The results obtained from the initial formulation of the programming model provided the "without project" base income figures. The model was then expanded by the inclusion of the investment activities. The activities associated with the investment permitted allowed use to return to its pre-AMP level as a result of the seeding, water projects, and additional fencing. The added costs of the investment were the figures reported in Table 1 as the permittee's share of the project's costs.

The model was then solved again with the investment activities included. The investment did, indeed, enter the solution. Since the costs and livestock prices used in the model were undiscounted, entry of the investment activities into the solution has the interpretation that, in undiscounted dollars, the benefits of the investment exceed the costs. The problem remains to find the magnitude of the rate of return accruing from the investment. Ranch herd inventories and sales data resulting from the solutions are presented in Table 4.

The annual net revenues resulting from undertaking the investment were derived, thus providing the "with project" annual returns. The difference between the "with project" and the"without project" net returns was calculated for each of the 50 years in the planning horizon, and the modified internal rate of return was calculated from these annual differences.

3/ Details of the model are not presented here because the technical aspects of the model's formulation would detract from the descriptive nature of this paper. Inquiries may be addressed to the author if more information is desired.

Table 4. Range Improvement Program: Ranch Perspective.

Ranch Capacity (Before Reduction)			
	468 Brood Cows		
Ranch Capacity - Without Investment			
	431 Brood Cows		
		Sell	173 Yearling Steers
			91 Yearling Heifers
			73 Cull Cows
			7 Cull Bulls
Ranch Capacity - With Investment			
	468 Brood Cows		
		Sell	188 Yearling Steers
			98 Yearling Heifers
			80 Cull Cows
			8 Cull Bulls
MIRR[a] = 9.71%			

a/ Safe rate = 7.5%; Risk rate = 10.0%.

Before presenting this result, the methods leading to its derivation should again be discussed. As opposed to the federal agencies' use of a uniform AUM forage value, a programming model was developed to estimate the value of the additional forage resulting from the investment. Ranch production costs directly entered the model, as did forage utilization costs on federal rangeland for an Eastern Oregon ranch.

Seven different sets of livestock prices were used for the different classes of stock marketed by this sample ranch in order to represent the cyclic nature of prices. Actual capital and operating costs associated with the investment projects were used. Given the level of detail inherent in the data used to run the model, it is therefore rather surprising that the modified internal rate of return of the investment from the rancher's perspective closely approximated the rate developed from the grosser analysis of the Bureau. The modified internal rate of return developed through the ranch model was 9.71 percent; this compares to the 9.34 percent rate resulting from the agency analysis of livestock benefits compared to permittee costs.

Sensitivity of Results

Little difference was seen in this particular example between the efficiency analysis conducted by the private investor and that conducted using average forage value estimates by the federal land management agency. The federal manager could show the permittee the results of his or her investment analysis (if the federal agencies were to calculate the modified internal rate of return) and feel confident that they accurately portray the investment from the permittee's perspective. However, neither the federal manager nor the rancher can be certain of these results without analyzing the investment from the private perspective. The results will be sensitive to the following parameters of the model: (1) livestock prices; (2) ranch production costs; (3) forage utilization costs on the public rangeland; and (4) costs of the investment to the permittee.

Seven different levels of livestock prices were used to account for the cyclical nature of the market. It was assumed in the programming model that prices were on the upswing, increasing for the first three years, then decreasing for four years before climbing again. Due to the discounting process inherent in the rate of return calculations, the higher initial prices carry more weight than the future downturns. The investment thus looks more attractive on an improving market. The same investment would not return as high a rate if prices were initially depressed and falling.

The cost of production figure used in the model was an average figure from interviews conducted in northeastern Oregon. If a particular ranch had higher (lower) production costs the rate of return of the investment would be lower (higher). A ranch producing beef at a lower cost per pound would view an opportunity to increase its herd size more favorably than a higher cost operation. Similarly, if the total fee and nonfee cash costs (excluding the investment) of utilizing a public land allotment were higher than they were for this hypothetical ranch, the investment would carry a lower rate of return. Higher per AUM utilization costs would mean that the costs of using the allotment at the higher stocking rates possible after the investment would be higher than they were for the sample ranch.

Finally, the cost sharing arrangements for the investment will affect the attractiveness of the project. Investment costs were shared equally for the livestock projects in the example. If the permittee were required to pay more (less) of the investment's costs, the rate of return from the projects would be lower (higher). It is true that the federal analysis of the livestock benefits to permittee costs would also change with a different cost-sharing arrangement; it cannot be stated in general how the rate of return of the federal analysis would change relative to the private analysis.

Summary and Conclusions

A hypothetical range investment was presented and analyzed in this paper. The results of the federal economic efficiency analysis showed the project to not be beneficial when total benefits were compared to total costs. However, the benefits accruing to the livestock operator did compare well with the permittee's share of the capital and operating costs of the project. A very close relationship was seen to result between the modified internal rates of return of the project when calculated via the somewhat gross value estimates used by the federal agency and by the more detailed, ranch specific model constructed for the analysis. It was briefly discussed how this close relationship might change if the cost and price assumption of the model were changed.

The purpose of this paper has been to emphasize how the public and private perspectives of the same investment or practice might differ. It is important for all parties to the decision making process to remember that the various components of the decision will be viewed with greater or lesser value, depending upon the objectives of the particular group. It is also of importance that the federal analyst realize that, what may appear to be a wise investment for the permittee based on the federal analysis may, in fact, not be acceptable to the rancher with his or her better knowledge of the particular ranch's resources and cost structure. It is the burden of both the private and public analyst to conduct the analysis with reference to their respective management objectives.

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