Riparian Areas: Perceptions in Management

Wayne Elmore and Robert L. Beschta

A Narrow Strip of Land

Until a few years ago, the phrase "riparian zone" was used primarily by researchers and managers in the arid Southwest. Their primary concern was the role of streamside vegetation (phreatophytes) in water loss from streams. Such is no longer the case. Today, throughout eastern Oregon and other parts of the West, people with diverse backgrounds and interests are taking notice of riparian zones for a variety of reasons.

Riparian zones or areas have been defined in several ways, but we are essentially concerned with the often narrow strips of land that border creeks, rivers or other bodies of water. Because of their proximity to water, plant species and topography of riparian zones differ considerably from those of adjacent uplands. Although riparian areas may occupy only a small percentage of the area of a watershed, they represent an extremely important component of the overall landscape (Fig. 1). This is especially true for arid-land watersheds, such as those in eastern Oregon. Even though our comments focus on issues related to riparian zones in eastern Oregon, similar concerns exist for riparian areas throughout the West.

Riparian areas can be the most important part of a watershed for a wide range of values and resources. They provide forage for domestic animals and important habitat for approximately four-fifths of the wildlife species in eastern Oregon. Where streams are perennial, they provide essential habitat for fish and other aquatic organisms. When overbank flows occur, riparian areas can attenuate flood peaks and increase groundwater recharge. The character and condition of riparian vegetation and associated stream channels influence property values. Other values associated with riparian areas, such as aesthetics and water quality, are also important but difficult to quantify.

Complex Riparian Issues Need Open Discussion

Interest of the public, landowners, and natural resource agencies in management of riparian areas is increasing. However, we are concerned that much discussion is misdirected, and that installing permanent instream structures in rangeland riparian areas without changing vegetation management will be counterproductive over the long haul. In addition, we suggest that several important issues that are not being addressed need to be subjected to the rigor of public discussion. Thus, the objectives of this paper are:

Authors are, respectively, State riparian specialist, Bureau of Land Management, Prineville, Ore. 97754, and hydrologist, Oregon State University, Corvallis 97331.

We very much appreciate the extensive comments, suggestions, questions, and alternative viewpoints provided by the following reviewers when this manuscript was in the formative stages: Dr. George Brown, hydrologist, Oregon State University; Jim Hancock, District manager, Bureau of Land Management; P.D. (Doc) Hatfield, D.V.M., rancher, eastern Oregon; Dr. Bill Jackson, hydrologist, Bureau of Land Management; Dr. Boone Kauffman, rangeland riparian ecologist, Oregon State University; Chris Maser, ecologist, Bureau of Land Management; Lew Meyers, wildlife biologist, Bureau of Land Management; Dr. Bill Platts, research fisheries biologist, USDA Forest Service; Dr. Byron Thomas, soil scientist, Bureau of Land Management. This is Paper 2273 of the Forest Research Laboratory, Oregon State University, Corvallis.

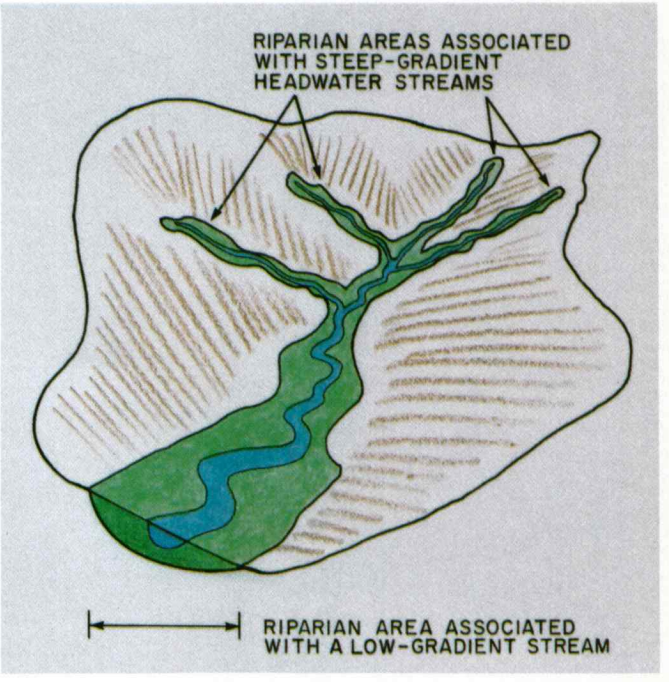

Fig. 1. *Riparian areas along a stream system.*

1. to promote awareness and discussion of riparian issues by and among livestock owners, land managers, environmentalists, biologists and the general public;

2. to identify the characteristics and benefits of productive riparian systems;

3. to encourage managers of public and private lands to reconsider the effects of traditional grazing practices and of recent efforts to control channels structurally.

What are the Problems?

The influence of European man in eastern Oregon's riparian areas began with the influx of fur trappers in the early 1800's. At that time, many streambanks apparently were lined with woody vegetation, such as willow, aspen, alder, and cottonwood. For example, the Indian term "Ochoco," which was used to name a mountain range in central Oregon, means "streams lined with willows." Widespread beaver trapping initiated changes in the hydrological functioning of riparian areas and streams. Beaver ponds, which had effectively expanded floodplains, dissipated erosive power of floods, and acted as deposition areas for sediment and nutrient-rich organic matter, were not maintained and eventually failed. As dams gave way, stream energy became confined to discrete channels, causing erosion and downcutting.

Homesteaders and ranchers followed the trappers. Grazing practices on the rangelands of eastern Oregon were similar to those throughout much of the West and relied primarily on year-long or season-long (April-October) use.

These practices allowed livestock to concentrate their foraging in riparian areas, rather than on the adjacent hillslopes. As a result, many of the riparian areas in eastern Oregon are in a state of disrepair and degradation. Streams that were a perennial water source for early settlers may no longer flow in late summer. Channels that once handled spring runoff and summer freshets easily are now unstable and eroding. Where channel gully erosion proceeded unabated, extensive deep gullies now remain as monuments to a lack of appreciation of how riparian areas function and maintain themselves.

Many riparian areas are of marginal or no value for livestock forage in their present state and lack productive habitat for fish, other aquatic organisms, and wildlife. They may no longer dampen flood peaks or assist in recharging subsurface aquifers. Once-productive wet meadows are occupied by sagebrush, cheatgrass, or plants typical of the adjacent uplands. Any attempt to generalize about riparian areas and streams obviously ignores the exceptions that exist. We nevertheless feel that historic patterns of land use have left most riparian areas of eastern Oregon in a far less productive state than their natural potential.

Part of the problem with riparian-area management is perception. When changes are dramatic, such as during a large flood, the consequent damages are attributed to "acts of God," even by nonbelievers. Even an observant person living along a creek may not detect the subtle changes in stream character and vegetation composition that are occurring with time. While each generation may be aware only of seemingly small and incremental changes, the cumulative effect of these changes over long periods of time can be substantial. Many people have never seen a "healthy" rangeland riparian area, since degradation was widespread before many of us were born. The whole picture may not be obvious even to oldtimers, because many changes occurred before the turn of the century. Attempts to establish what presettlement stream systems and riparian areas were like by searching the early literature are not always successful. Journals of early fur trappers and ranchers, however, do provide glimpses of how riparian areas may have looked originally—glimpses showing that significant changes have occurred.

The Fallacy of Floods and the Fortitude of Vegetation

We often assume that floods inevitably have undesirable impacts. While flood damage may be great in watersheds with deteriorated riparian and upland areas, floods are not always catastrophic. Streams typically transport large amounts of sediment during floods, and sometimes channel changes are swift and desirable. However, on streams with sufficient diversity and cover of riparian vegetation, bank building through the deposition of sediment occurs during high flows.

The exact species composition of riparian vegetation varies from area to area and depends on elevation, soils, geology, topography, and climate. Generally, plants with strong root systems are required to hold streams and riparian zones together. In eastern Oregon, the willows, sedges, and rushes fit this requirement admirably. Their stems provide roughness and resistance to flow. At high flows these species bend but do not break, and they are extremely effective at trapping sediment transported by the stream. Their root systems, in conjunction with other herbaceous vegetation, usually can resist a stream's erosive power. The importance of these species in maintaining bank stability, filtering, and depositing sediment has long been underrated; they are essential to

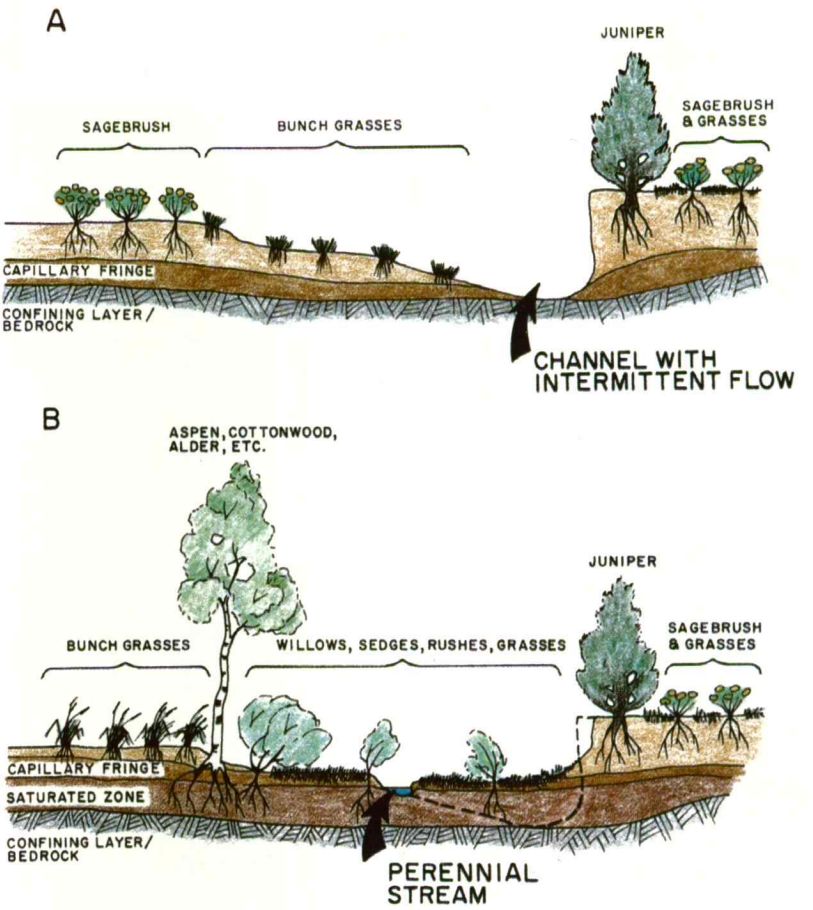

Fig. 2. *General characteristics and functions of riparian areas.*
(A) Degraded riparian area
- *Little vegetation to protect and stabilize banks, little shading*
- *Lowered saturated zone, reduced subsurface storage of water*
- *Little or no summer streamflow*
- *Warm water in summer and icing in winter*
- *Poor habitat for fish and other aquatic organisms in summer or winter*
- *Low forage production and quality*
- *Low diversity of wildlife habitat*

(B) Recovered riparian area
- *Vegetation and roots protect and stabilize banks, improve shading*
- *Elevated saturated zone, increased subsurface storage of water*
- *Increased summer streamflow*
- *Cooler water in summer, reduced ice effects in winter*
- *Improved habitat for fish and other aquatic organisms*
- *High forage production and quality*
- *High diversity of wildlife habitat*

the integrity of stream channels and associated riparian areas.

Vegetation Is Important for Summer Streamflow

Riparian studies historically have been associated with efforts to reduce evapotranspiration "water losses" by removing streamside vegetation (primarily shrubs and trees). Such management practices were primarily intended to increase streamflow. While trees and shrubs can evapotranspire more water over the course of a year than might evaporate from bare soil, this simple scenario ignores the more important beneficial hydrological consequences that shrubs (and trees, in some cases) can have in riparian areas.

Woody species often provide local channel stability and and resistance to channel erosion so that other species (sedges, rushes, grasses, and forbs) can become established. As vegetation becomes established and total biomass increases along a stream, channels typically begin to aggrade (i.e., channel elevation will increase as sediment is deposited within and along the banks of the channel). With continued sediment deposition and bank-building, particularly along low-gradient channels, water tables rise and ultimately may reach the root zone of plants on former terraces or flood plains. Species composition and community structure of vegetation occupying terraces or flood plains change dramatically, becoming dominated by typical riparian species. It should be noted that accelerated soil erosion from upland areas is neither needed nor desirable to produce the sediment necessary for bank building. Natural erosion rates typically provide enough sediment for successful recovery of a riparian area (Fig. 2).

An aggrading channel and a rising water table have many benefits. More water is stored during wet seasons, and slow release of this water may allow a stream to flow during the driest of summers. Hence a paradox: establishment of additional vegetation in degraded channels can cause a stream to flow throughout the summer. Summer flows have improved in a variety of streams in eastern Oregon where riparian vegetation has been allowed to recover and stream channels have begun to aggrade. Such responses are happening in areas that receive, on the average, only 10 to 15 inches of annual precipitation. The important point is that streamside vegetation provides the key to improving the productivity and stability of riparian systems. This vegetation is also critical in reestablishing perennial flow in degraded channels, where the slow release of water from increased subsurface storage can more than offset the amount used by streamside vegetation.

To Graze or Not to Graze

Adverse changes in streams and riparian vegetation can result from a wide variety of causes: changing climatic and precipitation patterns, more frequent flooding, altered beaver populations, heavy streamside grazing, improper use of upland watersheds or adjacent slopes, road construction close to channels, and others. On a geologic time scale, persisting uplifting of terrain may cause streams to entrench. Yet, when we look at all the factors that can and do influence the present condition of riparian areas in the West, livestock grazing is unquestionably a significant factor. Since grazing is intrinsically associated with the problems, it is also fundamentally important in the solutions. Grazing management provides a major opportunity to improve riparian areas without large expenditures of money.

In the past, rangeland management and research have focused largely on trying to understand and increase productivity from upland areas and plant species. Because the riparian community occupies such a small portion of a watershed (less than 0.5% of eastern Oregon rangelands), it may have been assumed that riparian plants responded to grazing pressure similarly to upland species. Unfortunately this is not the case. Species in "recovered" riparian areas are numerous and diverse in their requirements and responses to grazing, and our understanding of how these species interact and function as communities is limited. We do know that continuous heavy grazing of riparian areas can cause long-lasting detrimental effects. Grazing needs to be closely managed in both riparian areas and uplands for recovery of degraded streams to begin. Timing is particularly crucial for riparian areas. Allowing vegetation to grow all summer, only to graze it heavily in the fall, can eliminate chances for recovery. Springtime grazing in some eastern Oregon riparian areas allows for vegetation regrowth throughout the summer, so vegetation still provides stability to channels and banks during periods of high runoff. This grazing strategy also allows for rest during the growing season of upland plants.

Grazing Fees and Riparian Condition

Because riparian areas are usually limited in size, allotment administration usually includes them in adjacent landforms and vegetation types. The importance of narrow riparian areas in allocation of AUMs (Animal Unit Months) for an allotment thus becomes relatively insignificant. For example, riparian areas on public lands in eastern Oregon comprise, on the average, about 4 acres of land along each mile of stream. Because streamside zones are subsumed in the adjacent uplands, they are typically allocated at the same intensity of forage use, often only one AUM for every 13 to 16 acres. Assuming the current public land grazing fee of $1.35 per AUM, the revenue from grazing in riparian zones is approximately 35 to 40 cents per mile of stream. Riparian vegetation actually is grazed more intensively than any other portion of an allotment, and at a rate much greater than one AUM per 13 acres. Consequently, forage on the rest of the allotment often is underutilized. As a result, the overall health of riparian zones continues to decline because of concentrated livestock use along streams.

Efforts are currently underway in Congress to raise livestock grazing fees. With respect to riparian areas, however, the dollar value of an AUM should not be the issue. Instead, we need to focus on management of the land. Riparian management will not improve just because more is charged for using these lands. Perhaps no fee should be charged when management is improving the riparian area, but a high fee for areas where current management precludes recovery. We need to concentrate our efforts on improving riparian vegetation and companion resources—that's the real issue.

Grazing Strategies and Riparian Recovery

Some people consider the current condition of riparian areas to be acceptable; however, we suggest that it is not acceptable along many streams. The continued use of grazing systems that do not include the requirements of riparian vegetation will only perpetuate riparian problems. Ranchers and managers of public lands need to select riparian areas for long-term demonstration sites where nontraditional grazing strategies can be tested and the results compared with naturally recovering systems. These strategies should be

directed toward the recovery of both biological systems (vegetation diversity and structure) and physical systems (channel characteristics and hydrology) and should entail various seasons of use, levels of utilization and exclusion, classes of livestock, and so forth. Such demonstration areas would provide important reference sites against which the characteristics of riparian systems managed in the standard manner can be evaluated. Describing and monitoring channel characteristics and streamside vegetation should be an important component of these demonstration studies.

Demonstration areas that are established need to be continued over several years, for the recovery of riparian areas is not always rapid. Time is required for Mother Nature to work her magic, and changes may not be obvious within the first few years. Where a channel is currently beginning a cycle of erosion, seed sources for native riparian species are absent, channel gradients are steep, or silt loads are low, recovery may require decades or longer. From the perspective of future generations, perhaps the actual rate of recovery is relatively unimportant, as long as management is nudging streams and riparian systems in the "right" direction.

Recovery can be extremely rapid along low gradient streams that traverse alluvial valleys were streams carry substantial loads of silt during high flows. As production of vegetation increases, these areas may appear to be productive and stable systems once again. However, initial vegetation "expression" should not be confused with vegetation "succession" (Fig. 3). As vegetation succession progresses, the plant diversity in riparian areas increases greatly. Channel characteristics also change. Wide shallow channels, with either flattened banks or steep eroding cutbanks, are replaced by narrower, deeper, and more stable channels with well-vegetated banks.

AUMs and Ecosystem Health

Recently there has been considerable debate about excluding livestock from riparian areas as the solution to the riparian problem." In some cases, such a drastic change may be the most appropriate way to begin recovery. For many streams, however, total livestock exclusion is not necessary; livestock grazing and healthy riparian systems can coexist even during recovery. Although the season and intensity of use need to be controlled carefully, experience in eastern Oregon is beginning to show that the number of available AUMs in many riparian areas can increase as recovery occurs.

When vegetation succession starts and the riparian system begins to function properly, it moves towards a more productive and healthy ecosystem (Fig. 3). At this point, all the benefits of a healthy riparian area will begin to reappear, including increased AUMs for livestock, improved habitat for wildlife and aquatic organisms, more stable channels, improved water quality, a shift toward perennial streamflow, reduced flood peaks, and others (Figs. 4, 5, 6, and 7). Allowing grazing only at certain seasons is an investment in the health of the riparian system, and this investment will pay off in improved future productivity.

Once recovery is underway, it is tempting to relax management prescriptions and return to previous grazing practices. Early successes in forage production may intensify the pressure to increase AUMs immediately. It's hard to leave "unused forage" along a healthy riparian area, but it must be left to maintain the integrity of the system. A few years of grazing at inappropriate times can quickly undo what may have taken years to establish.

Each Steam System is Unique

Each stream has unique combinations of channel morphology, streamside vegetation, hydrology, geology and soils, and so forth. The vast array of conditions may lend credibility to the concern that the pattern of riparian recovery observed on certain streams may not occur on other stream systems. Our knowledge of recovery rates is indeed imperfect, and quantitative predictions are not always reliable on a site-by-site basis. Additional research on arid-land riparian systems is certainly needed to improve understanding of many questions:

1. Which riparian areas have the greatest potential for vegetation response (increased productivity and species diversity)?
2. In which areas will vegetation succession occur quickly, and what pathways will this succession take?
3. Which streams have the greatest capacity for storing subsurface water and regulating stream flow?
4. Which streams have the greatest potential for filtering and storing sediment and improving water quality?
5. Which riparian areas have the greatest potential for increased AUMs, and how can the preferred timing and intensity of use be determined?
6. To what extent will habitat for wildlife and fish improve?

These major gaps in our knowledge indicate tremendous opportunities for research and innovative management as we move toward understanding the function of riparian areas and the wide array of benefits they provide. It is perhaps a sad commentary that, with few exceptions, researchers and managers have long ignored opportunities for managing riparian areas. Some managers, preoccupied with a lack of knowledge about the ultimate potential of riparian sites, may use this as a rationale for taking no action. This is folly. Perhaps the major question to be addressed, given our current state-of-the-art, is—*are we allowing succession to occur?*

Structures and Streams

Many proponents of improved riparian management would like to spend large amounts of money to correct riparian problems. Additional funds are needed to assist in changing grazing strategies, but only spending large amounts of money to build instream structures (e.g., gabions, dikes, check dams, rip-rap, sills) or structurally modify channels will seldom "solve" riparian problems. Building expensive instream structures without solving the problems associated with management of riparian vegetation allows managers to sidestep difficult decisions.

By placing permanent structures in a channel, we are attempting to lock the stream into a fixed location and condition. However, alluvial streams naturally develop and function by continual channel adjustments as flow and sediment loads vary. These incremental changes allow streams to withstand the wide range of dynamic forces that occur as flows fluctuate rapidly during storm runoff. None of the changes in channel characteristics and riparian vegetation shown in Figures 3 through 7 resulted from structural additions to the streams. Even where structural additions to a channel may help recovery, we often install structures in sections of stream where they are not needed, because we rarely allow several years of vegetation recovery before identifying where they might do the most good. Improvement of riparian areas cannot be expected without changes in grazing management.

3A

B

5A

B

4A

B

Fig. 3. *Vegetation "expression" (A) versus vegetation "succession" (B). The "expression" photo, taken in 1976, reflects species present under heavy grazing that were simply allowed to mature. The "succession" photo, taken in 1984, shows changes that can occur as grass, willow, sedge, and forb species increase. Note the narrowed channel and the well-protected, overhanging banks of the recovered stream.*

Fig. 4. *Vegetation and channel responses (A) and (B) after 3 years of rest followed by spring (May) grazing. Note the decreased width and increased sinuosity of the stream channel as recovery proceeds.*

Fig. 5. *Ten years (1976-1986) of vegetation and channel responses (A) before and (B) after 5 years of rest followed by 5 years of a late winter (Feb)/early spring (March) grazing system. Grazing use increased from 72 AUMs in 1976 to 313 AUMs in 1986. In 1976, banks were poorly defined and the stream was actively eroding the steep cutbank on the left. In 1986, the cutbank had been stabilized by vegetation. The channel had also narrowed, as vegetation stabilized stream banks being built from sediment deposits.*

In the rush to install expensive and often counterproductive structures, we have ignored what should be the primary management focus—restoring streamside vegetation. In contrast to structures, riparian vegetation can maintain itself in perpetuity as new plants continually replace those that die. Riparian vegetation allows streams to function in ways that artificial structures cannot replicate. The resiliency that these plants provide allows riparian systems to withstand a variety of environmental conditions.

The View at the Crossroads

We have presented several issues and concerns that can

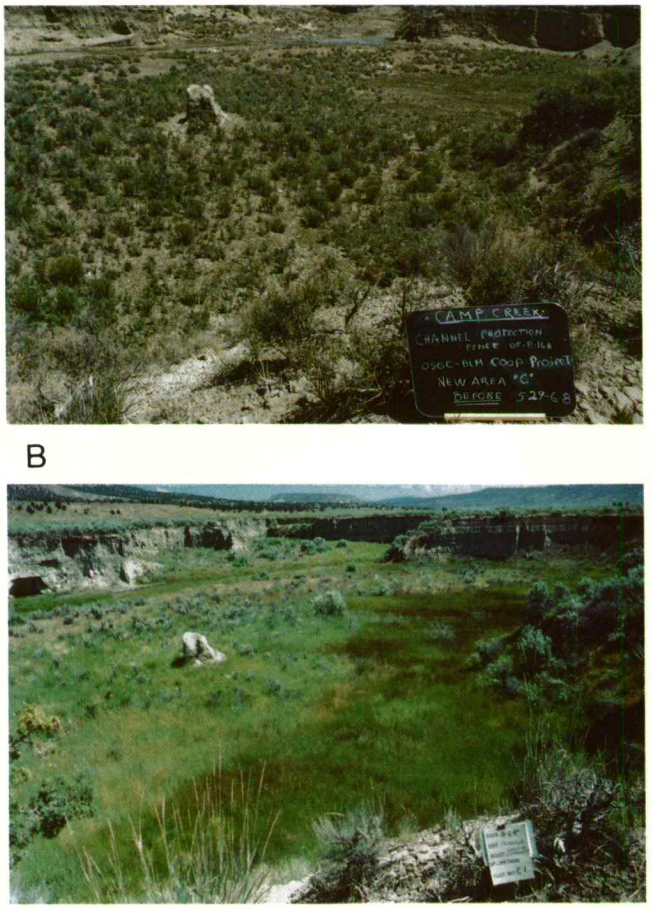

Fig. 6. *A wide, entrenched channel system that has incised 5 to 15 feet into silty-clay deposits. View (A) shows the area in 1968. View (B) shows the same area 16 years later, after exclusion from grazing. Note the expanded riparian area, as the water table influences vegetation composition across the entire bottom. Perennial streamflow does not occur during relatively dry summers either upsteam or downstream of the exclosure. Within the recovered section, however, the stream now flows continuously even during dry summers.*

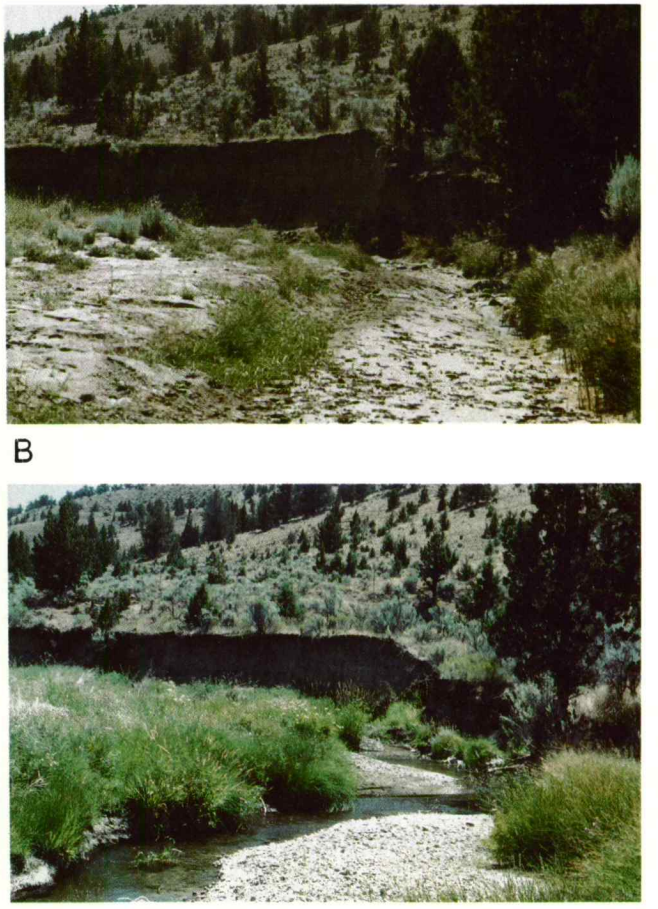

Fig. 7. *Vegetation and channel responses (A) before and (B) after 8 years of exclusion from grazing. Water now flows throughout the summer in a formerly ephemeral channel. The channel bed is gravel but previously was primarily fine sediments (silts and clays). These fine sediments are now being deposited at high flow—for example, on the left bank. The steep cutbank in the background, along the right side of the stream, is no longer being actively eroded by the stream.*

significantly affect the approach to managing riparian areas. Private land owners and users and managers of public lands need to reconsider the effects of current management activities on riparian areas. All riparian areas cannot be improved immediately to improve the functioning of riparian systems to arrive at productive and self-perpetuating riparian areas.

A word of caution is appropriate. As we endeavor to focus on restoring and enhancing the unique attributes of riparian areas, we must not forget the need to manage upland areas properly. Upland areas occupy up to 99% of eastern Oregon's rangeland watersheds and are an essential component of any land-management program. They also influence profoundly the ultimate character of the downslope riparian areas.

We are at an important crossroads in the management of riparian areas. Members of the livestock industry can provide leadership in understanding and solving complex riparian questions. Their support is critically needed for studies that will have long-term payoffs. More importantly, they need to support changes in grazing strategies and other uses in managed riparian areas. A fresh start at establishing dialogue between ranchers, land managers, biologists, hydrologists, environmental groups and the general public is mandatory.

If confrontation politics continue, grazing riparian areas on public lands may be eliminated, and we may lose the option of managing riparian systems for livestock production. The American public is becoming increasingly involved in both public and private land use issues, even though most people live in urban areas well away from rangelands. If the riparian management issue were placed on a national ballot today, is there any doubt which way the vote would go? The timing is ripe for ranchers and other land managers who operate on private or public lands (riparian vegetation doesn't know the difference) to initiate management strategies that will allow our stream and riparian systems to approach their productive potential.