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Abstract

Agriculture has historically been based in the subirrigated riparian ecosystems. Often the engineering and agricultural practices have altered the systems and many of the associated ecological processes. In the Western United States, the most common agricultural practice affecting riparian systems has been livestock grazing. Effects have been both positive and negative. Lack of management has deteriorated many of these systems. Current research has shown what types of management have been successful in allowing grazing by livestock to improve the grazing capacity.

INTRODUCTION

Water is a fundamental basis of life and consequently is a major determinant of agricultural production. The proximity of riparian zones to water supplies has naturally led to intensive and extensive agricultural uses of these zones. The annual floods of the Nile River in biblical times left rich deposits of sediment that were the basis of major farming activities. Throughout the world, agriculturalists have used the rich and often subirrigated soils of riparian zones for intensive farming activities. The development of irrigation technology in modern times has allowed expansion of agriculture into uplands but has not diminished the use of riparian systems for intensive farming practices.

Most intensively farmed riparian zones are privately owned; and because of economic and social pressures, they are likely to remain farms. The impact of the farming systems on lakes and rivers will continue with inputs that degrade the natural processes in the riparian systems and inputs that enhance these river and lake systems. Nonpoint pollution problems of rivers and lakes are largely attributed to agricultural practices. The Environmental Protection Agency estimated that 64 percent of the nonpoint pollution in United States river systems was agriculturally based (Chaney et al. 1990). This pollution is caused by agricultural chemicals or unacceptable farming practices. As knowledge of agricultural effects increases, especially as related to water quality, practices will become more environmentally sound and will change to minimize pollution. Significant improvement will be seen in the 1990s.

The impacts of farming not related to pollution are also extensive. In the Western states, reclamation projects have built reservoirs that supply massive quantities of irrigation water. This water is applied to the land in the dry season and augments subsurface flows of adjacent river systems, a major force influencing late-season stream flows in heavily irrigated areas. Along with augmentation of water to farmland, frequently the streams and rivers have been constrained on reduced floodplains. Sometimes floodplains were entirely eliminated. Once a river system has been substantially altered by these and other practices, it should be considered an altered ecosystem. Since society is not likely to change the basic flood control and irrigation projects of the West, much of the lower elevation land area will remain as altered systems with altered ecological processes. The approach to understanding these systems should be in this context. Care should be given in applying ecological concepts derived from wildland systems in these altered ecosystems. The utilization of engineering practices and agricultural technology may well disrupt natural processes to the extent that a new body of theory will be required to accurately predict cause and effect relationships.

GRAZING

Extensive agricultural effects on riparian zones derive principally from grazing of livestock. Few riparian zones have remained ungrazed during the past century. Impacts of livestock grazing have been described as being both beneficial and devastating. However, observations of riparian zones in the Western states clearly indicate that livestock have substantially altered many of these systems. The result of this broad scale, poorly managed grazing has been well documented through description of soil compaction, stream-bank erosion, channelization, and loss of vegetation. In these same areas where extensive riparian zone alteration is apparent, there are examples of reversals of the alterations by changing management of the land and livestock. The research, demonstration, and management programs of the past fifteen years have allowed development of management strategies that will yield the desired objectives on the riparian area.

RESEARCH

Riparian grazing research conducted at Oregon State University since the mid-1970s has led to generalizations that help explain the interaction between cattle grazing and mountain riparian systems (Krueger 1983). These studies have continued for more than fifteen years, evaluating several herds of cattle, a wide variety of management strategies, and thousands of hectares of mountain rangeland.

Under traditional grazing-management systems utilized on public and private land (e.g., season-long grazing, deferred rotation, rest rotation), riparian zones are frequently a focal point of cattle-grazing activity. When livestock are allowed selection between riparian zones and uplands, riparian zones are highly preferred. These mountain riparian zones are more abundant and productive than those in the high desert at lower elevations. Typically, the riparian zones were 2 to 3 percent of the land area and produced 20 percent of the available livestock forage in the area. Forage yield was generally about 2500 to 4000 kg/ha.

Livestock utilization of the riparian zones, using traditional grazing systems, was typically about 75 percent of current year's growth of herbaceous vegetation and 30 to 50 percent of current year's growth of shrubs. Even though riparian zones produced only 20 percent of the forage available, 80 percent of total forage consumption by cattle came from the riparian zone. At the same time, uplands were utilized at a rate of about 8 to 12 percent of current year's growth. The heaviest utilization measured on uplands was 30 percent. Obviously, there is great opportunity to change management practices to reduce grazing on riparian zones and increase grazing on uplands.

Riparian zones are exceptionally complex systems that yield varying responses to management among stands even in a small pasture. In the riparian zone of Meadow Creek in northeastern Oregon, 44 different plant communities were found on 45 ha. The stream bed itself occupied more total area than any single plant community. Nearby on Catherine Creek, the situation is even more complex. In an area about 50 by 3500 meters, 60 discrete plant communities, about 260 stands of vegetation, 400 plant species, 81 species of birds, and 20 species of mammals have been identified. Both of these riparian systems are considered representative of the region.

The relationships of these riparian zones to livestock grazing are probably indicative of what can be found in mountains of the Northwest. The riparian zone provides a high-quality forage in late summer and fall that is equal to or better than that available in the uplands. In dry years, the riparian zones are nutritionally superior. In fall, cattle grazing in riparian zones produced calves 18 to 25 kg heavier than cattle confined to upland pastures. This weight difference accrued during the last three weeks of the grazing season (September).

Early in the season, cattle tend to voluntarily use uplands more than they do later in the summer. In general cattle prefer, in order, riparian meadows; grasslands; clear-cut areas (especially when seeded to exotic grasses); logged forests; and mature forests. Cattle made heavy use of roads to move about the summer range. Diets of cattle were typically 85 to 95 percent grasses and sedges. Browse was not used until green grass was limited in availability.

The effect on specific plant communities in riparian systems was variable. Of ten plant communities studied intensively for four years in one meadow, only four were measurably affected by cattle grazing, with average utilization about 60 percent of available forage. In the spring, growth starts earlier in grazed areas; and in high-producing stands, grazing stabilizes fluctuations in forage yield by reducing the mulching effect of residual plant material. Generally, grazing tended to dry the meadows by inducing vegetation changes to less hydric vegetation. Development of vegetation adapted to dryer conditions appeared to enhance the productivity of cattle and encourage aerobic rather than anaerobic soil conditions.

Clearly, these systems are complex and management will be equally complex. When consideration is given to the necessary interdependence of riparian zones to the uplands that make up the other 97 to 99

percent of the watershed, the complexity increases. However, riparian zones cannot be effectively understood unless the interconnection with uplands is likewise understood. The watershed is the minimal interactive unit that can function as a single entity. When long-term upland changes are evaluated, particularly west of the Rocky Mountains, the problems faced by society are nearly overwhelming. The widespread increases of woody vegetation in the sagebrush, juniper, pine, and mixed-forest zones during the past fifteen years will probably cause further drying of riparian systems. The causes of this woody plant expansion are many. The result of this expansion is a continued decrease in range condition and a devaluation of multiple-use values, especially those that depend on concentration of water, i.e., riparian zones.

STRATEGIES FOR MANAGEMENT

Development of management strategies that permit or enhance the natural functioning of watersheds should result in sustainable management practices. The site-specific nature of watersheds and the riparian zones within watersheds prohibit selection of generalized management strategies to yield universal results. Barrett et al. (1991) have developed an approach to management of watersheds that guides development of site prescriptions. Their fundamental premise is that a watershed should capture, store, and safely release the precipitation that falls within its boundaries. If precipitation is captured, it has an opportunity to move into the soil. If it is retained by the soil and moved through the soil by gravity into springs, streams, rivers, and lakes, the watershed will function in a sustained way. Any practice can be examined by how well it will allow the capture, storage, and safe release of water. An entire watershed must be managed. Paying attention primarily to the riparian zone cannot compensate for a lack of attention to the upland component of the watershed.

Buckhouse and Elmore (1991) have developed a conceptual model that facilitates evaluation of the effects of management on any specific stream system. Their generalized model is illustrated in Figure 1.

If a system is inherently stable, it can withstand a greater stress due to some form of management than if it is naturally unstable. Natural stresses include climate, gradient, soil, rock, and water flow. Management stresses include grazing intensity, season of use, logging practices, road systems, and recreation, among others. The combination of stresses from natural and/or management sources can lead to recovery of a deteriorated system or to decline as stresses exceed the capability of the system to maintain its natural functions.

Riparian systems must have disturbance at some points to maintain their natural functioning. This disturbance may be periodic flooding, burning, or perhaps man-induced actions. Without disturbance

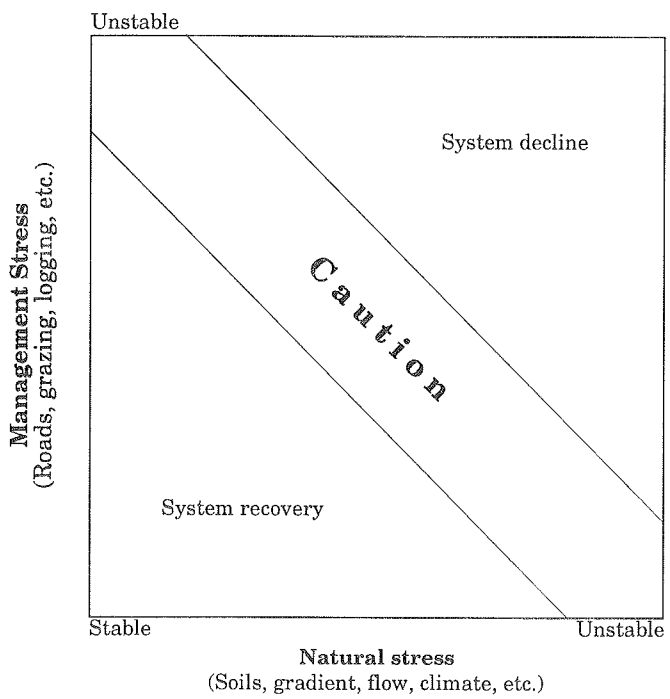

Figure 1. Generalized relationship between natural and induced (management) stresses.

the system will age and reduce its abilities to perform the many processes required to yield clean water, healthy fisheries, and wildlife habitat; and other natural features of wildland riparian systems will be impaired. A system that functions in response to disturbance should have a degree of resiliency. Through understanding the capacity of each system to buffer stresses from agricultural practices, it is possible to develop productive, sustainable agricultural uses of riparian systems as components of a total watershed.

REFERENCES

Barrett, H., T. E. Bedell, J. Buckhouse, T. Deboodt, W. Elmore, S. Fitzgerald, C. Jacks, and P. Test, eds. 1991. Watershed management guide for the interior Northwest. Oregon State University Extension Service EM 8436, Corvallis.

Buckhouse, J., and W. Elmore. 1991. Grazing practice relationships: Predicting riparian vegetation response from stream systems. Pages 47–51 *in* H. Barrett, T. E. Bedell, J. Buckhouse, T. Deboodt, W. Elmore, S. Fitzgerald, C. Jacks, and P. Test, eds. Watershed management guide for the interior Northwest. Oregon State University Extension Service EM 8436, Corvallis.

Chaney, E., W. Elmore, and W. S. Platts. 1990. Livestock grazing on Western riparian areas. U. S. Environmental Protection Agency, Washington, D.C.

Krueger, W. C. 1983. Cattle grazing in managed forests. Pages 29–41 *in* B. F. Roche, Jr., and D. M. Baumgartner, eds. Forestland grazing: Proceedings of a symposium held February 23–25, 1983, Spokane, Washington. Office of Conferences and Institutes, Washington State University, Pullman.