



Wetlands
Program



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Riparian Restoration

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Introduction

Riparian ecosystems are located on river floodplains, and are part of the highly integrated system that includes the stream channel. Overlapping terms commonly used are riparian forests, riverine wetlands and riparian corridors. Riparian ecosystems are connected to aquatic ecosystems both by direct fluxes and, below-ground, through the hyporheic zone (Lowrance et al. 1997).

In much of the world, riparian areas are dominated by forests. However, not all riparian zones or river marginal areas are forested in their natural condition. Even predominately forested areas may have inclusions of marshes dominated by emergent herbs, open water dominated by submersed plants or plankton, and unvegetated sand bars lacking trees (Brinson and Verhoeven 1999). Only a small portion of most landscapes are occupied by riparian forests and while the contribution of these ecosystems to sustain aquatic organisms is profound, they also have a central role in sustaining a variety of terrestrial organisms.

A riparian forest buffer is an area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water. Buffers are managed to maintain the integrity of stream channels and shorelines. They also reduce the impact of upland sources of pollution by trapping, filtering and converting sediments, nutrients, and other chemicals. Buffers help to absorb periodic flood pulses, and to supply food, cover, and thermal protection to fish and other wildlife. Brinson et al. (1981) described four ecological attributes of forested buffers that are im-

portant to the animals of the riparian ecosystem: (1) predominance of woody plant communities, (2) presence of surface water and abundant soil moisture, (3) diversity of interspersed habitat features, and (4) corridors for dispersal and migration. In heavily farmed or urban regions, riparian areas are often the only wooded segments remaining. Trees and shrubs found in these buffers provide protection, roosting areas, and favorable microclimates for many species. The riparian vegetation also shades the stream, stabilizes the streambank with tree roots, and produces leaf litter, all of which support a greater variety of aquatic life in the stream.

Riparian ecosystems have many functional characteristics that result from the unique physical environment. It is recognized that they are highly productive because of the convergence of energy and materials that pass through riparian wetlands in great amounts. Riparian wetlands are also generally more productive than adjacent upland ecosystems because of their unique hydrologic conditions (Mitsch and Gosselink 1993).

These shoreline landscapes concern land managers and social scientists because they are affected by water resource developments and associated land use (Malanson 1993). Riparian areas have many values (Figure 1). Because of their location, riparian areas were often selected for early settlements. The existing waterways were used for transporting people and goods quickly and efficiently, and the water offered a simple system for primitive waste disposal. Because of these benefits, riparian areas have historically been a popular choice for urban development. Expanding population centers directly impact stream-side lands that once sup-

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Existing Riparian Systems

| Economic Values | Social Values | Biological Values |
|--|--|---|
| <ul style="list-style-type: none"> › reduce downstream flooding › high yield of timber › recharge aquifers › surface water supply › support secondary productivity (e.g. fisheries) | <ul style="list-style-type: none"> › recycle nutrients, tighten spiral and storage › store heavy metals and toxins › intermediate storage for sediments › natural heritage › natural laboratories for teaching and research › recreation › aesthetics | <ul style="list-style-type: none"> › special habitat for some endangered or threatened species › refugia for upland species › corridors for species movement |

Former Riparian Systems

| Economic Values |
|---|
| <ul style="list-style-type: none"> › transport corridors › water supply and electricity › construction materials and waste disposal › agriculture and livestock › settlement |

Figure 1. The values of riparian ecosystems (Malanson 1993)

ported riparian ecosystems and continually increase their demands on a decidedly finite water supply (Patten 1998). The popularity of riparian recreation sites also leaves them vulnerable to over-use and misuse (Johnson and Carothers 1982). Motorized recreation has major impacts on many riparian resources.

Losses of riparian habitat are difficult to estimate but are considered to be great (Malanson 1993). Early logging operations used major waterways to transport large logs to downstream mills, greatly impacting the shoreline ecosystem and water quality. Riparian lands have suffered catastrophic losses due to federal water projects along major river systems. Mining along rivers and streams has taken its toll on the surrounding habitat and associated water quality. Mines can intercept the deep water table, disrupting regional aquifers and reducing stream and spring flows over a large area (Nelson et al. 1991). Mining also produces chemical contaminants that find their way into streams.

Agriculture and urban development have a great impact on today's riparian lands. Land developers generally clear large areas of shoreline to build homes and establish lawns. Urban residences along rivers and streams are often concerned about floods and property damage. Therefore, flood control dams are built upstream from urban centers, which results in direct and indirect impacts on riparian habitats. Many riparian wetlands are maintained by annual or semiannual flooding, especially those on the first terrace above the river channel (Johnson et al. 1999). Below the reservoir, the river flow regime is altered and traditional riparian systems are destroyed. Above the dam, riparian areas are lost due to increased inundation and, more often, increased housing and recreational development around the resulting reservoir.

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Commonwealth's Declared Policy: "to preserve the wetlands and to prevent their despoliation and destruction..."

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Riparian areas offer rich soils and are cleared of natural vegetation for agricultural development in many places. Farm landowners continue to remove more vegetation from the edges of their cultivated fields in hopes of gaining increased crop harvest each year, thereby greatly impacting the existing buffer. Streams and rivers that border or cross livestock fields are often used as the primary water source and are often left widely available to the animals. Domestic livestock concentrated in bottomlands for extended periods destroy riparian ground cover, destabilize streambanks, and thus increase sediment loads to streams (Patten 1998). Livestock also deliver waste material high in nitrogen directly into the water source. Each of these practices has contributed to the depletion of forested riparian buffers, a great loss of diverse wildlife habitat, and increased erosion and nutrient runoff into streams and rivers.

Because the benefits derived from riparian systems are provided by nature without cost, it is difficult to compare the real economic worth of riparian systems with activities, such as agriculture and grazing, that have well-defined market values. In addition, these more easily quantified activities receive subsidies that increase their value and encourage their development (Burns 1984).

Riparian Restoration

Landscape ecology is based on the hypothesis that the interactions among biotic and abiotic components of the landscape are spatially mediated. Not only are the flows of energy, material or species from place to place affected by their locations in the landscape, these flows then determine the interactions among energy, material and species. Landscape ecology has arisen from practical consideration of how ecological ideas could be applied in land management (Malanson 1993). This idea is especially important when considering riparian restoration because the potential site is part of an interactive watershed network. Management decisions made on any portion of the watershed will affect another portion or portions, either directly or indirectly, positively or negatively.

Landscape ecology is a useful approach when working to identify and prioritize areas for riparian restoration. The location within the watershed can help to identify objectives for a potential project. Most watersheds have three

major geomorphic zones: (1) erosion, (2) storage and transport, and (3) sediment deposition. The first two zones make up the drainage basin and the sediment deposition (zone 3) generally occurs at the lake or ocean into which the watershed feeds (Mitsch and Gosselink 1993). This is not to say that erosion does not occur in each of the zones. However, erosion rates are generally greatest in the upper watershed (zone 1). Taking under consideration the effects a restoration project would have downstream and on the surrounding properties is an important step in determining and categorizing riparian projects.

Technology tools such as remote sensing, aerial photographs and Geographic Information System (GIS) are helpful in identifying and mapping riparian areas within an entire watershed. Watershed analysis can provide a template for restoration practitioners to use in prioritizing restoration activities. Although the analysis requires significant time, money, and personnel, experience suggests that watershed analysis provides valuable direction for managing aquatic and riparian resources (Kershner 1997). Once a potential restoration site has been identified, clear goals and objectives must be developed and should be used to drive the project design.

Restoration projects must be designed with an understanding of: (1) the processes that remove or sequester pollutants entering the riparian buffer system; (2) the effects of riparian management practices on pollutant retention; (3) the impacts of riparian forest buffers on aquatic ecosystems; (4) the time necessary for recovery after harvest of trees or reestablishment of riparian buffer systems; and (5) the effects of underlying soil and geologic materials on chemical, hydrological, and biological processes (Lowrance et al. 1997). A clear understanding of the landowner's desires and goals for the project is also important.

The vegetation composition and width will determine the buffer's effectiveness in trapping sediment, recycling nutrients and providing wildlife habitat. Whenever possible, a forested buffer should be established. Adding trees to a buffer zone can increase the potential reduction of sediment and nutrients (Figure 2). Plus, a forested buffer can offer more diverse wildlife habitat and critical travel corridors for wildlife along waterways. However, not all riparian restoration plans will require reforestation. Bank stability is a major factor in tidally influenced areas because of wave action, boat wakes, storms, and rising

| Buffer Width (ft.) | Buffer Type | Sediment Reduction % | Nitrogen Reduction % | Phosphorus Reduction % |
|--------------------|----------------|----------------------|----------------------|------------------------|
| 15 | Grass | 61.0 | 4.0 | 28.5 |
| 30 | Grass | 74.6 | 22.7 | 24.2 |
| 62 | Forest | 89.8 | 74.3 | 70.0 |
| 75 | Forest / Grass | 96.0 | 75.3 | 78.5 |
| 95 | Forest / Grass | 97.4 | 80.1 | 77.2 |

Figure 2. The Effects of Different Size Buffer Zones on Potential Reductions of Sediment and Nutrients from Field Surface Runoff

sea level undermining trees at the water's edge. It is possible that trees in this situation could contribute to localized erosion and destabilization (Lowrance et al. 1997).

Management & Policies

It has long been known that land management and conservation management go hand in hand. More recently, we have begun to understand the implications of farming and forestry on water quality. As these realizations have emerged, so too have tools to address the evolving needs of the farm landowner. Foremost among those tools has been the long-running series of U.S. Department of Agriculture (USDA) farm programs collectively known as the Farm Bill. The Farm Bill currently authorizes about 20 agricultural conservation programs with a combined funding level of \$2.5 billion per year. Collectively, these programs have significant potential to affect water quality, shoreline stability, fish and wildlife populations, and their habitats. And if the trend of recent years continues, public funding for commodity subsidies will continue to decline, and will be replaced with increased funding for conservation on agricultural lands.

Current riparian management policies have focused on several issues: (1) widths of riparian management zones, (2) retention of live trees and snags within the riparian zone, (3) the extent of shade cover, (4) floodplain protection, (5) yarding corridors, (6) erosion protection, and (7) nutrient and sediment trapping (Gregory 1997). The USDA has specifically recognized the importance of riparian areas. Proposals have been made for using riparian vegetation as filters for agricultural nutrients as well as traps for agricultural sediment. The USDA has also desig-

nated riparian zones as eligible for inclusion in the U.S. Conservation Reserve Program (CRP), in which farmers can be paid for not farming certain environmentally sensitive areas. Most recently, the USDA added the Conservation Restoration and Enhancement Program (CREP) which provides funding to enhance and protect riparian areas, including fencing-off riparian areas from livestock and replanting native trees and grasses. In addition to federal funds and cost-share provided by CREP, qualified landowners in Virginia can combine CREP with State and Chesapeake Bay Foundation cost-share to create a 100% cost-share total. Figure 3 outlines several other federal, state and local agency programs that also offer conservation assistance to riparian landowners in Virginia.

In addition to restoration issues concerning riparian lands, preservation issues must also be addressed. Several options are available to landowners that wish to protect their riparian areas. Landowners may wish to protect their property from the pressures of surrounding development, undesirable land-use, or from property division and sale upon their death. Many options can provide financial payments and tax benefits to the qualified landowner. Conservation easements offer one of the best permanent land protection strategies for riparian landowners. Easements can be donated by the landowner, providing tax benefits, or easements may be purchased by a qualifying organization. In either situation, easements become part of the property's title and the property can be protected from undesirable land use. Although conservation easements tend to be permanent, they represent the most significant financial reward among the long-term land protection strategies.

Figure 3. Conservation Programs Available to Riparian Landowners

| | Program Name | Description | Cost Share Rate | *Contact |
|--------------------------|---|--|--|------------|
| Environmental Protection | Conservation Reserve Program (CRP) | A large-scale land retirement program that offers an annual rental payment plus cost-share to convert environmentally valuable cropland or pasture to suitable grass or tree cover for 10-15 years | 50% | NRCS, SWCD |
| | Environmental Quality Incentives Program (EQIP) | Offers financial, educational, and technical help to install practices on croplands or livestock areas to improve and maintain the health of natural resources. | 75% | NRCS |
| Water Quality | Wetlands Reserve Program (WRP) | Offers financial incentives to restore or protect wetlands in exchange for retiring marginal agricultural land | Three options: 1) permanent easement; payment for easement + 100% cost share for wetland restoration 2) 30-year easement; payment for 75% of easement value + 75% cost share for wetland restoration 3) Restoration Agreement; 10 year agreement (no easement) + 75% of cost share for restoration activity | NRCS |
| | Habitat Stewardship Program | Offers assistance for wetlands restoration, planting vegetation, livestock fencing, watering systems, and stream crossings. | 75-90% 10-year agreement period | DU-CBF |
| | Stream Protection (WP-2) | Offers incentive to change streamside land use by planting vegetation, permanent fencing, and installing livestock crossings. | 75% 5-year agreement period | SWCD |
| | Grass Filter Strips (WQ-1) | Provides cost share to install and maintain suitable grass filter strips along streams. | One-time payment of \$175 per acre 5-year agreement period | SWCD |
| | Woodland Buffer Filter Area (FR-3) | Offers financial assistance to change crop and pasture land use to establish a forest buffer along streambanks. | One-time payment of \$100 per acre 10-year agreement | SWCD |
| Wildlife | Wildlife Habitat Incentives Program (WHIP) | A farmland management program that helps landowners plan and pay for habitat improvements in association with active farming. | none | NRCS |
| | Partners for Wildlife | Offers financial assistance to restore waterfowl habitat, install livestock fencing, stabilize streambanks and install buffer strips. | 75-95% 10-year agreement | USFWS |

*Virginia Contact Agency List:

DCR - Department of Conservation and Recreation, (804) 786-2121
 DU-CBF -Ducks Unlimited-Chesapeake Bay Foundation, (804) 780-1392
 FSA - Farm Service Agency, (804) 287-1500

NRCS - Natural Resources Conservation Service, (804) 287-1691
 SWCD - Soil and Water Conservation District, (804) 786-2064
 USFWS - U.S. Fish and Wildlife Service, (804) 694-6693
 VDOF - Virginia Department of Forestry, (804) 977-6555

Conclusion

Riparian forest buffer systems are generally effective for control of sediment and sediment-borne pollutants carried in surface runoff. Consideration of existing riparian forests and linkage of forested riparian buffers as continuous stream corridors is desirable. However, watershed-wide implementation of riparian restoration requires tremendous levels of coordination by multiple partners.

Because so much of the protection of riparian land relies on voluntary and contractual programs, a central element of riparian forest policy involves incentives, cost-share programs, fee payments for land taken out of production, subsidized seedlings, and so on. These incentives are delivered through a host of agents, state and local natural resource agencies, private industry, and citizen groups. Pennsylvania's Streambank Fencing Program is exemplary in that it provides fencing to restrict livestock access to streams free of charge to farmers. This has resulted in the installation of over 100 miles of fencing. Forestry corporations provide subsidized seedlings to landowners for reforestation, and countless private businesses and citizen organizations are involved in community forest buffer replanting programs. However, the question remains as to how effective various incentive programs are in meeting the economic needs of landowners while maintaining and restoring riparian forests.

The financial benefit a landowners receives can have a significant impact on his or her willingness to participate in riparian forest programs.

For example, Maryland's Buffer Incentive Program had a backlog of applicants when the program offered landowners a one-time \$500-per-acre payment to establish and maintain minimum 50-foot forested buffers. A legislative modification to the program lowered the payment to \$300 per acre; the result was a steep decline in the number of applicants (Chesapeake Bay Commission 1995). A more detailed, formal analysis of economic incentives could help determine what level of cost-share is economical to landowners in differing land-use scenarios. Some relatively minor adjustments to funding levels or structures could result in a significant change in the willingness of landowners to participate in incentive programs.

In *The Influence of Forestry upon the Lumber Industry*, Overton Price (1902) noted that "it is the history of all great industries directed by private interests that the necessity for modification is not seen until the harm has been done and its results are felt." It is this characteristic of human nature and our society that necessitates awareness of historical changes, anticipation of future trends and the development of more effective approaches to maintain and restore riparian forests and aquatic ecosystems. The protection of riparian systems will not be won simply by the passage of a law by a county board of supervisors or the State Legislature. Pressures for development will continue to increase and an effective lobby, supported by scientific research, for protecting riparian systems will be needed to balance the political influence of industrial and development lobbies.

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