AN ASSESSMENT OF THE NEED FOR PROTECTION AND RESTORATION OF RIPARIAN HABITATS IN GEORGIA

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Abstract. Georgia is probably typical of most southeastern states in patterns of land use along streams and resulting impacts to riparian habitats. Land uses along streams vary with stream order, soil type, topography, demographic patterns, and other factors, but may include row crop production, silviculture, residential use, livestock production, recreation, and commercial/industrial development. Resulting impacts also vary greatly from region to region and site to site, but may include the following: loss of vegetative cover, erosive soil loss from streambanks, sedimentation of streams, and changes in flora and fauna of wetland, upland and aquatic habitats.

Several different functional aspects of riparian zones have been elucidated in the scientific literature. These include: 1) riparian corridors as buffers for protection of water quality; 2) riparian corridors as regulators of interactions between aquatic and upland systems; and 3) riparian corridors as important wildlife habitat. The need for protection and/or restoration of riparian systems follows from all of these attributes. However, it is important to realize that, in order to be effective, riparian restoration and protection efforts should be planned within the context of an overall strategy for watershed protection. Regional differences in land use patterns and resulting impacts should be examined in developing such strategies.

INTRODUCTION

Riparian habitats have been defined as the "water's edge", or the ecotone between aquatic and upland systems (Schaefer and Brown, 1992). In contrast, riparian corridors are usually considered the area encompassing a stream channel, stream bank, and active floodplain up to the edge of the adjacent upland. Several studies have emphasized the importance of riparian habitats for protection of water quality and aquatic habitats. Riparian habitats and processes are important in determining temporal and spatial dynamics of riverine species (Angermeier and Bailey, 1992). These systems are relatively well-developed landscape features, but they are difficult to delineate in terms of ecosystem functions. Riparian habitats represent interfaces between terrestrial and aquatic habitats, and usually include sharp environmental gradients. Both continuous and sporadic exchanges of energy, nutrients, and species take place across these interfaces (Schaefer and Brown, 1992).

It is difficult to describe a "typical" riparian habitat. While there are certain shared characteristics and functions of riparian habitats, the relative importance of these characteristics and functions depends on landscape context. Riparian corridors are unique expressions of fluvial and geomorphic processes within a given watershed. In this paper "riparian habitat" and "riparian zone" are used interchangeably to mean riverbank and adjacent floodplain habitats, excluding the stream channel.

LAND USE PATTERNS AND RIPARIAN IMPACTS

Georgia is probably typical of most states in the Southeast in terms of land use patterns along streams (Healy, 1985); the variety of land uses in riparian zones within the state reflects the diversity present within the region as a whole. Riparian zones in Georgia are distributed over portions of five physiographic provinces. Patterns of land use within a given physiographic province are often more similar to those of the same region in adjacent states than to land use patterns in other provinces in Georgia. Land uses along streams vary greatly with stream order, soil type, topography, human demographic patterns, and other factors. For example, first-order streams of higher elevations in the Georgia Blue Ridge often have intact riparian corridors surrounded by dense forest. Streams of the same order in the Ridge and Valley province are often bordered by zones of intensive agricultural use. Piedmont streams near major metropolitan areas are often rimmed by residential or industrial developments, and traversed by numerous roads and utility rights-of-way. Below the Fall Line, headwater streams typically have relatively narrow riparian zones bordered by areas of row crop production, kaolin or sand mining, or silviculture, while the major alluvial river systems have broad

floodplains exhibiting a patchwork pattern of intact and clearcut bottomland hardwood forests.

In some settings, riparian habitats represent the areas of greatest land use change, or zones of concentrated development activities. Historically, this pattern of development was attributable to a dependence on rivers and streams for potable water, food, power, and transportation. More recently, riparian areas have been developed into utility corridors, trails, railroad and highway corridors, and parks. Changes in the value of land, timber and agricultural products may greatly affect patterns of use of riparian corridors. Angermeier and Bailey (1992) found that although only 2.1 percent of the Clinch River basin in Virginia was urban land, 4.9 percent of land within 1 km of streams was classified as urban. A study of land use changes in the watershed of a coastal plain blackwater stream in Georgia found that areas within 1 km of the stream experienced the greatest rates of change. Most of this change represented a transition from forested land to residential, urban, and harvested/new growth (Crow and Ambrose, 1997).

Human impacts on riparian habitats also vary considerably across the state due to differences in topography, soils, hydrology, and human demographic patterns. Impacts resulting from disruption of natural riparian processes are many and varied, but include the following: loss of vegetative cover, erosive soil loss from streambanks, sedimentation of streams, and changes in the biotic diversity and functions of wetland, upland, and aquatic systems.

FUNCTIONS OF RIPARIAN HABITATS

Protecting water quality

Several studies have demonstrated the ability of vegetated riparian zones to protect aquatic ecosystems from sedimentation by trapping sediments originating from upland areas and reducing erosive soil loss from streambanks. Other functions of include reducing the risk of pollution of aquatic systems by trapping and processing excess inorganic nutrients, pesticides, heavy metals, and toxic organic materials (Wenger, 1998). The ability of riparian habitats to provide this protection is dependent on slope, vegetated patch width, spatial and temporal patterns of disturbance in the watershed, rainfall patterns, and other factors.

Sediment is, by volume, the major pollutant in streams and rivers (Cooper, 1993; cited in Wenger, 1998). Much of the Georgia landscape has been subjected to severe erosional soil loss and sedimentation of streams, due to past agricultural practices and current patterns of residential and commercial development. This is most evident in the Piedmont, where years of poor erosion control during the heyday of cotton farming resulted in some shoals being buried under more than ten feet of sediment (Ferguson, 1997). Siltation of streams impacts aquatic diversity by reducing available habitat for benthic organisms, causing direct mortality to fish, mussels, and arthropods, and decreasing primary productivity. Other contaminants may affect aquatic community structure and function by promoting eutrophication, altering competitive and trophic relationships, and causing direct mortality through chemical toxicity and introduction of disease organisms. Maintenance of intact riparian habitats is an important factor in protecting adjacent aquatic systems from pollution.

Regulating interactions between upland and aquatic systems

In a broad sense, riparian habitats are important regulators of aquatic-upland exchanges of materials, energy, and species (Schaefer and Brown, 1992). As interfaces between terrestrial and aquatic systems, riparian zones function as ecotones, providing semipermeable boundaries for ecological processes and materials. Riparian vegetation regulates light and temperature regimes, provides nutrients, and serves as a source of large woody debris to both aquatic and terrestrial habitats. Vegetation in the riparian zone intercepts runoff from upslope areas, modifying the rate of movement of water, sediment, and nutrients to adjacent aquatic systems. During overbank flow events, this vegetation helps to dissipate kinetic energy and moderate the effects of flood waters on floodplain environments. Streambanks and floodplain terraces function similarly as regulators of matter and energy fluxes.

Elevational and hydrologic gradients within the riparian corridor often result in a distinct zonation of vegetation. Distribution patterns and movements of animals are also directed by these environmental gradients, though less obviously. The connections between floodplains and adjacent aquatic habitats are temporally variable, and this lends further complexity to community structure and trophic relationships in both environments. By regulating the availability of light, water, and nutrients, riparian habitats greatly influence the structure and function of adjacent habitats.

Providing important wildlife habitat

While the importance of riparian habitats in protecting water quality has been emphasized in many studies, the role that riparian habitats play in maintaining biological diversity has often been overlooked. Natural riparian corridors represent unusually diverse combinations of landforms, communities, and physical environments, which typically support a remarkable diversity of species (Naiman et al.,

1993). This high biological diversity is thought to be related to the fact that such habitats represent non-equilibrium systems, where the process of interspecific competitive exclusion is inhibited by periodic environmental fluctuations and resulting population fluctuations. Ecologically diverse riparian corridors are thought to be maintained by a complex suite of natural disturbances operating over broad ranges of time and space. This natural disturbance regime provides both spatial heterogeneity and temporal variability, and is expressed biologically in terms of high species diversity.

An inclusive list of wildlife species utilizing riparian habitats in Georgia is not available. Indeed, most riparian zones have not been adequately surveyed in Georgia or elsewhere. While some animal species are restricted to riparian habitats, many others migrate in and out, contributing to the function of these ecosystems only occasionally. Some animals (e.g., wading birds, aquatic turtles, otters, muskrats, water snakes) are found in close proximity to the water's edge, while others (neotropical migratory birds, bears, raccoons, bats) may range widely through and across riparian habitats. Some riparian corridors are characterized by a sharp linear zonation of vegetation, while others represent more complex mosaic patterns of plant distribution.

An examination of the habitat requirements of rare species in Georgia is instructive. Of the 583 rare or uncommon plant species monitored by the Georgia Natural Heritage Program (GNHP), 106 species (18%) are found primarily in riparian or lotic systems. Of the 335 rare or uncommon animal species tracked by the GNHP, 212 species (63%) are found in riparian or lotic habitats. The wide disparity between these figures seems surprising at first glance, but is a reflection of differences in patterns of endemism and rarity in plants and animals in Georgia.

Most rare plants in Georgia are associated with upland habitats (e.g., granite outcrops, Altamaha grit outcrops, limestone glades, longleaf pine-wiregrass savannas, sandhill pine-oak scrub) or with lentic aquatic or wetland habitats (limesink ponds, wet savannas, upland depression swamps and bogs). These plants generally have low dispersal capabilities, and are threatened by destruction or degradation of relatively discrete habitat patches. Rare plants of riparian habitats are often associated with microhabitat features (e.g., hammocks, seepage slopes, rocky bluffs) that are relatively scarce in the riparian zone. Others may be widespread, but nowhere common, within active floodplains. A few rare vascular plants are restricted to lotic habitats, often associated with gravel bars, rocky shoals, or spring runs. In general, vascular plants have relatively few species associated with flowing waters. The major portion of plant diversity in such habitats is associated with diatoms and other algae, especially in smaller streams (Allan and Flecker, 1993).

Most animal species recognized as rare or uncommon in Georgia are associated with stream environments. These include large numbers of fish, mussels, aquatic gastropods, insects, crayfish, reptiles, and amphibians, and relatively few birds and mammals. Many of these rare aquatic species are endemic to relatively small drainage basins, isolated by natural or man-made barriers, and increasingly threatened by impoundments, sedimentation, chemical pollution, or introduced exotic species. Other rare animals of aquatic systems are found in widely-distributed but uncommon habitats (e.g., springs, caves, shoals) or depend on exceptionally good water quality. Some are locally common, but restricted in their ability to colonize other suitable habitats by physical dispersal barriers, competitive exclusion, or predation. Most are vulnerable to impacts from changes in the aquatic environment resulting from impairment or destruction of riparian habitats. Relatively few rare animals are restricted to riverbank or floodplain habitats, though many wide-ranging rare species use these habitats periodically.

CONCLUSION

Riparian habitats serve several important functions, including protecting stream water quality, regulating exchanges of materials and energy between upland and aquatic environments, and providing habitat for wildlife, including rare species. The need to protect and restore riparian habitats follows logically from any one of these functional attributes. Several authors have pointed out the need to view the role of riparian corridors from a landscape perspective (Schaefer and Brown, 1992; Naiman et al., 1993). It should also be emphasized that assessments of the need for protection and restoration of riparian habitats should take into account the various functions of these systems in different landscapes.

Restoration attempts that focus on only one aspect of riparian habitat function (e.g., protection of stream water quality) may work at cross-purposes to other functional attributes. For example, some riparian restoration projects have actually promoted the spread of invasive exotic plants, threatening the biotic integrity of riparian plant communities throughout the watershed and elsewhere. "Ideal" or "minimal" widths of vegetated riparian zones are often described in terms of the ability of these habitats to buffer impacts from adjacent land uses on water quality or riverine habitat. This reflects a limited view of the overall importance of riparian habitats in the landscape.

Riparian corridor protection and restoration projects

should be undertaken with specific, measurable goals, including the maintenance of native species richness. While this approach seems logical and straightforward, it requires substantial effort in establishing baseline data on the composition of plant and animal communities within a watershed. To date, very few riparian conservation strategies have been based on specific wildlife criteria.

It is important to remember that protection of riparian areas in a given watershed can be a very important factor in maintenance of native plant and animal diversity, but it cannot serve as a substitute for proper land management in the rest of the watershed. Neither can it address the needs of rare species associated with other habitats. In Georgia, protection and restoration efforts directed toward riparian habitats will provide much greater benefits to rare animals than to rare plants.

In order to be effective, riparian protection and restoration efforts should be planned within the context of an overall strategy for watershed protection. All applicable conservation tools (education, fee-simple acquisition, incentive-based programs, conservation easements, etc.) should be evaluated for employment in the watershed protection plan. Regional patterns of land use and resulting impacts should be examined in developing such strategies. Finally, an understanding of local riparian functions and patterns of plant and animal community composition is necessary to establish priorities for conservation activities within the watershed.

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