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Introduction

Nora A. Murdock

Green pitcher plant (Sarracenia oreophila).

Introduction

In the past this continent was lush with wetlands and full of the related benefits. The features of rich biodiversity and clean water attracted human settlers to shores and wetland rich areas. The tribal peoples on this continent shared an intimate bond with the natural world that is evident in their song, dance, stories, and ceremonies. Their impact on the landscape, although not entirely benign, was within the ability of the natural communities to adapt, allowing both to flourish. European settlers, guided by a different ethic, initiated a series of transformations that would change the land forever.

During the last 400 years agriculture, urbanization, transportation, and industrialization have resulted in large modifications in the landscape (Table 1.1). The importance of wetland ecosystems (Table 1.2) were not understood or appreciated. When wetlands were considered at all, it was often in a derogatory fashion resulting from the perceived infestation of these "swamps" with pestilence, disease, and loathsome creatures. Wetlands were equated with wastelands. Farmers were not considered industrious unless they "reclaimed" these areas through ditching, draining, or filling for the higher use of agriculture or development.

The technology and persistence applied to wetland draining has resulted in large wetland losses in most areas of North America. In North Carolina alone, about 90% of the bog and fen habitats have been lost. Federal, state, and local programs provided assistance and incentives for destruction of wetlands as early as the mid-1800s (e.g., Swamp Lands Acts of 1849, 1850, 1860). Today, as human populations in most watersheds grow, stress accumulates in the integrated natural systems. This stress is manifested in a decline in the health and resilience of the ecosystem.

The negative impacts of wetland destruction were becoming apparent by the early to mid-1900s with noticeable declines in fish and waterfowl populations. Yet destruction of wetlands continued to be the accepted and encouraged practice in the United States until the late 1960s. As a result some types of wetlands have become very rare, along with the biodiversity that depends on them, and the benefits of wetlands have been lost to the surrounding human community.

Through a number of educational programs initiated by public agencies such as the Natural Resources Conservation Service (NRCS), US Fish and Wildlife Service (FWS), and non-governmental organizations (NGOs) like Ducks Unlimited and the World Wildlife Fund, the public now has a new awareness of the importance of wetland ecosystems. The Clean Water Act of 1972 initiated the use of regulation to protect wetlands under Section 404. However, wetlands are still being lost at an astonishing rate. Earlier in our nation's history wetland losses were due primarily to draining for agriculture. Today many more are being destroyed for road construction, housing developments, and shopping centers. Economic prosperity and an increasing human population often mean tremendous losses for wildlife and natural areas.

Manual Focus

In the past two decades a new appreciation for wetlands and the benefits they provide has begun to develop throughout the nation. A large body of evidence continues to suggest the importance of preservation and restoration of wetlands for the benefit of natural systems and the human populations that depend on them. This manual will focus

Table 1.1 Methods of Altering Wetlands

Physical

a) **Filling** - adding any material to change the bottom level of a wetland or to replace the wetland with dry land.

b) **Draining** - removing water from a wetland by ditching, tiling,or pumping.

c) **Excavating** or **dredging water away** - preventing the flow of water into a wetland by removing water upstream or lowering groundwater tables.

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Ditching of wetlands is still a common practice.

d) **Flooding** - raising water levels either behind dams, by pumping, or otherwise channeling water into a wetland, often done for the purpose of creating livestock watering ponds, irrigation ponds, detention ponds, or water hazards on golf courses.

e) **Fragmenting** - bisecting wetlands with roads that create barriers to normal flow of water and normal activity of wildlife, also creating a source of mortality for wetland animals migrating from one portion of the wetland to another.

f) **Shading** - placing pile-supported platforms or bridges over wetlands, causing vegetation to die.

g) **Conducting activities in adjacent areas** - disrupting the interconnectedness between wetlands and adjacent land areas, or incidentally impacting wetlands through activities at adjoining sites.

Chemical

a) **Changing levels of nutrients** - increasing or decreasing levels of nutrients within the local water and/or soil system, forcing changes in the wetland plant community

b) **Introducing toxins** - adding toxic compounds to a wetland either intentionally (e.g., herbicides and/or pesticides) or unintentionally (e.g., storm water runoff from nearby roads containing oils, asbestos, heavy metals, and others), which adversely affect wetland communities.

Biological

a) **Grazing** - consumption and compaction of vegetation by large numbers of domestic livestock.

b) **Disrupting natural populations** - altering the number or abundance of existing species, introducing exotic or domestic species, or otherwise disturbing resident organisms.

Modified with permission from World Wildlife Fund and The Conservation Foundation, 1988.

on a particular group of wetlands called freshwater bogs, fens, wet meadows, marshes, or seeps. In particular, these wetlands are found in the headwaters of the Mountain and Piedmont geomorphic provinces of the eastern states from New York to Georgia. Of particular interest in these freshwater wetlands is the high level of biodiversity of rare plants and animals, including federally listed species like the Mountain sweet pitcher plant (Sarracenia rubra ssp. jonesii) and the bog turtle (Clemmys muhlenbergii).

The goal of this manual is to provide landowners and land managers with an easy-to-read guide based on the best available scientific and technical information available as they work in and around small wetlands of the Mountains and Piedmont of the Southeast. It is an attempt to develop a framework for decision making, which includes information about wetland functions, human values, ecology, and restoration techniques. Hopefully, this guide will provide a foundation to begin restoration and management of these small wetland communities.

What is a Wetland?

Wetlands can be described as lands where the water table is usually at or near the surface, or the land is covered by shallow water (also see Glossary). These lands are saturated with water or covered with water all year, or for long periods of time during the year. Wetlands have hydric soils (the type that form under flooded or saturated conditions) and are inhabited by water-loving plants. Southern Appalachian wetlands are significant ecological communities and include many different types such as bogs, fens, pools, and seeps (Appendix A). Some wetlands, like ephemeral pools, are ecologically important because they dry seasonally, and allow a fish-free environment necessary for the development of several species of amphibians. Other types of wetlands are important because they usually stay wet throughout the year.

Benefits of Wetlands: Functions and Values

Small wetlands perform environmental services that benefit larger ecosystems in numerous ways: They function to purify water, provide habitat for plants and wildlife, help recharge groundwater, and abate damage from floods (Table 1.2). Additionally, shallow aquatic habitats are important for many forms of life and over 90 species of rare plants and animals are associated with these ecosystems in the Mountains and Piedmont of the

Table 1.2 Importance of Wetlands

a) **Floodwater storage** - wetlands may store water during floods and slowly release it to downstream areas, lowering flood peaks.
b) **Habitat for wildlife** - wetlands provide essential breeding, nesting, feeding, and predator-escape habitats for many amphibians, reptiles, mammals, birds, and insects.
c) **Home of many rare and endangered species** - over 90 rare and endangered species are found in small wetlands of the Mountains and Piedmont in the Southeast.
d) **Water supply** - some wetlands are important in maintaining groundwater levels.
e) **Education and research** - wetlands provide unique opportunities for nature education, observation, and scientific study.
f) **Open space** - wetlands provide undeveloped space for ecological processes to continue.
g) **Aesthetic values** - wetlands are areas of great diversity and beauty.
h) **Water quality** - wetlands contribute to improving water quality by removing excess nutrients and many chemical contaminants.

Modified with permission from Kusler, 1983 and National Research Council, 1992.

Introduction

Hank Henry

Small, spring-fed wetlands are important habitats for many species.

Southeast (Appendix B). In areas where wet spots are scarce, populations of many types of plants, amphibians, insects, crustaceans, and mollusks depend upon small wetlands for survival. Some are wetland obligates, that is, they are unable to live in other types of aquatic environments such as nearby streams, creeks, and ponds.

Several animals, abundant in earlier years, are becoming increasingly less common due to wetland losses. Examples are: spotted salamanders (Ambystoma maculatum), marbled salamanders (Ambystoma opacum), southern bog lemmings (Synaptomys cooperi), wood frogs (Rana sylvatica), red salamanders (Pseudotriton ruber), mountain chorus frogs (Pseudacris brachyphona), and the American woodcock (Scolopax minor). Even the call of the spring peeper (Pseudacris crucifer), a once familiar sound piercing the night in late winter and early spring, has become a strange and unusual sound to many children. The musical trill of the American toad (Bufo americanus) has never been heard by a whole host of citizens, and many students, when asked by their teachers to describe an experience with a toad or turtle, report they have never had one.

On the landscape level, discrete patches of wetlands may occur within reach of nearby wet areas, forming a web or mosaic of suitable habitats (Figure 1.1). Whether or not streams connect the wet areas, the close proximity of suitable wetlands permits animals to move between them. There is also significant movement of plant species between small adjacent wetlands. The individual plants don't move, but their seeds can be blown by the wind into adjacent areas or transported by wetland animals migrating from one patch to another.

A population in one wetland may occasionally exchange individuals with a nearby population through migration. Such sub-populations form a larger unit called a metapopulation (Box 2.1). Sub-populations are often small and if they become isolated, are vulnerable to extinction caused by chance demographic fluctuations, inbreeding, or disease. Isolation can be caused by changes in the use of the land separating them, such as new roads, subdivisions, and shopping areas that disallow plant and animal populations the opportunity to move safely to an adjacent wetland. Severe weather events or succession of woody vegetation are also serious threats to small, isolated populations. Thus, long-term survival of some wetland organisms is dependent upon the persistence and connectedness of the many small wetlands that form a mosaic in the landscape.

Many of the above functions, long understood by biologists, have only recently entered into public awareness. The values we now place on wetlands are derived from a greater understanding of the importance these functions have for the quality of our lives. In previous times, we never thought of ourselves as capable of doing harm on a grand scale; we did not recognize that altering small patches of wetlands could have detrimental cumulative effects. Now we know of our power to impact the environment. There is a new reverence, not just for wetlands, but for all of nature. It is no longer acceptable to view natural systems, such as wetlands, as blemishes that must be dealt with. We have come to appreciate wetlands, not only for the water quality benefits, but also for their aesthetic qualities. The negative views of wetlands, such as mosquito-infested wastelands, are changing to a broader understanding that such systems should be preserved and restored.

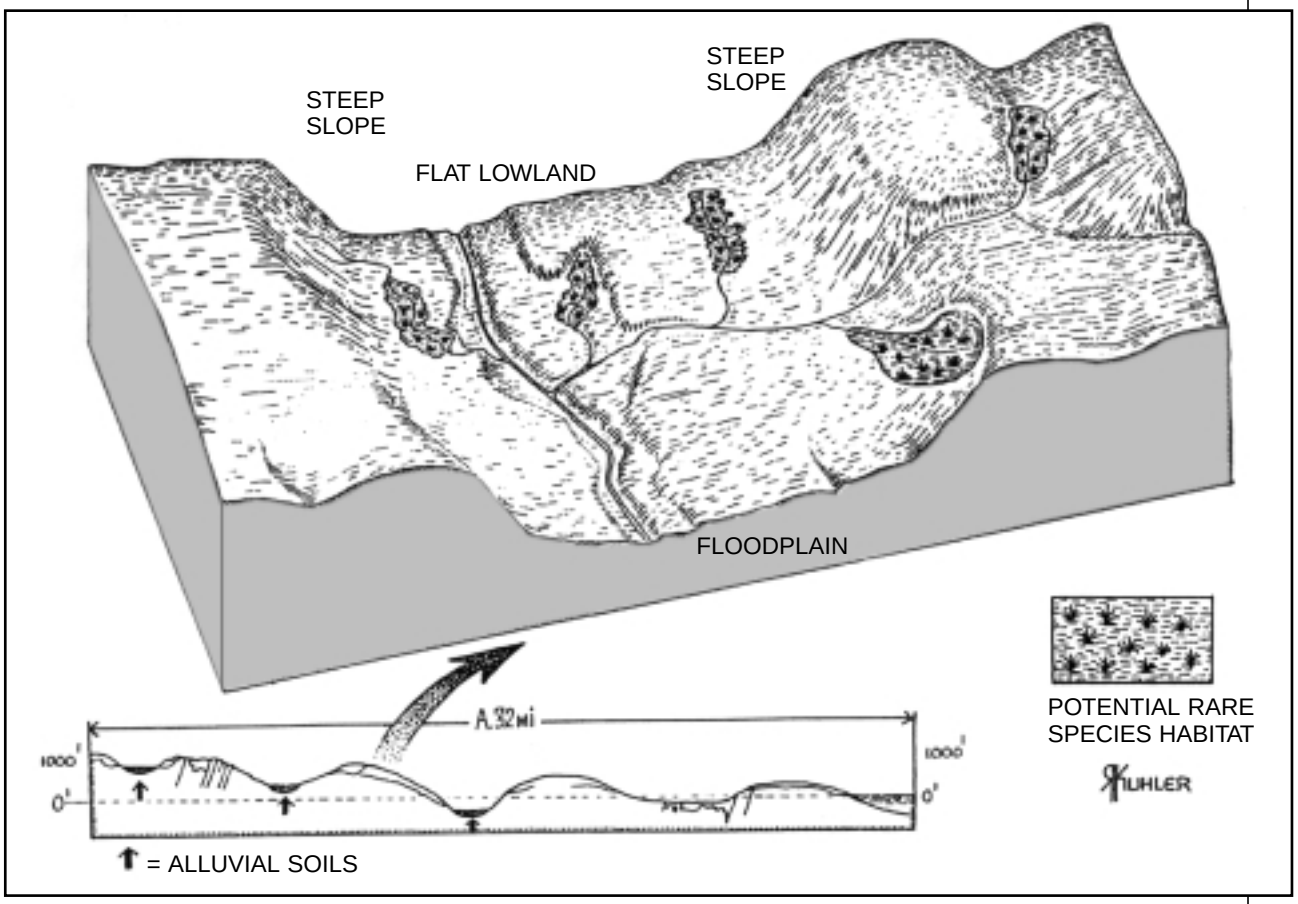

Figure 1.1 *Generalized view of a western Piedmont landscape showing topographic and hydrologic units prior to alteration by draining and fragmentation by roads. Note patchy occurrence of small wetlands.*
Modified with permission from Lee and Norden, 1996.

Can Wetlands Be Restored?

Restoration can be defined as a recovery of ecological function. Although few believe that full restoration of damaged wetlands is possible, this manual is based on the conviction that at least partial restoration is feasible and beneficial, and should be a high priority for land managers.

Many wetland definitions and descriptions have official connotations depending on the context. **Wetland preservation** is the most obvious and basically means that impact to an existing wetland should be avoided, and the wetland be allowed to continue to develop and function unaltered. **Wetland restoration** is defined as active rehabilitation of a degraded wetland or hydric soil area to recover its natural attributes, ecological functions and values. **Wetland enhancement** is defined as improvement, maintenance, and management of existing wetlands for a particular function or value, possibly at the expense of others. **Wetland creation** is defined as the conversion of a non-wetland area into a wetland where one has never existed. **Wetland mitigation banking** is a term that denotes the trade-off of "unavoidable" wetland destruction with wetland preservation, restoration, enhancement, and creation with the objective to avoid a net loss of wetlands.

In order for people to make wise decisions about the management of freshwater wetlands, reliable information is a key component. Data must be collected before and after modifications in order to determine the effects of treatments (before-after sampling design). The quality and effectiveness of restoration projects is often proportional to the amount of knowledge available about the system. The ultimate success of one's efforts

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*Wetlands benefit rare species as well as familiar ones like this American toad (*Bufo americanus*).*

may depend on the level of preparation that occurs prior to manipulation. The National Research Council Committee on Restoration of Aquatic Ecosystems recommends that a wetland be monitored for a minimum of 10 years after restoration is attempted, and landowners and managers are advised to follow this practice whenever possible.

Wetlands restored in regulatory contexts (mitigation) often include little monitoring after initial enhancement or creation. Since the law does not require it, funding for monitoring is usually not available and long-term scientific data about the success or failure of these projects has not been generated. Since it has not been scientifically demonstrated that replacement wetlands function as well as natural wetlands, creation and restoration are not recommended to mitigate avoidable destruction of wetlands. It should also be noted that United States law requires consultation with the US Fish and Wildlife Service when modifications are undertaken in any area that could negatively impact threatened or endangered species.

When working in wetlands along creek and stream channels or in other significant natural resource areas, it is often best to enlist the assistance of local experts who can bring resources and partners to aid in the success of the project. The advice of local conservation professionals and officials can be helpful beyond the legal and regulatory aspects of the project including technical support, design, contacts, and financial assistance. Since three-quarters of national wetlands are privately owned, many agencies and programs have been developed to help landowners design and implement voluntary conservation plans. For current information that applies to any local situation, consult current and local resources such as those listed in Appendix D.

Importance of Landowners

Three-quarters of the remaining wetlands in the United States are privately owned. Millions of wild birds, mammals, and other creatures depend on wetlands for food, breeding, and nursery areas. Nearly one-third of America's endangered and threatened plants and animals need wetlands to survive. Wetlands also benefit people by providing natural floodwater storage, affording recreational opportunities, recharging groundwater supplies, filtering pollutants, and providing irrigation water.

Landowners are of critical importance in the identification, restoration, and management of wetlands. Protected, preserved, and restored wetland areas become the local biodiversity banks. These banks will be increasingly important during periods of environmental stress such as droughts, storms, and disease. Careful land-use planning and conservation of exemplary wetland communities and rare species populations are two important ways that this natural heritage can be retained. Since the vast majority of wetlands are on private property, conservation of these valuable systems cannot be achieved without the efforts, support, and protection of good citizens. Private landowners are the key to conservation in the Southeast, and the programs available to help them are continually improving.

"We need to recognize the landowner as the custodian of public game on all private land... compensate him...with either cash, service, or protection, for the use of his land and for his labor...on the condition that he...safeguards the public interest."

— Aldo Leopold

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