

The Wetlands of the Mid-Atlantic Coastal Region Provide Vital Ecosystem Services Including Support of World Class Biodiversity

Land that is inundated with water for at least part of the year can be characterized as a wetland. These include marshes, swamps, bottomland hardwoods, pocosins and wet flats. They can be located near the shore, where tides flood the soil daily, in fluvial flood plains or in depressed areas of land where rainwater collects. Regardless of location, these lands all share similar characteristics in vegetation and soil. The plants are well adapted to wet, anoxic conditions for at least part of the year; the soils have properties of color, texture and odor that reflect their development in water-logged conditions.

Wetlands are often split into two categories: coastal and inland. Coastal, or tidal, wetlands are usually associated with the estuaries along the shore where seawater and freshwater mix. The salinity creates a harsh environment unfavorable for most life except for certain hardy grasses. Inland, or non-tidal, wetlands are found near bodies of water such as rivers and lakes, or in low-lying lands where the groundwater level intercepts the land surface. Vegetation varies from grasses to shrubs to trees. Many of these are in saturated conditions for only part of the year, but the seasonal wetlands are just as important and perform vital functions (18).

Historically thought as useless, disease festering plots of land, wetlands are now understood to be some of the most important, productive and biologically diverse ecosystems in the world. Many of these products and functions provided by wetlands—including water filtration, providing habitat for commercial species and many more—directly benefit humankind and are termed ecosystem services. Although there is a clear demand for this multitude of resources and processes, the current market does not reflect this demand in monetary terms. This results from a lack of understanding of interrelations between natural systems and our dependence on them and creates the unfortunate situation where industrial activity decimates the natural processes that make possible the very activity. However, these ecosystem services are indeed valuable and are quantifiable. Experts are currently working to translate the scientific knowledge into economic terms.

Covering only 3% of all the land on earth, wetlands provide us with 40% of annual ecosystem services (20). Indeed, the frequently cited study Costanza *et al.* (1997) values the total global ecosystem value of wetlands at approximately 4.9 trillion USD per year. While the exact monetary amount has been disputed, the message is strong and clear: wetlands are valuable. Yet in the US, we face ongoing loss and degradation of this important ecosystem. According to the EPA, 220 million acres of wetland were thought to have existed in the contiguous 48 states (16), more than half of which have already been lost. In addition, we continue to lose wetlands at a rate of 60,000 acres per year (14).

Globally, the primary causes of wetland loss are agriculture (although this has become less important in the past decade), forestry and urban development. In the southern US, home to the greatest expanse of forested wetland in North America, the leading cause of wetland loss is industrial logging and related forestry practices (**USFS SRFA**). Across the South, wetlands have been ditched and drained or filled to make space for pine plantations, agricultural fields and conglomerations of concrete and steel.

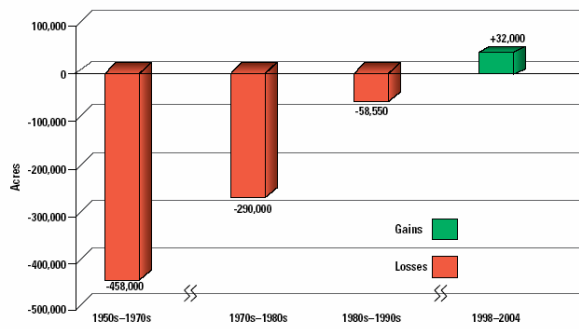


Figure 56. Average annual net loss and gain estimates for the conterminous United States, 1954 to 2004. Sources: Prager et al. 1983; Dahl and Johnson 1991; Dahl 2000; and this study.

Figure 1. U.S. Fish and Wildlife Services,
http://www.fws.gov/nwi/PubsReports/trends_2005_report.pdf

valuable functions for the environment and people, such as naturally purifying water. They also store water, which eases social and economic strain in a flood and recharges aquifers to provide us with more drinking supply in a drought. Wetlands have an enormous range of biodiversity. They trap sediment to prevent erosion, especially along the coast. Wetlands provide a wide variety of important ecosystem services and are a critical component of our Southern Forests.

The chart to the left illustrates the massive wetland loss since the 1950s and the net wetland gain of 32,000 acres from 1998-2004. While this increase is small in comparison to historical losses, it shows an encouraging recent trend reflecting society's better appreciation for the ecological and other values of wetlands.

Wetlands are a finely tuned, complicated ecosystem serving many

WETLAND ARE HOME TO AN INCREDIBLE RANGE OF BIODIVERSITY

Wetlands, in all its productivity, provide terrific homes for a variety of organisms. Although they cover on 5% of the land area in the US, wetlands are home to 31% of all plant species (5). According to the EPA, habitat destruction since the 1970s has been the leading cause of species extinction. The US Fish and Wildlife Service estimates that about 43% of the nation's threatened or endangered species depend on wetlands for survival and in North Carolina in particular, this number is over 70%. Wetlands provide a habitat for fish, amphibians, reptiles, mammals, birds, waterfowl and a variety of plants. **Additional discussion of specific species and their habitat areas can be found further down in this report.** (how to phrase)

WETLANDS SERVES AS CRITICAL FILTERS IMPROVING WATER QUALITY

With the growth of human population and expansion of urban development, our freshwater resources are diminishing and our limited remaining water resources are compromised by man-made pollution. Runoff—contaminated waters from storm surges, urban leakages and agricultural fields—is a huge water quality problem in coastal North Carolina. Water pollutants—nitrogen, metals, sediment, oils, infectious agents—find their way into our lakes, rivers and groundwater, posing a threat to human and animal life. Eutrophication, for example, illustrates how runoff damages the population of aquatic species.

Eutrophication, the overabundance of chemical nutrients such as nitrogen, occurs when excess nutrients from fertilizers accumulates in the waters, promoting algal growth and subsequent decay. Decaying algae uses up the oxygen in the water, creating anoxic conditions unsuitable for life. Eutrophication is responsible for fish kills in the Chesapeake Bay and the Dead Zone in the Gulf. It contributes to half of the damaged lakes and 60% of damaged rivers in the US (5).

. Wetlands function as a natural filtration system that removes all these pollutants. Natural microorganisms in healthy wetlands break down toxins; soil particles trap metals and other sediment; plant roots take up nitrogen and phosphorus from fertilizers. This new clean water recharges into streams and aquifers, which we pump for drinking water. In this purification process that provides water for all life, wetlands take up and recycle the pollutants (such as nitrogen) into the food chain, turning what would have otherwise been waste into life supporting nutrients. Wetlands are thus very efficient. They can remove 20-60% of metals in the water, trap and retain 80-90% of sediment from urban runoff and eliminate 70-90% of entering nitrogen (5).

. Healthy wetlands are so effective at providing clean water that the use of wetlands in place of current water treatment plants is an extremely cost-effective method of providing clean water. In fact, hundreds of wetlands used for water purification processes are in operation across the United States today. The US spends over \$2 billion annually for clean water initiatives and the EPA estimates that ensuring safe drinking water for the next 20 years will cost \$138.4 billion just in infrastructure (5). That's a lot of money! New York City intelligently avoided this cost by restoring and protecting their watershed including upstream wetlands that had been degraded due to urban development instead of investing in costly treatment plants to address its water quality problem. They saved \$6 billion (1). Closer to home, the Congaree Bottomland Hardwood Swamp in South Carolina is able to cleanse water at a level equivalent to the amount removed by a \$5 million treatment plant (4). These examples show that it is much easier to protect and preserve wetlands as a natural means to water purification than to spend money on costly treatment plans. Wetlands are a wonderful asset in this regard.

WETLANDS ARE A NATURAL SPONGE - RETAINING WATER AND PROTECTING US FROM FLOODS AND SEVERE STORMS

Over the past few decades, the damages caused by flooding have become more costly in part due to draining or filling the wetlands that would have otherwise reduced high water levels. Unlike porous soils of wetlands, impervious concrete surfaces in urban areas do not take up and retain water, leading to rapid runoff and causing severe damages to life and property. With more serious flooding, individuals and insurance companies are increasing spending to remove the water and clean up mold. Damaged infrastructure also leaves a long term negative effect on industries. Hurricane Katrina resulted in a total insured loss of \$40-60 billion and a total overall economic loss of over \$125 billion (6). Just the Louisiana fishing industry lost \$1.3 billion in annual revenue (10). Over half of these various costs were a direct result of the New Orleans Flood (6).

While such storm intensities are relatively rare in today's reference frame, scientific models project that with rising global temperatures, storms are projected to become more severe (7). Intense precipitation will become more prevalent due to an increased rate of evaporation at higher global temperatures. Coastal populations' lives and properties are exposed to the full fury of these storms. In fact, in coastal North Carolina, sea level rise has been estimated to continue on the range of 4 inches to 2 feet per century (12). Under this scenario the value of wetlands as buffers to destructive storm surges become even more important.

Wetlands are an amazingly effective sponge, collecting and holding onto water, decreasing flood damage. An acre of healthy wetland can store 1-1.5 million gallons of

water (17). That is equivalent to three feet of water covering an acre of land. This also means that the maximum flood level of Hurricane Katrina—about 131 billion gallons of water (15)—could have been absorbed and held in only 87,000 acres of wetland. In comparison, the southeast coastal region has over 13 million acres of wetland, about 150 times necessary (8).

Wetland soil and vegetation also help slow flood runoffs, saving a big sum of money, as flood damages in the US, according to the National Oceanic and Atmospheric Administration, average to a spending of 2 billion dollars each year. Locally, over \$16 billion dollars could have been saved in the Mississippi Great Flood in 1993 had upstream wetlands been in healthy conditions; along the Charles River in Boston, the US Army Corps of Engineers found that protecting wetlands saved \$17 million in potential flood damages; a case study from London, Ontario showed that storm water management plans were 22% more effective with the inclusion of a wetland system (17). These experiences illustrate that there is a great deal of money to be saved in wetland preservation and restoration.

WETLANDS ARE VALUABLE IN PROTECTING SHORELINES FROM EROSION

Shoreline erosion, the loss of land into the estuary, bay or ocean is a natural phenomenon driven by the movement of water and gravity. Lighter sediments are transported by the waves to deeper water, while the heavier gravel and boulders stay close to the shoreline and settle toward the bottom as the finer sediments are removed. Higher water levels and storm surges, which, as previously discussed, are expected by current science and tend to increase erosion rates

The situation is exacerbated by human activities along the coast. Over the centuries in North Carolina, agriculture and industrial development have destroyed most of the forests and marshes along the coast, leaving the uplands more vulnerable to erosion. This is of particular concern because sea level rise along North Carolina's coast is projected to rise up to 2 feet per century and studies have shown that shoreline erosion rates have increased from -2.8 feet per year in 1978 to -3.2 feet per year in 2003 (11).

Coastal wetlands help stabilize shorelines because of its dense array of vegetation. The plants, both above and below ground, help absorb and dissipate the wave energy, decreasing its impact on the soil. Roots in particular trap sediment and encourage deposition, preventing them from washing away into the waters (18).

HEALTHY WETLANDS CAN SERVE TO PROTECT HUMAN HEALTH

Wetlands provide a number of services that promote human health, increasing quality of life and decreasing healthcare costs. Historically, swamps and bogs were often associated with swarms of mosquitoes and other unhealthy bugs, yet interestingly enough, current science explains that wetlands along the East Coast can actually help prevent the spread of the West Nile virus. This occurs because healthy wetlands limit the habitat of its primary carrier, *Culex pipiens*, a species of mosquito (19). This species does not survive well in healthy wetlands; rather, it thrives in polluted areas. Clogged gutters, sewage effluent, old buckets and tires etc. can all be called home. *Culex pipiens* are also well adapted to degraded wetlands with stagnant pools of water because unlike in healthy

wetlands, these places do not support mosquito predators. Wetlands in which eutrophication occurs is also a popular breeding ground because mosquito larvae feed on the algae. Restoring health wetlands would discourage breeding of this species of mosquito and thus help protect us from the West Nile virus.

Water filtration by wetlands promotes cleaner drinking water for humans in general. However, one specific contaminate can only be easily removed by wetlands. Giardia is an intestinal parasite that survives standard water treatment procedures such as chlorination or ozonolysis and occurs in high concentrations in water with urban pollution. Giardia does not spread through the body; rather, it attaches to the wall of the small intestine where it absorbs nutrients, causing symptoms such as diarrhea and vomiting. Although this protozoan cannot be removed through a trip in the water treatment plant, it can be when it passes through the wonderful filtration system of wetlands (5).

The relationship between wetland restoration and human health may not be readily apparent. Besides health improvement in a generally cleaner environment and reduced spread of infectious disease, wetlands are also a resource for future medicinal discoveries. 118 of the 150 top prescription drugs in the US were originally isolated from a natural source: 74% from plants, 18% from fungi, 5% from bacteria and 3% from snakes (3). Even if we only had selfish reasons to maintain wetlands and biodiversity, it would still be a worthy cause.

RECREATION

Wetlands offer a variety of recreational activities, including hiking, hunting, fishing, birdwatching, canoeing, rafting and photography. The significant amount of money spent on wetlands related activities demonstrates the demand for wetlands on a cultural and aesthetic level, while the demand justifies their economic importance. More than 82 million Americans partook in activities previously enumerated in 2001, spending over \$108 billion

Recreational fishing is estimated to have \$116 billion of economic impact and up to 90% of the catches were from wetlands. In 2001, over \$2.2 billion were spent on hunting related activities. About 3 million people hunted migratory birds, and 6.5 million hunted small mammals, creatures often found on wetlands. Out of the \$2.2 billion, \$111 million were paid to lease hunting areas, often found on private property including wetlands

Wetlands are also profitable purely by their aesthetic values. In 2001, over 66 million people ages 16 and up (31% of all Americans) fed, photographed and observed wildlife. Their spending totaled up to \$40 billion.

WETLAND HELP SUPPORT LOCAL ECONOMIES

Wetlands are not only a place of vibrant wildlife activity, but of human industrial activity as well. Coastal wetlands are the breeding nursery for many important commercial fisheries. Wetlands are an essential link in the life cycles of 75% of the commercially harvested aquatic species, valued at \$1,167 billion in 2004 (4). Wetland degradation not only destroys their habitats, but also negatively affects aquatic life downstream. Hypoxia, or lack of oxygen, is responsible for many of the fish kills in the Chesapeake, as well as the infamous “Dead Zone” in the Gulf of Mexico. This condition arises from an excess of nitrogen runoff. Nitrogen promotes algal growth, whose decomposition depletes the water of essential oxygen. No fish can survive in the expanding Dead Zone, which creates a dilemma for local fisheries. Because wetlands are an important water filter that

can remove 70-90% of entering nitrogen, they are invaluable to continued well-being of the fishing industry (5).

Wetlands also provide a crucial habitat for many small mammals and game species. U.S. Fish and Wildlife Service thus names wetlands as a key resource for hunters. In 2004, muskrat pelts alone were valued at \$124 million. Minks, beavers and other fur-bearing mammals depend on wetlands for part of their life cycles. Another product from a sustainably managed wetland is rice, which can be grown for part of the year in an area that can serve as wildlife habitat during the rest. This can produce not only food, but also medicines, cosmetics, decorative items and hay for livestock (4). Even if we did not value the wildlife and only cared about human industrial activity, we would have reason enough to take proper care of our wetlands.

THROUGH CARBON SEQUESTRATION, WETLANDS BUFFER US FROM CLIMATE CHANGE (9)

In face of global warming, people are looking for various ways to reduce greenhouse gas emission and reduce the overall carbon footprint. Carbon sequestration, the act of capturing carbon from the earth's atmosphere and storing it elsewhere, is one method currently receiving much attention. Wetland are a very effective carbon bank. In fact, current science suggest that wetlands can store 35% (and some sources say even up to 71%) of terrestrial carbon in their vegetation and soil (20). With such important carbon sink possibilities, wetland restoration presents a terrific opportunity to mitigate climate change as we reinstate the other ecological values.

The sequence through which wetlands sequester carbon is relatively straight forward. Wetland vegetation continuously sequesters carbon through photosynthesis and the soil traps carbon rich sediments from upstream in the watershed. Long term carbon storage generally occurs in organic litter and peats that collect in the soil. The saturated conditions create an anoxic (lacking in oxygen) environment which hinders decomposition. This unique form of carbon storage can last for thousands, even millions, of years and cannot be found in other ecosystems.

However, it is unclear what the *short term* effects of wetlands are on mitigating climate change because wetlands also release some dissolved carbon dioxide and methane. That said, ditching and draining and poor management practices expose the enormous reservoir of organic matter to air, resulting in oxidation and release of carbon dioxide, methane and other greenhouse gases. Thus, though the short term effects on carbon sequestration of wetland restoration are ambiguous, the effects of wetland destruction are very obvious.

While effects of short term carbon storage are unclear, we have solid proof that wetlands are an extremely effective long term carbon sink. The fossil fuels we burn today that are creating the global warming were formed long ago, when the earth was covered in wetlands. Peat depositions back then (which store huge amounts of carbon) are what we call coal today. Maybe it's time for the carbon to return to where it came.

WETLANDS ARE WORTH YOUR PROTECTION

Wetlands are valuable for their own ecological worth. They are a critical component of the complicated web of life on our planet. Beyond this deep and unique intrinsic value, the ecosystem services of wetlands are phenomenal. Any single service by itself would make wetland restoration worthwhile but we in fact benefit from all of them. Yet we continue to ditch and drain wetlands for pine plantations that ultimately end up in landfills in the form of packaging, office supplies and other paper products.

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