Sharon Davis, Bear Island, NC

Wetlands

Introduction

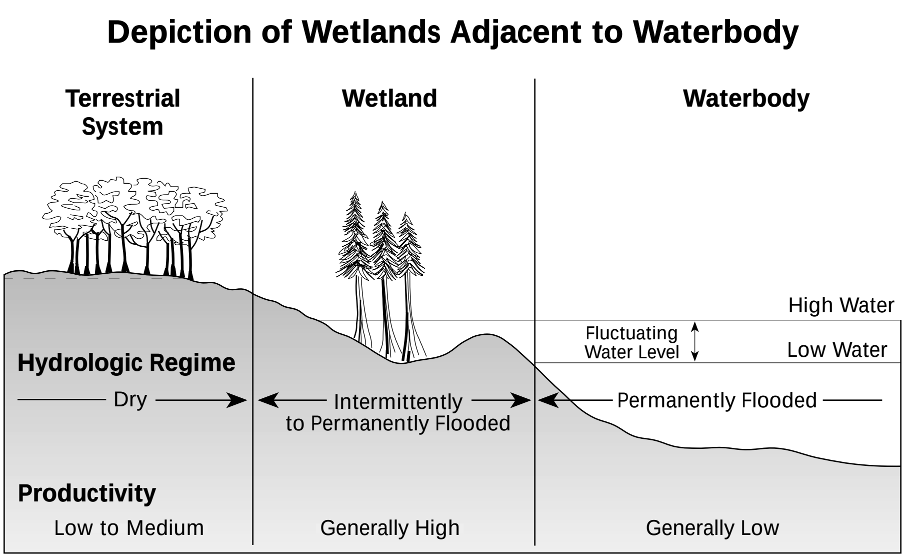
Wetlands are the link between land and water (Figure 6-1). Wetlands generally include swamps, marshes, bogs, fens, prairie potholes, seeps, vernal pools, pocosins, and similar areas. Most people can easily identify some kinds of wetlands, such as marshes, as being wetlands. However, other kinds of wetlands are not as easily identified because they may not be flooded and are often dry during part of the year.

All wetlands, however, are flooded or have water just below the ground surface long enough during the growing season to develop oxygen-poor soils. This is important because almost all animals and plants use oxygen to convert sugar, protein, and other organic molecules into the energy necessary to grow and survive. Normally, when bacteria and microbes in the soil decompose dead plants and animals, the oxygen that they use is replaced from the air. However, oxygen moves through the water about ten thousand times slower than the air. When a wetland or "hydric" soil is saturated or flooded, the oxygen used by the bacteria and microbes is not replaced fast enough. As a result, most plants cannot grow there because they do not have enough oxygen for their roots. Wetland plants, such as cattails and water lilies, have special adaptations to temporarily survive without oxygen in their roots or to transfer oxygen from the leaves or stem to the roots.

A wide variety of wetlands exist across the country because of regional and local differences in hydrology, vegetation, water chemistry, soils, topography, climate, and other factors. Wetland type is determined primarily by local hydrology, the unique pattern of water flow through an area. In general, there are two broad categories of wetlands: coastal and inland.

With the exception of the coastal wetlands of the Great Lakes, coastal wetlands are closely linked

Figure 6-1



Wetlands are often found at the interface between dry terrestrial ecosystems, such as upland forests and grasslands, and permanently wet aquatic ecosystems, such as lakes, rivers, bays, estuaries, and oceans.

Reprinted with modifications, by permission, from Mitsch/Gosselink: *Wetlands 1986*, fig. 1-4, p. 10. ♦1986, Van Nostrand Reinhold.

to estuaries. In these estuarine systems, sea water mixes with fresh water to form an environment of varying salinity and temperature. Tides and wind also cause the water levels to fluctuate. Coastal marshes dominated by grasses, sedges, rushes, and halophytic (salt-loving) plants are generally located along the Atlantic and Gulf coasts due to the gradual slope of the land. Mangrove swamps, which are dominated by halophytic shrubs and trees, are common in Hawaii, Puerto Rico, Louisiana, and southern Florida.

Inland wetlands are most common on floodplains along rivers and streams, in isolated depressions surrounded by dry land, and along the margins of lakes and ponds. Inland wetlands include marshes and wet meadows dominated by grasses, sedges, rushes, and herbs; shrub swamps; and wooded swamps dominated by trees, such as hardwood forests along floodplains. Some regional wetland types include the pocosins of North Carolina, bogs and fens of the northeastern and north central states and Alaska, inland saline and alkaline marshes and riparian wetlands of the arid and semiarid West, vernal pools of California, playa lakes of the Southwest, cypress gum swamps of the South, wet tundra of Alaska, the South Florida Everglades, and prairie potholes of Minnesota, Iowa, and the Dakotas.

Functions and Values of Wetlands

In their natural condition, wetlands provide essential ecological processes called functions, which are beneficial not only to wetlands but also to their surrounding ecosystems and people. Wetland functions can be grouped into several broad categories:

- Storage of water
- Storage of sediment and nutrients
- Growth and reproduction of plants and animals
- Diversity of plants and animals.

The location of a wetland in a watershed and the size of a wetland help determine what functions it will perform. Not all wetlands perform all functions nor do they perform all functions at equivalent levels. For example, some wetlands naturally have greater capacity to store water because of their landscape position. Many other factors can influence how well a wetland will perform these functions, including weather conditions, quantity and quality of water entering a wetland, and human alteration of a wetland or surrounding landscape.

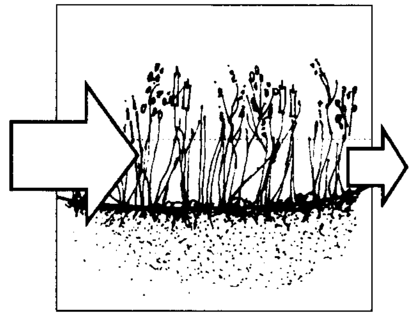
Storage and Filtering of Water

The historic loss of wetlands in the Midwest was a significant factor contributing to the severe flooding in the Upper Mississippi and Missouri River Basins in the summer of 1993. Wetlands help prevent floods by storing and slowing the flow of water through a watershed. Many wetlands act like natural basins and hold water from rain storms, overland flow, and from flooding rivers. As water passes through a wetland, it is also slowed by the wetland's plants (Figure 6-2). Through the combined effects of retaining and slowing water, wetlands allow water to percolate through the soil into the ground water and slowly move through the watershed (Figure 6-3). In watersheds that have lost most of their wetlands, the rainfall flows quickly into streams and rivers and overloads their capacity to transport water through the watershed. The graph in Figure 6-4 shows the flow of water in two streams in Massachusetts. One stream does not have many wetlands left in the watershed and has a steep hydrograph. The other stream has a lot of wetlands left in the watershed and has a more stable hydrograph. Increasing the amount of pavement in a watershed can cause similar problems. The result is that streams and rivers flood and damage homes, farms, and businesses. In addition, streams and rivers are severely damaged as their banks erode and their channels become flatter and deeper. Downstream lakes and estuaries are also damaged by the large influx of silt in mud that makes the water cloudy, buries plants and animals, and prevents underwater plants from getting the light they need.

Floods continue to seriously damage the property and threaten the livelihood of thousands of Americans despite expenditures of billions of local, state, and federal dollars over the years to reduce flooding. Loss or degradation of wetlands indirectly intensifies flooding by eliminating their capacity to absorb peak flows and gradually release flood waters. Following are several examples of the monetary cost of wetland loss.

Figure 6-2

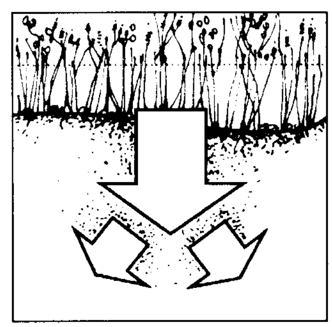
Flood Protection Functions in Wetlands



Source: Washington State Department of Ecology.

Figure 6-3

Ground Water Recharge Functions in Wetlands



Source: Washington State Department of Ecology.

Figure 6-4

Streamflow Through Wetlands

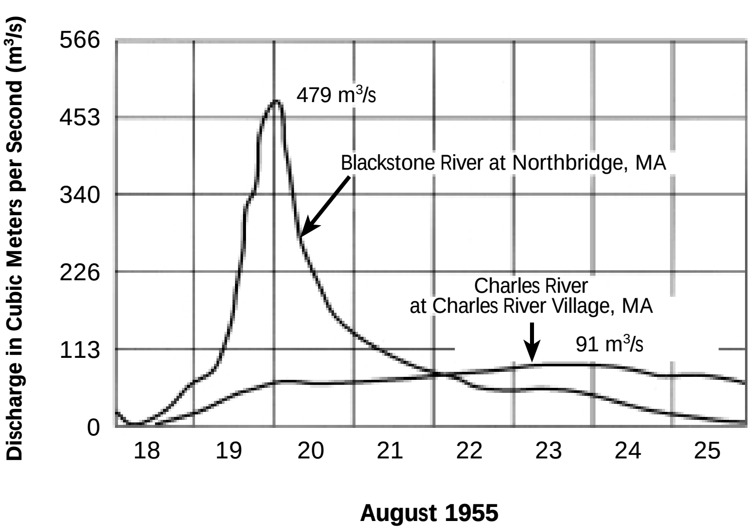
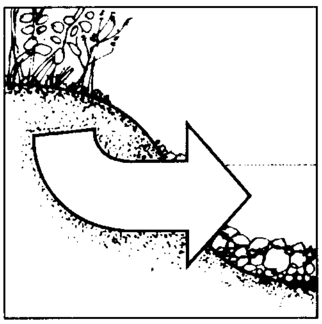


Figure 6-5

Streamflow Maintenance Functions in Wetlands



Source: Washington State Department of Ecology.

■ In Massachusetts, the U.S. Army Corps of Engineers estimated that over $17 million of annual flood damage would result from the destruction of 8,422 acres of wetlands in the Charles River Basin. For this reason, the Corps decided to preserve wetlands rather than construct extensive flood control facilities along a stretch of the Charles River near Boston. Annual benefits of the preservation project average $2.1 million and annual costs average $617,000.

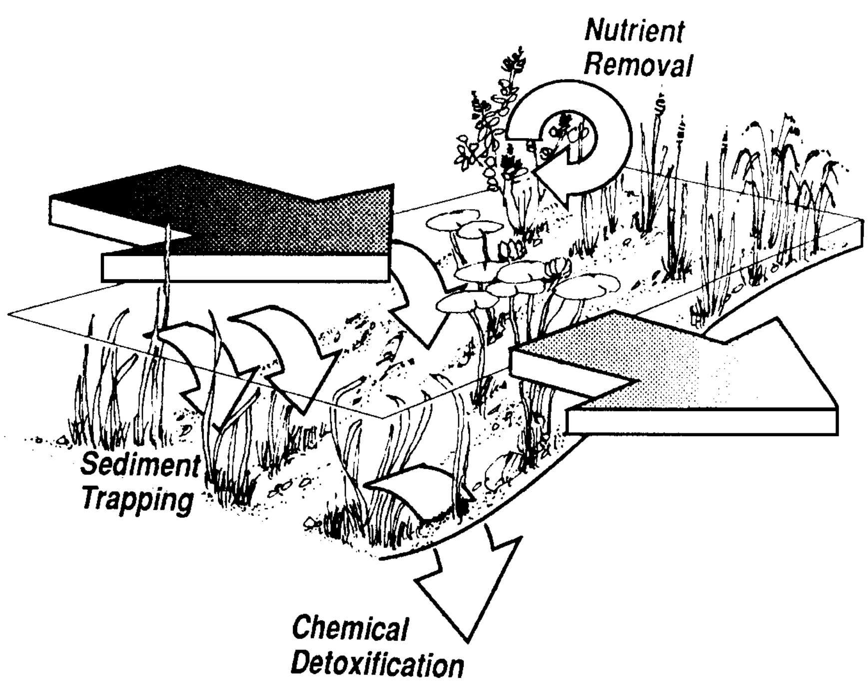
■ The Minnesota Department of Natural Resources estimated that it costs the public $300 to replace the water storage capacity lost by development of 1 acre of wetlands that holds 12 inches of water. The cost of replacing 5,000 acres of wetlands would be $1.5 million, which exceeds the state's annual appropriation for flood control.

■ In 1988, DuPage County, Illinois, found that 80% of all flood damage reports came from homebuilders whose homes were built on converted wetlands. The county spent $0.5 million to $1.0 million annually to correct the problem.

Restoring wetlands in a watershed can help prevent the amount and severity of flooding. Restoring wetlands can also improve the flow of water during dry seasons by allowing water to percolate into the ground water and gradually enter a stream rather than having rapid runoff (Figure 6-5). Water entering wetlands during wet periods is released slowly through ground water, thereby moderating stream flow volumes necessary for the survival of fish, wildlife, and plants that rely on the stream.

Figure 6-6

Water Quality Improvement Functions in Wetlands



Source: Washington State Department of Ecology.

Storage of Sediment and Nutrients

Wetlands act like filters that purify water in a watershed. Often the water leaving a wetland is much cleaner than the water that entered the wetland. When water is slowed or stored in a wetland, much of the sediment settles out and remains in the wetland (Figure 6-6). Thus, the water leaves a wetland less cloudy. Wetlands also trap nutrients that are attached to the sediment or dissolved in water. Nutrients are either stored in the wetland soil or are used by plants to grow.

Wetlands on the fringes of lakes and estuaries keep the larger waters clean by trapping sediment and preventing shoreline erosion. Marsh plants help dissipate wave energy and their extensive root networks anchor the marsh (Figure 6-7). Without the plants, the waves would eat away at the shore and cause extensive erosion. Marsh plants also slow the movement of water, allowing sediment and nutrients to settle and remain in the marsh. Wetland loss and degradation reduce water quality purification functions performed by wetlands.

The following examples show the value of the capacity of wetlands to store sediment and nutrients.

■ The Congaree Bottomland Hardwood Swamp in South Carolina provides valuable water quality services, such as removing and stabilizing sediment, nutrients, and toxic contaminants. The total cost of constructing, operating, and maintaining a tertiary treatment plant to perform the same functions would be $5 million.

■ Forested riparian wetlands play an important role in reducing nutrient loads entering the Chesapeake Bay. In one study, a riparian forest in a predominantly agricultural watershed removed about 80% of the phosphorus and 89% of the nitrogen from the runoff water before it entered a tributary to the Bay. Destruction of such areas adversely affects the water quality of the Bay by increasing undesirable weed growth and algae blooms.

■ A study of two similar sites on the Hackensack River in New Jersey showed the amount of erosion that often results from the destruction of marshlands. In the study, marsh vegetation was cut at one site and left undisturbed at the other site. The river bank at the cut site eroded nearly 2 meters (more than 6 feet) in 1 year while the uncut site had very little bank erosion.

These examples illustrate the integral role of wetlands in our ecosystems and how wetland destruction and degradation can have expensive and permanent consequences. Preserving wetlands and their functions will ensure that wetlands continue to provide many benefits to people and the environment.

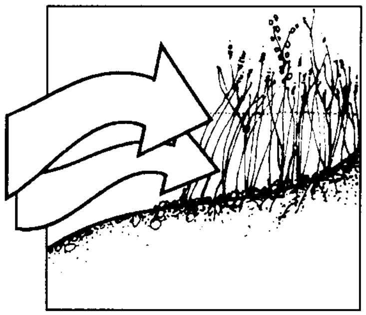
Growth and Reproduction of Plants and Animals

Some wetlands, such as salt marshes, are among the most productive natural ecosystems in the world. Only rain forests and coral reefs come close to matching their productivity. They produce huge amounts of plant leaves and stems that serve as the basis of the food web. When the plants die, they decompose in the water and form detritus (Figure 6-8). Detritus and the algae that often grow on plants are the principal foods for shrimp, crabs, clams, and small fish, which, in turn, are food for larger commercial and recreational fish species such as bluefish and striped bass.

Wetlands produce a wealth of natural products, including fish and shellfish, timber, wildlife, and wild

Figure 6-7

Shoreline Stabilization Functions in Wetlands



Source: Washington State Department of Ecology.

rice. Around 95% of the fish and shellfish species commercially harvested in the United States are dependent on wetlands during some stage of their life. A national survey conducted by the U.S. Fish and Wildlife Service in 1991 illustrates the economic value of some of the wetland-dependent products. Over 9 billion pounds of fish and shellfish landed in the United States in 1991 had a direct, dockside value of $3.3 billion. This served as the basis of a seafood processing and sales industry that generated total expenditures of $26.8 billion. In addition, 35.6 million anglers spent $24 billion on freshwater and saltwater fishing.

Diversity of Plants and Animals

Wetlands are critical to the survival of a wide variety of animals and plants, including numerous rare and endangered species. Wetlands are also primary habitats for many species, such as the wood duck, muskrat, and swamp rose. For others, wetlands provide important seasonal habitats where food, water, and cover are plentiful.

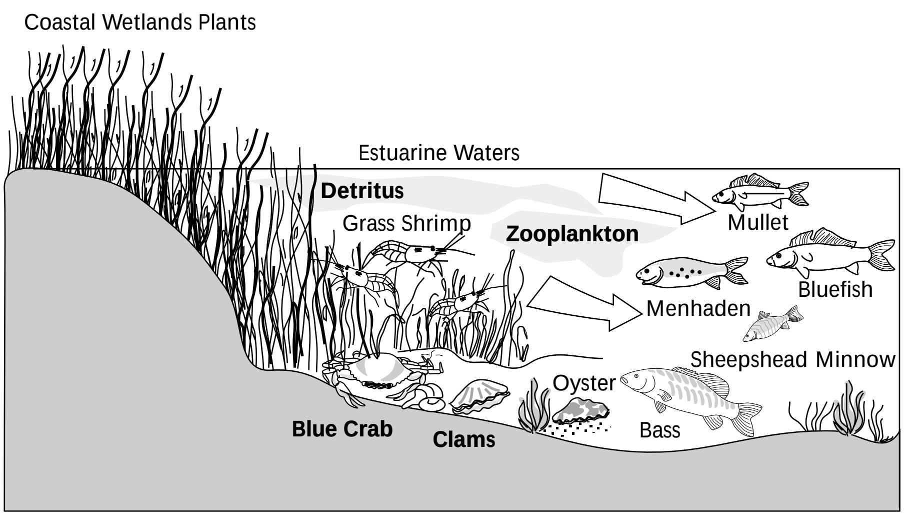
The Arizona Game and Fish Department estimates that 75% or more of all Arizona's native wildlife species depend on healthy wetlands and riparian systems during some portion of their life cycle.

The abundant wildlife in wetlands also attracts outdoor recreationists. Outdoor recreationists attracted to national wildlife refuges (NWR), which often protect extensive wetlands, bring millions of dollars and many jobs to adjacent communities. The Fish and Wildlife Service estimated that, in 1994, bird watchers and other outdoor recreationists spent $636,000 in the communities around the Quivara NWR in Kansas, $3.1 million around the Salton Sea NWR in California, and over $14 million around the Santa Ana NWR in Texas.

When wetlands are removed from a landscape or are damaged by human activities, there is a decline in the biological health of a watershed. Many species of plants and animals decline in number. As shown by the alarming amount of amphibian deformities in the Great Lakes and New England regions, many animals suffer from deformities and reproductive failure. Some, such as the Ivory-billed Woodpecker and Dusky Seaside Sparrow, become extinct. The Nature Conservancy estimates that two-thirds of freshwater mussels and crayfishes are rare or imperiled and more than one-third of freshwater fishes and

Figure 6-8

Coastal Wetlands Produce Detritus that Support Fish and Shellfish



amphibians dependent on aquatic and wetland habitats are at risk (Figure 6-9). Forty-six percent of the threatened and endangered species listed by the U.S. Fish and Wildlife Service rely directly or indirectly on wetlands for their survival (Table 6-1).

Extent of the Resource

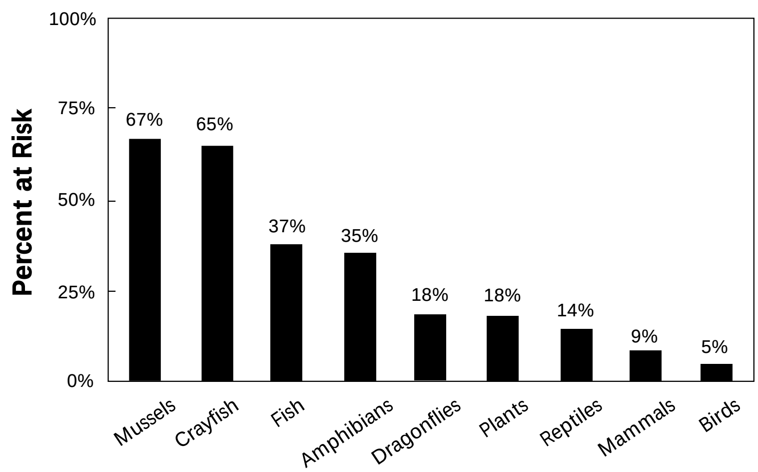
Wetland Loss in the United States

It is estimated that more than 200 million acres of wetlands existed in the lower 48 states at the time of European settlement. Since then, extensive wetland acreage has been lost. Many of our original wetlands have been drained and converted to farmland and urban development. Today, less than half of our original wetlands remain. When added together, the total amount of wetland loss is greater than the size of California (see Figure 6-10). According to the U.S. Fish and Wildlife Service's *Wetlands Losses in the United States 1780s to 1980s*, the three states that have sustained the greatest percentage of wetland loss are California (91%), Ohio (90%), and Iowa (89%).

The average annual loss of wetlands has decreased over the past 40 years. The U.S. Fish and Wildlife Service's reports on the status and trends of wetlands estimate average annual losses of 458,000 acres of wetlands from the mid-1950s to the mid-1970s and average annual losses of 290,000 acres between the mid-1970s and mid-1980s. Recent federal studies lead to an average annual net loss of wetlands

Figure 6-9

Aquatic and Wetland Species at Risk



Source: The Nature Conservancy and State Natural Heritage Data Centers, 1996.

Table 6-1. Summary of Threatened and Endangered Species That Are "Wetland-Associated"

Category	Number of U.S. Endangered and Threatened Species as of May 31, 1997, that are Wetland-Associated or Dependent	Total Number of U.S. Endangered and Threatened Species as of May 31, 1997	Percent of Total
Mammals	42	63	66.7
Birds	72	89	80.9
Reptiles	21	33	63.6
Amphibians	15	15	100
Fishes	107	107	100
Snails	10	22	45.5
Clams	62	62	100
Crustaceans	18	18	100
Insects	9	33	27.3
Arachnids	0	5	0
Plants	143	635	22.5
Totals	**499**	**1,082**	**46.1**

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New England Biological Assessment of Wetlands Work Group

The New England Biological Assessment of Wetlands Work Group (NEBAWWG, pronounced "Nee-bog") was formed in June 1998 to develop and improve existing programs for assessing the biological health of wetlands in the New England region. NEBAWWG includes representatives from each of the New England states, various federal agencies, universities, and nongovernment organizations. NEBAWWG has three main objectives:

- Develop and institutionalize a region-wide biomonitoring network for wetlands
- Oversee state pilot projects and address logistical and technical issues
- Coordinate with and complement the efforts of other biomonitoring groups and interested parties.

Workshops and Training Sessions

The first NEBAWWG workshop, held in October 1998, provided field demonstrations, an overview of national bioassessment efforts, and a discussion of planned New England pilot projects. NEBAWWG will host a series of technical training sessions with field components. Topics to be addressed include:

- Classifying wetlands
- Selecting reference wetlands
- Sampling methods for different assemblages (e.g., macroinvertebrates, plants)
- Data analysis, including selecting metrics and developing an index of biological integrity (IBI)
- Managing, storing, and communicating data and information.

State Pilot Projects

NEBAWWG has started three state pilot projects in Maine, Massachusetts, and Vermont.

Maine

The Maine Department of Environmental Protection (ME DEP) started its preliminary field work in the summer of 1998. The objectives of the project are to develop biological sampling protocols for nontidal wetlands, measure wetlands attributes across a gradient of human disturbance in a pilot watershed, and identify candidate metrics/indicators of biological integrity on a watershed basis. The Casco Bay watershed, located in southern Maine, was selected as the

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study area because it is experiencing high levels of development pressure and consequent impacts to wetlands. The Casco Bay watershed contains a broad range of wetland types and conditions, ranging from relatively undisturbed wetlands to wetlands that are severely damaged. During 1999 and 2000, ME DEP intends to develop sampling methods and identify candidate metrics for the macroinvertebrate, algae, and plant assemblages.

Massachusetts

Since July 1995, Massachusetts Coastal Zone Management (MA CZM) has been engaged in a regional research and demonstration project, called the Coastal Wetland Ecosystem Protection Project. The goal of the project is to develop, test, and refine a transferable approach to evaluating the condition of both salt and freshwater marshes using plants and macroinvertebrates. MA CZM is developing the bioassessment methods to determine the impacts of adjacent land uses and nonpoint sources of pollution on the ecological integrity of these aquatic resources. A product of the Coastal Wetland Ecosystem Protection Project is the publication, *Wetland Ecological Integrity: An Assessment Approach*, which was published in 1998. This included development of the *Wetland Health Assessment Toolbox*, which can be accessed on the Internet at *http://www.magnet.state.ma.us/czm/what.htm*. The current pilot project will refine the existing wetland ecological assessment approach, protocols, and metrics. MA CZM also intends to broaden and field test the assessment approach in other wetland types and conditions.

Vermont

The Vermont Department of Environmental Conservation (VT DEC) and the Vermont Nongame and Natural Heritage Program (VT NNHP) will jointly develop and implement biological assessment programs for vernal pools and northern white cedar swamps. The primary objectives of the first year are to

- Evaluate existing information
- Identify and classify the vernal pools and northern white cedar swamps based on physical, chemical, and biological characteristics
- Identify candidate metrics of biological integrity
- Develop and evaluate sampling protocols.

STATES REPORT that agriculture, road construction, and residential development and urban growth are the leading sources of recent wetland loss.

around 100,000 acres per year in the contiguous United States.

Although losses continue to decline, we still have to make progress toward the Clean Water Action Plan goal of annual net gain of 100,000 acres per year by the year 2005 and every year thereafter (see highlight on page 152). In addition, we need to be mindful of the long-term Administration goal of increasing the quality of the nation's wetland resource base.

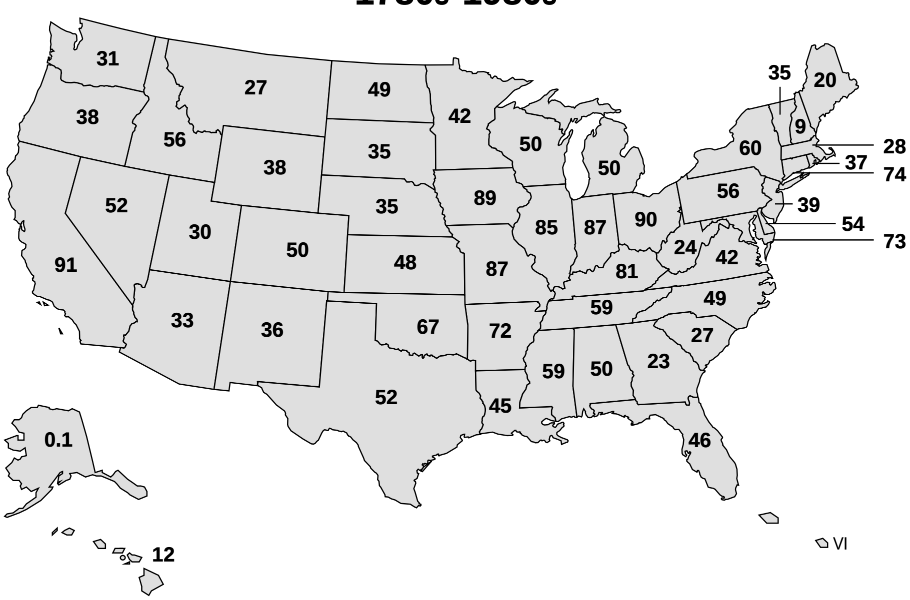
The decline in wetland losses is a result of the combined effect of several trends:

- The decline in profitability in converting wetlands for agricultural production
- Passage of Swampbuster in the 1985 and 1990 Farm Bills
- Presence of the CWA Section 404 permit programs as well as development of state management programs
- Greater public interest and support for wetland protection
- Implementation of wetland restoration programs at the federal, state, and local level.

Limited conclusions can be drawn about sources of recent wetlands loss because only eleven states and tribes listed this information in their 1998 305(b) reports (Figure 6-11). These states and tribes cited agriculture as the leading source of current losses (see Appendix D, Table D-1, for individual state information). Other losses were due to residential growth and urban development; construction of roads, highways, and bridges; filling and/or draining; construction; industrial development; hydrologic modification; commercial development; and channelization.

Figure 6-10

Percentage of Wetland Acreage Lost, 1780s-1980s



Twenty-two States have lost at least 50% of their original wetlands. Seven of these 22 (California, Indiana, Illinois, Iowa, Missouri, Kentucky, and Ohio) have lost more than 80% of their original wetlands.

Source: Dahl, T.E., 1990, *Wetlands Losses in the United States 1780's to 1980's*, U.S. Department of the Interior, Fish and Wildlife Service.

Designated Use Support in Wetlands

The states, tribes, and other jurisdictions are making progress in incorporating wetlands into water quality standards and developing designated uses and criteria specifically for wetlands. But many states and tribes still lack wetland-specific designated uses, criteria, and monitoring programs for wetlands. Without criteria and monitoring data, most states and tribes cannot evaluate attainment of water quality standards. To date, only 11 states and tribes reported the designated use support status for some of their wetlands (see Appendix D, Table D-1). Only three states used monitoring data as a basis for attainment of water quality standards.

■ California reported that 11% of the 138,208 acres of assessed wetlands fully support all uses and 88% are impaired for one or more uses. Causes of impairment include metals, nutrients, salinity/total dissolved solids/chlorides, flow alterations, and other habitat alterations. Sources impacting wetlands include agriculture, urban runoff and storm sewers, and hydrologic modifications.

■ Iowa used best professional judgment to determine the use support status of 33,221 wetland acres during 1996 and 1997. The state reported that 6% of assessed wetland acres fully support all uses, 38% fully support all uses but are threatened for at least one use, and 57% are impaired for one or more uses. Impairment is due to nutrients, siltation, flow alterations, noxious aquatic plants, and exotic species. Sources of impairment include agriculture and hydrologic and habitat modifications.

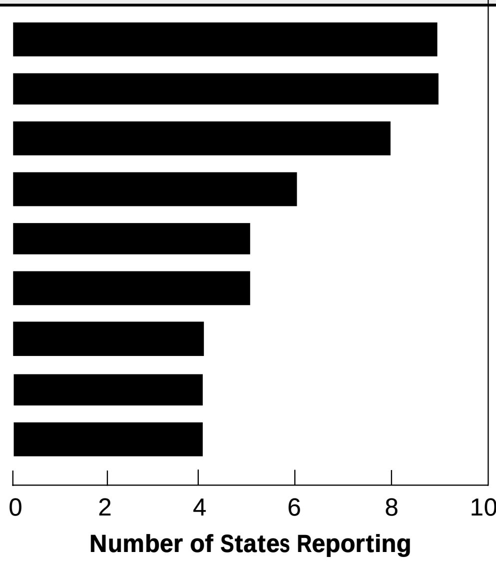
■ Kansas assessed 35,607 wetland acres for the current reporting cycle, of which 25,069 were monitored and an additional 10,538 were evaluated. The state reported that, for aquatic life use support (acute criteria only), 29% of assessed wetland acres are fully supporting but threatened,

Figure 6-11

Sources of Recent Wetland Losses

(11 States Reporting)

Sources	States
Agriculture	9
Residential Development and Urban Growth	9
Road/Highway/Bridge Construction	8
Filling and Draining	6
Construction	5
Industrial Development	5
Hydrologic Modification	4
Commercial Development	4
Channelization	4

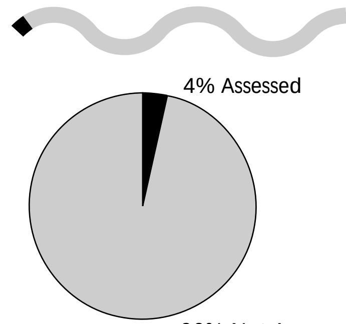


Based on data contained in Appendix D, Table D-4.

Wetland Acres Assessed by States and Tribes

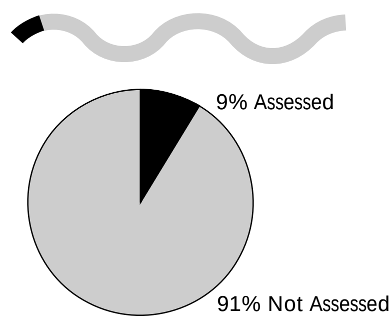
Including Alaska's Wetlands

■ 9,831,988 acres = 4% assessed
■ Total acres (including Alaska) = 274 million[a]



Excluding Alaska's Wetlands

■ 9,831,988 acres = 9% assessed
■ Total acres (excluding Alaska) = 107 million



[a]From Dahl, T.E. 1990. *Wetlands Losses in the United States 1780's to 1980's*. U.S. Department of the Interior, Fish and Wildlife Service.

Source: 1998 Section 305(b) reports submitted by states, tribes, territories, and commissions.

More states are monitoring unimpacted wetlands to define baseline conditions in healthy wetlands.

5% are partially supporting, and 66% are not supporting this use. Major causes of impairment are nutrients, flow alterations, low dissolved oxygen, and turbidity/siltation. Major sources of impairment were agriculture, hydrologic modifications, and natural processes such as climate variations.

■ Kentucky reported that 973,168 wetland acres are threatened due to the pressure of development. This acreage includes all wetlands in the state not in public ownership or under some form of protection. The estimate is based on National Wetlands Inventory maps.

■ Louisiana assessed aquatic life use support in nearly 700,000 acres of its 8.1 million total acres of wetlands. Over 99% of these acres are impaired because of either mercury or organic enrichment/low dissolved oxygen. The state reported unknown sources and atmospheric deposition as sources of impairment.

■ Michigan reported on one wetland 10 acres in size. This wetland was impaired for aquatic life use in the past, but has now been remediated and fully supports this use. The improvement is due to a reduction in nickel contamination by an upstream point source discharge.

■ Nevada used best professional judgment to assess 21,326 acres (16%) of its 136,650 total acres of wetlands. The state reported that all of the assessed wetlands fully support designated uses.

■ North Carolina used aerial photographs and soil information from a 1992-1993 survey to rate use support by current land use. North Carolina rated wetlands on hydric soils with natural tree cover as fully supporting uses. Partially supporting wetlands have modified cover and hydrology but still retain wetland status and support most uses. For example, pine plantations still retain value for wildlife habitat, flood control, ground water recharge, nutrient removal, and aquatic habitat, although the modified wetlands support these uses less effectively than undisturbed wetlands. Wetlands converted to agriculture or urban land use are classified as not supporting original wetland uses. The state used this methodology to assess use support in over 7 million acres of wetlands. The state reported that 66% of the assessed wetlands fully support uses and 34% are impaired for one or more uses.

■ Tennessee used evaluative data to assess 787,000 wetland acres. Of the assessed acres, 93% fully support all designated uses. The state reported that siltation, flow and habitat alterations, and priority organic chemicals impair the remaining acres. Sources of impairment include agriculture, hydromodification, filling and draining, development, ground water loadings, and construction.

■ The U.S. Virgin Islands used evaluative data to assess 927 wetland acres. More than 99% of these acres fully support all designated use. Impairment to 1 acre is due to sediment, bacteria, and low dissolved oxygen associated with urban runoff, municipal point sources, and spills.

■ The Coyote Valley Tribe used evaluative data to assess 1.6 wetland acres, all of which are impaired for one or more uses. This impairment is associated with siltation, habitat and flow alterations, weeds, and exotic species. The tribe identified agriculture, development, public projects, and municipal point sources as sources of impairment.

EPA can draw only limited conclusions about water quality in wetlands because the states used different methodologies to survey only 4% of the total wetlands in the nation, and because 73% of the assessed wetland acreage is in one state alone (North Carolina). More states and tribes will assess use support in wetlands in the future as they develop standards for wetlands. Many states are still in the process of developing wetland water quality standards, which provide the baseline for determining beneficial use support (see Chapter 2). Improved standards will also provide a firmer foundation for assessing impairments in wetlands in those states already reporting use support in wetlands.

Monitoring Wetland Health

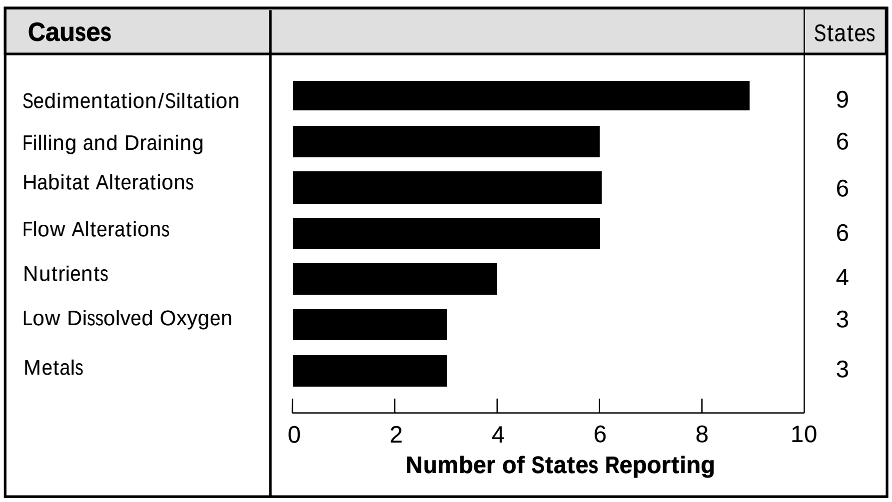
More than 25 years after it was passed, the Clean Water Act still challenges us to answer critical questions about the physical, chemical, and biological condition of the nation's waters. While great strides have been made to develop and implement methods to evaluate the condition of streams and lakes, research on wetlands has lagged behind. Considering that states and tribes collectively reported the quality of only 4% of the nation's wetlands, the nation needs an effective means to measure wetland health.

Currently, states and tribes have insufficient data to evaluate the health of wetlands or quantify the extent of pollutants degrading wetlands and the sources of these pollutants. Although most states cannot quantify the wetland area impacted by individual causes and sources of degradation, 11 states and tribes identified causes and 10 states and tribes identified sources known to degrade wetland integrity to some extent (Figures 6-12 and 6-13). These states listed sediment as the most widespread cause of degradation impacting wetlands, followed by draining, habitat alterations, and flow

More information on wetlands can be obtained from EPA's Wetlands Hotline at 1-800-832-7828, 9 a.m. to 5 p.m. Eastern Standard Time.

Figure 6-12

Causes Degrading Wetland Integrity
(11 States Reporting)



Based on data contained in Appendix D, Table D-2.

alterations. Agriculture and hydrologic modifications topped the list of sources degrading wetlands, followed by development and draining (see Appendix D, Tables D-2 and D-3, for individual state information).

As states and tribes incorporate wetlands into water quality standards and adopt wetland-specific uses and criteria, monitoring programs will become increasingly important to determine if wetlands are meeting their existing and designated uses. Monitoring programs are also needed to prioritize wetlands for protection and restoration and to develop performance standards for successful mitigation and restoration efforts. Several states are developing biological assessment methods to evaluate the health of wetlands, designate uses for aquatic life, develop biological criteria, and determine if they are supporting aquatic life uses.

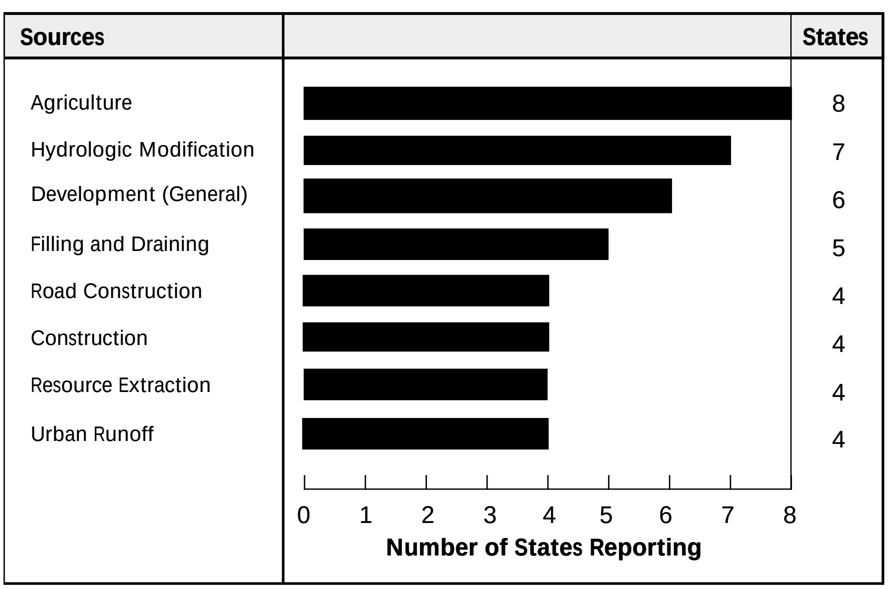
- Minnesota has developed a Wetland Index of Biological Integrity (WIBI) using macroinvertebrates and a Wetland Index of Vegetative Integrity (WIVI) using plants for depressional wetlands. Minnesota plans to use these tools to evaluate the biological integrity and aquatic life use support of depressional wetlands. They are also partnering with local governments to train volunteers to use simpler versions of these methods to evaluate the condition of wetlands.

- Montana is developing biological assessment methods for wetlands using macroinvertebrates and algae. To partition natural variability between wetland types, Montana developed a classification system to group reference wetlands by ecoregion and then by wetland type. Preliminary results indicate detection of impairments caused by metals, nutrients, salinity, sediment, and fluctuating water levels.

- North Dakota started its pilot project in 1993. They are developing bioassessment methods for depressional wetlands that are temporarily or seasonally flooded. They have developed a preliminary index of biological integrity for the plant community.

Figure 6-13

Sources Degrading Wetland Integrity
(10 States Reporting)



Based on data contained in Appendix D, Table D-3.

■ Ohio started a pilot project in 1994 to develop biological criteria for wetlands. Ohio is applying the same approach to wetlands that it used to develop its stream biological criteria program. Methodologies to assess vegetation, macroinvertebrates, and amphibian assemblages are under development. Ohio has developed a Floristic Quality Assessment Index to evaluate the condition of the plant community.

■ In 1999, Maine started a pilot project to develop bioassessment methods for wetlands in the Casco Bay watershed. They are using the macroinvertebrate and algal communities to evaluate the health of the wetlands. They are testing sampling methods and intend to use multimetric indexes of biological integrity and advanced statistical tests to evaluate the data.

■ Florida is developing an integrated biological approach for evaluating wetlands. The project is focusing on forested and herbaceous depressional wetlands. They are developing sampling methods and multimetric indexes of biological integrity for plants, benthic macroinvertebrates, and fish.

Summary

Currently, most states are not equipped to report on the integrity of their wetlands. Only 11 states and tribes reported attainment of designated uses for wetlands in 1998. National trends cannot be drawn from this limited information. This is expected to change, however, as states adopt wetland water quality standards and enhance their existing monitoring programs to more accurately assess designated use support in their wetlands.

River of Words 1999 Finalist, Jennifer Koo, *Earth's Cry*, Age 18, CA

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Wetlands and the Clean Water Action Plan

The Clean Water Action Plan, announced by President Clinton and Vice President Gore on February 19, 1998, is a comprehensive plan that will not only protect public health through clean water programs but will also restore the health of the nation's waters. The Plan sets strong water protection goals and provides states, communities, farmers, and landowners the tools and resources to meet them. Also included in the Action Plan are cooperative strategies that encourage local communities to develop and implement actions that take a watershed approach (*http://www.cleanwater.gov/*). Within the Action Plan are action items that address wetlands both directly and indirectly. These unique waterbodies are directly addressed through the themes discussed below and are indirectly protected by improving water quality programs, implementing unified watershed assessments, reducing polluted runoff, and improving monitoring and assessment.

A Net Increase of 100,000 Acres of Wetlands per Year by 2005

The Clean Water Action Plan sets an ambitious goal of a net increase of 100,000 acres of wetlands each year, beginning in 2005. To achieve this goal, the Plan includes the following action items:

- The Corps of Engineers (Corps) and EPA will work with their partners to avoid wetland losses, deter unpermitted losses, increase mitigation of unavoidable losses, and improve the reliability of wetland restoration.
- The U.S. Department of Agriculture (USDA) will play a large role in restoring wetlands through the Wetlands Reserve Program, a voluntary program that farmers join to receive financial assistance for protecting wetlands.
- By 2005, EPA will work with the Wetlands and River Corridor Partnership, a group of 30 government and nongovernment organizations involved in habitat restoration, to restore wetlands in 500 watersheds.
- The National Oceanic and Atmospheric Administration (NOAA) will increase the acreage of coastal wetlands restored annually by encouraging wetland restoration planning in state coastal zone management programs. NOAA will also continue state and local partnerships under the Coastal Wetlands, Planning, Protection, and Restoration Program.

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■ The Federal Highway Administration (FHA) will increase net wetland acreage resulting from federal aid highway projects by 50% in 10 years.

Consistent Determination of Wetland Losses and Gains

A necessary prerequisite to achieving the wetland goal is ensuring that reliable data systems are in place to record losses and gains in the nation's wetland inventory. Currently the federal government supports two major statistical inventories of wetlands:

■ U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI)

■ USDA's Natural Resources Inventory (NRI).

These two approaches need to estimate more consistently the rate of wetland loss. The differences between the two approaches need to be reconciled, and a method of tracking wetland gains achieved through restoration needs to be developed to accurately track progress toward the 100,000-acre-per-year goal, evaluate the impact of policy and program decisions on the goal, and make the inventory more sensitive to relatively small changes in acreage. The Plan

U.S. EPA, Office of Water, Wetlands Division

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contains three action items to improve national estimates of changes in wetland acreage:

- The White House Wetlands Working Group will finalize a plan to use existing inventory and data collection systems to develop a single status and trends report for the nation's wetlands by the year 2000.

- The involved federal agencies (EPA, the Corps, NRCS, FWS, and NOAA) will develop technical guidance on restoration, creation, and enhancement of wetland functions.

- The White House Wetlands Working Group will establish an interagency tracking system that will accurately account for wetland loss, restoration, creation, and enhancement.

Geographic-Based Planning to Protect and Restore Wetlands

Although many individual wetland losses are small in terms of area, together the cumulative losses of wetlands and other aquatic habitats accumulate to significant levels of environmental damage in many areas of the United States. One way to better protect these valuable resources is to integrate wetlands and similar habitats into geographic-based planning programs, such as watershed approaches. Geographic-based planning offers the potential to develop a cohesive framework that addresses both clean water and aquatic habitat, reflecting the interdependence between wetlands and other components of a watershed. While geographic-based planning relies on strong local leadership and is enhanced by state or tribal backing, EPA and other federal agencies will contribute by strengthening existing assistance programs and developing new ways to provide support. The Plan contains three action items to improve geographic-based planning to protect and restore wetlands:

- The FWS, NOAA, NRCS, and EPA will coordinate with states and tribes to improve access to information on programs for wetlands and other habitats. Such information will be made available to geographic-based planners through toll-free help lines, the Internet, one-stop information centers, dedicated staff for outreach, and/or newsletters and other publications.

- Watershed Assistance Grants will be established to ensure that those whose wetland interests may be affected by planning have the means to participate in the process.

- The Corps, NOAA, FWS, NRCS, National Park Service, and EPA will provide technical and/or financial assistance to states and tribes to integrate habitat considerations into geographic-based planning and will offer incentives to programs that appropriately balance clean water and habitat factors.

I Want to Be

I want to be a dogfish
and catch a leaping catfish
with whiskers as long as a stream.
And I want to be
the rain trinkling down on the world
telling it it's springtime.

River of Words 1998 Grand Prize Winner (Poetry, Grades K-2)
Noah Frank, Grade 2, CA

River of Words 1998 Grand Prize Winner (Art, Grades 3-6)
Holly Heuer, *Untitled*, Grade 5, CA