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Wetlands Program

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Technical Report

College of William and Mary
Virginia Institute of Marine Science
School of Marine Science
Wetlands Program
Gloucester Point, Virginia 23062

Dr. Carl Hershner
Program Director

Commonwealth's Declared Policy:

"to preserve the wetlands and to prevent their despoliation and destruction. . ."

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TIDAL WETLAND VALUES

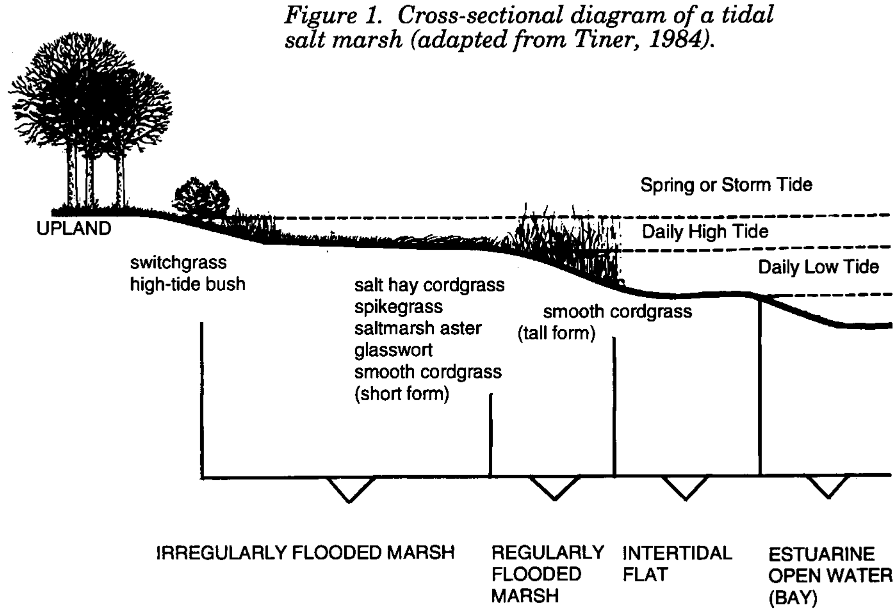
Maryann Wohlgemuth

Throughout the state of Virginia there is a variety of wetland types which range from tidal marshes and swamps near the coast, to nontidal wetlands found anywhere from the coastal plain to the mountains. Wetlands are found in topographic depressions or along rivers, lakes, and coastal waters.

Wetlands, in general, are areas that are wet or have wet soils during some part of the growing season.

Tidal wetlands are found along the coastline where they are influenced by daily tidal fluctuations and include vegetated marshes and swamps or nonvegetated mud and sand flats (Figure 1).

Figure 1. Cross-sectional diagram of a tidal salt marsh (adapted from Tiner, 1984).



Wetlands were historically considered wastelands that harbored bothersome snakes and disease-carrying insects. They were considered useless for most farming or building because of the unstable, wet substrate. These lands were often drained or filled for farming, housing, and urban development. However, this negative view of wetlands was not shared by the fishermen, hunters, and trappers who benefited from the productive and diverse supply of mammals, fish, and waterfowl found in wetlands.

Wetland Values

Tidal wetlands provide many ecological and socio-economic benefits including: water quality improvement, aquatic productivity, fish and wildlife habitat, shoreline erosion control, stormwater treatment, flood protection, potable water supplies, economically valuable resources, and recreation. The level of these values varies with the type, setting, size, and hydrology of the particular wetland. The health of the Chesapeake Bay and its fisheries are closely linked to the existence of wetlands.

Water Quality Improvement

Due to their strategic position between uplands and the aquatic environment, tidal wetlands can filter and trap sediments and pollutants from upland runoff before they reach an adjacent waterway. Water pollution problems can be reduced when urban and agricultural runoff pass through a wetland buffer before reaching the aquatic environment. The research of Cerco and Kuo (1979) concluded that a tidal marsh creek that received effluent from a poultry processing plant significantly reduced levels of nutrients and increased levels of dissolved oxygen.

As wetland plants grow, they utilize and recycle nutrients, which otherwise may contribute to decreased water clarity by stimulating algal blooms. There is a seasonal uptake and release of nutrients in wetlands. During the growing season nitrogen and phosphorous are assimilated by plants. After death of the aboveground portions of plants, nutrients may be released by decomposition. Mitsch and Gosselink (1986) point out that the uptake during the growing season may be beneficial to water quality because it coincides with the periods when serious algal blooms occur.

It has been shown that some wetlands are successful at reducing nutrients, heavy metals, and bacteria from sewage effluent and other waters (Grant and Patrick, 1970; Sloey et al., 1978; Kadlec and Kadlec, 1979). In Monterey, a town in western Virginia, a bulrush wetland was the most economical alternative for accomplishing secondary wastewater treatment. (Virginia Natural Resources Newsletter, 1989). Wetland vegetation and the associated root mass act to slow water flow, which results in settlement and deposition of suspended sediments, and the associated pollutants, and nutrients (Boto and Patrick, 1979). Benefits are realized by increased water clarity and reduced siltation in downdrift oyster beds, fish spawning and nursery areas, seagrass beds, and navigation channels (Anderson et al., 1978).

For erosion control on tidal banks where water quality improvement is a consideration, the Commonwealth's manual: Best Management Practices for Agriculture (VSWCB, 1979) suggests planting vegetation. It is especially important to maintain fringe wetlands adjacent to development sites and agricultural lands to filter upland sediments, nutrients, and pollutants before they enter the marine environment. Trees are good stabilizers of river banks and subsequently reduce shoreline erosion. Their roots bind the soil, while their trunks and branches slow the flow of flooding waters and dampen wave height (Tiner, 1984; Burke et al., 1988). Marshes have a significant effect on water quality in estuaries with large marsh areas, small water volume, and small point sources of nutrients, as shown in Sweeney's (1980) calculations for the York and James rivers.

Aquatic Productivity

Some wetlands produce more plant material per area than the most productive farmlands (Figure 2). Wetlands along the East Coast produce 5-10 tons of organic matter per acre annu-

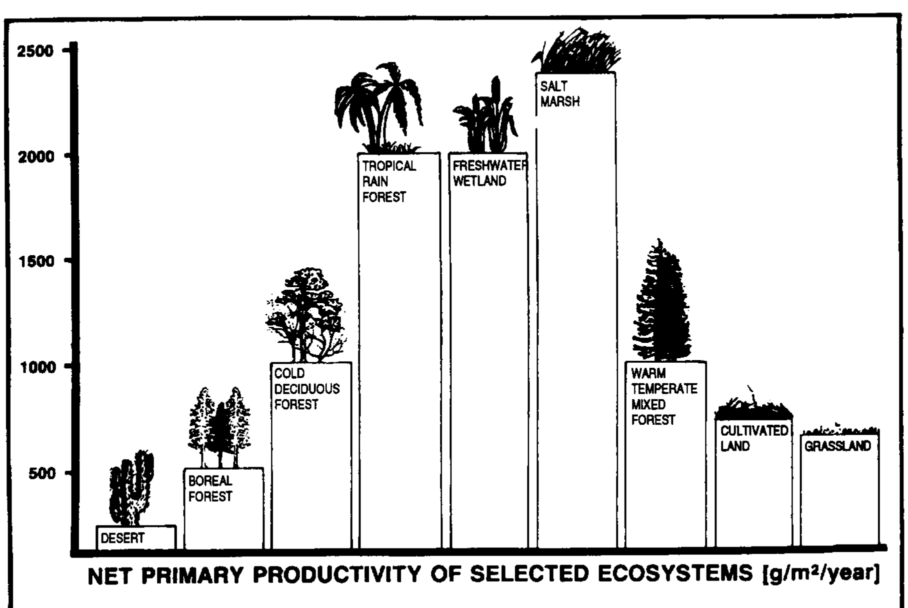


Figure 2. Relative productivity of wetland ecosystems in relation to others (adapted from Tiner, 1984).

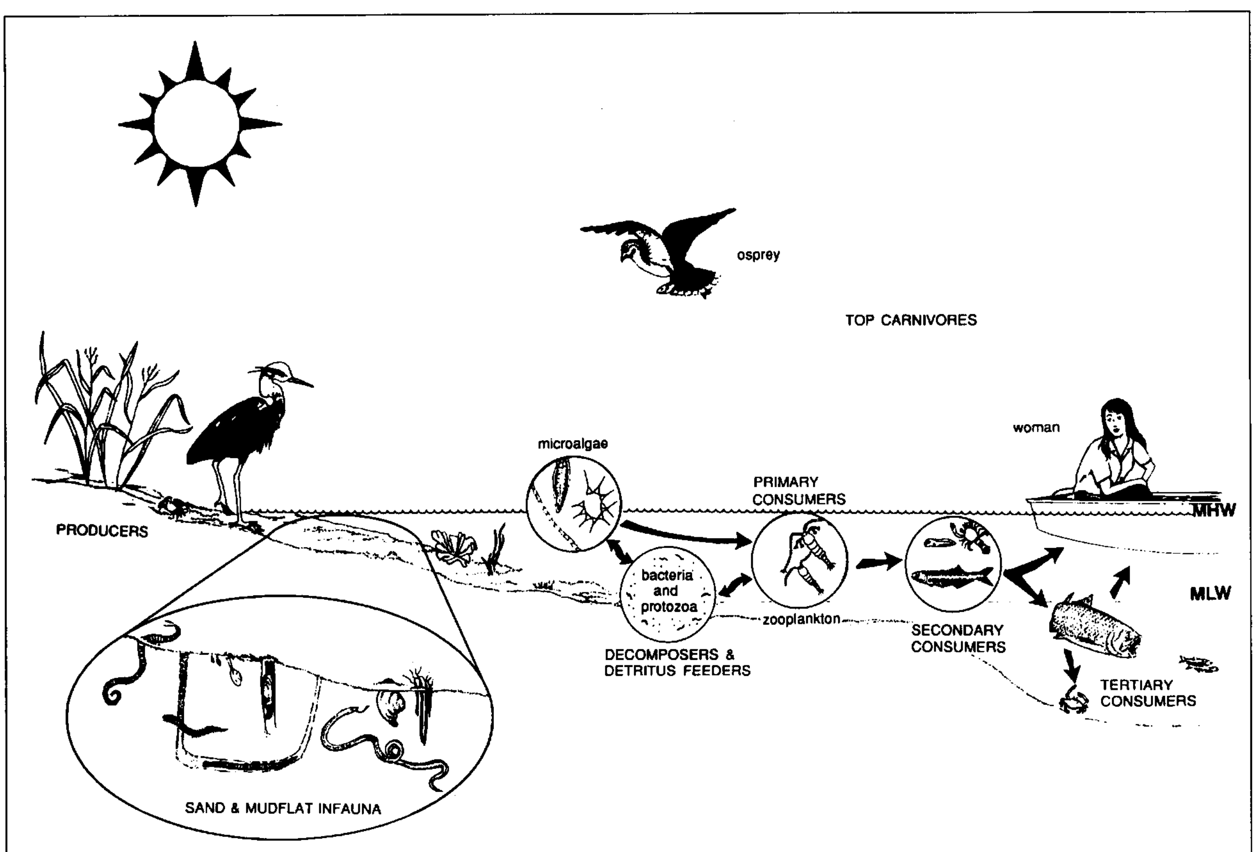
ally, while agricultural fields produce 0.3 to 5 tons per acre annually (Teal, 1969). This large amount of productivity provides a food source for fish, birds, invertebrates, and furbearers. The plant material can be utilized directly by marine grazers or used in a decaying form called detritus. Detritus is consumed by many small invertebrates, juvenile fish, and oysters, which in turn are eaten by larger fish, birds, and crabs (Anderson et al., 1978). This pattern of feeding is called a food web and is essential to the viability of the Chesapeake Bay and for providing fish for human consumption (Figure 3).

Fish and Wildlife Habitat

Tidal wetlands are used by a large variety of birds, fish, mammals, and invertebrates for food, shelter, and spawning and nesting sites. Approximately two-thirds of the fish and shellfish species that are harvested commercially are associated with wetlands (Mitsch and Gosselink, 1986). These species include: blue crab, oyster, clam, shrimp, striped bass, menhaden, bluefish, flounder, sea trout, spot, and croaker. Rozas and Hackney (1984) found 29 species of fish in a tidal marsh and suggested that shallow marsh areas are a preferred habitat because of reduced competition, slow currents, scarcity of predators and an abundant food supply.

In 1967-1968, 95% of Virginia's annual fish harvest was shown to be at least partially dependent on wetlands (Wass and Wright, 1969). Blue crabs use tidal marsh creeks as shelter from predators during molting (Hines et al., 1987). Juvenile blue crabs and 14 species of fish were more abundant on flooded salt marsh surfaces than in non-vegetated subtidal areas (Zimmerman and Minello, 1984a). Some species, such as mummichogs (minnows) and fiddler crabs, utilize wetlands throughout their lifespan. Other species, such as striped bass, spawn in waters adjacent to tidal freshwater marshes similar to those along the Pamunkey River (McGovern and Olney, 1988). Many coastal fish, including spot, menhaden, and mullet, use wetlands as nursery areas for their juvenile stage (Weinstein, 1979). The diet of menhaden has been shown to consist of 30% marsh derived detritus and 70% plankton (Deegan et al., 1990).

Figure 3. Food Web.



Of the nation's endangered and threatened species, 50% of the animals and 28% of the plants are dependent on wetlands for their survival (Niering, 1988).

Migratory waterfowl are dependent on wetlands for feeding during their seasonal stopovers. Metzgar et al., (1973) estimated that the Bay's wintering population of waterfowl has been more than one million. Various shore and wading birds use wetlands as a food source and a location for nest sites. Atlantic coast salt marshes are used for nesting by birds such as laughing gulls, Forster's terns, clapper rails, willets, and marsh hawks (Tiner, 1984). Coastal wetlands are also used as foraging and nest sites for wading birds such as the herons and egrets (Tiner, 1984).

Shoreline Erosion Control

Tidal wetlands provide a buffer against shoreline erosion by reducing wave energy and current velocity. Wetlands dissipate the full force of waves before they reach upland areas. Vegetated wetlands can reduce shoreline erosion by four mechanisms: increased stability of the sediment-root matrix, wave damping as the waves propogate through a stand of grass, reduction in current velocity from additional friction forces as it flows through grasses, and storage of sand in dunes (Dean, 1979). Wetlands have a complex root and rhizome system that binds shoreline sediments together which helps reduce the loss of uplands to coastal erosion.

As wave action and current speed are reduced by the wetland, sediments in the water settle to the bottom, resulting in improved water quality and the build-up of the marsh surface. Knutson et al., (1982) found that more than 50% of the energy associated with waves passing through a fringe marsh was dissipated within the first eight feet of the marsh. A planted salt marsh fringe may be an effective, inexpensive, and ecologically-preferred alternative to a bulkhead or a revetment (Hardaway et al., 1984). Boon (1975) demonstrated that the configuration of meandering marsh creeks and broad tidal flats can cause diversion and retention of peak tidal current flows. Wave height and current speed are also reduced by nonvegetated wetlands, such as beaches and mudflats by causing waves to spread out as they pass over the flat (Theberge and Boesch, 1978). This reduces the final impact on the upland, thereby reducing erosion of upland areas.

Flood Protection

Wetlands adjacent to watercourses slow surface water flow and may temporarily store flood waters. This effect is particularly evident in riverine systems. Estuarine wetlands adjacent to tidal rivers provide a temporary storage of flood water, but their storage effect may be either increased or reduced by the tidal stage during flooding (Carter et al., 1979). The ability of wetland vegetation to slow flood waters depends on the type and density of vegetation and the depth of the water (Carter et al., 1979). These processes desynchronize peak flows by temporarily slowing and storing water, which results in a non-simultaneous gradual release of peak waters minimizing flow downstream (Figure 4) (Zacherle, 1984). Flood control has become increasingly important in urban

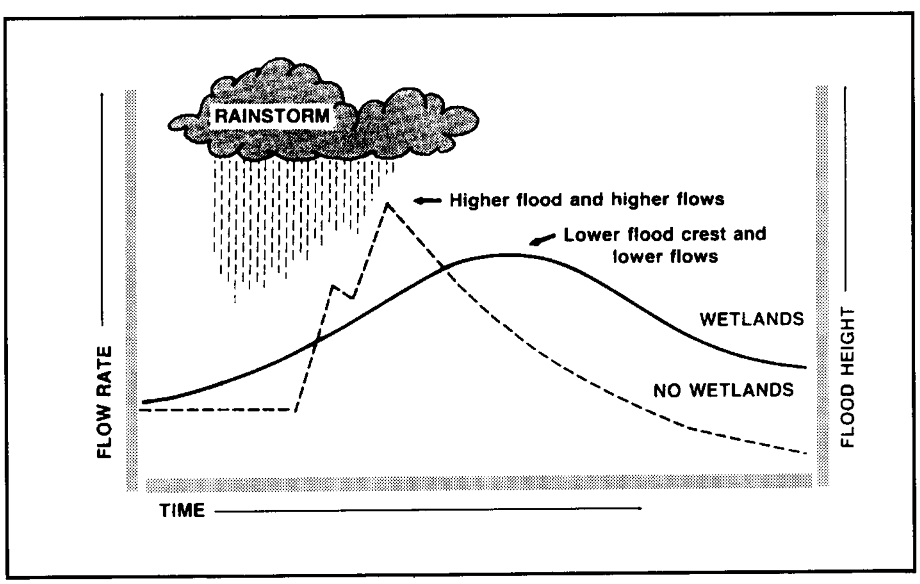


Figure 4. Wetland value in reducing flood crests and flow rates after rainstorms (adapted from Tiner, 1984).

areas where the rate and volume of stormwater runoff have increased with non-porous surfaces, such as roads, parking lots, and buildings. Mangrove swamps are so effective at reducing flood levels and buffering storm water damage that the Federal Flood Insurance program requires coastal communities to probibit mangrove destruction if they wish to remain eligible for insurance (Tiner, 1984).

Water Supply

Most wetlands are areas of groundwater discharge. In Massachusetts at least 60 municipalities have public wells in or near wetlands (Motts and Heeley, 1973). Some wetlands may recharge groundwater aquifers, but most do not. Recharge potential varies according to wetland type, geographic location, season, soil type, water table location and precipitation (Tiner, 1984). Most estuarine intertidal wetlands are discharge rather that recharge areas (Carter et al., 1979). In coastal areas large groundwater withdrawls for urban and industrial use have caused saltwater intrusion into the drinking water aquifers.

Economic and Recreational Values

The economic benefits of wetlands are realized in natural products, shoreline erosion control, stormwater treatment, flood protection, water supply, livestock grazing, and recreation. Natural products include timber, fish, shellfish, waterfowl, furbearers, peat, and wild rice. Commercially important species such as striped bass, menhaden, bluefish, flounder, spot, blue crabs, oysters, and clams are partially dependent on coastal wetlands during some part of their life history. Wetland grasses are also used for livestock grazing or harvested for hay. Recreational activities in wetlands include boating, swimming, fishing, hunting, and nature study. All of these activities and products derived from wetlands bring direct and indirect economic benefits to the adjacent communities.

Economic benefits from hunting and fishing are significant: in 1980 furs from muskrats yielded approximately $74 million; in 1980 5.3 million people spent $638 million on hunting waterfowl and other migratory birds; and in 1975 sport fishermen spent $13.1 billion to catch wetland dependent fishes in the U.S. (Burke et al., 1988). In 1980, 47 percent of Americans spent $10 billion observing and photographing waterfowl and other wetland birds (Burke et al., 1988).

The ablity of wetlands to control flood waters reduces property damage from flooding, and reduces costs for flood control structures. Property damage from floods for 1975 in the U.S. was estimated to be $3.4 billion (U.S. Water Resources Council, 1978). The U.S. Army Corps of Engineers found that buying wetlands adjacent to the Charles River in Massachusetts was the most inexpensive solution to flooding problems in the Charles River Basin (Tiner, 1984). Wetlands provide perpetual values, (Table 1) whereas economic benefits from wetland destruction are finite (Mitsch and Gossilink, 1986).

Table 1. Tidal Wetland Values.

ECOLOGICAL VALUES

Water Quality Improvement

- Pollutant removal
- Sediment trapping
- Nutrient recycling
- Wastewater treatment

Aquatic Productivity

Fish And Wildlife Habitat

- Spawning and nesting sites
- Nursery areas for young
- Shelter from predators

SOCIO-ECONOMIC VALUES

- Shoreline Erosion Control
- Flood protection
- Groundwater recharge and discharge
- Natural products (timber,fish,waterflowl)
- Recreation (boating, fishing, hunting)

Wetland Losses

Human threats to wetlands include drainage, pollution, dredging, filling, shoreline structures, groundwater withdrawal, and impoundments. Between 1956 and 1977, coastal wetland loss in Virginia was approximately 6.3 thousand acres (Tiner, 1987). Of those losses, urban development accounted for 43 percent, and coastal waters (from impoundments) accounted for 36 percent (Tiner, 1987). The natural inland migration of wetlands is slowed or stopped where bulkheads or riprap are placed along shorelines for erosion control. As sea level rises, wetlands in front of hardened shorelines will eventually be drowned. Wave reflection from shoreline defense structures may accelerate erosion on adjacent or channelward wetlands. Natural events that may cause wetland loss include rising sea level, natural succession, the hydrologic cycle, sedimentation, erosion, beaver dam constuction, and fire (Tiner, 1984). As wetlands are lost so are their associated benefits.

Regulation of Tidal Wetlands

In 1972 Virginia enacted a law with the intent to protect tidal wetlands while accommodating necessary economic development. The Virginia Marine Resources Commission (VMRC) was given the responsibility of lead state agency. Under the Act's local option alternative most localities have adopted the model ordinance and administer their programs through local wetlands boards and ordinances. Federal wetland regulation under the Clean Water Act is administered by the U.S. Army Corps of Engineers (COE) and overseen by the U.S. Environmental Protection Agency (EPA). The Corps and the VMRC have developed a joint permit application that is used by the local, state, and the federal regulatory authorities to streamline the permit process. The Commonwealth has compiled a set of Wetland Guidelines which describe tidal wetland types, their values, and methods of coastal construction that minimize wetland impacts. These guidelines can be used to assist applicants when filling out the joint permit application. Other state and federal agencies that may comment on wetland applications during the joint permit review include: the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Environmental Protection Agency, Council on the Environment, the State Department of Health, State Water Control Board, Shoreline Erosion Advisory Service, Virginia Institute of Marine Science (VIMS), and Game and Inland Fisheries.

Concerned citizens can assist in wetland protection through various activities by: attending Wetlands Board public hearings, locating and monitoring wetlands in their area, supporting wetland legislation, informing neighbors and developers of the values of wetlands, and encouraging them to minimize their impact on wetlands.

"In the beginning, wetlands were considered valueless. Only when most of the native waterfowl vanished was it determined that wetlands might ensure the survival of many endangered plants and animals. Only after billions of dollars were spent on structural flood control that resulted in further flooding were wetlands recognized for reducing flood peaks. Only after additional billions were spent to purify streams was it realized wetlands naturally filter pollutants for free." (Illinois Institute of Natural Resources)

Bibliography

Anderson, G., J. Brokaw, T. Lassen, G. Mapp, and L. D. Theberge. 1978. In: E. L. Shea and N. B. Theberge, eds. Wetland Evaluation and Management in Virginia. SRAMSOE No. 211, Virginia Institute of Marine Science, Gloucester Point, Virginia. 116 pp.

Boon, J.D. 1975. Tidal discharge asymmetry in a saltmarsh drainage system. Limnology and Ocean. 20(1):71-80.

Boto, K. G. and W. H. Patrick, Jr. 1979. Role of wetlands in the removal of suspended sediments. In: P. E. Greeson, et. al. Wetland Functions and Values: The State of Our Understanding. Amer. Water Resources Assoc. pp. 479-489.

Burke, D. G., E. J. Meyers, R. W. Tiner Jr., and H. Groman. 1988. Protecting nontidal wetlands. American Planning Association. Washington D.C.

Carter, V., M. S. Bedinger, R. P. Novitski and W. O. Wilen. 1979. In: P. E. Greeson, et al. Wetland Functions and Values: The State of Our Understanding. Amer. Water Resources Assoc. pp. 344-376.

Cerco, C. F. and A. Y. Kuo. 1979. Water quality in a small tidal creek: Parker Creek, Virginia. SRAMSOE No. 231 Virginia Institute of Marine Science, Gloucester Point, Va. 112 pp.

Dean, R. G. 1979. Effects of vegetation on shoreline erosional processes. In: P. E. Greeson, et al. Wetland Functions and Values: The State of Our Understanding. Amer. Water Resources Assoc. pp. 415-426.

Deegan, L. A., B. J. Peterson, and R. Portier. 1990. Stable isotopes and cellulase activity as evidence for detritus as a food source for juvenile Gulf menhaden. Estuaries 13:14-19.

Grant, R. R., Jr. and R. Patrick. 1970. Tinicum Marsh as a water purifier. In: Two Studies of Tinicum Marsh. The Conservation Foundation. pp. 105-123.

Hardaway, C. S., G. R. Thomas, A. W. Azcherle, and B. K. Fowler. 1984. Vegetative erosion control project: Final report 1984. Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, Virginia.

Hines, A. H., R. N. Lipcius and A. M. Haddon. 1987. Population dynamics and habitat partitioning by size, sex, and molt stage of blue crabs *Callinectes sapidus* in a subestuary of central Chesapeake Bay. Mar. Ecol. Prog. Ser. 36: 55-64.

Illinois Institute of Natural Resources, Illinois Wetlands, p. ix. Quoted in Zinn, J. A. and Copeland, C. 1982. Wetland Management. Congressional Research Service The Library of Congress, Washington D.C.

Kadlec, R. G. and J. A. Kadlec. 1979. Wetlands and water quality. In: P. E. Greeson, et al. Wetland Functions and Values: The State of Our Understanding. Amer. Water Resources Assoc. pp. 436-456.

Knutson, P. L., R. A. Brochu, W. N. Seelin, and M. Inskeep. 1982. Wave damping in *Spartina alterniflora* marshes. Wetlands 2: 87-104.

McGovern, J. C. and J. E. Onley. 1988. Potential Predation by Fish and Invertebrates on Early Life History Stages of Striped Bass in the Pamunkey River, Virginia. Transactions of the American Fisheries Society 117:152-161.

Metzgar, R. G. 1973. Wetlands in Maryland. Maryland Dept. of State Planning, Baltimore, Md.

Mitsch, W. J. and J. G. Gosselink. 1986. Wetlands. Van Nostrand Reinhold Co., New York, NY.

Motts, W. S. and R. W. Heeley. 1973. Wetlands and groundwater. In: J. S. Larson, ed. A Guide to Important Characteristics and Values of Freshwater Wetlands in the Northeast. University of Massachusetts, Water Resources Research Center. Pub. No. 31, pp. 5-8.

Niering, W. A. 1988. Endangered, threatened and rare wetland plants and animals of the continental United States. In: D. D. Hook and others, eds. The Ecology and Management of Wetlands, Vol. 1 Ecology of Wetlands. Timber Press, Portland, Oregon. p.227-238.

Rozas, L. P. and C. T. Hackney. 1984. Use of oligohaline marshes by fishes and macrofaunal crustaceans in North Carolina. Estuaries 7: 213-224.

Sloey, W. E., F. L. Spangler, and C. W. Fetter, Jr. 1978. Management of freshwater wetlands for nutrient assimilation. In: R. E. Good, et al. Freshwater Wetlands. Ecological Processes and Management Potential. Academic Press, New York. pp. 321-340.

Sweeney, J. T. 1980. Measurement and analysis of tidal marsh fluxes of oxygen demanding materials. College of William and Mary, Virginia Institute of Marine Science Master's Thesis. 122 pp.

Teal, J. and M. 1969. Life and Death of a Salt Marsh. Boston. Little, Brown, and Co. 274 pp.

Theberge, L. and D. F. Boesch. 1978. Values and management strategies for nonvegetated tidal wetlands. Special Scientific Report No. 90, Virginia Institute of Marine Science, Gloucester Point, Virginia. 55 pp.

Tiner, R. W., Jr. 1984. Wetlands of the United States: Current Status and Recent Trends. Washington, D.C.: U.S. Fish and Wildlife Service.

Tiner, R. W., Jr. 1987. Mid-Atlantic Wetlands a Disappearing Natural Treasure. Washington, D. C.: U.S. Fish and Wildlife Service.

U. S. Water Resources Council. 1978. Estimated flood damages. Appendix B., Nationwide Analysis Report. Washington, D. C.

Virginia Natural Resources Newsletter. 1989. Vol. 3.

Virginia State Water Control Board. 1979. Best Management Practices Handbook Agriculture. Planning Bulletin 316.

Wass, M. L., and T. D. Wright. 1969. Coastal wetlands of Virginia. Special Report No. 10 in Applied Marine Science and Ocean Engineering, Virginia Institute of Marine Science, Gloucester Point, Virginia.

Weinstein, M. P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. Fish. Bull. 77: 339-357.

Zacherle. A. W. 1984. A method for evaluating the long-term, cumulative impacts of tidal marsh alterations: the York River system - a case study. College of William and Mary, Virginia Institute of Marine Science Master's Thesis. 197 pp.

Zimmerman, R. J. and T. J. Minello. 1984. Densities of *Penaeus aztecus*, *Penaeus setiferus*, and other natant macrofauna in a Texas salt marsh. Estuaries 7: 421-433.

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