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# FORECASTING THE IMPACTS OF GLOBAL FORCES ON AMERICA'S WETLANDS

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**ABSTRACT**

The forces and trends shaping America's wetlands and the manner in which proper futures forecasting methods can be used to determine more adequate policies for their preservation and maintenance are the focus of this article. The most current scientific definition of wetlands is provided with a description of the roles and functions of wetlands. A section is devoted to the continuing decline in the quality and quantity of wetlands in the United States. A description of the forces, both nationally and internationally, which are specifically leading to the declines is also presented. The article concludes with a section which provides suggestions of how current forecasting techniques could be used by policymakers, or their staffs, to minimize the negative side-effects of development decisions on wetlands.

The future of this nation's wetlands is being shaped by forces in action throughout this country and around the world. If government decision makers are to develop policies adequate to protect these environmentally sensitive resources, wetland scientists and policy analysts will have to integrate their skills to develop a forecasting capability which will effectively predict how these forces will affect the future status of wetlands.

## AMERICA'S WETLANDS

### Definition

An internationally recognized scientific classification system was developed by the U.S. Fish and Wildlife Service to clarify the definition of wetlands. Wetlands are defined as follows:

*The results presented here should not be construed as official U.S. Fish and Wildlife Service policy.





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> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsoil and is saturated with water or covered shallow water at some time during the growing season of each year [1].

## Role

Wetlands perform an invaluable role in the support of diverse food chains, fish and wildlife resources, and in maintaining natural hydrologic systems [2]. Coastal marshes and bottomland hardwood forests are some of the most productive ecosystems present on the face of the earth. Eugene Odum has found that estuaries produce as much growth as tropical jungles and twenty times as much plant material (biomass) as the open ocean [3]. Consequently, they act as nutrient collectors which convert the sun's energy into tons of organic material. This organic material provides the basis for the continuing existence of innumerable species, in the form of food and breeding and nesting habitats.

Aside from their somewhat more obvious productivity, wetlands perform a less obvious, but equally important, role as a buffer against storm-induced events, such as flooding and wave action. Wetlands often slow down the flow of raging flood waters which otherwise would erode thousands of acres of prime agricultural lands. In coastal areas, wetlands have the resilient capacity to absorb tons of pounding surf which, if left unabated, could destroy millions of dollars of property and erode acres of valuable shoreline.

## Impacting Forces

Unfortunately, the world's wetlands are facing threats from industrial and post-industrial stresses associated with a highly urbanized environment. The direct threats come in the form of dredging, filling, and pollution. Urbanized man has placed tremendous demands upon water-related lands; shorelines of lakes, rivers and oceanfronts are the focal points of development activities. The majority of the world's cities have evolved along riverfronts and natural harbors. Examples quickly bring to mind London, New York, Paris, Boston, Rio de Janeiro, Chicago, San Francisco; the list goes on. Few of these cities were specifically designed to accommodate or even to anticipate future developmental pressures. Consequently, as populations in these urbanized areas burgeoned, or as their expectations have matured over time, the demand for limited waterfront sites has escalated beyond available resources. In order to accommodate growing demands, governments have attempted and will continue to create additional space for water-related commerce and recreation. The simplest approach to obtaining more land is to drain and fill the wetlands adjacent to bodies of water.

There are continuing population shifts in the United States which demonstrate a definite trend away from the "Frostbelt" states (northeast and north central) to the "Sunbelt" states (southeast and southwest). Along with this shift in population centers will be a shift in environmental stresses. Man inherently desires to be close to his place of work and as the population base gravitates to the South, industries are sure to follow; this is already occurring. With more people and more industry, the urban centers of the South will generate increasing pollution loads which will inhibit the capacity of wetlands to perform their basic functions as sources of food, habitat and pollution control.

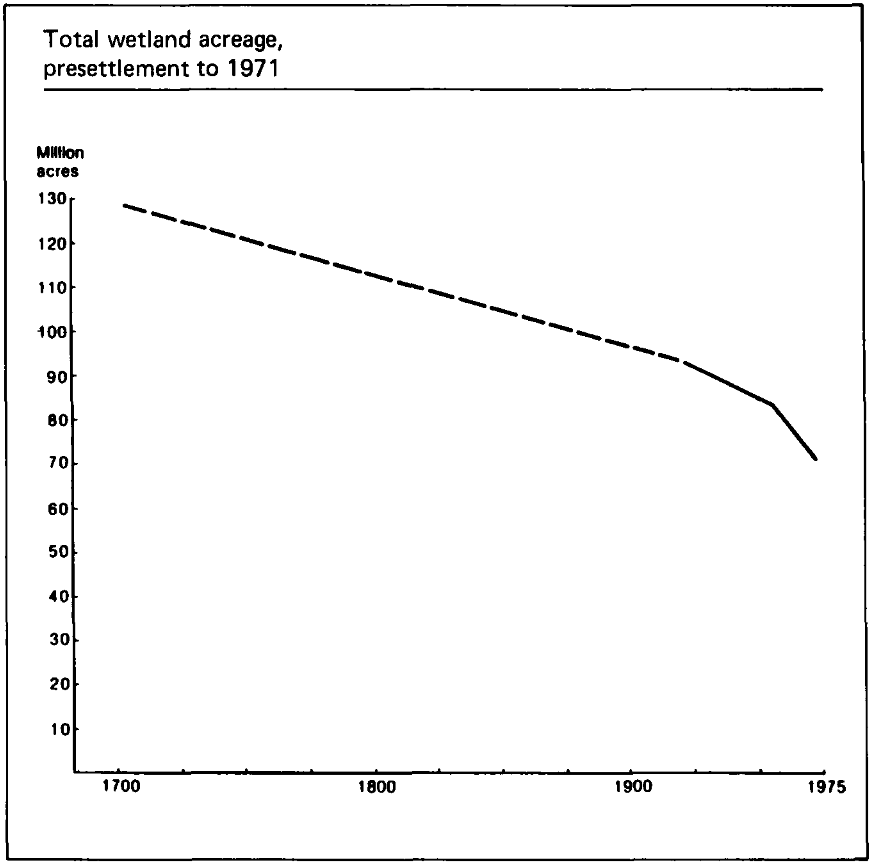


Figure 1. Source: U.S. Council on Environmental Quality, *Environmental Trends*, Washington, D.C., U.S. Government Printing Office, 1981, p. 18.

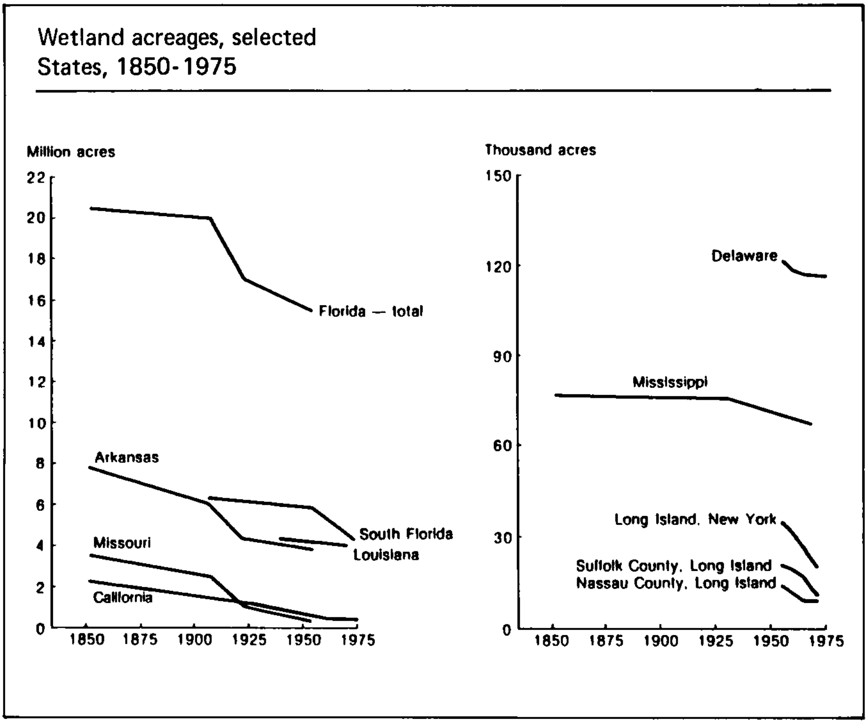


Figure 2. Source: U.S. Council on Environmental Quality, *Environmental Trends,* Washington, D.C., U.S. Government Printing Office, 1981, p. 19.

The pollution control function of wetlands is considerable, since wetlands trap and hold nutrients they also serve as pollution filtration systems [4]. A pollutant is basically too much of any naturally occurring substance and the pollutants in wastewater from treatment plants and non-point sources such as urban and agricultural runoff contain high levels of nutrients such as nitrogen and phosphorous. These nutrients are absorbed by the plants within wetlands and turned into biomass. However, there is a point at which a wetland area can no longer absorb wastes and this capacity is reduced even further as wetlands are reduced in size and quality.

Wetlands in the southern United States will continue to have greater stress placed upon them as a result of increased world-wide demands for food products. Although the rate of increase in the American population is projected to be near zero in the year 2000, the world's population is projected to increase exponentially over the next twenty to thirty years. As populations increase in other countries, their capacity to produce food in sufficient amounts to nourish themselves is likely to be reduced. There will be greater numbers of people requiring food-stuffs. Consequently, there is likely to be a greater demand for

American agricultural crops in the world marketplace. Simultaneously, there will be a greater demand to drain wetlands, particularly in the Southeast United States to meet the increased demand for this Nation's corn, rice, and wheat. A similar demand for forest products from our forests will place even greater ecological stress on the environmentally sensitive wetland areas which are the breeding and nesting areas for millions of waterfowl.

Wetlands are disappearing rapidly. A little more than half of the original wetland acreage remains in the United States; since the mid-1950's, an average of more than 600,000 acres of wetlands has been lost each year [5] (see Figure 1). Connecticut has lost over 50 percent of its wetlands [6], while Louisiana is losing wetland marshes to agricultural and industrial development at the rate of over 10,600 acres per year [7]. Since 1950, 200,000 acres of bottomland forest have been cleared annually in the Mississippi Delta area [4, p. 35]. Most of California's coastal wetlands have been destroyed [5, p. 19] (see Figure 2).

The downward trend in wetlands is partially substantiated in a preliminary Fish and Wildlife Service report on the statistical analysis of the wetland gains and losses in the conterminous United States [8]. From the mid-1950's until the late 1970's, only 78 percent of the total of all wetlands remained unchanged.

The rate of loss of wetlands has only been slowed down in those states and localities where they have enacted vigorous wetland protection or management regulations such as in Florida, California and Nassau County, New York. Clearly, the demand for improved policy processes for the establishment of anticipatory legislation is present in the case of the rapidly increasing disappearance of wetlands.

## DEVELOPMENT OF ANTICIPATORY POLICIES FOR WETLAND PROTECTION

In 1975, Congress held hearings on the topic "Choosing Our Environment: Can We Anticipate the Future?" The Senate Subcommittee on Environmental Pollution posed four basic questions:

1. What institutions are available, within or outside of government, for future analysis of the environment?;
2. How effective are the tools for future analysis of the environment?;
3. Is there resistance to futures analysis and long range forecasting in our society and, if so, where does it lie?; and,
4. How can long-range forecasting and planning assist us as a society in choosing our environment [9]?

The compelling interest in the use of futures analysis to help shape public policy was predicated, in part, on the rapidly evolving character of the global physical environment, especially wetlands. Senator John Culver, from the State of Iowa, noted that it is readily apparent that we are living in an era of finite resources, accelerated change, increasing complexity, and growing interdependence [9, p. 1]. Consequently, the policy makers of today have an enormous responsibility to formulate public policies which attempt to take into consideration the future state of the global environment. The consequences of policy decisions made today will determine the quality of the physical environment for future generations. It would be foolish to simply assume that some future technological panacea will evolve to deal with any or all of the problems which will arise from current technological advances which seem to be increasing at an exponential rate. And, as the complexity of the technological breakthroughs increases, the complexity of the environmental problems associated with them will increase similarly.

The disposal of complex chemical substances into wetlands in places as remote from one another as New Jersey and Louisiana is becoming a common occurrence because we have not been able to determine how to dispose of such materials in a cost-effective manner. The magnitude of the problem has become so great that Congressman John Dingell called a hearing, in 1981, on "Organized Crime Links to the Waste Disposal Industry." [10] The extensive involvement of organized crime in such activities is symptomatic of both the financial lucrativeness of the hazardous waste disposal business and the inability of society to deal with the problem. If long-range forecasting had been used appropriately by the chemical industry and/or government agencies, it could have aided decision makers to anticipate such problems for the purpose of developing solutions prior to their actual occurrence.

Long-range planning can be an effective tool in the protection of wetlands. Typical long-range planning activities would include:

- monitoring
- forecasting
- goal setting
- analysis
- policy generation (with appropriate pre-testing), and
- implementation [9, p. 18]

The U.S. Fish and Wildlife Service is currently focussing on the first phase of the futures planning process. The Fish and Wildlife Service is working closely with State and local governments to collect the data necessary to identify trends in the quantity and quality of wetlands through the National Wetlands Inventory. This mapping process is both costly and time-consuming and, by 1982, only 24 percent of the wetlands of the conterminous lower forty-eight states had been mapped. Although many of those areas which have been mapped probably would be considered the higher priority wetlands, principally those wetlands in the coastal areas.

The data from the National Wetlands Inventory can be used for forecasting and goal setting purposes. Once we have established how much wetlands acreage is in existence (by type) and where it is located, we will be in a better position to determine the best strategies for their protection.

In the analytical phase we will need to determine through a complex process of weights and measures of societal preferences, balanced by objective scientific opinions, how much of any particular wetland type will be necessary for the continuing maintenance of the populations of those species most important for maintaining a global ecological balance.

The products of detailed, objective analysis can be used to improve policies designed to protect wetlands. Increased knowledge of the value of wetlands has led many State and local governments, as well as the Federal government to develop statutes for the protection of these critically valuable resources. The Federal government's principal legislative tool for the protection of wetlands is currently Section 404 of the Clean Water Act of 1977. As with most legislation, this law has been formulated on the basis of partial knowledge of its likely impact. But, as more information becomes available with such tools as the National Wetlands Inventory and public attitude surveys, policy makers will be able to generate improved policies. The effects of proposed policies can then be gauged better through the use of complex modeling and scenario techniques which will provide more accurate predictions as the quality of the information put into them increases.

Wetland scientists need to focus on four basic areas in order to improve the nation's ability to consider wetland policy issues, according to a recent analysis of the Congressional Research Service:

1. Better comparative knowledge of different types of wetlands;
2. Better ability to measure and compare wetland values;
3. Better knowledge of the value of wetlands in optimum and sub-optimum natural conditions; and
4. Improved understanding of the effect of wetland size on value [10].

With such information, policy analysts will be able to develop recommendations which can lead to a better anticipation of future needs and requirements for the protection of wetlands.

## BIBLIOGRAPHY

1. U.S. Fish and Wildlife Service, Office of Biological Services, *Classification of Wetlands and Deepwater Habitats of the United States*, FWS/OBS-79/31, prepared by Lewis Cowardin, et al. Washington: U.S. Government Printing Office, p. 3., December, 1979.
2. U.S. Fish and Wildlife Service, Office of Biological Services, *Proceedings of the National Wetland Classification and Inventory Workshop, 1975, College Park Maryland,* FWS/OBS-76-09, U.S. Government Printing Office, Washington, p. 1., July, 1976.

3. E.P. Odum, *Fundamentals of Ecology,* 3rd ed., W.B. Saunders Co, Philadelphia, p. 359, 1971.
4. Council on Environmental Quality, *Our Nation's Wetlands,* U.S. Government Printing Office, Washington, p. 23, 1978.
5. Council on Environmental Quality, *Environmental Trends,* U.S. Government Printing Office, Washington, p. 19, July 1981.
6. W. Niering, Wetland Values, in *Proceedings of the National Wetland Protection Symposium,* Reston, Virginia, 1977, FWS/OBS-78/79, U.S. Fish and Wildlife Service, Washington, Office of Biological Services, November, 1978.
7. U.S. Fish and Wildlife Service, Division of Program Plans. *Important Resource Problem Source Document,* prepared by William R. Mangun. Washington, September, 1980.
8. W.E. Frayer, D.C. Bowden and F.A. Graybill, Preliminary Report on Statistical Analysis of Wetland Gains and Losses Between Mid-1950's and Late 1970's in the Conterminous United States, U.S. Fish and Wildlife, National Wetland Inventory, Washington, 1982.
9. U.S. Senate, Hearing Before the Subcommittee on Environmental Pollution of the Committee on Public Works, Serial No. 94-H31, Part 1, December 15, 1975.
10. U.S. House of Representatives, Hearing Before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, Serial No. 97-32, May 28, 1981.
11. U.S. Senate, Wetland Management, A Report prepared by the Congressional Research Service for the Committee on Environment and Public Works, Serial No. 97-11, p. 69, July 1982.

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