

Management of the national estuarine resource of the United States

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KURZFASSUNG: Bewirtschaftung der nationalen Hilfsquellen in Flußmündungsgebieten der Vereinigten Staaten. Die Probleme, die sich bei der Erstellung eines Generalplans zum Studium der Flußmündungsgebiete und der Entwicklung eines Bewirtschaftungssystems der Ästuarie in den USA ergeben, werden erörtert. Politische, soziale, wirtschaftliche sowie geographische und klimatische Unterschiede bestimmen ihre Ausnutzung durch die Bevölkerung und die Industrie. In 25 Staaten der USA liegen Flußmündungsgebiete; an der Nordatlantikküste dienen sie vorzugsweise für Hafen- und Fischereizwecke, während an den übrigen Küsten mit stärker landwirtschaftlichem Charakter sich weniger Häfen und Industrieunternehmungen finden. Einander widersprechende Gesetze der Bundesstaaten und örtlicher Instanzen hatten eine unterschiedliche Bewirtschaftung der Mündungsbereiche zur Folge. Hinzu kommt die Verschiedenheit der geschichtlichen Entwicklung bei der Kolonisierung Amerikas; der Norden und die Pazifikküste wurden durch britische Kolonisatoren besiedelt, der Golf und Südpazifik durch Personen mit französischer und spanischer Tradition. Die Notwendigkeit einer optimalen Nutzung der Flußmündungsgebiete unter Berücksichtigung der ökonomischen und sozialen Gegebenheiten sowie einer systematischen Erfassung und wirksamen Kontrolle der Wasserverunreinigung wird hervorgehoben.

INTRODUCTION

The people of the United States have, in recent years, become increasingly concerned with the damage being done to our waters by the impact of man's activities on the environment. The water pollution control agency of the United States government has, for about 50 years, carried on research and engineering studies to understand and control the effects of waste discharges on the aquatic environment. Within the past 10 years the Federal Water Pollution Control Administration has begun planning the water resources development of each major river basin in an integrated fashion, taking into account a broad spectrum of use characteristics and economic values.

Less than a year ago the Congress directed that a study be made of the entire estuarine system of the United States, and called for recommendations for the preservation, use and development of the National estuarine system. The FWPCA of the United States Department of the Interior is responsible for conducting this study. This discussion outlines some of the problems involved in developing such a plan and some of the approaches used to resolve these problems.

POLITICAL, ECONOMIC AND ENVIRONMENTAL BACKGROUND

During the 400 years since the first permanent colonies were established on the North American continent, the estuarine areas have been used and exploited as an unlimited resource. The last 50 years have seen increasing concern with water pollution, but have resulted in extremely limited efforts in the estuarine areas. Only when there was an immediate critical pollution problem in an estuary were estuarine processes investigated. The results of this unrestrained exploitation of the estuarine resource have been the development of a variety of conflicting uses and laws, a lack of understanding of estuarine processes, and many badly polluted estuaries.

The major problem which arises in planning the management of the National estuarine system of the United States is the differences existing among the estuarine areas which make up the system. The primary differences which exist are: (1) political, which reflect the variety of State and local governmental arrangements; (2) social and economic, which reflect major differences in population, industrial development, and estuarine uses around the country; and (3) the local estuarine environment itself, which reflects differences in geography, coastal features, climate, and local offshore oceanographic characteristics.

The United States consists of 50 States, 25 of which have estuarine zones. The Commonwealth of Puerto Rico and the territories of the Virgin Islands and American Samoa also have estuarine areas. Each State, and often each county or city, has its own approach toward owning and controlling the land and water associated with estuarine areas.

These variations reflect the cultural differences of the original settlers and the uses initially made of the estuarine areas. On the North Atlantic Coast, the rapid growth of an urban economy and dependence on commerce led toward a system in which land was owned in small lots and ownership and property rights were clearly defined. Coastal and ocean fisheries provided large amounts of food, and political and legal forces supported the primary use of the estuaries for harbors and commercial fishing.

On the other coasts, a primarily rural economy developed with only scattered harbors and commercial centers. Land was owned in large tracts and the waterfront and seaward boundaries were often poorly defined. The marshlands which abound on the South Atlantic and Gulf Coasts were regarded as relatively useless and, consequently, very little political and legal concern was shown for them. Fisheries were important locally, but the estuarine areas available for fishing far exceeded the needs of the economy, so the need for clear definition of ownership and use rights arose only occasionally.

Such conflicts as did arise were settled on a local basis by reference to the common law practice used in the particular area. Since the Atlantic and North Pacific Coasts were colonized primarily by persons of English tradition and the Gulf and South Pacific Coasts were colonized by people of French and Spanish tradition, considerable differences in law and political philosophy were brought to bear on the problems that arose.

Those early political differences generated today's variations in the social and economic values and uses of the estuarine areas in different parts of the United States.

These are again related to the culture and needs of the original settlers as well as to the present economy.

The North Atlantic Coast has a highly industrialized economy centered in the large cities extending from Boston, Massachusetts, to Washington, D. C. The estuaries provide to this megalopolis an avenue of commerce, a source of food, a recreational area and a place to dispose of municipal and industrial wastes.

The social and economic pressures in this region are directed toward restoration of polluted or otherwise damaged estuaries and resolution of conflicts in present use.

Along the South Atlantic and Gulf Coasts industrial and population centers are more widely separated. Conflicts in use are serious in the industrialized areas, but the economic pressure in estuarine use throughout this region is on exploitation as a natural resource. The management of marshlands as waterfowl and furbearing animal habitats, controlled production of fish and shellfish, oil production, phosphate mining and power production, are all directions which exploitation of the estuarine resource is taking. The need in this region is to foster the use of the estuarine system as a resource, but to avoid ruining it in the process.

On the Pacific Coast the estuarine system is quite small, and the few estuaries have been heavily built up. In this region there is again the need to restore estuarine areas and resolve present conflicts in use. The need here is to stretch a very limited resource as far as it will got.

In addition to the political-economic conflicts which must be resolved, the estuaries themselves impose differing constraints on how they can be used.

ESTUARIES OF THE UNITED STATES

In contrast to the North Sea, which might be regarded as a mammoth estuary almost completely surrounded by countries, the United States can be regarded as a country almost completely surrounded by estuaries. The coasts of the United States face four of the world's major oceanographic features: the Atlantic Ocean, the Pacific Ocean, the Gulf of Mexico and the Arctic Ocean. Each of the coasts is affected by the characteristics of the offshore waters and current patterns.

Foremost among the oceanographic features which exert control over characteristics of the estuarine system of the United States, is the width of the continental shelf. Along the Pacific Coast the shelf is quite narrow, less than one mile in places, so that deep water and oceanic conditions come close inshore. There are relatively few major estuarine systems; Puget Sound, which is primarily a fjord type of system, and San Francisco Bay, which is probably of tectonic origin, are the major ones.

Along the Gulf and Atlantic Coasts the continental shelf is wide, being measured in tens of miles, so that a significant zone of coastal water lies between the estuaries and the major ocean currents. The Atlantic and Gulf Coasts feature numerous important estuarine systems, but each coast has its dominant features. The major estuarine feature of the Gulf Coast is the Mississippi delta, which has been built up over many thousands of years from sediments carried down the Mississippi which drains about 60 percent of the continental United States. On the Atlantic Coast the major estuarine features are the Chesapeake Bay, essentially the drowned mouth of the Susquehanna

River, and the Hudson River system and New York Bight, which dominates much of the North Atlantic Coast.

The offshore ocean currents also play a role in controlling the estuarine environments along each coast. Through the temperatures, aquatic life, and nutrient concentrations associated with them, these currents modify the near shore oceanographic characteristics enough to control the adjacent estuarine environments.

The Gulf Stream is the predominant ocean current along the Atlantic Coast. From Florida to Cape Hatteras its warm, highly saline waters warm the estuaries and coastal marshes, fostering the growth of sub-tropical plants and highly productive shrimp nursery areas. From Cape Hatteras northward the Gulf Stream moves away from the Coast and cold, nutrientladen water from the Labrador Current system moves southward along the estuaries of the North Atlantic Coast. The near shore fisheries along the North Atlantic Coast are highly productive, and the density differences between the rivers and the cold offshore waters cause strong currents within and adjacent to the estuaries.

In the Gulf of Mexico the current structure changes from month-to-month, but generally a gentle current of warm, highly saline water (the parent water of the Gulf Stream) bathes the estuaries of the Gulf. The warm, saline water is a major controlling feature in maintaining the marshlands which are an important part of the estuarine resource in this region.

Along the Pacific Coast the California current moves southward along the shore, in this area bringing cold, nutrientladen waters close to the estuaries themselves; again the density difference and the strong offshore currents have a dominating effect on the circulation patterns of the estuaries.

The estuaries of Alaska, Hawaii, Puerto Rico, the Virgin Islands and American Samoa are all even more sensitive to the effects of major oceanographic features than are those of the continental United States. In fact, the ocean currents go far toward determining the entire estuarine ecosystem in each of these areas.

Other major environmental characteristics which account for the fundamental differences among the estuaries of the United States, are the amount of fresh water inflow and the shape of the estuarine system. On the Pacific Coast the slopes of the sides of the estuaries are quite steep and deep water is near the coast; the result is rapid interchange of oceanic and fresh water. Where there is a large river inflow, such as the Columbia, the "estuary" actually extends far out into the ocean itself. The narrowness of the continental shelf, the speed of water interchange, and the shape of the estuaries combine to make practical the use of ocean outfalls for the disposal of partly treated wastes.

On the North Atlantic Coast the estuaries in most cases also have steep sides and there is a moderate amount of fresh water inflow. The currents resulting from the differences in density and the steep sides result in very good interchange of ocean and fresh water and a consequent dependence on this characteristic in disposing of wastes.

On the South Atlantic and Gulf Coasts the sides of the estuaries are very flat and there is almost always an associated area of marshlands. The fundamental result is a lack of interchange of fresh and ocean water, and high temperatures, which makes the estuaries in this region extremely sensitive to any form of pollution discharge.

PROBLEMS OF MANAGEMENT

This paper has summarized the political, economic, and environmental differences among the estuaries of the United States, indicating how these differences create problems in the management of the estuarine system on a national scale. The question now is, how can these differences be resolved and an effective management plan be developed.

The differences among the estuaries are indeed real and do impose constraints in the development of a management plan. However, the differences also provide the key for putting together a suitable program and making it work. That there are regional differences shows that these problems can be resolved only by considering the regional importance of, and differences in, the estuarine system. Any plan which can be expected to work must, then, be firmly based on the need and use of the estuarine resource within each geographical area of the United States.

The approach being taken in this study of the estuarine system of the United States is the exact converse of the manner in which it has been presented here. First, the estuaries themselves are examined. All pertinent data are collected, damages to beneficial use because of pollution are documented, use trends which result in pollution are analyzed, and a coherent description is developed of the national estuarine system in terms of what it is, how it functions, and how it has been damaged. The properties of the systems are clearly defined so that we know what we can and cannot do in terms of the environment itself.

Next, the economic and social pressures on each part of the estuarine system are examined. The differences in resource use and the relative economic and social importance of each use are documented, and the result of these studies is an analysis of the relative importance of contributing factors in each regional zone of the Nation.

Finally, the political and legal implications of optimum use for the national estuarine system are examined, and recommendations incorporating all important environmental, economic, and political factors are prepared for submission to the Congress.

Much of the information needed as input to this program presently exists in a wide variety of Federal, State and local organizations and agencies. To collect this information and to obtain the views of the many groups interested in how estuaries should be managed, these approaches are being used:

First, we seek the assistance of the State governments and local organizations in collecting what information is available on the estuarine areas of each region, and in holding public hearings to ascertain what the feelings of individuals are about estuarine management.

Second, we contract for the collection and organization of certain types of information (e. g., ecology, sedimentation) which require special skills and a degree of staffing not available within the FWPCA. These contracts are negotiated with organizations which have already available the staffing and skills necessary to collect and analyze such information within the time allowed for completion of this study.

Third, the existing activities of the FWPCA are used to supplement existing information to illustrate a problem, a need, or a solution through special field studies.

The approach in this aspect of the study is to investigate the processes that are important in estuaries, not the estuaries themselves. A particular estuary is used to illustrate a process or problem that is important in managing the national estuarine system, and conclusions are based on the use of such a system as a "case study".

Even while this three-pointed approach is being used to attack the entire problem, a series of immediate steps is being taken to put the entire problem of estuarine pollution on an "immediate action" basis. The establishment of standards of water quality for the entire United States is a current major program of the FWPCA, and this will be supplemented by the use of all FWPCA activities to seek out all sources of water quality degradation, and use existing legal authority to remove them immediately.

Our ultimate objective is to present to the people of the United States an acceptable program which will give them maximum use of the estuarine resource with the minimum damage. The estuaries of a Nation are the boundary of land and sea together, where man's historical evolution from the sea and his future upon the land meet, and present to him the ultimate challenge in preserving the past and saving the future.

SUMMARY

1. The Congress of the United States has directed that the Department of the Interior conduct a study of the estuarine areas of the United States and prepare recommendations for the management of the entire estuarine system as a major natural resource. These studies include analysis of the effects of pollution on estuarine uses, the economic and social importance of the estuaries, and the management approaches that have been used.
2. This paper outlines some of the problems involved in the development of such a plan and some of the approaches used to resolve problems.
3. The great diversity of the estuarine system is the major problem which must be overcome. There are political differences, which reflect the variety of State and local governmental arrangements; social and economic differences, which reflect major differences in population, industrial development, and estuarine uses; and differences in the local estuarine environment itself, which reflects differences in geography, coastal features, climate, and local offshore oceanographic characteristics.
4. These differences and the reasons for them are discussed, and the means being used to obtain the necessary information and resolve the conflicts are presented.