

CONSIDERING ECOLOGICAL SERVICES WHEN MITIGATING EROSION OF SHELTERED COASTS

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INTRODUCTION

Coastlines are perpetually changing—some from natural processes—some from human activities—many from both. Within areas sheltered from high-energy regimes usually associated with open coastlines exist some of the most complex, dynamic, and biologically productive systems of the coastal region. They are also increasingly popular places for people to live, work, and recreate. When erosion occurs in the same area as human development, a “problem” is perceived and actions are taken to prevent erosion. The frequent human response to erosion is an attempt to stabilize, or “harden” the shoreline with bulkheads, revetments, or other structures. Usually this is an approach that results in long-lasting consequences for the natural system not just locally but also affecting surrounding areas. Although the armoring of a few properties has little impact, the proliferation of structures along a shoreline can inadvertently change coastal environments and ecosystems. Managers and decision makers have been challenged to balance the trade-offs between protection of property and potential loss of landscapes, public access, recreational opportunities, natural habitats, and reduced populations of fish and other marine species that depend on these habitats. There are however many effective alternatives to hardening and depending on the selections made, the long-term consequences to the area can be positive or negative.

At the request of the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (USACE), and the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), the National Research Council - Ocean Studies Board convened a panel of experts to examine the impacts of shoreline management on sheltered coastal environments. The report (NRC 2007) reviews options available to address and mitigate¹ erosion of sheltered coasts and explores why certain decisions are made regarding the choice of erosion mitigation options. It provides critical information about the consequences of altering sheltered shorelines; and, provides recommendations for a new shoreline management framework to help decision makers evaluate the spectrum of available approaches to shoreline erosion problems in the context of the environmental setting. The new framework would include assessment of the physical and ecological properties of the shoreline and the potential cumulative impacts.

The committee’s report identifies four broad categories of options to address erosion on sheltered coasts:

- 1) Land use regulation and management;
- 2) Vegetative stabilization;
- 3) Hardened structures (armoring the shoreline); and

¹ In this report, “mitigation” is used to describe efforts to reduce or lessen the severity of erosion and should not be confused with mitigation of environmental damages.

4) Trapping or adding sediment.

These options are described in the context of the physical environment, ecosystem services and values, and the various regulatory, engineering, esthetic, and financial considerations that contribute to the decision-making process for mitigating erosion.

SHELTERED COASTS, EROSION, AND SEA LEVEL RISE

Sheltered coasts are shorelines that face smaller bodies of water in contrast to open ocean beaches. These smaller water bodies typically have lower energy conditions that foster unique habitats and ecological communities, such as marshes and mud flats, typically not found on open coasts. Such coastal ecosystems provide a variety of marketable goods (e.g. fishes, fibers, seaweeds, crabs, sand) as well as processes (e.g. climate regulation, wave attenuation, removal of nutrients, contaminant sequestration, maintenance of biodiversity) that allow humans to thrive (NRC, 2005). These goods and ecosystem processes that benefit humankind are often referred to as ecosystem services.

Although natural processes such as wind, waves and weathering contribute to erosion the rate may be accelerated by human activities. For example, construction of groins and seawalls may alter the magnitude and direction of sediment transport. Other human activities that increase erosion include dredge and fill operations, wetland drainage, boat traffic, and channel dredging. Sea level rise will exacerbate the loss of waterfront property and increase vulnerability to inundation hazards. As the water level rises it changes the location of the coastline, moving it landward and exposing new areas and landforms to erosion. Additionally, sea level rise is chronic and progressive, requiring a response that is correspondingly progressive (Figure 1).

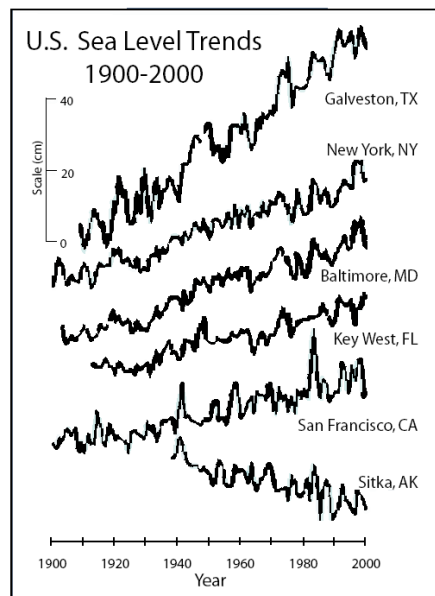


Figure 1. Relative sea-level trends in centimeters, for selected U.S. cities from 1900 to 2000. (EPA 200)

CURRENT APPROACHES TO PROTECTING AGAINST EROSION

The pressure to develop and stabilize shorelines along sheltered coastal coastlines is increasing as coastal populations continue to grow and land values increase. The most common mitigation responses currently are “hold the line” approaches that harden the shoreline with structures such as bulkheads and revetments. There are alternatives however, such as constructed marsh fringes that are designed to preserve more natural shorelines. The selection of the type of response to prevent or offset land loss depends on understanding local causes of erosion or inundation. A shift away from the hold the line approach has been slow, in part because there is a greater familiarity with these methods than with alternative approaches such as constructing a marsh fringe or using vegetation to stabilize a bluff. Landowners often assume that a hard, barrier-type structure is the only way to prevent loss of property and protect buildings. In many regions, government regulations may unintentionally encourage shoreline armoring because it is simpler and faster to obtain the required permit(s). Unfortunately, installation of a groin to trap sand can affect neighboring beaches and bulkheads, and may lead to loss of fronting beaches along with attendant public access and a change in ecological services being provided. When marshes are affected, highly diverse and productive plant and animal communities may be lost along with the vital ecosystem services they provide—nursery, areas for important fish stocks, removal of excess nutrients from land runoff, feeding areas for migratory birds, and sediment stabilization.

A NEW SHORELINE MANAGEMENT FRAMEWORK

Changing the current practice of armoring sheltered coasts will require a change in the shoreline management framework. The management framework should encourage approaches that minimize habitat loss and enhance natural habitats in environments where such methods offer effective stabilization. Overcoming the obstacles associated with the current regulatory environment will require a number of changes in the following areas:

Improving Knowledge of Sheltered Shoreline Processes and Ecological Services

In most areas, the scope and accessibility of information regarding the causes of erosion or the ecological services being provided at specific sites and the overall patterns of erosion, accretion, and inundation in the broader region (estuary, lagoon, littoral cell) is insufficient to support the development of an integrated plan for managing shore erosion. The report recommends that federal agencies (e.g., USACE, EPA, USGS, and NOAA), state agencies, and coastal counties and communities should support targeted studies of sheltered coast dynamics to provide an informed basis for selecting erosion mitigation options that consider the characteristics of the broader coastal system rather than simply addressing immediate problems at individual sites.

Improving Awareness of the Choices Available for Erosion Mitigation

Many decision-makers, particularly homeowners but also some state and federal regulators, are not sufficiently informed about the mitigation options available to them or the short and long-term impacts of their choices. The report recommends that the federal

agencies involved in permitting activities (EPA, USACE, and NOAA) should initiate a national policy dialogue that results in a common set of guidelines for mitigating erosion on sheltered coasts.

Considering Cumulative Consequences of Erosion Mitigation Approaches

Cumulative impacts refer to the combined effects on legal, social, ecological, and physical systems. From a legal or regulatory standpoint, issuing permits may set a precedent, potentially facilitating the approval process for future requests for similarly situated structures. From an ecological standpoint, the cumulative impact of the loss of many small parcels will at some point alter the properties, composition, and values of the ecosystem. These cumulative effects are rarely assessed and hence are generally unknown, but an understanding of them is necessary to prevent an underestimation of the impacts of individual projects. The report recommends that cumulative effects be assessed in shoreline management plans, and that a precautionary approach be taken if there is insufficient information to determine cumulative effects.

Revising the Permitting System

The current permitting system fosters a reactive response to the problem of erosion on sheltered coasts. Decision-making is usually parcel-by-parcel and based on relatively little environmental information. The path of least resistance drives choices through a rigid decision-making process, with inadequate attention to the cumulative effects of individual decisions. The report recommends that the decision-making process used for issuing permits for erosion mitigation structures be revised for sheltered coasts and include consideration of potential cumulative impacts. This could be accomplished by a working group convened by state and federal agencies (EPA, USACE, and NOAA) to evaluate the criteria for sheltered coasts. The report also recommends removing the often unintentional regulatory barriers for employing alternative erosion control approaches that have been proven to reduce erosion while preserving natural habitat.

Improving Shoreline Management Planning

Creating a more proactive “regional approach” to shoreline management could address some of the unintended consequences of reactive permit decisions. The term “regional” is used in this report to reflect an area of shoreline that is defined by functional physical or ecological parameters such as littoral cells, or the scale of processes that affect sediment transport. Several examples of regional planning already exist for shorelines: the USACE Regional Sediment Management (RSM) program, EPA’s National Estuary Program, and some special area management plans approved by state coastal management programs.

CONCLUSION

Until the government regulatory framework addresses the regional scale of the processes controlling sediment transport, stabilization of individual sites will often include structures that damage adjacent areas and create a domino effect of coastal armoring. The dimensions of the regulatory framework should match the scale of the processes that contribute to shore erosion. Currently there is no national mandate to document erosion processes on sheltered coasts or develop regional scale plans. No federal agency has been assigned to provide that scale of planning, although some states have become more

proactive in shoreline management. The report recommends development of a new shoreline management framework to help decision makers evaluate the spectrum of available approaches to shoreline erosion problems in the context of the environmental setting. The new framework would include assessment of the physical and ecological properties of the shoreline and the potential cumulative impacts.

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