Marine Resources

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Evaluating the extent to which current activities and uses are sustainable as they relate to coastal and marine resources is a challenging undertaking. State and local agencies are crafting measures to produce information and data that will shed light on the condition of our coastal waters, and their response to human activities in the marine environment and on adjacent lands. This is an evolving field, and different strategies have been developed for reporting the results of ongoing science and its implications for the management of coastal and marine resources.

Coastal condition reports rely on extrapolations of studies that focus on individual constituents of the environment, or on geopolitically defined geographic regions, are inherently subjective and sometimes criticized for their speculative nature. These reports attempt to address the coastal and marine environment systemically and comprehensively, but their ability to do so requires the use of less accurate measures. Diagnostic surveys and studies that focus on quantitative results, on the other hand, are often not well-suited to assess the inter-relatedness of different environmental factors that affect one another, or the variations that arise from persistent or episodic fluctuations in environmental conditions. Scientific, quantitative studies increase our understanding of individual constituents of the coastal environment incrementally, and as such are essential undertakings, but they typically fall short of addressing the complex relations of activities resources in the coastal zone comprehensively. While scientific studies can measure discreet changes in the environment, more circumspect discussions are sometimes needed when using broader terms like development and sustainability. A number of efforts are underway to accommodate the relative merits of both approaches - the use of sound science to identify measurable relationships and changes in the environment, and the use of planning and management tools to apply this science to address the broader context of sustainability.

Assessing the relative sustainability of the Cape's coastal environment presents these same problems. Towns on the Cape derive direct and indirect economic benefit from the marine and coastal environment through recreation, navigation, tourism, fishing and aquaculture. In addition, communities benefit from less tangible services such as key cultural and social characteristics derived from their relationship with the sea, and the scenic beauty of the coast and the moderating effect of the ocean on the Cape's climate. These same coastal resources also serve as a receptor, a repository for some of the Cape's wastes and a substrate supporting communication lines and energy cables and other infrastructure.

In this, the first attempt to incorporate coastal elements into the CCSI report, three measures (Cape Cod Tidal Restrictions http://www.capecodedc.org/documents/TidalRestrictions_000.pdf,

Cape Cod Fish Passage Restrictions
http://www.capecodedc.org/documents/FishPassageRestrictions_000.pdf, and

Cape Cod Stormwater Discharge Points
http://www.capecodedc.org/documents/StormwaterDischarge_000.pdf, have been chosen to demonstrate the relationship between human activities and coastal and marine ecosystems. These three topics are not intended to serve as adequate measures of the full complement of human activities and the resulting effect on the Cape's coastal resources. Rather, they are intended to draw attention to the links between activities conducted on land and subsequent - often diffuse and unseen - impacts to the coast and the marine environment.

This report follows a period of intense dialog about coastal and ocean management planning. The Massachusetts Ocean Management Task Force, the Pew Oceans Commission and the U.S. Commission on Ocean Policy all engaged in lengthy deliberations to evaluate the current status of the ocean environment and uses of ocean resources. All stressed the need for greater attention including the collection of additional data and the development of improved frameworks for decision making.

This report also comes shortly after one of the most intense and widely distributed red-tide blooms in the Cape's history. The basic mechanics of red tide are becoming clear, and professionals in the Massachusetts Division of Marine Fisheries conduct sentinel monitoring to ensure that harvested shellfish are free from contamination. Despite this precautionary work, implications of the deposition of spores in the Cape's nearshore areas from the 2005 bloom are poorly understood. Nutrient-rich waters can facilitate blooms of nuisance species, and we do not know whether the enrichment of the Cape's nearshore waters could someday result in conditions resulting in a persistent resident reservoir of red-tide cells in our local waters. In the past, blooms transported into Cape Cod Bay from the Gulf on Maine have not established a significant, permanent presence in our local waters. Now it seems possible that, if discharges go on unchecked and further enrichment of our near shore waters occurs, such a cycle could come to pass and blooms of red tide could become a local phenomenon with more frequent and pernicious impacts to our coastal environment.

Herring have been a part of Cape Cod life since its settlement, harvested for use as bait for the robust lobster fishery, as fertilizer for agricultural operations, and for human consumption. An offshore fishery of Atlantic Sea Herring, long considered to be separate and distinct from the diadromous population of river herring, has been a significant fishery – albeit primarily targeted by boats from other areas. Both populations seems to be in decline and the Commonwealth's Division of Marine Fisheries (DMF) has imposed protective closures and limitations for both the pelagic commercial fishery, and for harvest in the Cape's rivers and estuaries. The offshore fishery may have succumbed to the effects of generous commercial

catch limits and from incidental harvest as “bycatch” by vessels targeting other species. The picture is less clear for the nearshore population, which may be manifesting the effects of nonfishing human activity. The mechanics of the recent decline are still being investigated, and DMF and other fishery management authorities are investigating any connections may exist between the two fisheries that may be resulting in additional, unexpected mortality. However, it is clear that the extent to which fish runs have been affected through the construction of infrastructure and other obstructions and increases of siltation and changing water quality characteristics are contributing to declining reproduction and recruitment. The Natural Resources Conservation Service has identified fish runs that are currently obstructed. While blueback herring (*Alosa aestivalis*) are perhaps the most prominent and recognizable of the diadromous fish, other species including alewives (*Alosa pseudobarengus*) and white perch (*Morone Americana*) depend on the Cape’s tidal estuaries for spawning.

As the Cape has continued to develop, coastal waters have increasingly been adversely affected. Some of these effects come from diffuse sources such as non-point source discharges (such as runoff from roads and parking lots, or wastewater seeping from the ground). Others are more readily identifiable such as point source discharges (discharge pipes, essentially) and structural impediments to tidal inundation. Undersized or poorly maintained culverts under roadways and railbeds, obsolete flood control devices and other structures that inhibit tidal inundation of salt marshes result in a number of adverse impacts. The diversity and richness of plant species can be reduced, water quality is often degraded and its relative attributes (such as salinity and turbidity) are altered. These changes typically degrade the habitat value of the waterbody and underlying resources. Salt marshes that are degraded or ‘stressed’ by altered tidal regimes are often less effective at removing nutrients from coastal waters. In addition, systems that are stressed can be more susceptible to colonization by invasive species such as the common reed (*Phragmites australis)*.

Work to inventory and assess these problems is underway. The Cape Cod Commission in partnership with the Massachusetts Bays National Estuary Program produced the Cape Cod Atlas of Tidally Restricted Salt Marshes in 2001. Building on this effort and a companion work by the Buzzards Bay Project (printed in 2002), the Natural Resources Conservation Service has developed a GIS data layer identifying the location of tidal restrictions, discharges likely to affect shellfish habitat and obstructed diadromous fish runs.

Work by a number of organizations and collaborative efforts by the state, academia and local partners are creating a growing baseline of information to support better management of the ocean and coastal environments. The Center for Coastal Studies has a significant archive of water quality data from Cape Cod Bay and Massachusetts Bay, and their efforts to build upon this foundation continues. Closer to shore, the Massachusetts Estuaries Project is evaluating the relative health of embayments and diagnosing perturbations resulting in

degradation of water quality. The Association to Preserve Cape Cod supports a growing network of salt marsh monitoring citizen-scientists, working to assess the relative health of coastal marshes and to track changes in some locations where tidal restrictions have been mitigated.

The Cape's shoreline is being affected by sea level rise, partially as a result of global climate change and also as a result of long-term geologic mechanisms. Our coastline is becoming more susceptible to the effects of tropical hurricanes and Nor'easters (also referred to as extratropical cyclones or 'wintercanes'). Efforts are underway to develop tools to explore the vulnerability of our coastal landscapes to the effects of persistent factors such as sea level rise and episodic, compounding events such as hurricanes and extratropical storms. Municipalities such as Falmouth are at the vanguard of local planning for coastal resources, evaluating future scenarios of coastal change and the relative benefit of different approaches to coastal management and accommodating shoreline change.

A sustainable shoreline is a dynamic, rather than fixed, feature. Future reports may draw upon data to assess sustainability by measuring the development of new infrastructure in coastal high hazard areas. Such infrastructure is vulnerable to extreme storm events and the effects of sea level rise. Some types of development need to be sited near the coast and offer amenities to the public such as enhanced coastal access. However, private development such as docks and piers or shoreline protection measures can displace public access by occupying the intertidal or subtidal area, or extending into navigation channels. While the impacts from any one project are often minimal, additive changes to our estuaries and bays can be substantial when individual projects are viewed in the aggregate. In addition to physical displacement of the public, these structures sometimes result in other development that causes secondary impacts. The financial benefits and lifestyle enhancements that come with the construction of residential docks and piers can lead to demands for new dredging in areas that have not been dredged before, or that are too shallow to accommodate preferences for larger vessels. While dredging can have beneficial effects by removing sediments that are laden with contaminants or alleviating shoaling impeding historic navigation routes, it can also prove detrimental by allowing wave energy and storm-induced flooding to travel farther inland with greater force and momentum. Additional wave energy from storms and from more intense and frequent use of waterways can erode fringing salt marsh and banks and result in a change in the shape and dynamics of the waterway. Dredging projects are rarely able to address the mechanism that resulted in the need for the project, whether it is due to the deposition of contaminants in the sediment or a build up of sediment and shoaling of navigation routes. Therefore, once areas are dredged, it is likely that future dredging will be required, causing additional alteration to the system and burdening the public with additional costs.

In order for our community to be sustainable, our built environment must be both disaster-resistant and resilient in the face of natural hazards. Generally, this is

best accomplished by taking steps to ensure that fixed structures and features do not interfere with, or impede, the dynamics of the coastal environment and its response to storm events.

In the future, we should explore opportunities to measure the amount of our shoreline that is armored, artificially maintained or built upon. The introduction of solid structures in the dynamic coastal environment is not a sustainable practice. Structures that are constructed to inhibit coastal migration and artificially maintain a fixed shoreline interrupt natural processes. Storm and wave effects that interact with a hard shoreline structure typically reduce the elevation of the beach immediately in front of the structure and, over time, reduce the amount of sand available to maintain beaches downdrift of the structure. Structures in the intertidal area also cause erosion of material as wave energy is reflected off of the structure and into the surrounding substrate, scouring sand away.

The presence, or absence, and relative abundance of whales - particularly the North Atlantic right whale (*Eubaleana glacialis*) - in Cape Cod Bay and the plankton on which they feed has been the cause of concern and a source of speculation for many years. While the residence times of whales in Cape Cod Bay is correlated with the abundance of the food resource, the factors that effect the species distribution within that resource - and the potential for adverse impacts or shifts due to human activities - are still being explored. Work is underway, by the Center for Coastal Studies and others, examining the key habitat characteristics of Cape Cod Bay that attract and sustain this fragile population of endangered mammals. The extent to which the existing (or historic) habitat characteristics of Cape Cod Bay are preserved for right whales and other marine mammals may be a suitable measure of sustainability in the future.

The measures presented here are fallible surrogates for assessing the impacts of land based development on the coastal and marine resources surrounding Cape Cod. These are not comprehensive, however they may provide some measure of the relative success or failure of the Cape's communities as they strive to maintain and enhance the coastal environment. They provide a snapshot of how human activities have influenced the resilience of these resources at this point in time, and they provide a baseline for measuring our success in mitigating identified perturbations to the environment. As they are monitored in the future, trends may emerge that will illustrate whether we have been successful in maintaining and enhancing the coastal environment. There are many additional measures of both terrestrial and marine influences on the environment that might be addressed in future reports, should adequate data become available. As we look ahead, better measures and more robust approaches for assessing sustainable use of the coast should be developed.