

Sustaining Coastal Landforms

Coastal landforms are valuable environmental, aesthetic, and recreational resources that are subject to natural processes as well as the effects of human activities. Beaches, dunes, barrier beaches, coastal banks, saltmarshes and coastal floodplains are appreciated by the general public and regulated by government agencies to ensure protection of the beneficial functions of these landforms. Yet, in spite of these efforts, coastal landforms are vulnerable to human alterations, resulting in less stable landforms and lessening the value of these resources for future generations.

For example, seawall or revetment construction on an eroding shore may eliminate the fronting beach and alter the adjacent property. Home construction in a dune field may alter the form of the dune, eliminate stabilizing vegetation, and alter depositional patterns of dune sands.

To counteract the negative effects of human activities some communities are adopting procedures designed to re-establish

sustainability of coastal landforms damaged by previous activities. Removing roads from barrier beaches or elevating structures in dune fields are two such examples where dune growth and migration of dune sands may be maintained.

Are activities on coastal

landforms detracting from or adding to the beneficial functions of these landforms on both a short term and a long-term basis? To address this question WHOI Sea Grant has undertaken a Coastal Landform System Sustainability Project, focusing on the management of

coastal landforms on Cape Cod. The project began with a workshop held during October 1997, "Coastal Landform Management in Massachusetts," that addressed the science and management concerns of shoreline change and monitoring changes in coastal landforms.



Revetment construction on an eroding coastal bank in Eastham, MA, has resulted in the loss of the coastal beach fronting the structure.

Photo by Jim O'Connell, WHOI Sea Grant

The format of the workshop allowed participants to assume the various roles of landowner, coastal resource manager, commercial or recreational user, and public rights advocate in an effort to negotiate an action that imposed a minimal impact on the sustainability of the coastal landform.

A follow-up activity to the workshop was development of the Coastal Landform System Sustainability Project with participation by WHOI Sea Grant staff, the Cape Cod Commission and the local conservation commissions in each Cape Cod town. The objectives of the project were to:

1. Quantify, on a town-by-town basis, the gains and losses of Cape Cod coastal landform system sustainability resulting from decisions of local resource management and regulatory agencies;
2. Identify the state and local policies and/or regulations (or lack thereof) that have resulted in these gains and losses;
3. Describe permit conditions and/or technical approaches that may assist in maintaining coastal landform system sustainability; and
4. Identify future research needs that will add to our understanding of the interaction between coastal landform function and human actions that may assist in optimum management of our coastal landform systems.

To achieve the project goals, a questionnaire was developed to provide the data necessary to estimate the gains and losses of coastal landform sustainability. The conservation agent for each town completed a questionnaire for each activity permitted by the community's conservation commission. A ranking scheme was developed to evaluate the degree of impact from an activity on a coastal landform. In this project, 318 Orders of Conditions (permits) issued during 1999 for activities on or adjacent to coastal landforms by the participating 15 Cape Cod towns were analyzed. Collectively, 47 specific activities were permitted.

The results of the analysis are presented in the attached *Table 1*. Positive ratings suggest the coastal landform and the system in which it resides are being sustained (i.e., the beneficial functions of the landforms are being protected by the decisions). Conversely, negative ratings suggest that the sustainability of the landform and its system are not being adequately protected (i.e., the beneficial functions of the landforms are being diminished by the collective decisions). Although positive ratings exist within the data set presented in *Table 1*, cumulative negative ratings were summed for all coastal landforms. What this suggests is that, collectively, the natural functioning of certain coastal landform systems are not being sustained on Cape Cod.

This project documents the types of activities presently taking place on and

adjacent to the coastal landforms on Cape Cod and their potential effects, as well as potential mitigation being required by local conservation commissions to minimize these effects. It also documents the trade-offs and balances that may be necessary in the application of performance standard-based regulations governing activities proposed on coastal landforms. As our quantitative understanding of coastal landform function is still evolving, particularly on a small scale lot-by-lot basis, many decisions may be made using best professional judgment without the predictive capability of knowing what the impact will be on the applicant's or neighboring property and resources.

Massachusetts regulations, policies, and bylaws governing activities on coastal landforms are based on identification of their critical characteristics to preserve certain public interests (e.g., storm damage prevention, flood control, preservation of wildlife habitat). These standards are based on requiring the mobility of coastal landforms. Yet, it appears that in a strict sense we are not sustaining our coastal landforms. If we desire our decisions to ultimately maximize or optimize coastal landform system sustainability in the face of continuing development on and adjacent to these valuable landforms, we must begin an intensive program to research and monitor the impacts—positive and negative—of small scale activities to help guide our future decisions.

It is hoped that the results of this Sea Grant study will assist local, state, and federal coastal resource managers and regulators, as well as the public, to gain insight into the interactions of human activities and the natural functioning of coastal landform systems leading towards improved coastal resource management.

References:

Coastal Landform Management in Massachusetts: Proceedings of a Workshop held at the Woods Hole Oceanographic Institution, Woods Hole, MA, USA, October 9-10, 1997. T.I. Crago and S.D. DeRosa (eds.), WHOI Technical Report WHOI-98-16, 1998, 118 p.

Coastal Landform System Sustainability Project: An Analysis of Activities Permitted on Coastal Landforms on Cape Cod, MA, in 1999. J.F. O'Connell, WHOI Technical Report WHOI-2000-09, 2000, 56 p.

For more information about WHOI Sea Grant's Coastal Landform Sustainability project, coastal processes, or any other information included in this Focal Point, please contact the WHOI Sea Grant Program.

Table 1

Cape Cod COASTAL LANDFORM SYSTEM SUSTAINABILITY PROJECT: GRAND TOTALS								
(all Orders of Conditions Analyzed in 1999)								
TOWN	# of OOCs rev'd 1999	Bank	Beach	Dune	Barrier Beach	Salt marsh	Coastal Flood plain	# of projects in buffer zone (BZ)
Barnstable	82	-3.5	-4.5	-26.0	-17.5	-17.5	-15.5	(31 BZ to bank)
Bourne	21	NI	NI	(no proj)	- 3.0	+2.5	+/- = 0	(6 BZ to bank)
Brewster	10		-1.5	+10.5	(no proj)	(no proj)	(no proj)	(3 BZ to bank)
Chatham	5	-1.0	+/- = 0					(no BZ projects reviewed)
Dennis	7	-1.0	+1.0	-2.5	(no proj)	(no proj)	(no proj)	(no BZ projects reviewed)
Eastham	17	-1.5	+2.0	-0.5	(no proj)	-4.0	-1.5	(6 BZ to bank)
Falmouth	16	-2.0	-2.0	-3.5	-2.5	+1.5	-1.5	(1 BZ to bank)
Harwich	22	-3.0	+6.0	-2.0	No proj	-2.0	-1.5	(9 BZ to bank)
Mashpee	13		(no proj)	+4.5	(no proj)	(no proj)	NI (1 proj)	(6 BZ to bank)
Orleans	46	-1.0	-2.0	NI (1 proj)	(No proj)	NI (1 proj)	-2.0	(27 BZ to bank)
P-Town	6		+3.0	-2.5				(no BZ projects reviewed)
Sandwich	18		-3.0	-9.5	-7.5	+1.5	-2.0	(2 BZ to bank)
Truro	16	-4.5	-3.5	-16.5	-14.5	-1.5	-0.5	(2 BZ to bank)
Wellfleet	27	-7.5	-12.0	+4.5	No proj	-2.5	-2.5	(8 BZ to bank)
Yarmouth	12	-0.5	+5.5	+7.0	+4.0	-3.0	NI	(8 BZ to bank)
GRAND TOTALS	# proj 318	bank -25.5	beach -11.0	dune -36.5	barrier -41.0	marsh -25.0	LSCSF -27.0	+ sustaining landform system - not sustaining landform system

Positive (+): sustaining the beneficial functions of the coastal landform system

Negative (-): not sustaining the beneficial functions of the coastal landform system

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