Marine Nearshore

Protocol: Geomorphic Coastal Change

Parks Where Protocol Will Be Implemented: KATM, LACL, KEFJ

Justification/Issues Being Addressed: The problem of land loss/gain and landscape alteration at the marine edge is fundamental to the many issues facing coastal park resource managers. Shoreline change is a prime geo-indicator of coastal environmental resource threats within parks. The physical configuration of the SWAN coastal shoreline is dynamic and constantly changing due to coastal erosion and accretion from natural events, such as storm-driven waves, high tides, nearshore currents, rainfall and runoff, landslides, and earthquakes. Changes in the position of the shoreline affect the composition, relative abundance, and distribution of coastal habitats. Shoreline position also has jurisdictional implications for park management and affects cabins and other structures along the coast. Shape and sedimentary character of a beach (e.g., beach slope, cusp dimensions, bar position and morphology, barrier crest and berm elevation, sediment size and shape) are highly sensitive to oceanographic forcing, including deep-water wave energy, nearshore wave transformation, wave setup, storm surge, tides, and nearshore circulation. Qualitative assessments of shoreline morphology can be used as a proxy for shore-zone processes (Boak and Turner 2005).

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:

Question:

- How are the position, shape, slope, and sediment character of the shoreline changing?

Objectives:

- Document changes in the width of the dry beach, position of the mean water line, the high water line, and the base of the beach.
- Document how the position of the top and toe of the bluffs is changing.
- Document how the position of foreshore and backshore vegetation is changing.
- Document how the sediment type and grain size is changing between the high water line and the base of the beach.

Basic Approach: The options for monitoring this vital sign range from simple rod and transit ground surveys to aerial LIDAR imaging. Using traditional beach across-shore survey methods, data are collected along a transect seaward from a benchmark. Conversely, remotely sensed LIDAR data are collected from an aircraft and provide topographic information over broader areas of coastline. Shoreline change metrics that can be determined from ground and LIDAR surveys are mean-high-water contour, bluff toe/top, vegetation boundary, subaerial beach volume changes, and dune crest height. Each approach requires ground truthing using traditional surveying and new GPS technology.

Protocols for the use of LIDAR are under development and testing elsewhere (Northeast Coastal and Barrier Island Network) and may be applied to SWAN if partnerships materialize that make this technique affordable. In lieu of this, we anticipate using a ground-based approach that can be integrated with other nearshore monitoring tasks. Beach profiles are relatively simple and inexpensive to collect and are extremely accurate (Morton et al. 1993, Ruggiero et al. 2000). Cross-shore profiles will be measured by differential GPS at mixed sand/gravel beaches by walking from the landward side of the primary dune (bluff), over the dune crest, across the beach, and out to wading depth at low tide. Survey-grade GPS equipment is accurate to approximately 0.75 in (2.0 cm) in both the horizontal and vertical position. GPS is not as accurate as standard terrestrial surveying using a rod and level; however, its use is justified by both the reduction in survey time and the magnitude of change observed on the high-energy beaches of SWAN.

Variables such as slope, dune toe and crest elevation, beach width, and substrate volume above a specified datum can be extracted from the beach profiles. These variables will be used as inputs to models that predict coastal shoreline change. Cross-shore beach profiles can also provide an assessment of the current shoreline position at one alongshore location. Biannual or quarterly surveys make it possible to calculate the seasonal variability of shoreline position. Twelve beach profile transects were established along the LACL-Cook Inlet coastline in 1992. Eight of these sites were resurveyed in 2004 and will be incorporated into the long-term data set for the network.

Principal Investigators and NPS Lead:

- Joel Cusick, NPS-ARO
- Alan Bennett, NPS-SWAN (NPS Lead)

Development Schedule, Budget, and Expected Interim Products:

2005 Evaluate decadal change at LACL cross-shore beach profiles and draft final report.

2006 Draft monitoring protocol and select KATM sites.

2007 Implement and test protocol.

2008 Peer review and finalize.

There will be no staff salaries, and equipment costs will be $10,000.

Literature Cited:

Boak, E. H., and L. L. Turner. 2005. Shoreline definition and detection: A review. Journal of Coastal Research **21**:618-701.

Morton, R.A., M. P. Leach, J. G. Paine, and M. A. Cardoza. 1993. Monitoring beach changes using GPS surveying techniques. Journal of Coastal Research **9**:702–720.

Ruggiero, P., B. Voigt, and G. Kaminsky. 2000. Beach monitoring for enhanced decision-making. Proceedings of The Coastal Society 17th Conference, Portland, Oregon.