Sediment Budget: Applications and Opportunities, Gateway National Recreation Area, USA

Introduction

The challenge of managing sediment input, transport, and subsequent output dominates coastal concerns within the several units of Gateway National Recreation Area (Fig. 1). Driven by a generally persistent direction of functional incident waves at the local level, evolution of the coastal geomorphology of the several units in Gateway NRA is constrained by the factors affecting input sediment supply to the unit boundary, to the transport mechanisms within the units, and to the elements of sediment manipulation at the unit terminus. Some portions of the units have a process-response relationship in a quasi-natural system without impediments to sediment transfers, whereas other portions have groins, jetties, and bulkheads that direct or limit dimensions of the geomorphological responses and resulting features.

Great Kills

An extensive groin field and a long terminal groin limit the input of sediment from updrift and cause a downdrift deficit sediment supply. As a result, an expanding erosion zone downdrift of the groin field is encroaching inland at rates of up to 6 m/yr and causing losses of up to 10,000 m³ annually. An erosional scarp of up to 3 m limits access to the beach and is exposing a host of construction debris at the former site of a bathhouse. Farther downdrift, accumulations at and beyond a jetty are impacting a dredged navigation channel and entrance to a marina basin.

Plumb Beach

The central portion of Plumb Beach has the greatest exposure to the incident waves and the greatest net inland displacement. Alongshore transport occurs in both directions, with greater quantities of sediment moving eastward. Storm events remove as much as 5,000 m³ from the central portion, causing inland displacements as great as 6 m, whereas downdrift accumulations reach 5,000 m³ and localized displacements are greater than 8 m. As the downdrift spit extends, it is creating a dune zone that is encroaching on and covering existing wetlands, including habitat for waterfowl and horseshoe crabs. Negative impacts are occurring in the areas of erosion as well as in the areas of accumulation.

Sandy Hook

Under the influence of an extensive groin field and seawall updrift of the Park section of Sandy Hook, the Park holding is largely erosional at its southern margin, losing about 20,000-40,000 m³/yr for the past decade in the Critical Zone. Rates of inland displacement tend to increase immediately downdrift (north) of the end of the seawall, then gradually decrease to a location where the spit changes orientation toward the northwest. Seaward shoreline displacement of more than 20 m is associated with pulses of sediment, volumes of 30,000-60,000 m³ per pulse, moving downdrift to accumulate and extend the northern tip of Sandy Hook. A recently-constructed pipeline is intended to extract sand from the migrating sand waves and backpass the sediment to the erosional zone, thereby balancing the sediment budget through a recycling program.

Conclusions

The challenge of managing coastal resources that are being affected by both positive and negative sediment budgets within short distances is a situation that requires detailed knowledge of transport vectors and resultant geomorphologies. At Gateway National Recreation Area, an intensive program of coastal monitoring is generating timely data sets that provide science and guidance on management issues.
