Estuarine, Coastal and Shelf Science 116 (2013) 11–20

Contents lists available at SciVerse ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Restoration of overwash processes creates piping plover (*Charadrius melodus*) habitat on a barrier island (Assateague Island, Maryland)

Courtney A. Schupp [a,*], Neil T. Winn [a], Tami L. Pearl [a], John P. Kumer [a], Tim J.B. Carruthers [b], Carl S. Zimmerman [a]

[a] Assateague Island National Seashore, 7206 National Seashore Lane, Berlin, MD 21801, USA
[b] Integration and Application Network, University of Maryland Center for Environmental Science, 2020 Horns Point Road, Cambridge, MD 21613, USA

ARTICLE INFO

Article history:
Received 19 October 2011
Accepted 6 July 2012
Available online 20 July 2012

Keywords:
Charadrius melodus
coastal engineering
overwash
piping plover
rare species
vegetation cover
Regional terms:
USA
Maryland
Assateague Island

ABSTRACT

On Assateague Island, an undeveloped barrier island along Maryland and Virginia, a foredune was constructed to protect the island from the erosion and breaching threat caused by permanent jetties built to maintain Ocean City Inlet. Scientists and engineers integrated expertise in vegetation, wildlife, geomorphology, and coastal engineering in order to design a habitat restoration project that would be evaluated in terms of coastal processes rather than static features. Development of specific restoration targets, thresholds for intervention, and criteria to evaluate long-term project success were based on biological and geomorphological data and coastal engineering models. A detailed long-term monitoring plan was established to measure project sustainability. The foredune unexpectedly acted as near-total barrier to both overwash and wind, and the dynamic ecosystem underwent undesirable habitat changes including conversion of early-succession beach habitat to herbaceous and shrub communities, diminishing availability of foraging habitat and thereby reducing productivity of the Federally-listed Threatened *Charadrius melodus* (piping plover). To address these impacts, multiple notches were cut through the constructed foredune. The metric for initial geomorphological success—restoration of at least one overwash event per year across the constructed foredune, if occurring elsewhere on the island—was reached. New overwash fans increased island stability by increasing interior island elevation. At every notch, areas of sparse vegetation increased and the new foraging habitat was utilized by breeding pairs during the 2010 breeding season. However, the metric for long-term biological success—an increase to 37% sparsely vegetated habitat on the North End and an increase in piping plover productivity to 1.25 chicks fledged per breeding pair—has not yet been met. By 2010 there was an overall productivity of 1.2 chicks fledged per breeding pair and a 1.7% decrease in sparsely vegetated habitat. Ideally, overwash restoration will sustain the availability of foraging habitat, but future foredune modifications may be necessary to maintain or increase overwash processes and piping plover habitat in the project area.

Published by Elsevier Ltd.

1. Introduction

Barrier islands represent about 10% (210,000 km) of the world's continental oceanic shorelines, and approximately 68% of these islands are found on coastal plains (Stutz and Pilkey, 2011). These beaches have unique ecological features and harbor hundreds of species. They provide many ecological services including nutrient recycling, support of coastal fisheries, and provision of critical habitats (nesting and foraging sites) for colonial nesting waterbirds, threatened and endangered plants and sea turtles, and many other organisms (Schlacher et al., 2007). Beach fauna often exhibits unique adaptations to these highly dynamic environments, and physical factors, such as beach sediment supply and wave energy, likely have stronger control than biological interactions over faunal community composition, diversity, and abundance (Schlacher et al., 2007; Defeo et al., 2009).

Landscape-level threats to these coastal areas, such as increased human disturbance, predator expansion, and habitat alteration, are adding pressure to these coastal ecosystems (Erwin et al., 2003).

* Corresponding author.
E-mail address: Courtney_Schupp@nps.gov (C.A. Schupp).

0272-7714/$ – see front matter Published by Elsevier Ltd.
http://dx.doi.org/10.1016/j.ecss.2012.07.003

Coastal populations and associated coastal development are increasing worldwide. Although low-elevation coastal zones cover only 2% of the world's land area, they contain 10% of the world's human population (McGranahan et al., 2007); in the United States, 30% of the population (85.6 million) lives in counties with open-ocean and near-ocean shorelines (Crowell et al., 2007). These populations have reduced the natural character of many barrier islands through shoreline modification and hard stabilization (Nordstrom et al., 2007). Regional development can also threaten adjacent undeveloped lands, which may provide the last remaining refuge for a suite of wildlife and vegetation dependent on natural coastal habitats.

Assateague Island (Fig. 1), along the coastal plain of Maryland and Virginia, is one of the few remaining undeveloped barrier islands along the United States' Atlantic coast, but it too faces threats from changes within the mid-Atlantic region, within the surrounding watersheds, and within the Seashore itself including declining air quality, relative sea level rise, invasive species, agricultural nutrient inputs, increasing human populations along the Coastal Bays and associated urban development and degradation and loss of natural habitat (Dennison et al., 2009; Carruthers et al., 2011). Development has included the construction of jetties to maintain a 200-m wide navigational inlet at the north end of Assateague Island; the jetty on ASIS is 700-m-long, of which 400 m extends seaward of the shoreline. These structures have interrupted natural physical processes, thereby impacting biological resources and ecosystem functions that are now the focus of a major habitat restoration project at ASIS.

Restoration and management of habitats are complex and approaches are controversial (Higgs, 1997). Some criticize efforts to rebuild historical habitats that may not be sustainable under changing and future environmental conditions (Choi, 2004; Hobbs et al., 2011), or argue that even if restoration is worthwhile, rarely will it fully replace lost habitat (Elliott et al., 2007; Hobbs et al., 2011). In many cases, the best option is to remove the stressor causing the change in order to enable conditions suitable for natural recovery (Elliott et al., 2007). Although land managers can be hesitant to embrace disturbances and process-based goals, there is growing recognition of the need for compromise between stability and natural functions of coastal ecosystems, for controlling dynamism rather than preventing it (Nordstrom et al., 2007).

With this understanding, ASIS developed a project to mitigate ecosystem impacts by restoring natural overwash processes as a means of restoring habitat. Specific restoration targets and thresholds for intervention were developed based on biological, physical, and modeling data, and a detailed long-term monitoring plan was established to measure the sustainability of the restoration project. The success of the restoration effort was measured in terms of overwash processes and biological responses rather than structural attributes. As Simenstad et al. (2006) explain, this process-based evaluation, while not typical of restoration projects, is especially important in restoration of coastal ecosystems, where linkages between processes, structure and function are typically poorly understood. This project successfully demonstrated that a disturbance-resistant project was ultimately detrimental to ecosystem function, and that initial success was achieved by incorporating a range of temporal and spatial disturbance impacts into the restoration plan (Simenstad et al., 2006).

1.1. Ecology of Assateague Island

Assateague Island is 58 km long, is bounded to the north by the stabilized Ocean City Inlet, and is protected and managed in its entirety by three government agencies with similar missions for

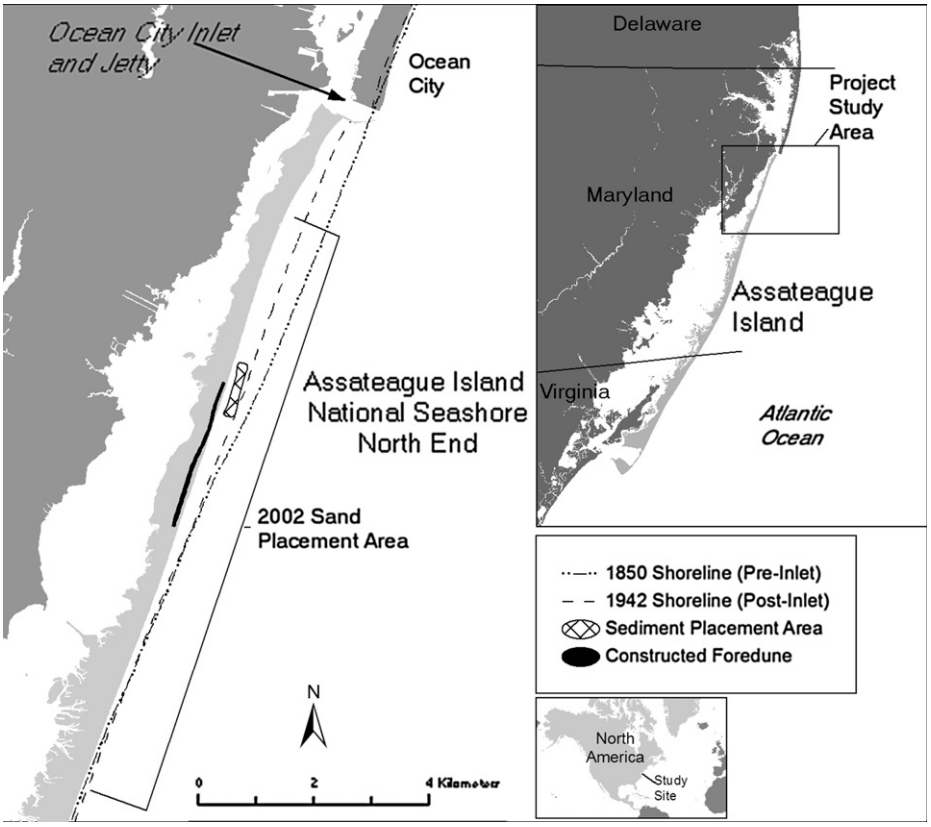

Fig. 1. Assateague Island is a barrier island that extends 58 km along the coast of Maryland and Virginia. Stabilization of the Ocean City Inlet in 1934 starved Assateague Island of sediment, leading to rapid landward migration. Along the North End, an ecosystem restoration project has included construction of a low foredune, a one-time beach renourishment, and biannual mechanical sand bypassing to the nearshore.