Engineering with nature for coastal protection purposes

Jean Taylor Ellis

Department of Geography, University of South-Carolina, Columbia SC 29208, United States
E-mail: jtellis@sc.edu

Coastal dunes naturally develop where and when there is an ample supply of sediment, consistent and sufficient wind, vegetation, and adequate fetch. Healthy and natural systems provide the first order of protection against significant wind and wave events and are ecologically and economically important. However, modern coastal dune systems are rarely natural, often sediment-limited, and impacted by an increasing number of climate change- and anthropogenic-related stresses. This keynote talk will highlight significant forcing factors affecting coastal dunes in the United States and assess the methods employed to increase dune resiliency, using the author's research as the foundation.

Storm surge, waves from mid-latitude cyclones, and exceptionally high tides (king tides) consistently erode and scarp the U.S. eastern seaboard foredunes. The magnitude of hurricane-force storm surge is extreme and often results in dune overwash. However, these events occur on an annual time scale. King tides are more concerning, as these can occur more than 50 times per year, using South Carolina as an example.

Sand fences, beach scraping, and dune cores are commonly used engineering techniques to accommodate dune erosion. Sand fencing is an anthropogenic alternative to planting vegetation. Emplacing fences speeds up dune growth, resulting in shorter and wider dunes because of the inhibited sand transport. Other researchers have conceptually identified ideal fence characteristics. Access to material and restrictive laws often prohibit the execution of these configurations in situ. Beach scraping employs heavy machinery to transport foreshore sand to the backshore. It differs from nourishment because no new sediment is added to the system. Scraping is employed before or after significant storms to protect or mitigate storm impacts. More recently, the scraped sand has been placed on the foredune line, thus creating a mechanical dune. The efficacy of these artificial structures is under scrutiny, especially those not vegetated. Dune cores (or geotextile tubes) are hybrid shoreline protection methods. These large cylindrical structures are pressure-filled with sand and installed along the toe of existing dunes or at the core of artificial dunes. Geotextile tube effectiveness varies, and substantial limitations include degradation due to incoming wave and UV energy, and policies limiting deployment. Sand fences, beach scraping, and dune cores are worthy of additional study toward combatting the impacts of dune erosion and building coastal resiliency, especially given the cumulative stresses on this delicate and dynamic system.