

US EPA ARCHIVE DOCUMENT



Role of ocean water in the eco-hydrology of coastal sand dune ecosystems

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Environmental Issue

The input of ocean water into soil and its effects on the vegetation of coastal dunes is poorly understood

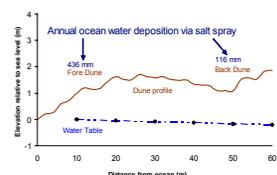
Sea level rise will increase ocean water input to coastal ecosystems increasing the salinity of soil water. Elevated soil salinity causes physiological stress and ultimately death of vegetation. Until we understand the interactions between the hydrology and vegetation under current climate conditions we will be unable to anticipate how sea level rise will affect coastal dune ecosystems. Coastal dune vegetation is important to stabilize and accrete sand on beaches. Beaches are important to the economy of coastal regions and host many species unique to this ecosystem.

Scientific Approach

Hypothesis: Ocean water input to dune ecosystems influences distribution of plant species and alters plant function

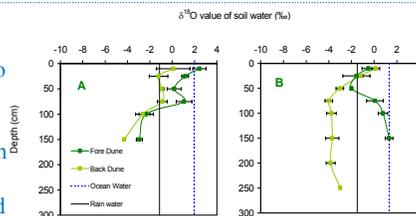
Research:

Obj. 1 Determine whether there are above and below ground mechanisms responsible for ocean water input to soil. Identify salt spray deposition of ocean water to soil. Use stable isotopes to trace environmental water sources (rain, ground and ocean water) in dune soils



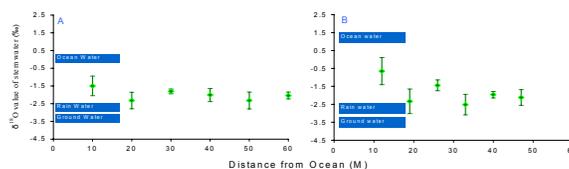
-elevation profile of site in Florida that shows the depth of the water table -steep gradient of ocean water deposition by salt spray, deposition is 3.5 times greater near the ocean than 45 m inland

- (A) Site in Florida shows ocean water deposited into shallow soil by salt spray - (B) Site in San Salvador Bahamas shows that ocean water enters via salt spray and intrudes below ground



Obj. 2 Determine sources of water that vegetation take up

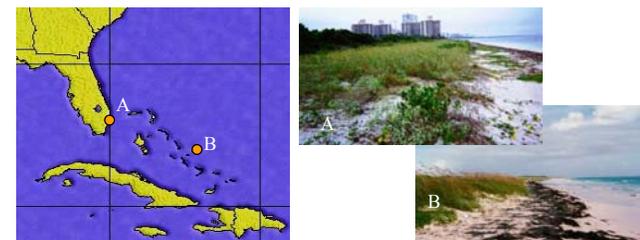
-use stable isotopes to trace environmental water sources (rain, ground and ocean water) used by dune vegetation (♦)



- (A) Site in Key Biscayne Florida, (B) Site in San Salvador Bahamas -species closest to the ocean uptake both ocean, rain and ground water, while species further inland use only freshwater sources

Obj. 3 Link soil hydrology conditions and plant function.

-Species near the ocean that uptake ocean water increase their water use efficiency and have elevated osmolites to help tolerate salinity, while species inland do not



(A) Bill Baggs State park is on Key Biscayne, a coastal barrier island in south Florida, USA (B) East Beach is on the small island of San Salvador in the Bahamian Bank/Platform system, Bahamas.

Impact

-this study confirms there is significant deposition of ocean water to soil surface via salt spray and islands in the open ocean that are not associated with a continental land mass have limited recharge of the freshwater lens and experience ocean water intrusion below ground

-dune species living closest to the ocean can make physiological adjustments required to tolerate and uptake ocean water, but are likely out competed further inland by species that specialize on freshwater

-plant stem water may be used as a bio-indicator of the ecological effect of sea-level rise

-future work will use modeling to determine how vegetation will respond to varying scenarios of ocean water deposition and intrusion.

-information gained from this study will assist the U.S. State Park service and Bahamian conservation efforts to assess the impact of ocean water on coastal dunes and restoration of dunes disturbed by anthropogenic activity or hurricane damage.

-collaborators include: US state park service, Rand Nature Center (Bahamas) and College of the Bahamas