MAKING LAND FROM WATER: UNEXPECTED BIOMIMICRY RESULTS

Experimental Barrier Beach & Dune Restoration on Nantucket Sound

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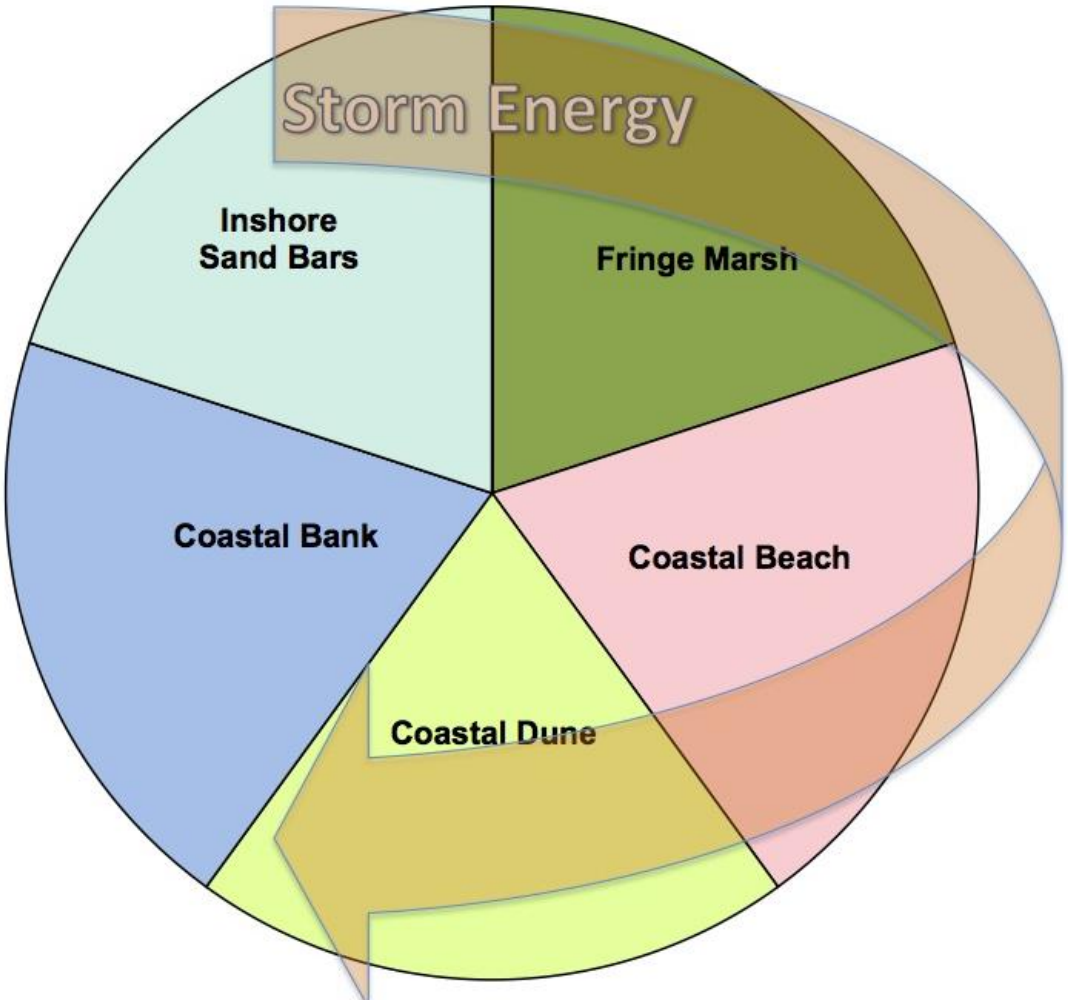
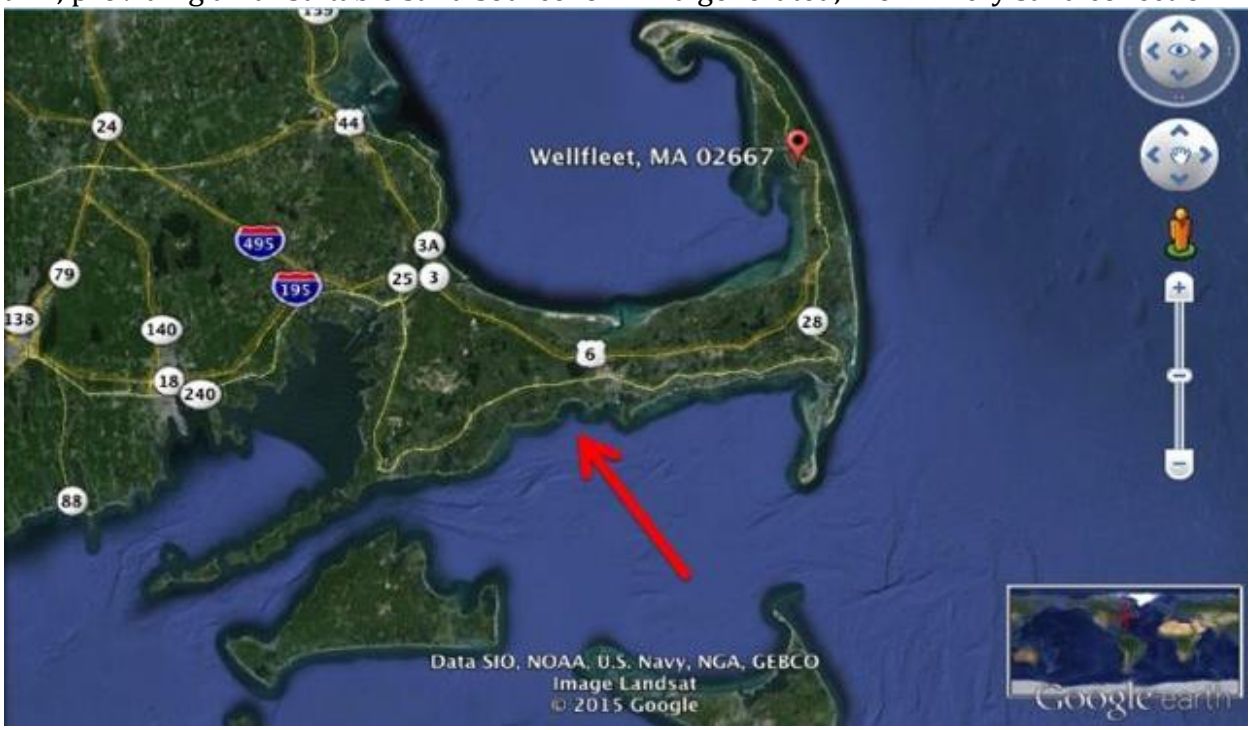


Safe Harbor believes resource systems include natural energy moving through them. When energy flows through multiple systems, we consider them as "**Linked Resource Systems**". ***In the fall of 2013***, we were contacted by owners of an eroding, barrier dune and beach. Shortcuts across the low-profile dune by recreational hikers and kayakers created chronic, serious Anthropogenic erosion. We assessed the site as high risk for potential (or possibly continued) over wash, breaching or breakthrough during high tides with southerly storms. Restoration using Biomimicry would require a sand source. The windward beach was fairly thin, providing an unsuitable sand source for wind generated, Biomimicry sand collection.



Above image shows restoration site 20 years ago, prior to kayak popularity.

Above image G. Peabody, shows view of flight over the site with potential risk, 2014.

Above image G. Peabody, shows lack of vegetation and reduced height in risk area. Without vegetation, Aeolian sand collection ceases and erosion continues, reducing elevations. Reduced elevations accommodate more frequent over wash events, excluding new vegetation, creating a negative feedback cycle. Biomimicry can be a "stand in" for native vegetation in risk areas, collecting and stabilizing wind-blown sand to restore elevations, which are then planted. On this particular site however, the beaches were very thin and not a natural sand source because the area had been nourished with dredge spoils.

Aerial overflights and Satellite imagery identified near shore sand bars, in Nantucket Sound. Safe Harbor strategized that these could become our sand source when Southerly Storms generated big, onshore waves, which would interact with the sand bars. The resulting benthic friction would transport sand onto the beach. However, these would be over wash events, which could also destroy the remaining barrier beach. We could see that some degree of over wash had already taken place, but no sand had been deposited. We theorized this was because there was no native vegetation or sand capture system in place.

In the late fall of 2013, we installed an experimental modification of our Biomimicry system. We rotated fifty percent of the shims 90 degrees to reduce cross sectional friction.

Our strategy began to play out with each Southerly Storm event. This image clearly documents storm energy interacting with near shore sand bars and onshore sand transport. Sand transport performance is dependent on wind speed, duration, and tide.

The 90-degree rotated shims successfully performed and we rotated all of our shims. We also began offsetting the shims forward to balance the incoming energy, which leaned them back. The biomimicry system was reset and post-storm over wash events continued collecting sand. As sand elevations continued increasing, we began planting American Beach Grass.

By spring 2014, we had combined Biomimicry and plantings of Beach Grass.

By late fall of 2014, there was enough sand captured by Biomimicry from storm over wash events to begin creating a barrier dune. Since this was a remote site, we used a boat for access. We adjusted the Biomimicry system when possible but were closed out by months-long sequences of winter storms, ice, and historic snow levels. We had no idea what we would discover, or what would remain, until we finally had a chance to return.

By early April, 2015, we were able to safely row out to the site again. We noticed significant accumulation of new sand in the Biomimicry system. By now we had built up several feet of sand at the barrier dune. The inshore wrack line was retreating as beach heights increased. Additional beach grass was planted around reset Biomimicry shims. This hybrid system of Biomimicry and vegetation contributed significantly to the sustainability of the system to transition over time. Hikers, often with pets, brave a 3-mile round trip to the nearest parking site. Rather than use prohibitive signage, we created a path and signs encouraging stewardship.

Image below, cross section of emerging barrier dune and hybrid sand collection system.

With increasing elevations, we began to transition from Biomimicry shims to Beach Grass.

Image above shows successful restoration of this Barrier Dune, from over wash. The unexpected success of this project was based on the following concepts:

- The principle that both air and water are fluids and both transport sand
- When Biomimicry, in some form, creates turbulence in that transport system, sand will collect
- Understanding the connectedness of storm **linked resource systems**

- It is reasonable to modify the shim alignment by rotation and offset, since water is 40 times denser than air.
- ***Over wash, is a normal part of the coastal process, but it plays a very different role than the anthropogenically generated case we responded to on this site.***