Bianca Reo Project Proposal:
Dynamics of Primary Dunes Following a Major Stochastic Event

***Background Research:*** New Jersey is home to the most developed and densely populated shorelines in the US (Jersey 2013). The 130-mile stretch of shore extends from Sandy Hook to Cape May and offers a relaxing weekend oasis and or a place many call home. Over 1.5-million people inhabit NJ's shore counties, despite the area's high geographic instability and high risk of storm damage (Bureau 2010). Furthermore, these issues are likely to become exacerbated in the years to come as global climate change continues to increase the frequency, severity, and unpredictability of hurricanes that would ravish the coast (Mann and Emanuel 2006, Knutson 2008). However, these shore areas are not completely without defenses as the beaches and sand dunes offer natural protection against the onslaught of storms.

Sand dunes are invaluable to shore communities. They are key ecological areas that provide refuge and incubation sites for many migrants, shore birds, invertebrates, and mammals. They also provide a number of invaluable ecosystem services, the most important being their role as a dynamic buffer to erosion. Sand dunes adsorb the destructive power of waves by physically blocking the upland areas during high tides and storms (Nordstrom and Jackson 2013). As a result, the dunes are constantly eroding from wind and waves, but they are able to rebuild because dune grasses and manmade structures trap wind blown sand, allowing the dunes to accrue. Each dune grass species has a certain tolerance for burial, but in time many of these grasses become completely buried, leaving bare spots that will not aid in accretion (Maun 1998). Because of this, it is important for communities to upkeep and restore their dunes, such as by planting new grasses or erecting fences where sand can catch (Doody 2013). Dune maintenance can be cumbersome, but their health is pivotal for the protection of coastal communities during storms, especially large-scale hurricanes like Superstorm Sandy.

Despite the prevalence of dunes on many NJ beaches, in some areas their importance had gone overlooked until Sandy. Sandy blew through the coast, damaging or destroying nearly 350,000 homes (Ellis 2013). Hindsight is truly 50/50, as towns that preserved and restored their dunes suffered millions of dollars less in damage than towns that did not (Nuwer 2012). Many of these restored and 'healthy' dunes were blown-out and breached due to the intensity of the storm, such as Bradley Beach's 15-ft dunes, but their walls of defense prevented so much damage before their collapse. Communities like Longbranch now understand that having dunes outweighs the benefit of beachfront properties with non-obscured views of the ocean (Rosenberg 2013). Because of Sandy, dunes are now viewed as invaluable commodities as opposed to plagues on property value. Numerous communities are now working to restore and buildup their dune defenses.

Many elements can be used as a tool to build up and or create dunes, but using Christmas trees for this job is thinking outside of the box. As of January, Jersey residents across the state have been recycling their used Christmas trees to be repurposed for dune accretion. This solution is biodegradable as well as much more cost-effective and aesthetically pleasing than using fencing (Ollestas 2013).

Furthermore, it is possible that in time these dunes will be stronger than natural ones, which are not anchored by anything. The trees have been successful in aiding accretion, but their relative ecological and geological impact on dune habitats and microhabitats are unknown. Therefore, I would like to conduct a field study in which I collect and compare sedimentation and vegetation data from natural control dunes to recently constructed Christmas tree dunes.

In conducting assessments, I expect that there will be differences in the sediment and plant composition. I hypothesize that: the sediment composition of newly accruing Christmas dunes will be different than older dunes; older dunes will be taller and have greater slopes than new growth dunes; there will be a difference in the vegetation composition on the two dunes types, new dunes may have more vegetation due to the increase nutrients and moisture fueled by the decomposing Christmas trees at their base (Rose 1986). It is important to understand the environmental implications of this form of dune accretion and storm mitigation; by understanding the strategy's dynamics, we can better utilize it to its full potential and foresee its potential areas of weakness.

**Figure 1**: Recycled Christmas trees from around the state were repurposed as sand catchers to aid in the accretion of new dunes and restoring of old (Schwirtz 2013).

***<u>Proposed Methods</u>*:**

***The Site*:** Data will be collected along the coast of Island Beach State Park. The park is off of Route 35 south of Seaside Heights on the Barnegat Peninsula in Berkeley Township, Ocean County, New Jersey. The park contains ≈10 miles of sandy beach shoreline along Barnegat Bay that transitions into sand dunes, tidal marshes, and maritime forests (Soulfulnature 2011). The study will be conducted in three areas of the park: a north, middle and south end study area. These areas contain both control and experimental dunes. Control dunes are sand dunes that have accrued over the years and were not destroyed by Hurricane Sandy. Conversely, experimental or new dunes, are dunes which were destroyed by Hurricane Sandy, but have been restored and accruing using recycled Christmas trees in January of 2013. The dunes will be marked with wooden stakes as well as with GPS.

***Data Collection*:** I will collect data from mid-June to August 2nd 2013. Dominick Solazzo, a Friend of Island Beach and dune enhancement expert, and John Wnek, Supervisor of Research and Science at the Marine Academy of Technology and Environmental Science, will serve as my advisors on this project. Also, 2-3 undergraduate students will work with me in completing this project. Largely ground truthing and core sampling data will be collected and analyzed. Field data will be collected either once or twice per week on standardized days and times to prevent discrepancies.

***Dune Coring & Slope Data Collection***: Coring samples will be collected from the top of the dunes. To do this I will use a 3" PVC coring device to extrude an unmixed and continuous sediment core (Glew and Smol 2002); I will also collect surface sand samples. I will use a drying oven to desiccate these two sample types. A hand sieve will likely be used on the surface sand samples, whereas I will use a cascade shaker to sieve the cores. The cascade shaker will separate the samples into the different layers of sand types (see figure 2) (Merrill and Robinson 2005). The duration of sieving in this machine will be standardized as increasing the time increases the effectiveness in fragmenting the particles because of added energy (Diaz-Zorita et al. 2007). We will sieve 200 gram standardized samples for 15 minutes; fifteen minutes should be ample time for the coarsest and finest sand to sieve, as coarser particles will pass more slowly (Gee and Bauder 1986). Lastly, I will use a clinometer to measure the height and slope of the dunes (Shafer 1996, Inc 2005). I will take this measurement from ground level at a baseline distance of 100' away.

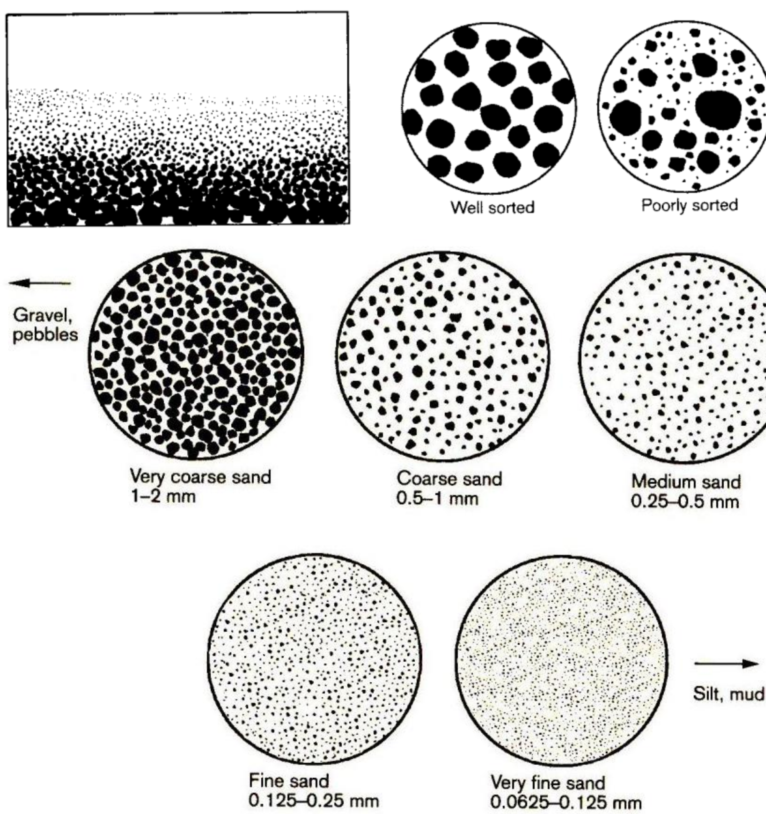


**Figure 2**: A vertical sand graduation that would be expected of natural dunes and the classifications of sand by diameter; images are to scale (Welland 2009).

***Vegetation Data Collection***: I will conduct vegetation surveys via contiguous transects. I will use 1-square meter PVC quadrants to measure the vegetation along a grid on the dunes (Schlacher et al. 2008). I will also use a vertical PVC marker to measure the vegetation height. These methods will allow me to randomly estimate ground cover, specifically percent cover and the relative proportion of new growth, senescent, and dead plant matter at the dunes. Furthermore, if possible, I will attempt to identify the types of dune grass growing on the dunes. However, I will only do this if I can accurately categorize the grasses, such as American Beachgrass (*Ammophilia breviligulat)* members of the genus *Panicum* (Samuel 2012).

***Proposed Statistical Analysis:*** I will use the program JMP 9.0 to perform my statistical analysis. The study will likely be largely correlational and the data will likely be numerical as well as categorical. As a result, I will use a series of ANOVA, t-tests, regressions, and potentially chi-squared tests to infer the similarities and difference between the experimental and control dunes.

***Project Timetable:***
- **May 17th** - Meet undergraduates and determine data collection dates
- **Mid-May-August 2nd** - collect and analyze data
- **June 27th -** Mid-point Project Presentation*
- **August 2nd –** begin statistically analyzing data
- **August 9th –** Final Project Presentations
- **August 16th –** Final Written Research Report and Press Write Up

***Statement of Need for the Grant***: As a Jersey resident, I have been looking for ways to help my state rebuild after Sandy. I think that I can best contribute by using my knowledge of ecology, biology, and environmental studies to help us better understand the impact of Sandy. By understanding its effects, we can better prepare for potential future disasters, which in an ideal world would never come. Since I am a grad student, I m working to pay off student loans from my undergraduate studies at Princeton. This grant would not help me in this endeavor as I live in North Jersey and will need the grant to pay for the gas it will take to reach my study sites. I will likely break even, but I cannot afford to pay for this without the grant's aid.

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