Hither Creek Washover and Salt Marsh Monitoring

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Overview

October 2017, a storm generating high tides and large surf on the south shore of Nantucket caused the erosion of the dune at the southern end of Hither Creek. The erosion led to extensive washover from the Atlantic Ocean which deposited a lot of sand into Hither Creek and surrounding wetlands. Prior to the storm, the southern end of Hither Creek, past Millie's Bridge, consisted of a deep almost circular salt pond (Millie's Pond) surrounded on three sides by well-established salt marsh, shrub wetland, and coastal shrubs (Figure 1). Following the storm, sand from the eroded dune was displaced onto the salt marsh and filled in a significant portion of Millie's Pond. Once the storm subsided, the overwash ceased and normal tidal water flows connecting Hither Creek to Madaket Harbor resumed. While Millie's Bridge itself remains stable, the vegetated coastal wetland, salt marshes, dune and coastal pond were all dramatically altered.

Figure 1: Top image depicts Millie's Pond, surrounding vegetation and the Stilt House prior to the October 2017 Storm (painting by Karen Allen-Kelley). The Bottom image was taken during the October storm and shows the dune erosion, deposited sand and overwash from the Atlantic Ocean (photo by Fabrizia Lu Macchiavelli).

Monitoring sand extent and vegetation communities over a year showed that the ecology in this spot has likely been permanently altered. The majority of salt marsh and shrub wetlands surrounding Millie's Pond have been lost due to sand burial. The bare sand will be colonized by plants from outside seed sources but the vegetation communities will likely never be exactly the same.

In fact, vegetation is already recruiting on the exposed sand and sand fences installed along the top of the dune are helping to retain sand and rebuild the dune system separating Millie's Pond from the Atlantic Ocean. Native dune vegetation is slowly establishing, including a state-listed plant species of special concern which was encountered in high numbers this past summer (seaside knotweed – *Polygonum glaucum*). The exposed sand also provided habitat to a wide variety of wildlife from shorebirds (including a piping plover pair), fiddler crabs, and mating, egg laying horseshoe crabs.

If this area is not further impacted by severe storms in the next 3-5 years, a new bordering wetland vegetation community as well as stabilized dunes will most likely establish. The Foundation plans to continue monitoring work of the sand extent, vegetation communities and the dune establishment over time.

Purpose and Objectives

This project documented the response of the salt marsh and coastal shrub wetlands surrounding Millie's Pond to deep sand burial, and also explored how the deposited sand settled around the Pond and any potential vegetation recolonization of this new sand bed over time. Salt marshes, a key habitat for moderating and buffering the effects of storm surge and sea level rise, typically rely on occasional sand deposition to build marsh soil surface height. Deposition of 5-12cm of sediment has been shown to increase the health and growth of salt marsh cordgrass (*Spartina alterniflora*) as well as increasing marsh surface stability (Slocum et al. 2005) and salt marsh cordgrass was able to grow up through artificial deposition of up to 23cm of sand (Reimold et al. 1978). Very little research has documented the response of salt marshes to being buried under a large amount of sand such as seen at Hither Creek following the October 2017 storm event.

As storm intensities and frequencies increase over time, as is predicted due to the impacts of climate change, events of this nature will likely only increase on Nantucket. Understanding the residence time of the deposited sand as well as the response of buried salt marsh vegetation will help us predict how other marshes and coastal habitats on Nantucket may respond to similar events. Salt marshes are not only an ecologically important habitat for birds, fish and shellfish; but they also provide important buffers to increased storm activity and flood waters, making them a valuable ecosystem to protect and maintain.

Study Objectives:

1) Document the extent and depth of sand deposits on the salt marsh
2) Track the movement/retention of sand deposits over a one year period
3) Examine salt marsh vegetation response to sand deposits and vegetation recruitment on the exposed sand

Sand Extent and Change over One Year

Immediately following the October 2017 storm event, we used a GPS unit to document the extent of sand coverage on and around Millie's Pond during a low tide cycle. Documenting at low tide allowed us to capture the maximum extent of exposed sand collected within the previously open Pond. The initial sand extent in November 2017 covered 2.196 acres from the top of the previous dune and down into the pond (Figure 2).

Figure 2: The tan area represents the extent of new sand covering previous shrub wetland, salt marsh and open water at Hither Creek and Millie's Pond, November 2017.

Through settling, erosion and further washover events in the winter of 2018, the sand coverage advanced further into Millie's Pond as well as covering more of the bordering salt marsh areas. Storms in March of 2018 caused the next largest loss of habitat through sand burial. By November 2018, a year after the initial storm event, the sand extent was 3.521 acres (Figure 3) and the Stilt House, still seen in aerial photos, was removed due to the eroding dune.

Figure 3: Sand extent at Hither Creek and Millie's Pond after 1 year. Daily tides and additional storm wash-overs caused the initial sand deposits to shift and migrate over a larger area.

Daily tides washing into Millie's Pond from Hither Creek moved up onto the surface of the deposited sand and transported it slowly and steadily further into the Pond. Over two weeks in early July, we took measurements of water turbidity (the cloudiness of water resulting from soil sediments) during the rising and falling tides within Millie's Pond. This helped us determine if each tide cycle was significantly moving sand further into the Pond and out into Hither Creek itself. On average we found turbidity to be fairly low to moderate during the rising tide (as high tide came in and water moved onto the sand): in the range of 2.78 – 7.63 NTU. During the falling tide (as the tide retreated off the sand), turbidity ranged from 8.57 – 11.9 NTU. The increase in turbidity measured during the falling tide indicates that more sediment is being moved into the Creek with each tide cycle.

In addition to daily tidal cycles moving sand further into Millie's Pond, additional storm and high tides events occurred over the winter and early spring of 2018 that added more sand to the system and rearranged the existing deposited sand to cover even more of the remaining vegetation. Photos taken at approximately the same location on the eastern end of Millie's Bridge show a private dock that had initially escaped coverage by sand (Figure 4). By January 2018, the sand had advanced just to the edge of the private dock and by April 2018, after additional storm events, the dock is buried by sand. By July 2018, the dock is still buried by sand although some of the bordering salt marsh vegetation can be seen growing through the sand.

October 2017

January 2018

April 2018

June 2018

Figure 4: Photos taken from approximately the same spot on the eastern end of Millie's Bridge showing changes in sand extent, loss of the Stilt House and salt marsh vegetation over time. (Photo credit to Susan Landmann for the Oct 2017 photo).

Sand Depth

We attempted to measure the depth of initially deposited sand on top of salt marshes and shrub wetlands surrounding Millie's Pond. Measurements were made by sinking a 1cm diameter PCV pole with a pointed bevel end into the sand until silt or muck sediments were encountered. Measurements could not be made within the previous pond as the depths to the bottom of the pond were too great.

Sand depth varied greatly, ranging from 0.02 meters of light coverage over the salt marsh furthest from the dune, to 0.26m and to up to 2 meters in some spots. Average sand depth was 0.711 meters. Across the sand extent, depths essentially ranged from half a meter to over a meter which likely represents sand coverage significant enough to prevent recovery of buried vegetation.

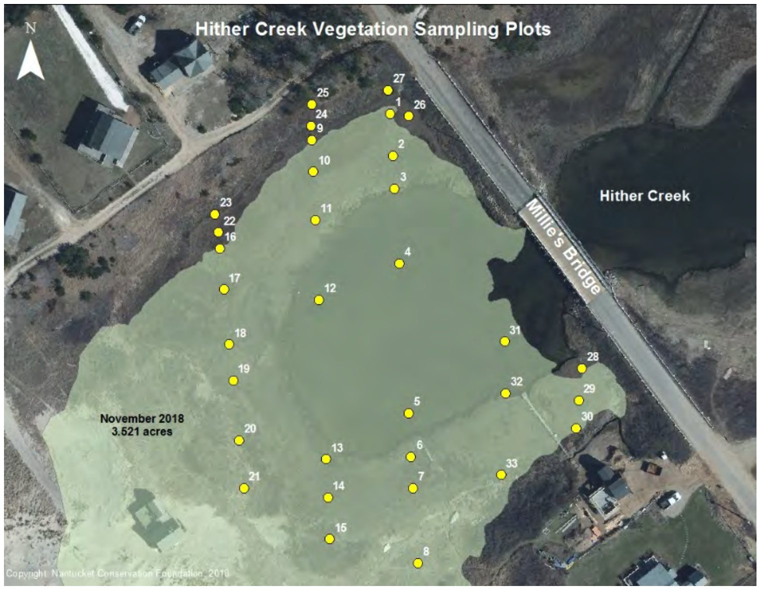

Figure 5: Vegetation sampling plots located along transects covering the deposited sand and surround wetland areas

Impacts to the Vegetation Community

Initial sand deposits buried a significant portion of the natural vegetation communities surrounding Millie's Pond including shrub wetlands and salt marshes. To monitor the long term impacts to these habitats, we established transects across the sand and adjacent wetlands to monitor vegetation growth through the sand and vegetation colonization on the new sand substrate (Figure 5). Plots were sampled in November 2017 to document areas where vegetation survived the initial sand burial event and then again in July 2018 to document colonizing and surviving areas of vegetation.

In November 2017, 76% of the sampled vegetation plots contained 100% sand with no other vegetation present, not even the tips of woody vegetation in the areas that were previously shrub wetlands. The sand was deep enough to completely cover woody shrubs present prior to the storm. Salt marsh vegetation was still present in plots nearest Millie's Bridge.

As previously mentioned, sand continued to advance over the winter and many of those salt marsh areas were covered by at least some amount of sand by July 2018. In addition to the advancing sand front, these salt marsh areas became the path of preferential water flow as tides rose and fell into Millie's Pond from Hither Creek (Figure 6). The salt marshes were at a lower elevation than the surrounding sand deposition so tides preferentially moved over and remained in these wetlands. These marshes were a mix of high marsh (adapted to only occasional flooding by water) and low marsh (adapted to daily flooding) prior to the sand deposition. High marshes are more susceptible to tides and flooding so as tidal waters continually moved over these areas, the high marshes died out leaving bare muck sediments that will hopefully be colonized by low marsh vegetation in the future.

Figure 6: Map showing preferential flow of water onto surrounding salt marshes. Those salt marshes areas were dead in April 2018 but had been previously alive in November 2017.

Resampling of vegetation plots in July 2018 showed very little of the original vegetation able to grow through the thick sand deposits. As seen in the photos in Figure 4, salt marsh cordgrass (*Spartina alterniflora*) was able to grow through sand near Millie's Bridge, although these deposits happened later in the winter and may not have been as thick as the initial deposits.

Native wetland species were found growing along the new sand deposits in lines that were likely a result of large high tide events bringing in seeds and depositing them on the sand face. A re-survey of the vegetation plots in July 2018 showed that 42% of them contained vegetation, although many of these plots had just one plant. Observed native plants included American beachgrass (*Ammophila brevigulata*), groundsel (*Baccharis halimifolia*), high tide bush (*Iva frutescens*), and seaside sandmat (*Euphorbia polygonifolia*). Two non-native and invasive plants were observed, beach wormwood (*Artemisia stelleriana*) and saltwort (*Salsola kali*), although both are fairly widespread on beaches and dunes in New England and Nantucket.

We did encounter and document a healthy population of a state-listed species of special concern that likely seeded in from populations elsewhere such as Eel Point. Seaside knotweed (*Polygonum glaucum*) was able to grow and established a seed setting population on the sand face (Figure 7).

Figure 7: Seaside knotweed populations found growing and setting seed on the new sand substrate at Hither Creek July 2018 (pink dots represent areas of 1-5 plants).

Future of Millie's Pond

The depth of sand deposited in one large storm event essentially eradicated existing salt marshes and shrub wetlands surrounding Millie's Pond while also infilling a large portion of that Pond. The fate of these natural communities will depend in large part on the cycle and intensity of winter season of storms over the next five years.

The buried vegetation communities will likely not be able to survive and grow through the sand deposits. Some studies have shown salt marshes being able to grow up through 5-23cm of sand depth (Slocum et al. 2005, Reimold et al. 1978). However, very few of the recorded and depths at Hither Creek are under or near that threshold.

Given time and a low incident of disturbance impacts from storms and severe high tides, vegetation that seeds in and recolonizes the exposed sand will create a new community of shrub wetlands, salt marshes and bordering vegetation to stabilize the sand dune and hopefully mediate high tide events in the Pond. The Foundation plans to continue monitoring of both the establishing vegetation community and changes to the sand depositions over time to track this community evolution.

A large concern is that future washover and storm events will open up the dune and allow Hither Creek to connect directly to the Atlantic Ocean. As vegetation colonizes and establishes, the sand surrounding the Pond will be stabilized and the dune system will continue to rebuild, reducing the likelihood of this connection happening. Reducing impacts to the sand by limiting foot traffic and vehicle access will help facilitate the establishment of vegetation and dune stabilization. Other areas on Nantucket have experienced similar single-year washover events such as Long Pond and Sheep Pond and these ponds have been able to rebuild sand dunes and vegetation, keeping the ponds separate from the ocean.

Sand fencing was installed (by persons unknown) at the top of the dune between Millie's Pond and the ocean during the late summer of 2018. This fence installation would have been a major recommendation of this report to facilitate building up the dune and reducing the chance of future wave actions. We took elevation measurements along the length of the dune fence and will repeat in spring 2019 if the fence remains.

Although the exposed sand is a dramatically different habitat than previously observed at the end of Hither Creek, observations over a year showed that a lot of ecological activity took place within the impacted area. The sand provided habitat for many shorebirds, even a pair of piping plovers, as well as fiddler crabs and a rare plant species. Horseshoe crabs very actively used the sand for feeding, mating and nesting at high tides. Given time, this habitat may prove as valuable and hopefully as aesthetically pleasing as what was present before.

References

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