ABSTRACT

Sand transport and vegetation are important influences on blowout evolution, but little research has focused on their effects on Lake Michigan coastal blowouts. This study investigated the patterns of vegetation and sand transport on two large, saucer-type blowouts in Kitchel-Lindquist Dunes Preserve, Ottawa County, Mic TJ [(bl)-2(ow)2(out)-2(s)]TJ 12.33 0 Td ( )Tj -0.004

BACKGROUND

Blowouts are depressions or hollows formed by wind erosion on pre-existing sand deposits (Gares and Nordstrom 1995; Hesp 2002). They come in a variety of sizes and shapes including shallow, saucer-shaped depressions and deep, elongated troughs (Trenhaile 1997) known as saucer blowouts and trough blowouts, respectively. The blowout includes both the area of wind erosion (also known as the deflation area) and the adjoining deposit of sand known as the “depositional lobe” (Hesp 2002).

Vegetation Type Examples from Lake Michigan Dunes Dune Activit

STUDY AREA

The study area encompasses two blowouts located on the coast of Lake Michigan in

Figure 3: Blowout 1 (right) and 2 (left) as viewed from North Shore Drive in June 2013.

METHODS

We used a variety of methods to investigate blowout characteristics, vegetation and dune

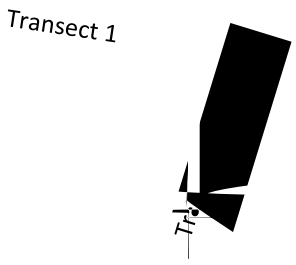

Figure 4: Map showing the deflation areas of the blowouts with erosion pin locations (including locations of pins replaced after vandalism). A, C, D indicate sand trap locations on October 25.

of deposition (where sand was deposited around vegetation), and areas of surface stability (where leaf litter and/or soils were observed on dune surfaces).

Figure 5: Blowout 1 (top) and Blowout 2 (bottom) viewed from the west.

Wind Patterns and Blowout Activity

Our study period included both strong and weak winds with a variety of directions (Figure 6). The three periods of significant winds were 1) the beginning of the study with two days of average winds over 6 m/s from the S and NW, 2) an extended period of strong winds from the NNW(daily averages greater than 5 m/s) which occurred as the remnants of Superstorm Sandy moved across Michigan, and 3) the strongest wind event on November 11-12 which included daily average winds greater than 8 m/s from the WSW on November 12.

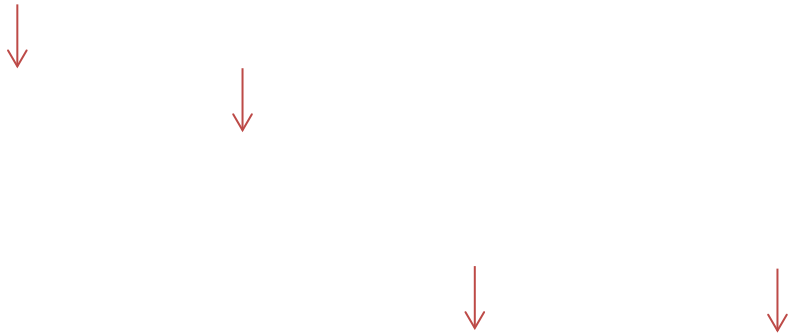

Figure 6: Daily wind speeds and directions measured at Hoffmaster State Park during the study period. Arrows indicate the dates of the measurements at the Kitchel-Lindquist blowouts.

Surface change occurred at most of the erosion pins in Blowout 1 along the main axis (Transect 1, Figure 8), both erosion and deposition occurred at pins, with the greatest amounts of change taking place on the upper windward slope of the blowout. Pin 13 was the site of both the greatest amount of deposition (almost 9 cm in Week 1) and the greatest amount of erosion (over 12 cm in Week 3). Most of the cumulative change during the study period was erosion. Transect 2 shows similar variability in and amounts of erosion and deposition at pins (Figure 9). Both transects show the least amount of surface change in the middle of the blowout.

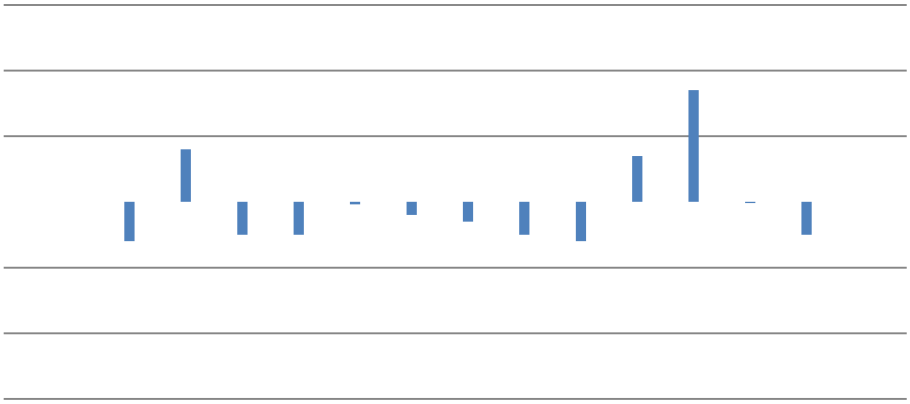

Figure 8: Surface changes measured at erosion pins along Transect 1 in Blowout 1.

Figure 9: Surface changes measured at erosion pins along Transect 2 in Blowout 1. 741 scn 2017

Smaller amounts of erosion and deposition were recorded at the erosion pins in Blowout 2. Along Transect 1 (Figure 10), net change was small amounts of deposition (< 1 cm) at the lower pins, followed by erosion at pins 11- (the middle and upper blowout slope) and deposition at pin 12. The greatest net surface change was 5 cm of erosion at pin 11, but most of the surface changes were 2 cm or less along this transect. Along Transect 2, the surface changes were erosion, with larger amounts (up to 8 cm) at the west edge of the transect (pins 14-18) compared to the eastern part of the transect (Figure 11).

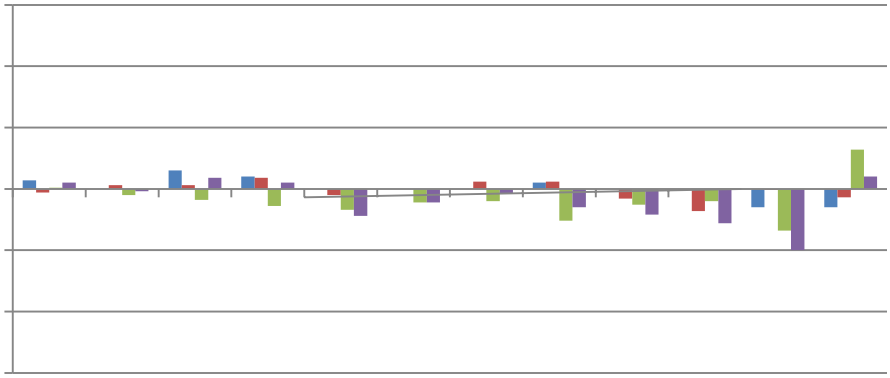

Figure 10: Surface changes measured at erosion pins along Transect 1 in Blowout 2.

Figure 11: Surface changes measured at erosion pins along Transect 2 in Blowout 2.

Both blowouts had visible evidence of erosion and deposition. We observed sand transport on the bare sand in the deflation areas of each blowout. Transport and wind scour were observed in the depression at the west end of the Blowout 1 deflation area (Figure 12). On the upper slopes of the deflation areas, we observed exposed bedding structures, along with scarps (near-vertical slopes) and exposed roots near the rim of the deflation areas (Figure 13). We observed sand deposits that were partially burying vegetation on the upper leeward slopes of both blowouts (Figure 14). No sand was observed moving into the blowouts from the west, the adjacent dune surfaces were almost completely vegetated between the blowouts and a vegetated dune ridge near the road.

Figure 12: Arrow points to scoured depression at the west end of Blowout 1, visible behind researchers in this view looking west fromrTD [(r)oum

Figure 14a: Upper deflation area of Blowout 2 (note bare sand and exposed roots) and sand deposits partially burying the vegetation on the slip-face. (Photo taken from the south.)

Figure 14b: Slip-face of Blowout 1 (as viewed from north) has sand deposits partially burying vegetation; the deposits that reach nearly to the bottom of the slip-face

Blowout Vegetation

All areas of the vegetation within the deflation areas of the blowouts appear on the map (Figure 15), along with sample areas of vegetation on the crest and backslopes of the blowouts. Where time did not permit mapping all vegetation on the slip-faces, locations of vegetation are

Figure 15: Map of areas of vegetation on Blowouts 1 and 2.

visible on the aerial photo underlying the vegetation map. The blowouts were mostly bare of vegetation in the deflation areas, although Blowout 2 had more vegetation present within the

Figure 17: This *Quercus velutina* (black oak) tree is substantially buried by sand deposits.

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least. While the plants suggest a lower boundary (even though “decades” is quite broad) for the ages of the surfaces, we have no evidence for an upper age boundary. If dune activity persists, pioneering species could thrive on a dune surface for decades, and as long as some small amounts of deposition continue, the secondary species will persist in an area without succession to a mature forest. The *Quercus velutina* (black oak) tree is an indicator of a dune surface with a