Dune Blowout Morphology: A Time Series

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Introduction

The coastal strand ecosystem lies on a variably thin strip of land parallel to the ocean. Within the coastal strand lies a system of dunes, which are formed by sediment deposition. Plants establish growth on these dunes providing a structure and stability for dune formation. This habitat is confined to a small area, and is threatened by human activity in the form of land use changes. Development of roads, paths, and other structures reduces the stability of the dunes, leading to the formation of dune blowouts. Dune blowouts are defined as sandy depressions void of vegetation. This study is an analysis of dune morphology in the coastal strand ecosystem found within the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR). This study consists of two components: An analysis of historic and current aerial imagery tracking changes in shape, size, and recovery of dune blowouts, as well as an exploratory in-situ salt deposition experiment to see if patterns of salt deposition within the blowouts is a factor in preventing primary plant succession.

Objective

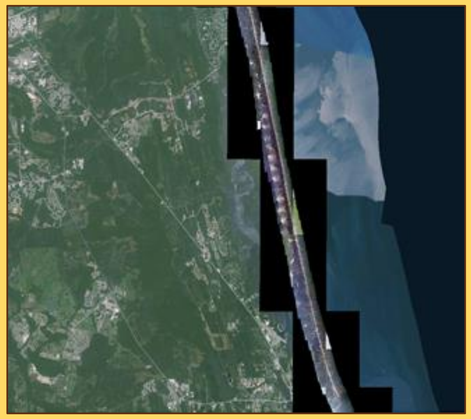
• To gather quantitative data regarding the dune blowouts in the GTMNERR, and compare the change in size through time using ArcGIS.

Methods

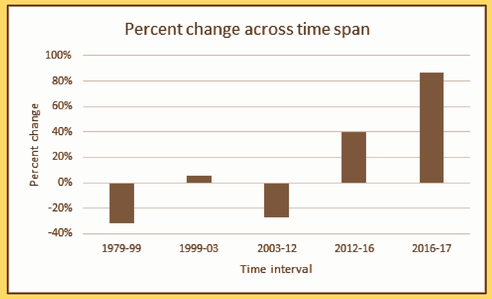
- Dune blowouts were surveyed in the field, using a TrimbleGeo7x to measure the area of each blowout.
- Upload data from TrimbleGeo7x onto ArcGIS, where area is calculated.
- Download historical aerial imagery of the study site using appropriate coordinate system.
- Identify dune blowouts found in the field using GPS in each representative year for the historical images.
- Mark each blowout for reference, and using the polygon feature in ArcGIS, measure area of dune blowouts
- Record area data in Excel accordingly

Visuals

Aerial imagery of 1999 laid over a basemap in arcGIS

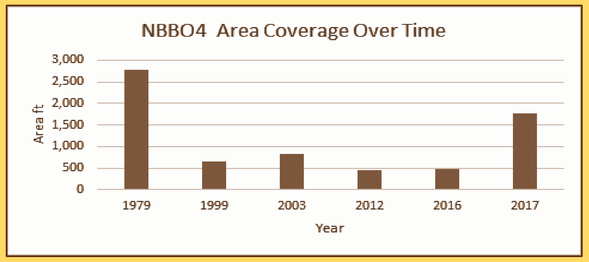


NBBO= North beach blowout, MBBO= Middle beach blowout SBBO= South Beach Blowout

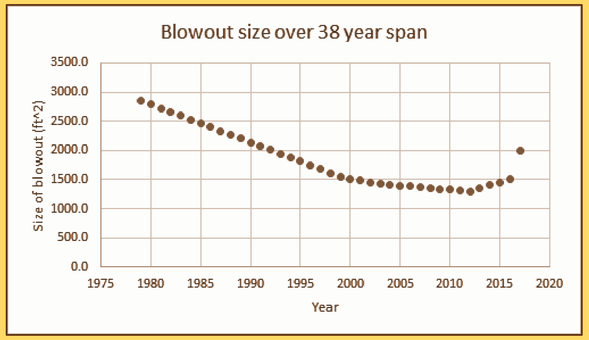


Average percent change of all blowouts measured

Years	MBBO	NBBO1	NBBO2	NBBO3	NBBO4	NBBO5	Average
1979-99	85%	-35%	-21%	-14%	-76%	-46%	-18%
1999-03	-9%	-33%	12%	70%	27%	-8%	10%
2003-12	-19%	-25%	-4%	6%	-48%	-9%	-17%
2012-16			55%	24%	9%	17%	26%
2016-17			8%	72%	271%	31%	95%



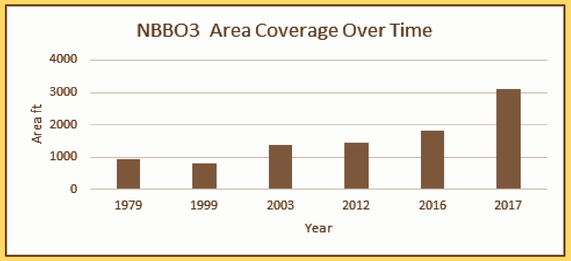
Change in area of North beach blowout 4 from 1979-2017



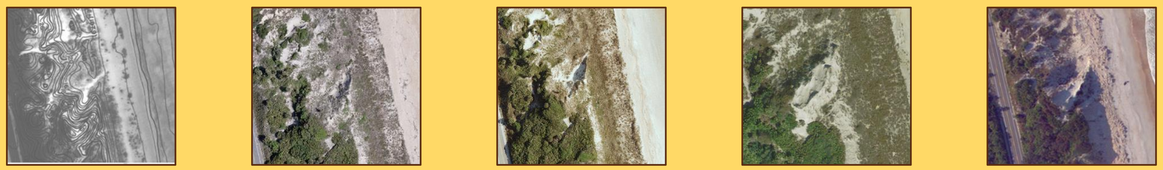
Mapped area based on rate of change extrapolated from differences in area between years

Percent change in blowouts measured with geo7x

Polygon created in arcGIS overlaid on a blowout to measure the area



Change in area of North beach blowout 3 from 1979-2017 (applies to the graph above and images below)



1979 *1999* *2003* *2012* *2017*

Results

The years that experienced the greatest change in average blowout area were 2012-2016, and 2016-2017. From 2012-2016 the average blowout size increased by 40% and from 2016-2017 the average blowout size increased by 87%. From the years 1979-2012 the rate of change per year is decreasing. This decreasing trend changed from 2012-2016 and grew drastically from 2016-2017

Conclusions

•The change in dune blowouts over time show the dynamic nature of the coastal strand ecosystem. Wind and wave erosion are the drivers of increase in blowout size, shape, and orientation which are caused by prevailing NE winds. Our results show disturbance events, namely Hurricane Matthew (2016) and Irma (2017), had the greatest impact on blowout size. This supports our hypothesis disturbance events such as hurricanes will cause an increase in the area of dune blowouts. Primary plant succession shows gradual recovery over time via aerial imagery gathered on ArcGIS, but the recovery is offset in all blowouts identified from these disturbance events.

Acknowledgments

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