Duxbury Beach Reservation:

Monitoring and Evaluation

10/30/18

DUXBURY BEACH RESERVATION, INC.

Outline

- Duxbury Beach
- Shoreline Changes
- Replicated Habitat Project
- Dune Renourishment Project
- Next Steps

Duxbury Beach

Map courtesy of Google Earth

- 7.5 mile barrier beach
  - South Shore
- DKP (Duxbury, Kingston, Plymouth)
  - Cape Cod Bay
- Managed by Duxbury Beach Reservation
- Dissipates wave energy
- Soft engineering solutions

2018 Duxbury Beach: 5 months of change

Monitoring Climate Change Impacts to Wildlife

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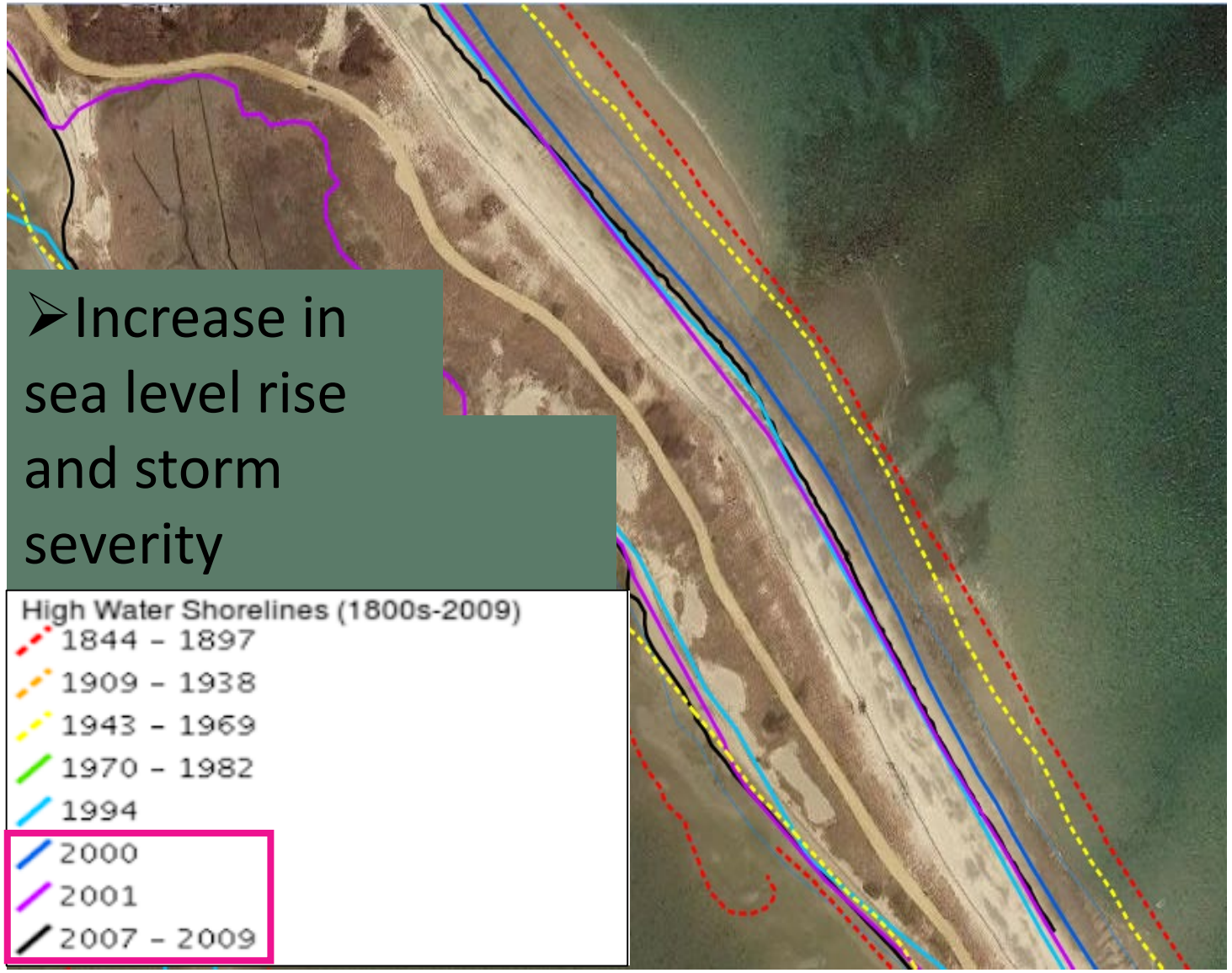
2018 Duxbury Beach: Increasing Storms Severity



- Increase in sea level rise and storm severity

- Decreases historical nesting habitat due to loss of habitat
- Directly impacts listed species Piping Plovers and Least Terns
- Protected by Federal and State Endangered Species Acts

Maps courtesy of MORIS

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Duxbury Beach: Creation of Replicated Habitats

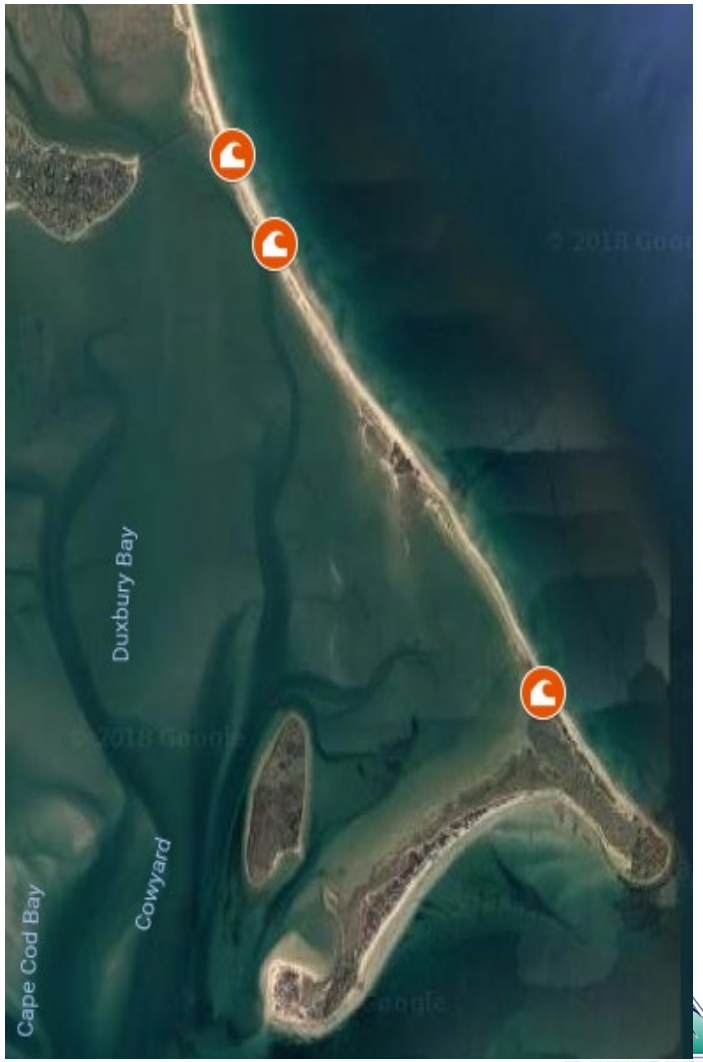
- Reduce habitat vulnerability in light of sea level rise and climate change
- Create replicated habitats in locations that minimized overwash
- Monitor, evaluate and adjust

Maps courtesy of Google Earth and Brynna McGlathery

Overwash Nest History

2017

- Increased storms leads to… reduced historical nesting habitat
- Plovers will renest however success of nest decreases
- Monitoring habitat and behavioral observations



2018

Maps courtesy of Google Earth

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Replicated Habitat Monitoring

Vegetation Maintenance

Plover Activity

Plover Nesting

Vegetation Growth

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Replicated Habitat: Plover Nesting

	Replicated Habitats		Overall Site	
	Total Pairs	Productivity (chicks fledged/pair)	Total Pairs	Productivity (chicks fledged/pair)
2016				
2017				
2018				

Data complied by Brynna McGlathery

- Replicated habitat had higher productivity than the site overall

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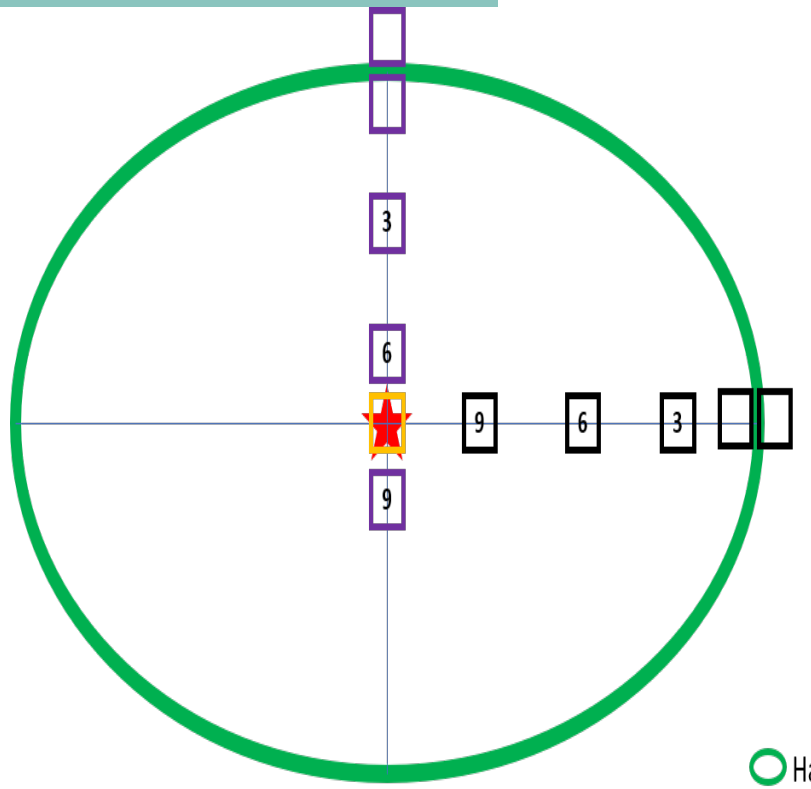
Replicated Habitat: Vegetative Growth

Vegetation survey protocol:

- Vegetation data collection every 10 days
- Four transects at each habitat area
- Using a 1 square meter frame, data was collected from a series of quadrants along each transect

Data collected:

- Leaf Area Index (LAI)
- Maximum height
- Plant type



Data complied by Brynna McGlathery

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Dune Renourishment

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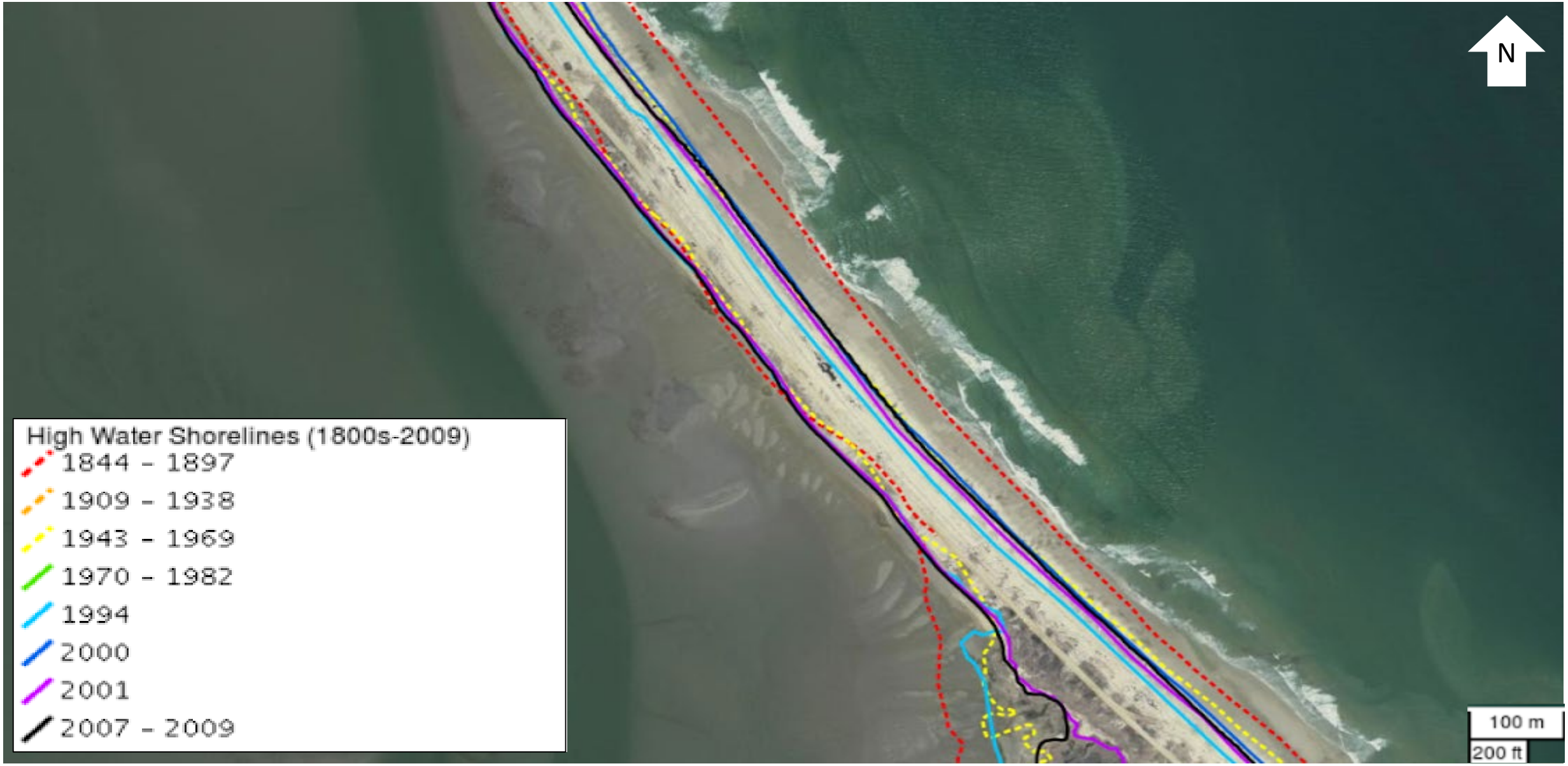
Historical High Water Shorelines Between Crossovers 1-2



Maps courtesy of MORIS

Project Specifics

Project: Dune restoration project between the first and second crossovers along Duxbury Beach

Reasoning: To address erosion due to increased wave energy during normal conditions and storm events

Source Data: "Coastal Processes Study and Resiliency Recommendations for Duxbury Beach and Bay" report

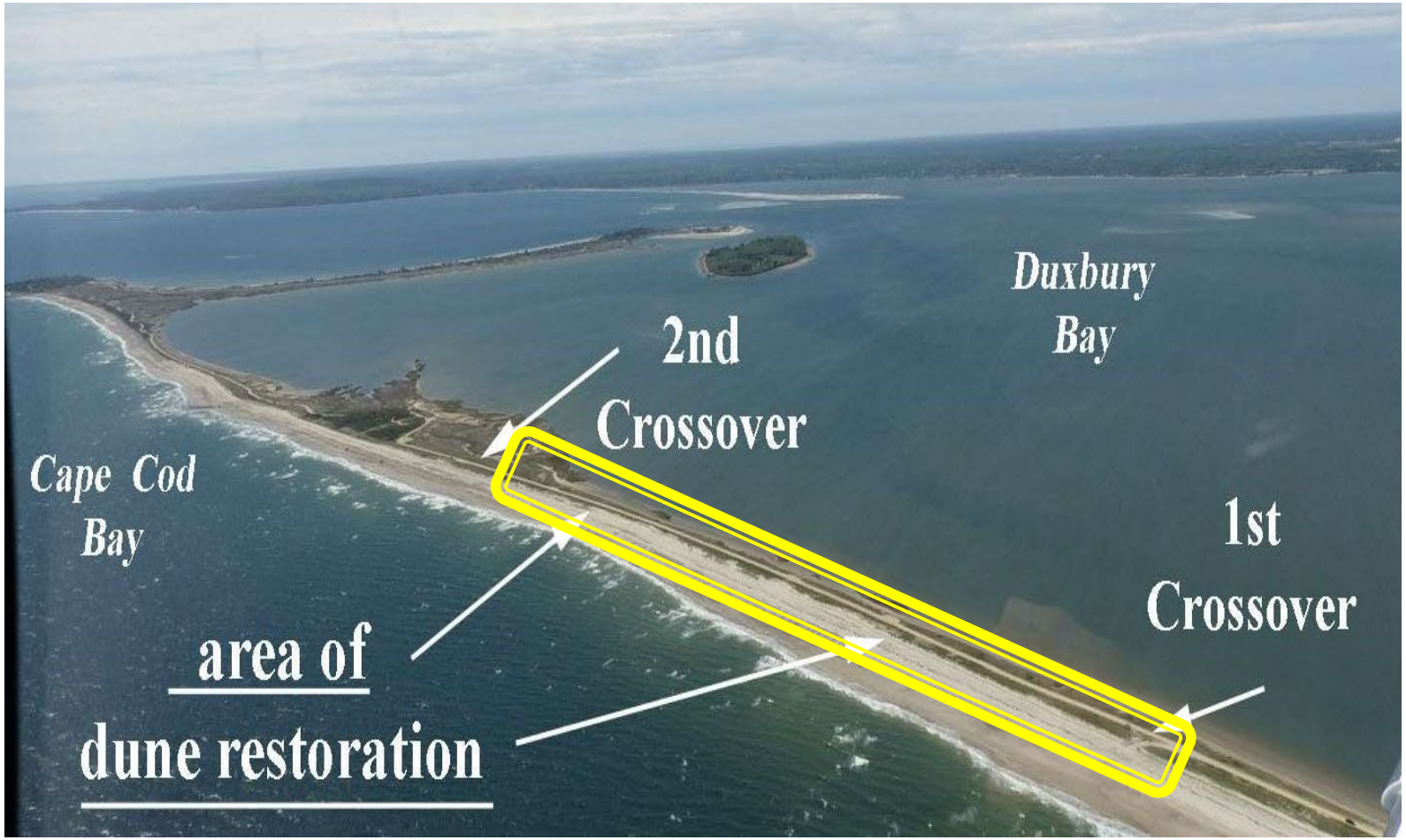


Photo courtesy of J. O'Connell

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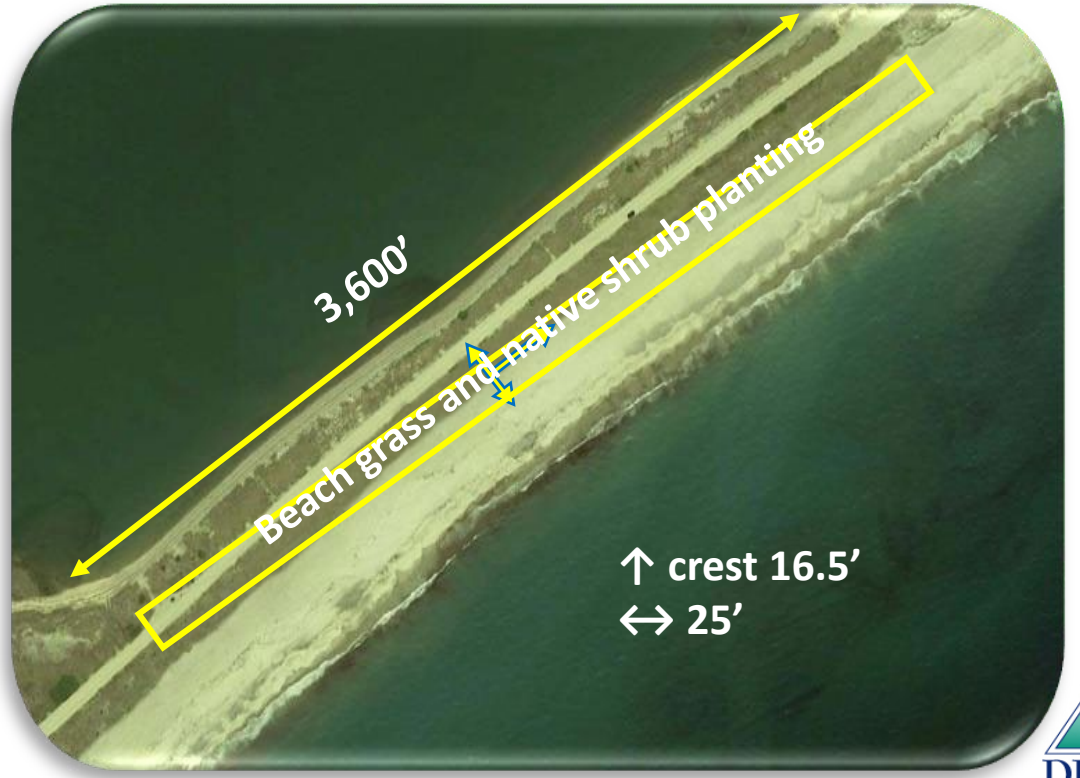
Project Specifics cont.

Goal:

- Increase the resiliency of the area between the First and Second Crossover

Current Conditions

Proposed Conditions



Graphics courtesy of Woods Hole Group

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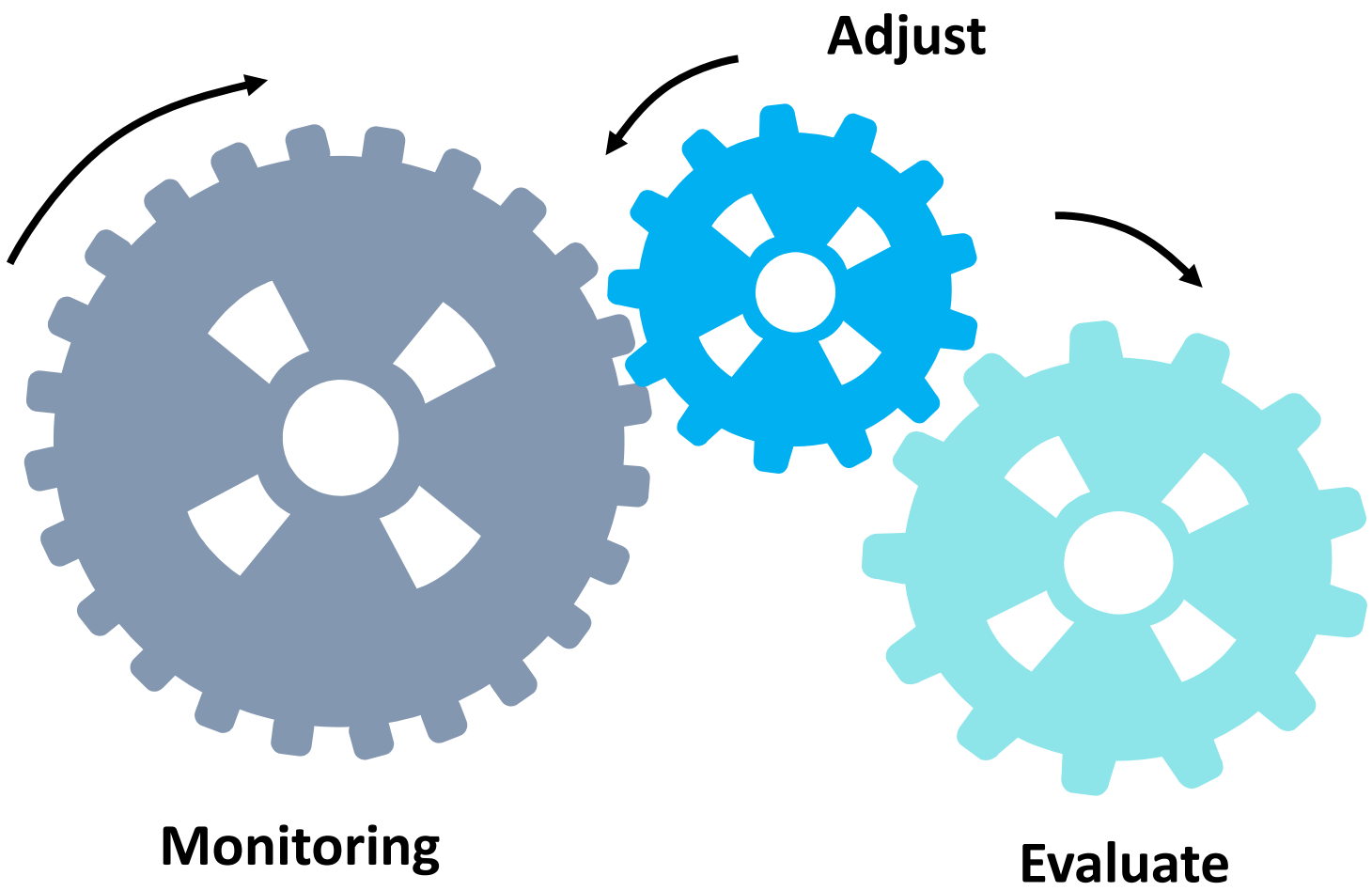
Duxbury Beach Monitoring Protocols



DBR Plant Monitoring

DUXBURY BEACH RESERVATION, INC.

Vegetation Monitoring Protocol
Updated: October 23, 2018
Updated by: Talia Kuras

Materials Needed

- *Establishing plots:*
  - 6' green rebar
  - 4mm green polytwine
  - Handheld GPS unit
- *Recording vegetation coverage*
  - Meter stick

Establishing Plots

- Divide the dune laterally into 3 zones:
- Establish a buffer zone between the r
- Moving North-South along the dune, e
  end of the first crossover ocean side
- Plots established as shown in Figure
  - Each plot is 3 m wide North-S
  - Each plot is subdivided into 3
    - Q1 located on the fore
      planting)
    - Q2 and Q3 located on
    - Q4 and Q5 located on
      zone
- Plots and quadrants are designated w
  twine placed 2' from the top end of the
- Once plots are established, the GPS
  symbolic fencing loss due to storms.

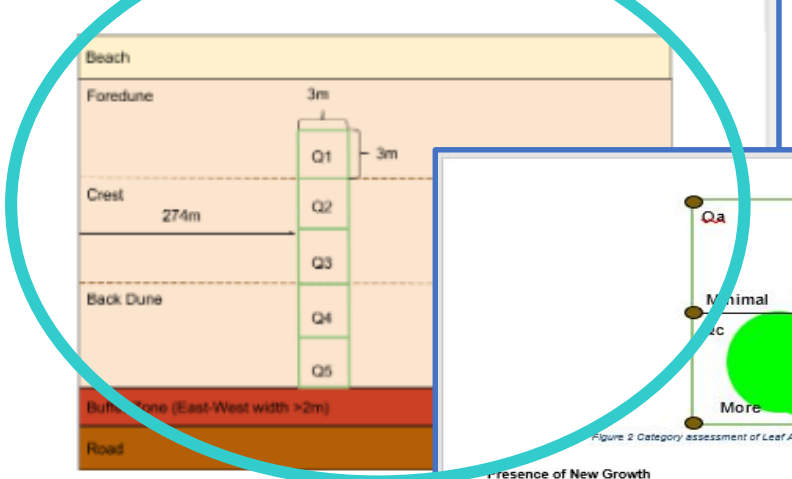


Figure 1. Vegetation monitoring plots

Recording Vegetation Coverage

Vegetation coverage data will be collected monthly (the first week
years following planting.

Determining Vegetation Coverage

- The Leaf Area Index (LAI) of each quadrant is recorded b
  vegetation covering each quadrant. This will be done in tw
  1. Vegetation coverage is recorded on the following
     category of coverage):
     - No Vegetation (0% of quadrant is covered
     - Minimal Vegetation (~1%-25% of quadrant
     - Some Vegetation (~26%-50% of quadrant
     - More Vegetation (~51%-75% of quadrant
     - Most Vegetation (~76%-100% of quadrant
  2. In addition to recording category of coverage, esti
     compared to visible sand/cobble) between 0-100%
- Due to the size of the quadrants (3m²), in order to accurat
  the quadrant from 2-3 sides (making sure not to step into
  required to split the quadrants into quarters (1.5m²) to en

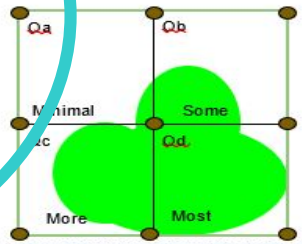


Figure 2 Category assessment of Leaf Area Index of vegetation quadrants on Duxbury Beach.

Presence of New Growth

- Looking from ground level, count and record the number of culms (not leaf blades) of grass in the quadrant.
- Visually assess the plants to determine the tallest blade in the quadrant. Using a measuring stick, collect and record the height (from the tip to the base) of the tallest blade in each quadrant.

Plant Survival and Condition

Year 1: Plant survival and condition are determined based on number of culms recorded in the current data collection compared to the most recent previous number of culms recorded at the quadrant.

*Years 2 and 3**: Plant survival and condition are determined based on the current LAI compared to the LAI the previous season during that month.

Survival:
- If the number of culms or LAI is the same between the two observations, or if the number or LAI has increased (indicating new growth), the survival rate will be 100%.
- If there has been a decrease than survival will be the percent decrease (in Year 1) or the difference between the percentages (Years 2 and 3)

Condition:
- If there is an increase in the number of culms or LAI list the vegetation condition as "increasing."
- If there is no change in number of culms or LAI, list the condition as "stable."
- If there is a decrease in the number of culms or LAI list the vegetation condition as "decreasing."

*If growth is low during Years 2 and 3, and it is possible to continue counting individual culms (without entering quadrants or substantially increasing time spent on data collection), continue to assess Survival and Condition in the same way as Year 1.

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DBR Munsell (soil)

DUXBURY BEACH RESERVATION, INC.

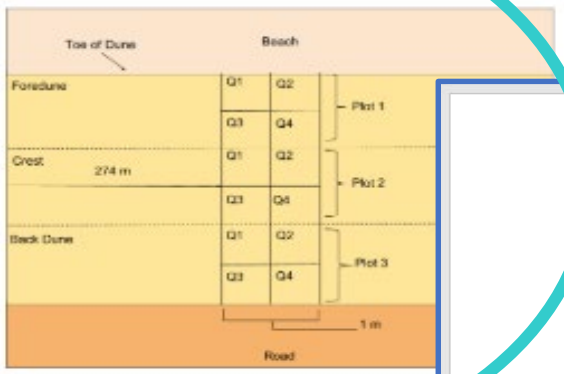
Munsell Soil Sample Study and
Updated: October 23, 2018
Updated by: Talia Kuras

Materials Needed

- *Establishing study plots:*
  - 4' wooden stakes
  - Symbolic fencing twine
- *Gathering data*
  - Munsell Soil Color Charts
  - Munsell Soil Color chip blo
  - Garden spade
  - Spray bottle with water

Establishing Study Plots

For the purpose of this study, the dune will
dune. Plots will be placed every 274 meters
be placed at the end of the first crossover o
entirety of the lateral section width. Each pl
marked with wooden stakes and twine outli



Sample Collec and Preparation

Samples will be collected qua sample will b
of each plot. Soil samples will also be collected from the sand which has been r
source).

Collection

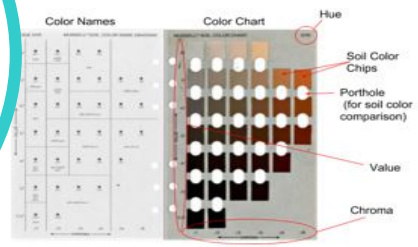
To collect each sample, use a clean garden spade to collect a small sample fro
question. Record the GPS location of the sample when it is taken.

Preparation

Using a misting bottle, gentle spray the sample until it no longer changes color.
soaked to the point of it becoming watery or glistening.

Munsell Color Comparison

The following diagram is provided to help with color comparison and identificat



Comparing Soil to Munsell Chart (see "Proposed Methodology for Comparing Soil Color Over Time Using Munsell Soil Color Chart" for further detail)

- Hold so that the soil sample is in front of you and rotate so that your back is to the sun (the soil sample should now be in your shadow).
- Remove sunglasses, as these will alter perception of the soil sample and Munsell chart color.
- Place the soil sample behind the Munsell soil chart and compare the soil colors to the color chip by looking through each color porthole.
- Once the soil color has been narrowed down to a few possibilities, use the chip blockers that come with the soil color charts to determine which chip most closely resembles the soil sample.
  - Use black chip for dark soil, white chip for light soil, and grey chip for intermediate soils.

Recording Color
When the soil has been matched to its respected paint chip, record the hue, value and color of the chip on the datasheet.

Matching H V/C to Color
Once the hue, value and color have been recorded, use the corresponding colors page to locate the soil's color name and record that on the data sheet.

Additional Data to be Recorded
The following data points should also be recorded at the time of each sampling, as these may alter the color of the soil:

- Weather (sunny, cloudy)
- Was there precipitation on the day the sample was taken?
- Is vegetation present in the quadrant where the sample was taken?
- Is the sample quadrant in a shaded area?
- Is the sample quadrant located in PIPL territory (as denoted by the northern/southern limits of territory recorded by monitors)? If yes, which brood?

Additional Reporting Information
Munsell soil analysis and PIPL activity must be incorporated in the summary report due on October 1st as per MESA NHESP File No. 18-37720 dated 6/12/2018.

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DBR Munsell (soil) Data Sheet

Data Collection is two-fold:

- Data capture
- Data analysis

Munsell Soil Color Monitoring Datasheet

Monitor Name: _____ Date: _____ Year of Study: _____ Quarter #:_____

Weather (circle all that apply): Sunny, Partly Cloudy, Overcast, Raining/Recently Rained

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Date	Time	Year of study	Quarter #	Weather (sunny, cloudy, etc)	Precipitation? Y/N	Segment of Dune (foredune, crest, back dune)	Sample Plot #	Quadrant/ Sample #	Sample GPS location	Hue	Value	Chroma	Color	Vegetation present in sample quadrant? Y/N	Is sample quadrant in PIPL territory? Y/N	PIPL Brood #
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
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DBR Elevation

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DBR Slope

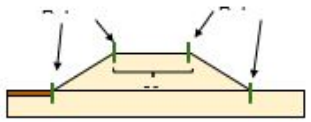
Duxbury Beach Reservation Measuring Dune Slope Prot
Updated: October 23, 2018
Created by: Bradford Bower

Introduction
Due to a large dune [nourishment] project, Duxbury Beach Reservation has tbe
change in slope of a newly constructed dune over time. Through this process th
the impacts climate change and altered storm patterns have on the dune morph
slope will be measured with a clinometer, an instrument used for measuring the
Before slope measurement can be taken, several steps must be taken.

Materials
- 6' rebar posts
- 6' fiberglass posts
- Post pounder
- Mallet and Drive caps
- Sharpie pen
- Clinometer

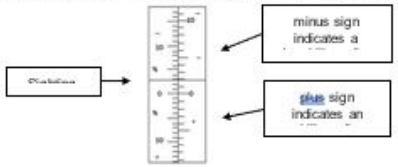
Site Preparation

Placing the markers
- Divide the dune into four equal cross sections; cross sections should be
(900ft)
- Place 6' rebar posts on the edge of the dune crest
  - These posts will act as markers for the target locations
  - Note: due to the variability in the dune crest a marker should be
on both the foredune and backdune
  - Drive posts into ground 2-3' to ensure posts won't move
- Place 6' rebar posts at the toe of the dune
  - These posts will act as markers for where the data collector will
  - These should be immediately downslope of the dune crest marke
  - Drive posts into ground 2-3' to ensure posts won't move
  - Note: fencing posts may be used as markers in lieu of rebar; to b



Data Collection

Using a Clinometer
When looking through the clinometer, there will be two scales. Below is a diagram describing each scale.



The scale on the left measures the percent slope. The numbers represent degrees.

The scale on the right measure the topographic slope. the numbers represent

- Hold the clinometer vertically and with both eyes open
- Look through the eyesight with one eye and view the internal scales
  - At the same time looking along the side of the clinometer housing.
- An optical illusion is created and the horizontal sighting line within the clinometer will appear to project to the side of the housing.
- Place this sighting line on the target (see section below) and read the scale

Calibrate the Clinometer
- On a level surface (e.g. the road) drive a fiberglass rod into the ground until the top of the post is at eye level
- Walk 10 paces (approx. 20ft) away from the rod
- Looking at the top of the rod through the clinometer, the sighting line should read 0-0
  - If it doesn't read 0-0, the post should either be pulled out or pushed into the ground accordingly
  - Re-check sighting line until it reads 0-0
- Mark where the posts enters the ground with a sharpie
  - You will need this mark to set the target (see section below)

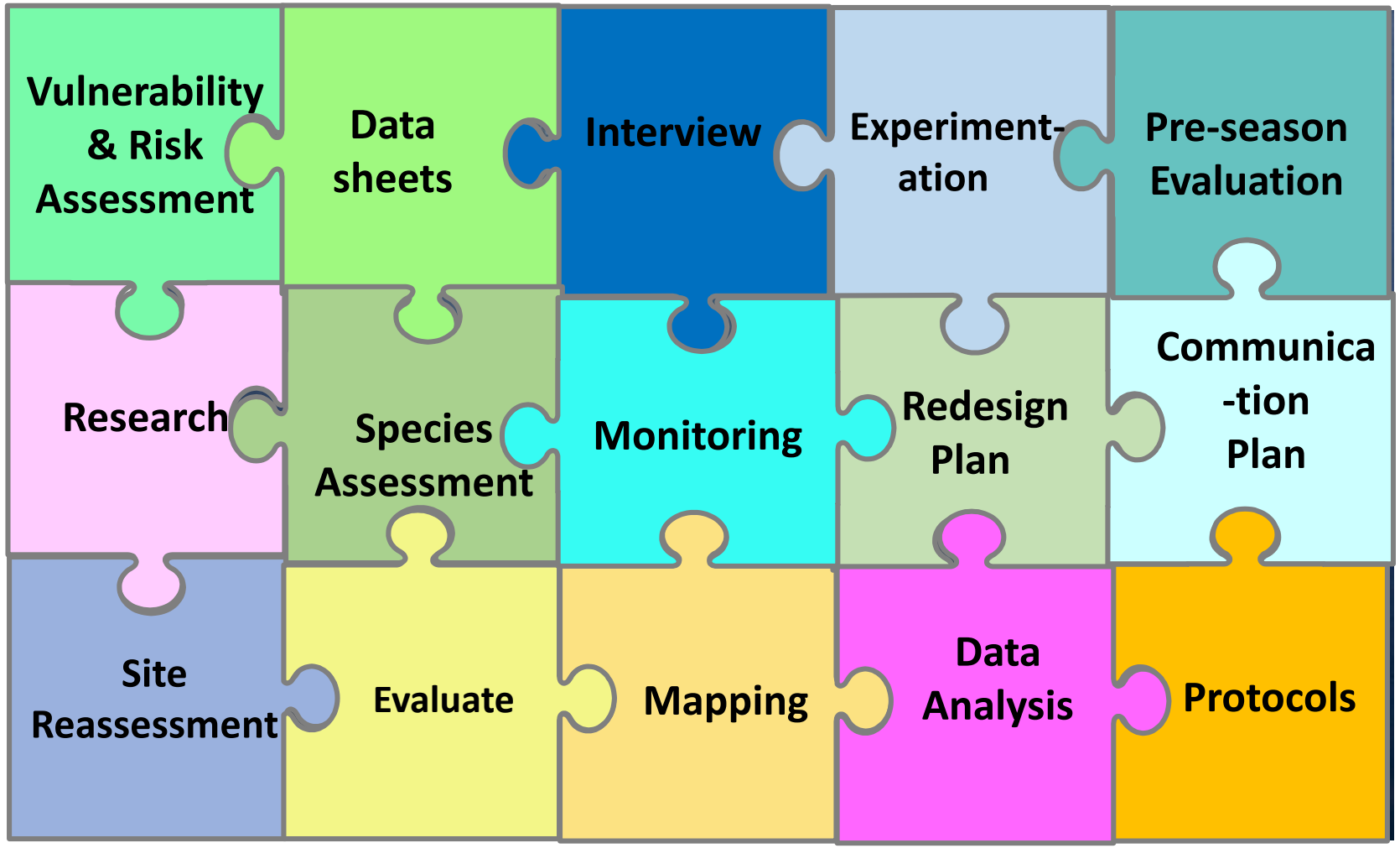
Set the Target
- Place a 6' fiberglass rod into the dune at the location of the dune crest marker
  - Ensure target is as close to marker as possible and positioned directly behind the maker
  - Top of the fiberglass rod should be at eye height of the data collector
    - Use mark made during the calibration process (see Calibration section above)

Collect the Data
- Stand at the toe of the dune with your heels against marker
- Looking through the clinometer sight the top of the slope and then fixate on the target (fiberglass rod).
- Read the degrees. This is the slope.
- Repeat this process on the foredune and backdune for all four cross sections (8 total measurements)

Slope Evaluation:

- 1:10 (east) & 1:6 (west)
- Station creations
- Clinometer

Advancement of Duxbury Beach



Next Steps

Photo courtesy of K. Cadoret

- Never too early to think about protocols
- Protocols are a continuously optimized
- Schedule data entry or analysis will not be timely
- Adapt, adapt, adapt!

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Acknowldegements

CZM Coastal Resiliency Grant

Thank you!