The Shifting Sand of Provincetown

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(Woods Hole Sea Grant & Cape Cod Cooperative Extension)

March 15, 2019
25,000 yr ago
400’ below SL, ~1 mile thick
By ~ 15,000 ice was gone.

11,000 years ago
6,000 years ago
Present Day
Arm of Cape Cod being reshaped over time...

Hey, it happens to all of us!
Longshore Sediment Transport

Downdrift Direction of Longshore Current
Coastal Structure
Direction of Longshore Current
Erosion
Deposition

+5'/yr
+8'/yr
+4'/yr
+3'/yr
-2'/yr
-2'/yr
0'/yr
-1'/yr

Source: MORIS: CZM’s Online Mapping Tool

Longshore Sediment Transport

Dune erosion
Overwash
Aeolian
Longshore drift - sediment movement
Longshore Current

Wave direction
Summer profile
Winter profile

Cross-shore
Bank erosion
Tidal transport

Updrift
Coastal Structure
Deposition
Erosion
Downdrift

Direction of Longshore Current
Direction of Incoming Waves
Wave Crest

Source: Woods Hole Oceanographic Institution
Longshore Sediment Transport

Longshore Drift
Longshore Sediment Transport
Longshore Sediment Transport

PROVINCE TOWN

TRURO

Longshore Sediment Transport
Barnstable County, Massachusetts

Net Transport Indicator
High Seasonal Variability
Littoral Cell Boundary
Longshore Sediment Transport

**Google Earth Engine:** Timelapse is a global, zoomable video that lets you see how the Earth has changed over the past 32 years. It is made from 33 cloud-free annual mosaics, one for each year from 1984 to 2016, which are made interactively explorable by Carnegie Mellon University CREATE Lab's Time Machine library.
General Coastal Processes

- Overwash
- Aeolian
- Longshore drift - sediment movement
- Bank erosion
- Tidal transport
- Dune erosion
- Cross-shore
- Longshore current
- Wave direction
- Summer profile
- Winter profile
Overwash: Storms push sand across the island and into the lagoon area beyond. Barrier ‘rolls over on itself.’
What is Erosion?

It’s all sediment transport!

What is Erosion???..... just more leaving than coming in

Accretion  Dynamic Equilibrium  Erosion
1. Erosion of glacial landforms is the MOST important source of sediment for dunes and beaches in Massachusetts.

2. Wind and waves then transport sediment.

3. Without erosion and then longshore re-deposition there would be no beaches.
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Thanks for contributing sand to our coastal resource areas.
WHAT STRATEGIES INCREASE COASTAL RESILIENCY ON CAPE COD?
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment = Fill of a CRA

Sacrificial

Cobble (Mixed)
The Spectrum of Coastal Erosion Control Methods

- Do nothing
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South Cape Beach

Popponesset Beach

Repair

Repair

Before

After
The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes
- Groin
- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
- Jetty

1.3mi
A beach undergoing net long-term retreat will maintain its natural width.

Beach loss eventually occurs in front of a seawall for a beach experiencing net long-term retreat.

Images adapted from *Natural Hazard Considerations for Purchasing Coastal Real Estate in Hawaii - A Practical Guide of Common Questions and Answers*, by University of Hawaii Sea Grant College Program, 2006.
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CEES

- Groin
- Gabion
- Breakwater
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- Seawall
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C E S
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Sediment Management On Cape Cod

$30 million Winthrop Beach Project, DCR
Sediment Management On Cape Cod
Sediment Management On Cape Cod

Images from the 10/2010 Report of the CRWG to the Falmouth BOS
Sediment Management On Cape Cod

Chatham - Andrew Harding’s Beach

Photo Credit: Ted Keon
Sediment Management On Cape Cod

Chatham - Andrew Harding’s Beach

July 2011

Photo Credit: Ted Keon
The only constant is change:
Sediment Management On Cape Cod

*Chatham – Cockle Cove*
Sandwich – Town Neck
Sandwich – Town Neck
Sandwich – Town Neck

Video by Peter Traykovski, WHOI
Sandwich – Town Neck

Video by Peter Traykovski, WHOI, Image by Issac Benaka
Sandwich – Town Neck

$2.7 million for 110,000 cy in 2016

ACOE Section 111 Study (which town pays for)

5/2015
10/2016
4/2017
2/2018
10/2018
Victim of our own success?

Land-use change, population 4.75x 1950s
Questions?

Keep in mind:
• Assess local erosion and flooding
• Evaluate hazards & management
• Incorporate higher projected SL in coastal designs
• Avoid vulnerable areas