2006

Variation in Beach Profile and Sediment Characteristics at Popham Beach, Phippsburg, ME

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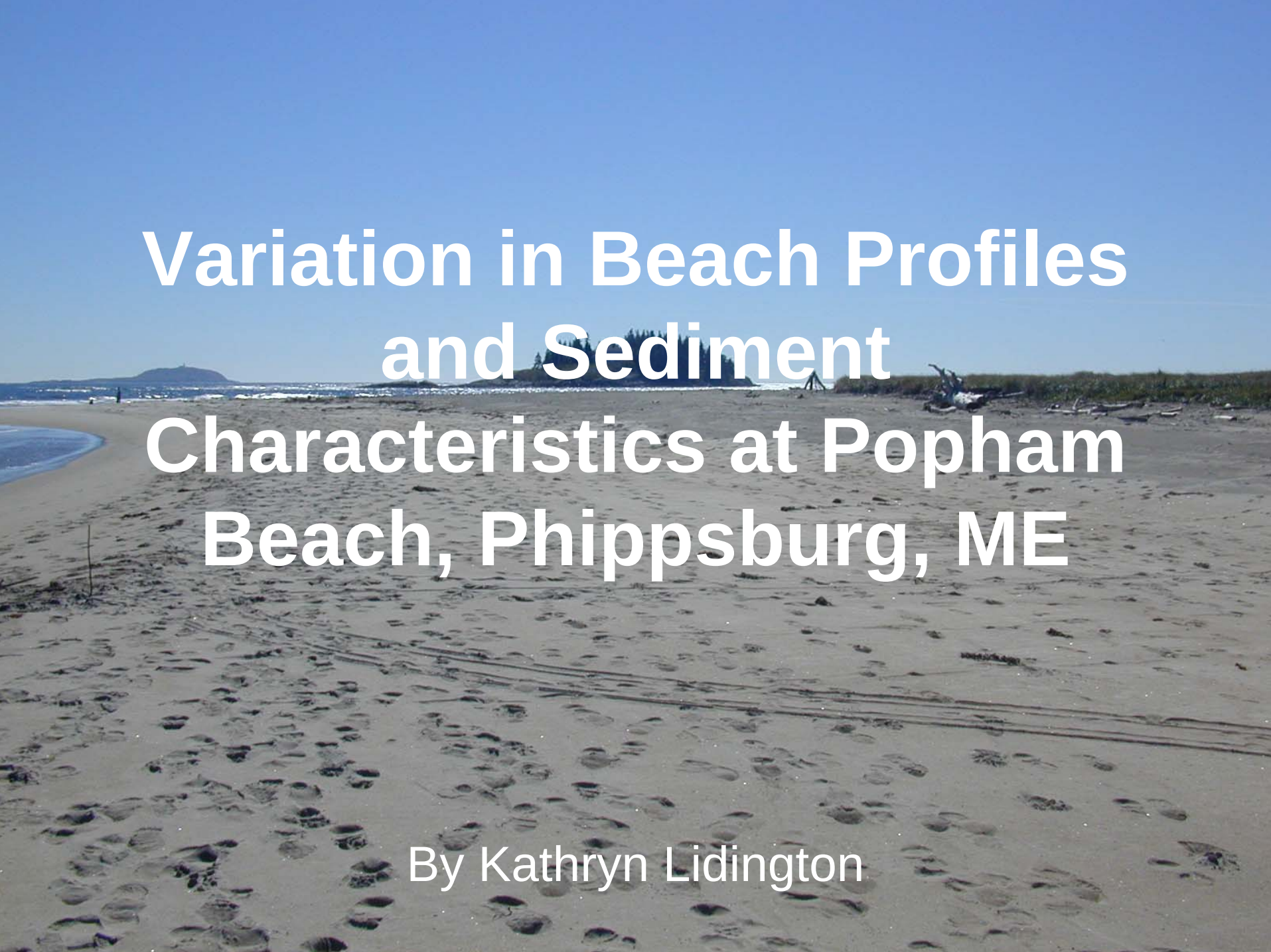


Variation in Beach Profiles and Sediment Characteristics at Popham Beach, Phippsburg, ME

By Kathryn Lidington

Outline:

- An introduction to beach systems
- An overview of Popham Beach
- Field work
- Beach profile and grain size analysis results
- X-ray diffraction results
- Conclusions

Beach Systems

- Defined as an accumulation of unconsolidated sediment situated at a boundary between land and a large expanse of water
- Affected by waves, winds, storms, currents, and tides

Beach Sediments

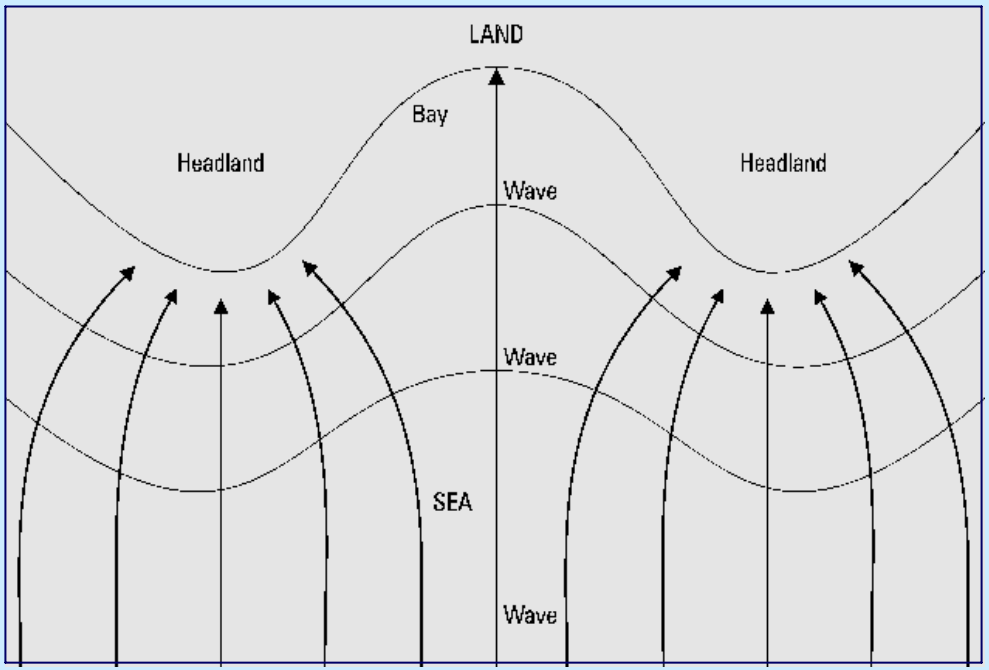
- A sediment source is required for the development of a beach:
  - Fluvial sediments
  - Erosion along the foreshore
  - Seafloor sediments
  - Marine organisms
  - Wind-blown sand
  - Human activities

Waves

- Formed by winds both locally and far offshore
- Move sand both to shore and offshore
- Three breaker types:
  - Spilling
  - Plunging
  - Surging

Wave Refraction

- Waves are subject to refraction as they enter shallower depths
- Longshore drift occurs when they hit the beach at an angle



Winds

- Wind transports sediment by:
  - -creep
  - -saltation
  - -suspension
- Amount of sand transported directly related to the velocity of the wind

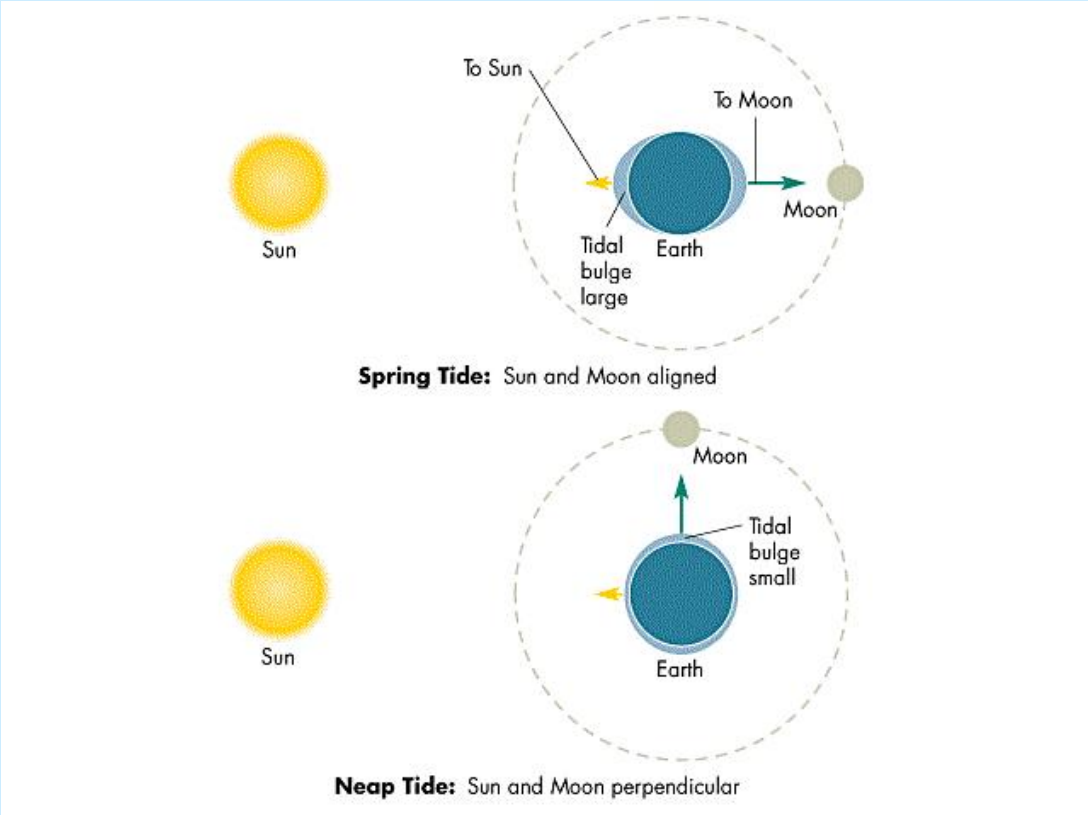
- Winds also cause the formation of dunes

Storms

- Even extreme storms do not cause permanent shoreline retreat
- But a rapid succession of storms can result in significant erosion

Tides

- Spring tides
  - higher than normal tides,
  - occur when the earth, moon, and sun are aligned
- Neap tides
  - lower than normal tides,
  - occur when the sun and moon are at right angles to one another

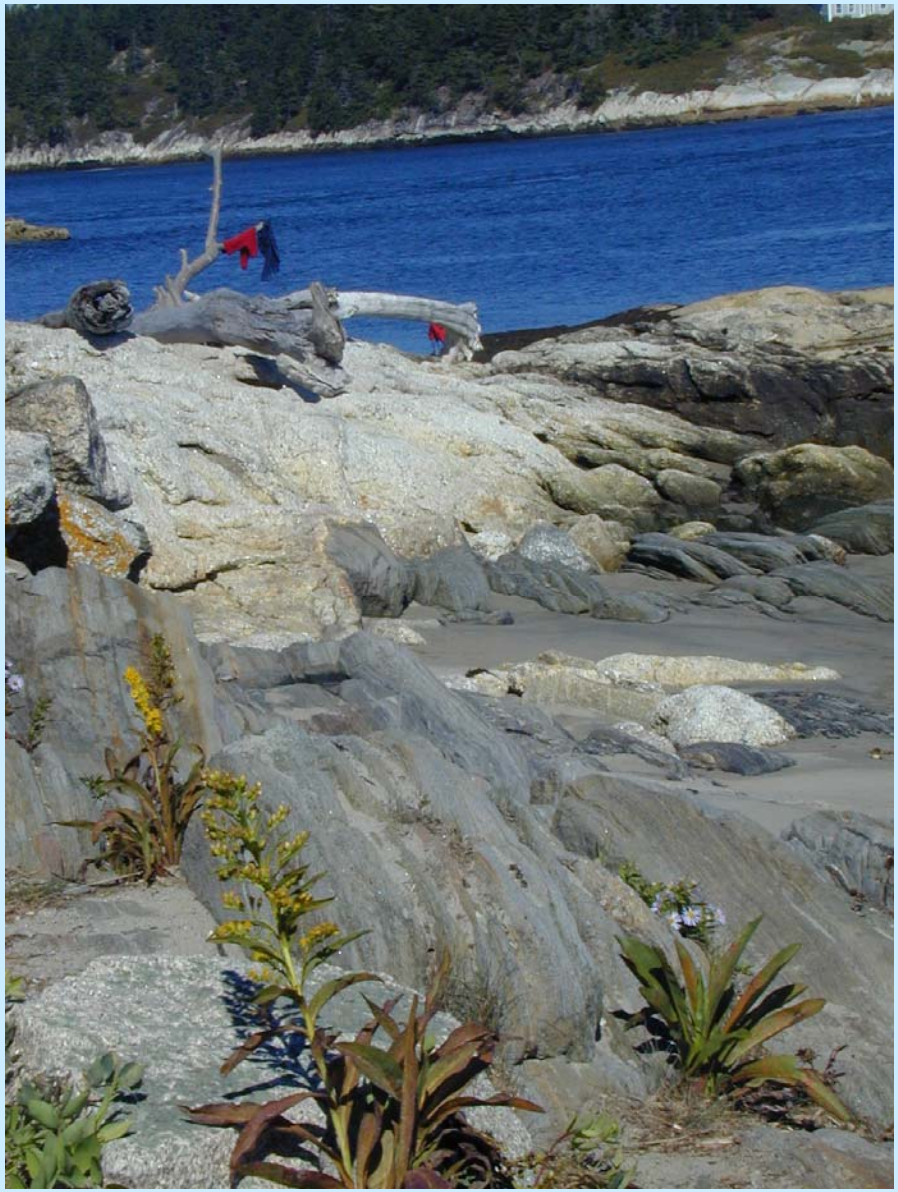


Tide Categories

- Based on their spring tidal ranges, coasts may be:
  - microtidal: < 2 meter range
  - mesotidal: 2 - 4 meter range
  - macrotidal: > 4 meter range

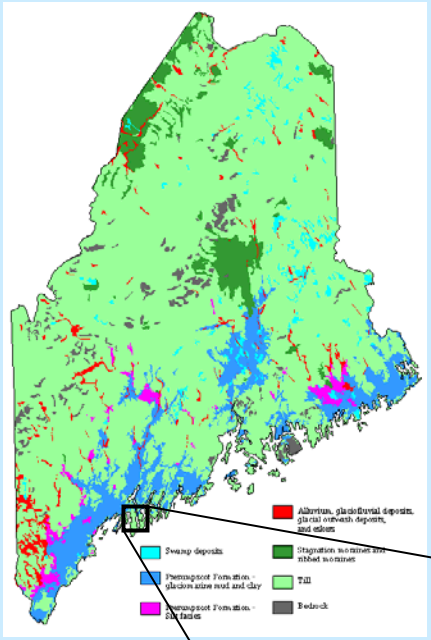
Currents

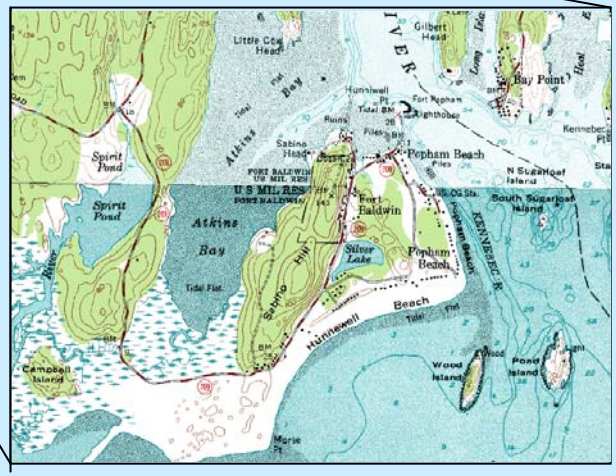
- Rip currents
- Longshore currents
- Nearshore currents may also be caused by:
  - tides
  - rivers
  - estuarine circulation



Popham Beach

- Located in Phippsburg, ME, at the mouth of the Kennebec River
- 3640 meters long with an area of 138 hectares





Popham:

- Sediment:
  - Major source is the Kennebec River
  - Sand is easily eroded
  - Heavy mineral sands
- Tides:
  - 3-4 meter range: mesotidal
- Storms:
  - Nor’easters

Human Impact

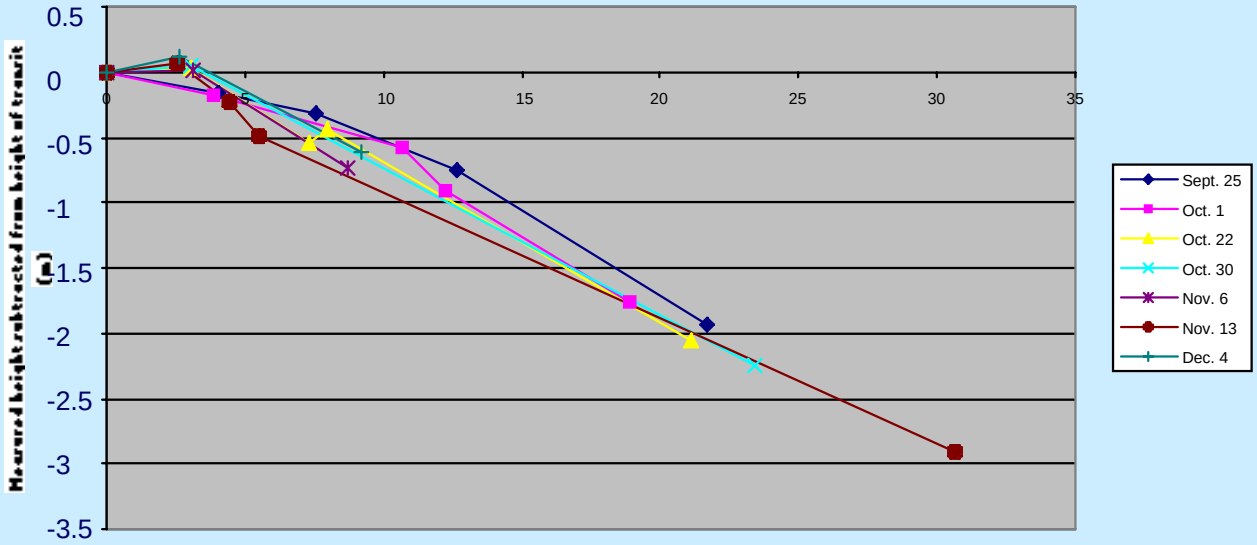
- Lightly developed: no jetties, seawalls, or breakwaters
- But there are roads, footpaths through the dunes, and houses

Field Work

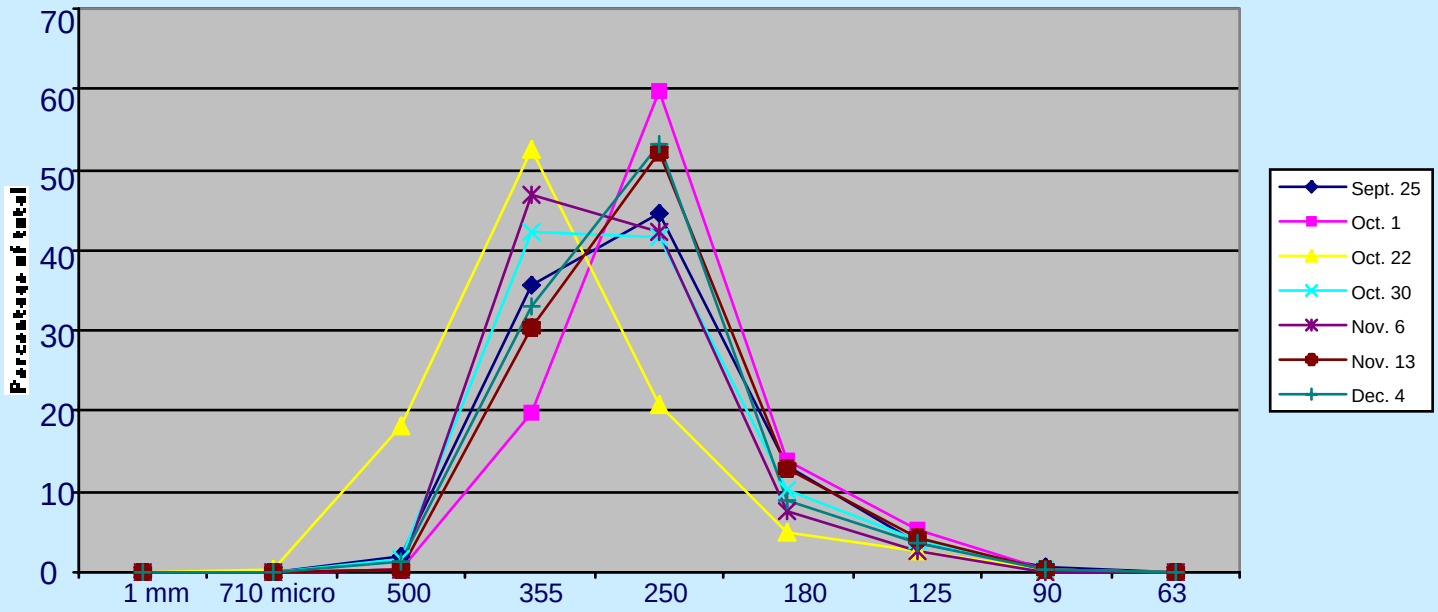
- Four transects measured over seven dates from September 25 to December 4
  - Beach profile was measured
  - Sand samples were taken at the water line

Site 1

- Little significant change
- Net loss of sand

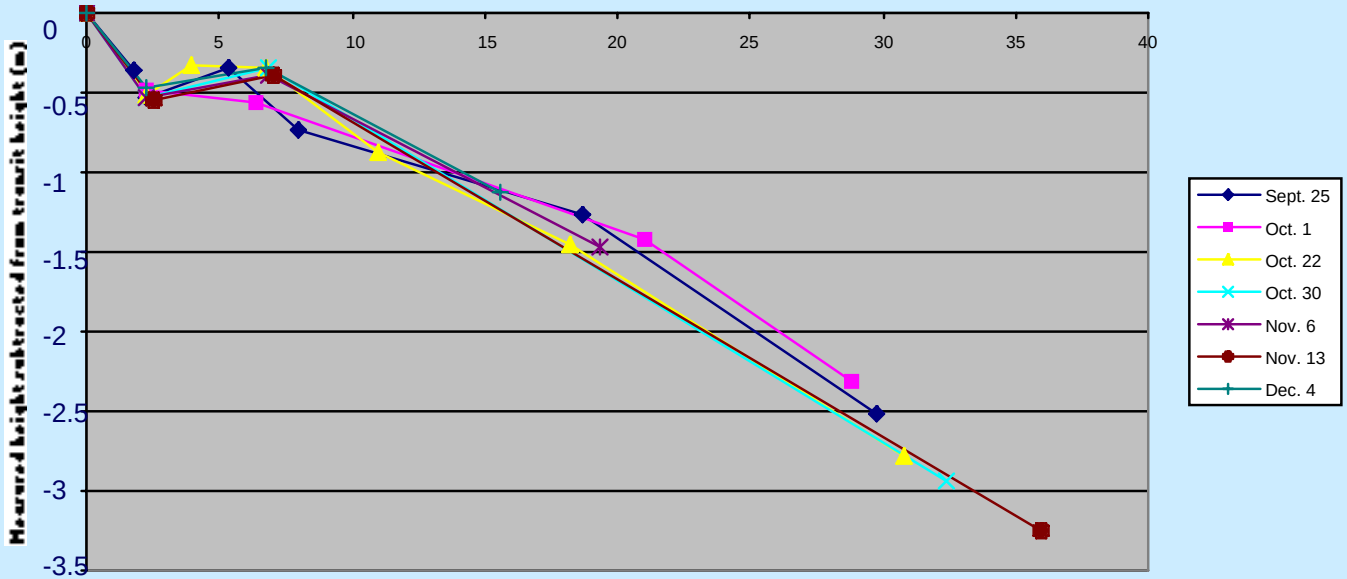


Site 1 Grain Size Analysis

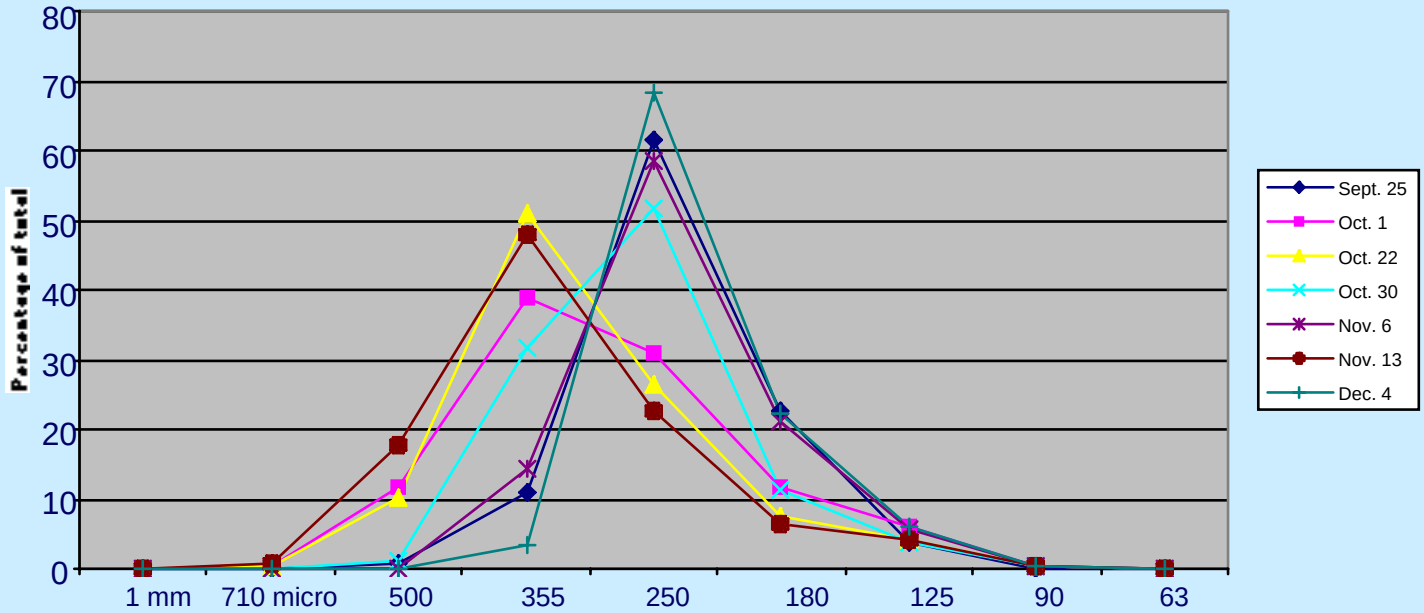


Site 2

- Stable profile

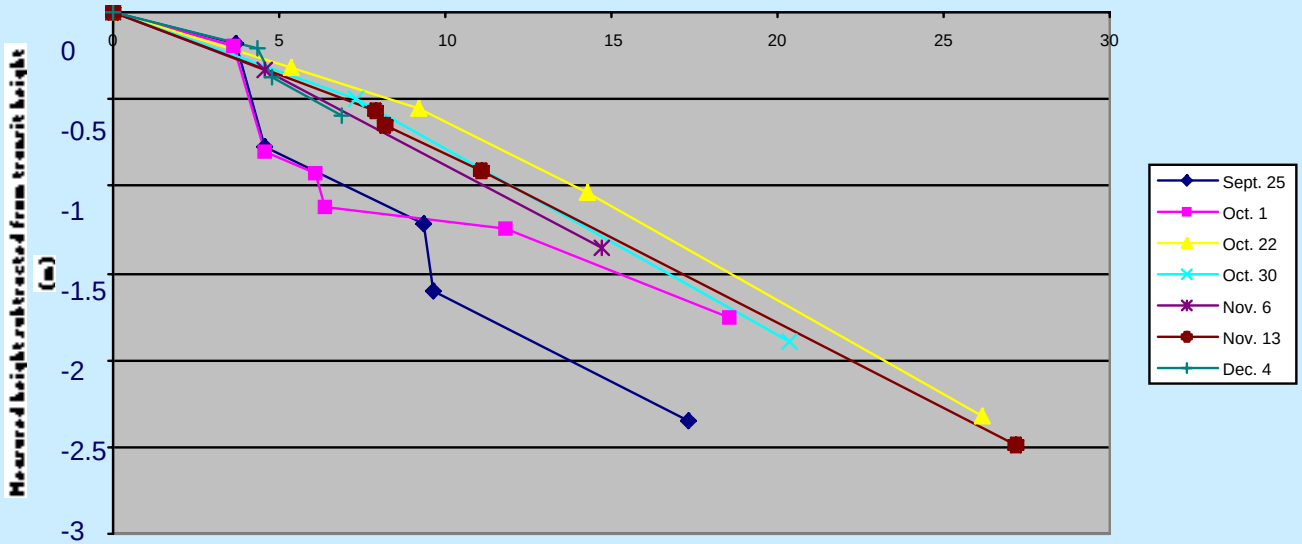


Site 2 Grain Size Analysis



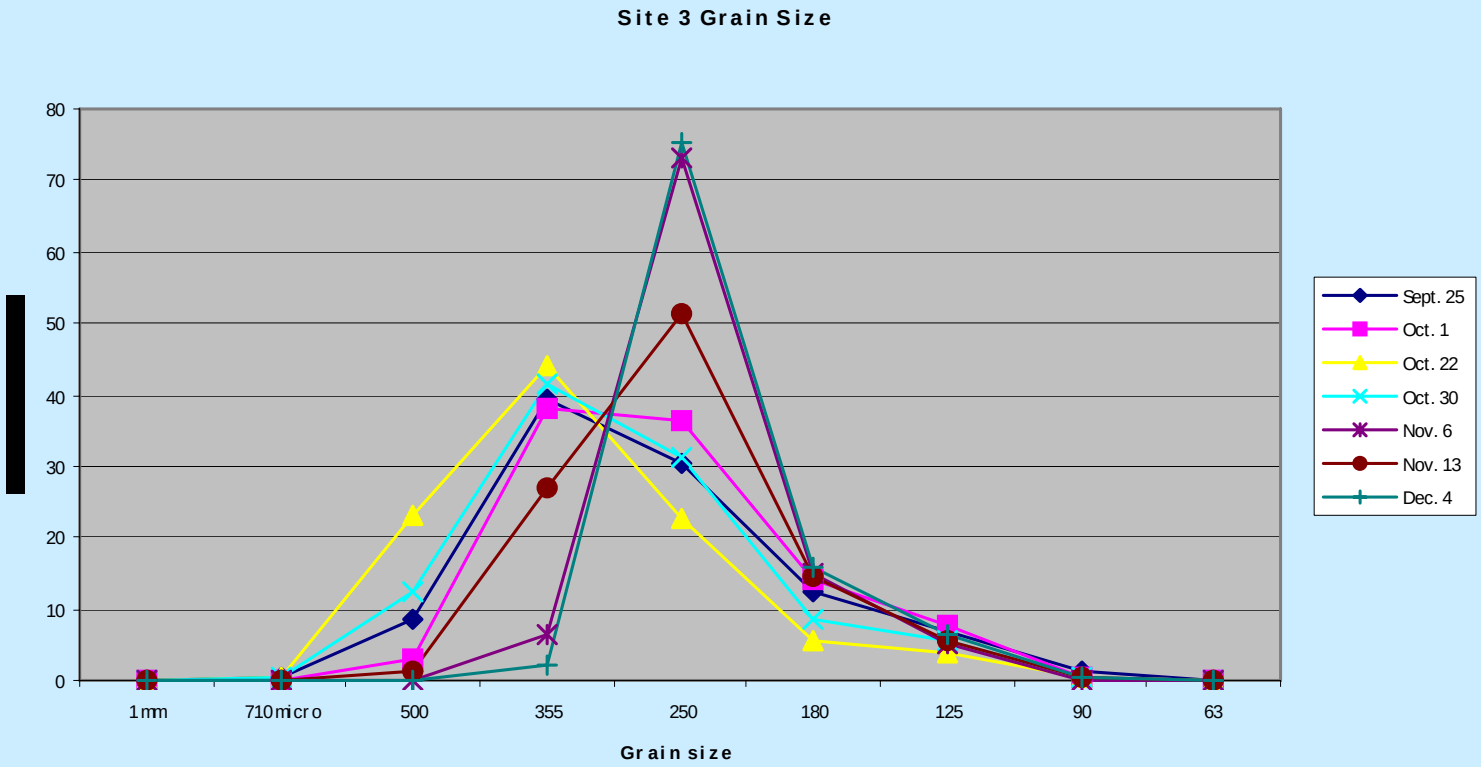
Site 3

- Beach scarps present on Sept. 25 and Oct. 1 were buried by a large influx of sediment



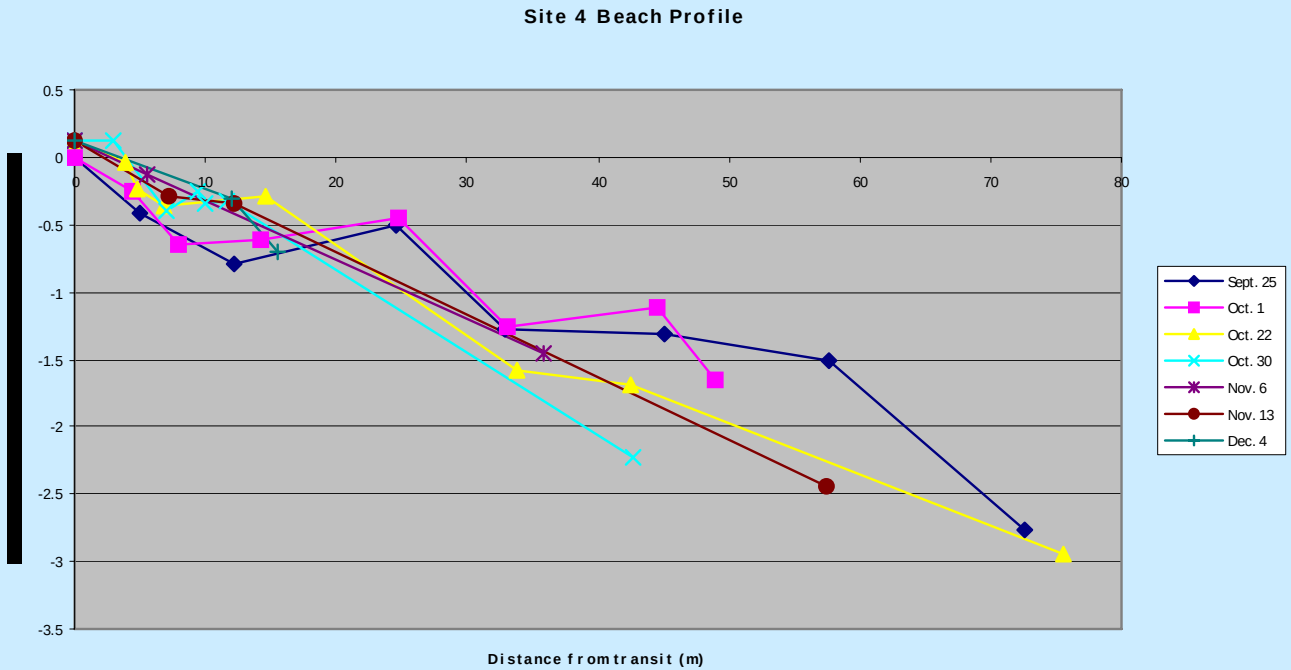
Wave Scarps

Site 3 Grain Size Analysis



Site 4

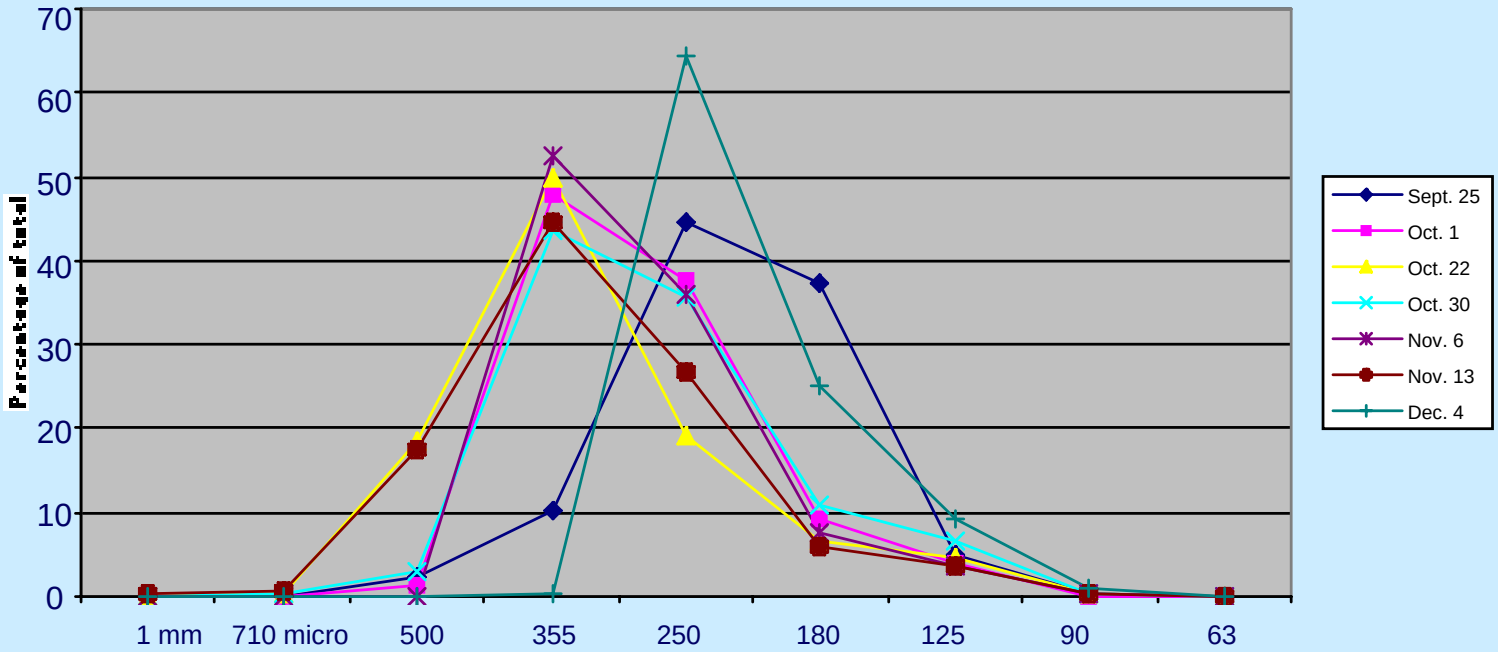
- Net erosion, but a large amount of deposition along the dunes from Oct. 22 to Oct. 30



Large Deposition of Sand at Site 4

Sandbar Located South of Site 4

Site 4 Grain Size Analysis



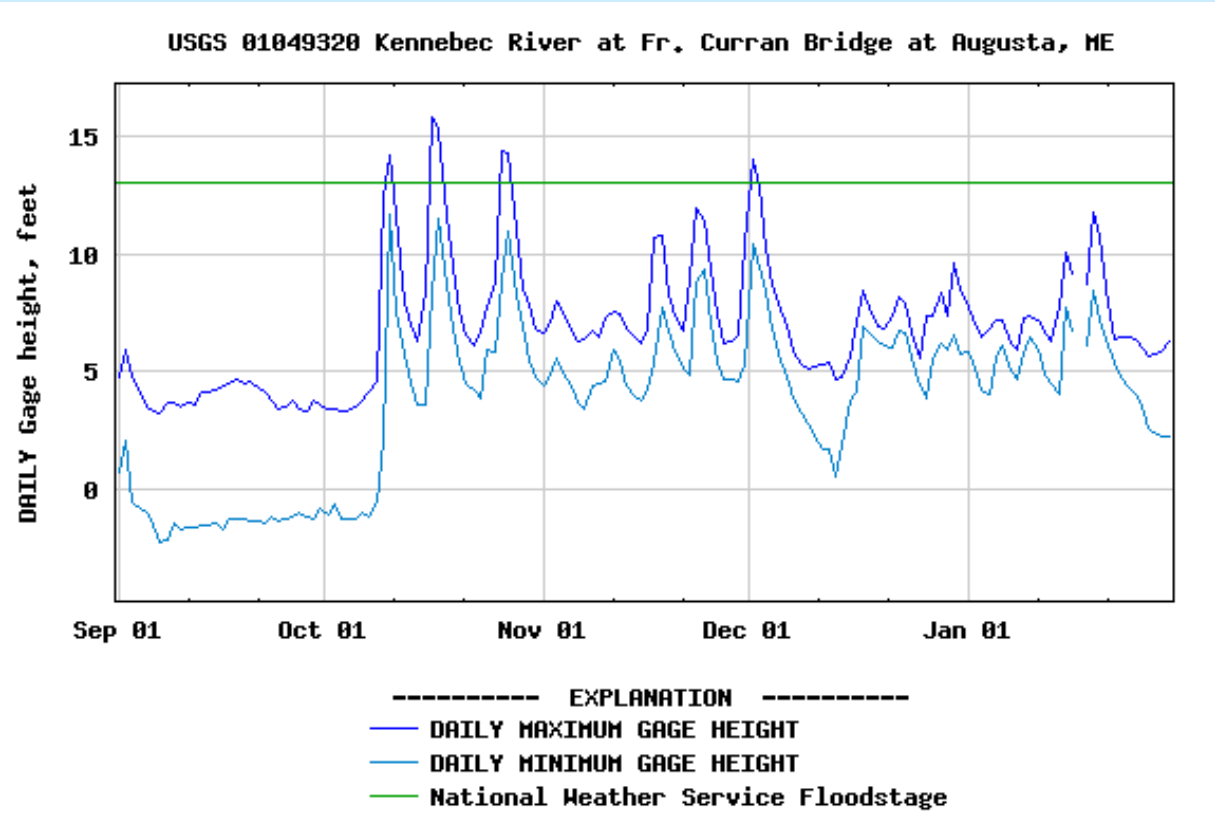
X-Ray Diffraction Results

- The garnet sand contained quartz, garnet (variety pyrope), actinolite and hornblende.
  - Minerals not stable in beach environments indicate that the sand is immature
- Sand collected at Site 2 on Oct. 30 and Dec. 4 consisted of quartz and minor albite,
  - A more mature sand

Conclusions:

- Winter profile: higher energy levels
  - coarser grain sizes
  - steep beach profiles
- Summer profile:
  - finer grain sizes
  - more gradual beach slopes
- But Popham Beach did not show this change…

→ High rainfall increased the Kennebec River discharge and caused an extremely large influx of sediment



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