Recent Sediment Transport Trends within Essex Bay
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Introduction
Recent erosion at the southeast end of Castle Neck barrier spit has resulted in a dramatic shift in sand dynamics, affecting valuable shellfish beds in Essex Bay, MA. The barrier spit has been consistently eroding throughout the last couple decades. Trends in sediment migration and areas of sand deposition were investigated.

Methods
• Sediment samples collect throughout the Essex Bay delta were sieved using eight, nested sieves (phi range 0.0-3.0) to examine grain size distribution (see: example on right).
• Google Maps and ArcMap were used to measure migration patterns and digitally survey various landforms and compare them to the landforms in images from other years (see: Figures 1 & 3).

Results
• As sea levels rise and coastal storms become more frequent, it is likely that sand movement within the bay will intensify.
• This influx of sediment has and will continue to bury marshes within the bay.
• Sand deposits also caused shifting of sand shoals and the relocation of bay channels.
• These processes will impact important shellfisheries/clam beds in the community, the creation and destruction of saltmarsh, and recreational boat navigation.

Discussion/Conclusions

• Sediment samples collect throughout the Essex Bay delta were sieved using eight, nested sieves (phi range 0.0-3.0) to examine grain size distribution (see: example on right).
• Google Maps and ArcMap were used to measure migration patterns and digitally survey various landforms and compare them to the landforms in images from other years (see: Figures 1 & 3).

Figure 1. Shoreline changes along Castle Neck. A. Barrier configuration in March 1995. Note extent of southern spit end. B. Barrier configuration in April 2018. During the 1995-2018 period the spit underwent extensive erosion. C. Comparison between 1995 (yellow) and 2018 (blue) shorelines. The graphs shown in Figure 2 correspond to line segments A-B (red) and C-D (purple).

Figure 2. Measurement of shoreline changes. A. Erosion at seaward and spit-end of barrier. Note greatest retreat occurred during 2010-2018 period. B. Cumulative retreat rates. This erosion amounted to 1.3 million cubic meters of sand entering the bay.

Figure 3. A. Movement of sand within the bay was determined using grain size data (see below) and bedform orientations. B. Historical imagery shows channel and shoal migration patterns between 2010-2018. These changes resulted from the influx of sand coincident with erosion of the barrier spit.

Figure 4. Clam beds within Essex Bay. Beds within outer Essex Bay are impacted most directly by the migration of sediment. Aerial image from 2008.

Figure 5. Measurement of shoreline changes. A. Erosion at seaward and spit-end of barrier. Note greatest retreat occurred during 2010-2018 period. B. Cumulative retreat rates. This erosion amounted to 1.3 million cubic meters of sand entering the bay.

Figure 6. Measurement of shoreline changes. A. Erosion at seaward and spit-end of barrier. Note greatest retreat occurred during 2010-2018 period. B. Cumulative retreat rates. This erosion amounted to 1.3 million cubic meters of sand entering the bay.

Figure 7. Measurement of shoreline changes. A. Erosion at seaward and spit-end of barrier. Note greatest retreat occurred during 2010-2018 period. B. Cumulative retreat rates. This erosion amounted to 1.3 million cubic meters of sand entering the bay.

Figure 8. Measurement of shoreline changes. A. Erosion at seaward and spit-end of barrier. Note greatest retreat occurred during 2010-2018 period. B. Cumulative retreat rates. This erosion amounted to 1.3 million cubic meters of sand entering the bay.

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