Distinguishing "Nourished" from "Natural" Sediments along the Grand Strand, SC: Implications to the Beach Erosion and Monitoring (BERM) Program

Speaker: Jeffrey Obelcz

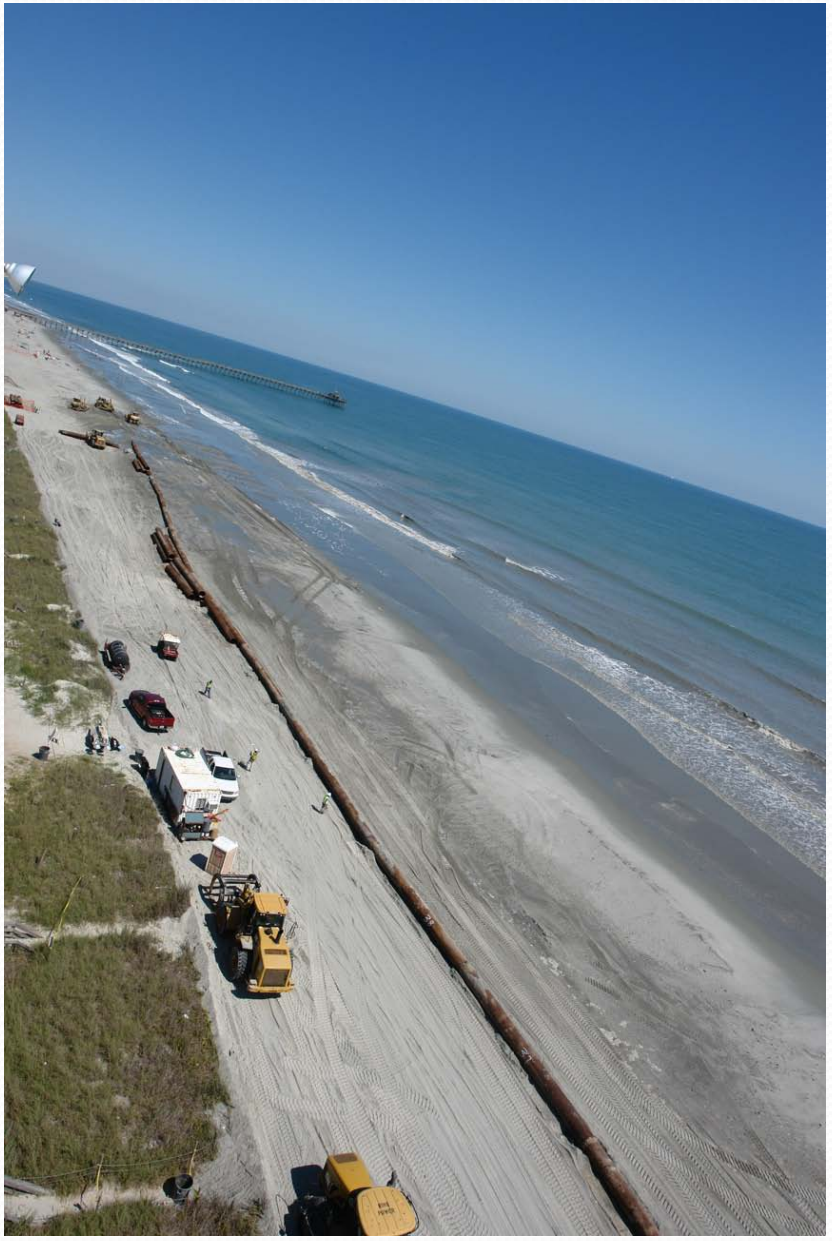
Project Collaborators: Kehui Xu[1,2], Clay McCoy[1,2], Jeffrey Obelcz[1], Thomas Bierce[1], Jeffrey Rabil[1]

[1]Department of Marine Science, Coastal Carolina University, Conway, SC USA

[2]Burroughs and Chapin Center for Marine and Wetland Studies, Coastal Carolina University, Conway, SC USA

Outline

- Background
- Statement of Purpose
- Field/Lab Methods
- Results
- Interpretation/Discussion
- Summary/Further Studies



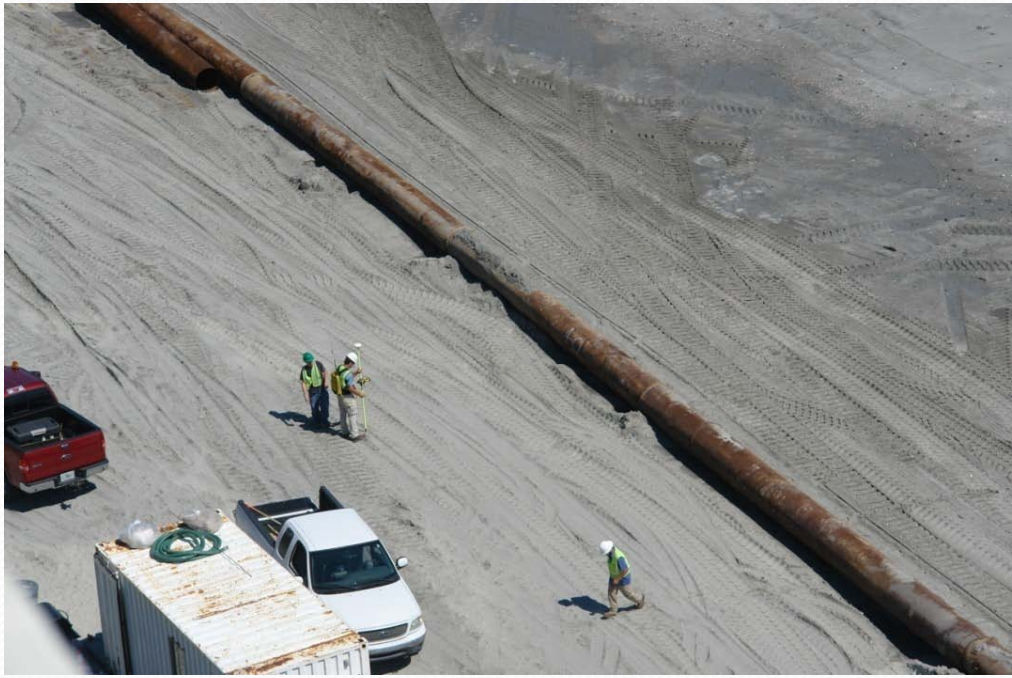
Background

- Grand Strand is sediment-starved region-rivers do not contribute significant amounts
- Tropical storm and hurricane events exacerbate erosion caused by limited sediment supply
- Myrtle Beach is huge tourist destination-$14 billion/yr
- Without intervention, erosion causes instability in beachfront structures

*Image courtesy of visitsouth.com

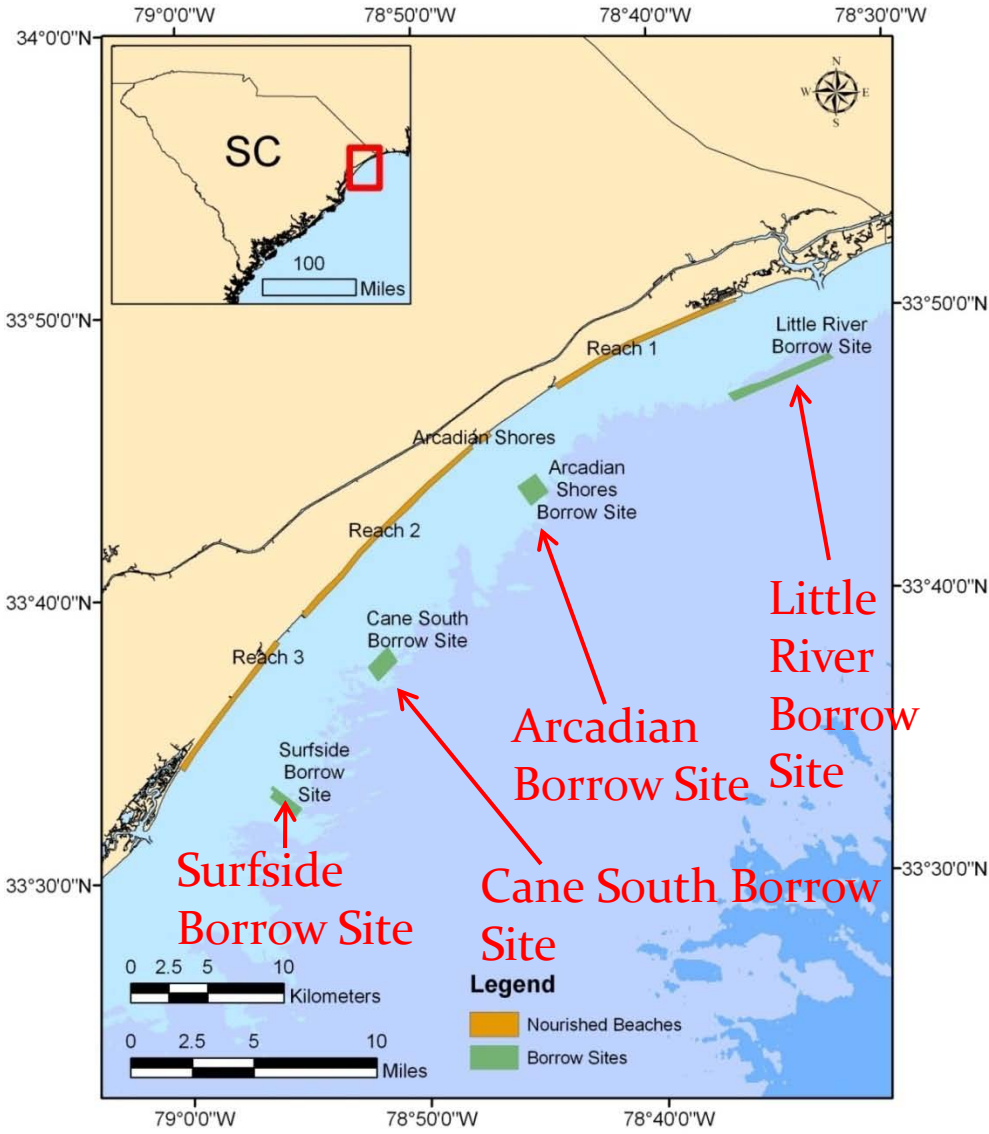
Beach Nourishment

- Beach renourishment is used to retard erosion
- 50 year ongoing project by the Army Corps of Engineers
- 3 renourishments so far: ‘86-87, ‘96-98, ‘07-09
- Previous nourishments used inland sediment, ‘07-09 used offshore ‘borrow sites’



Borrow Sites

- 4 in total: Little River, Arcadian Shores, Cain South, Surfside
- Total volume of sediment borrowed: 2.3 million m^3
- Sediment distributed over 37 km of shoreline from Little River to Surfside
- Figure from McCoy *et. al* 2010

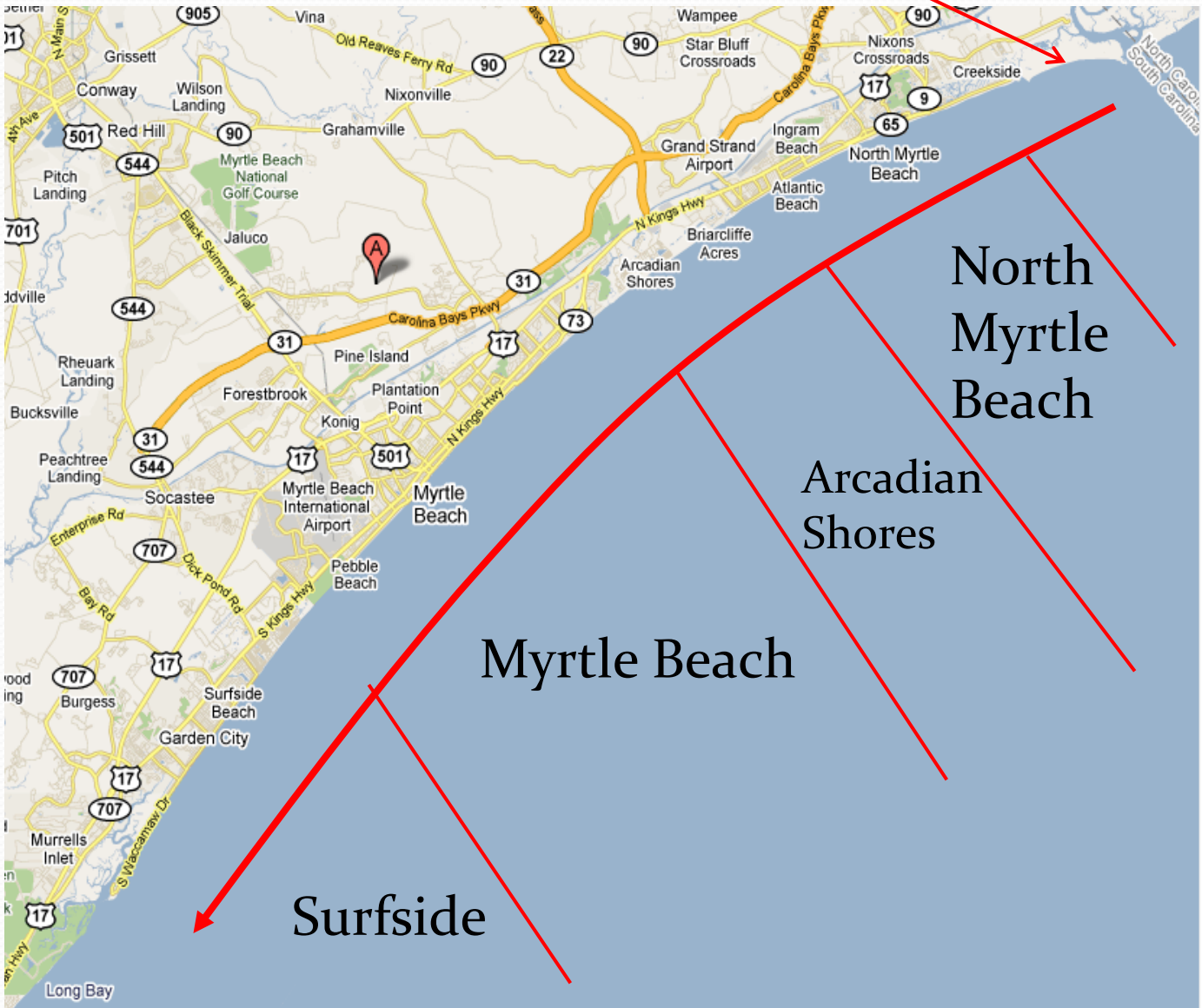


Project Goals

- Difference between nourished and unnourished sediments not well known, hinders ability to track spread of nourished sediment
- Overall objective of project: to quantitatively discern differences between nourished and unnourished sediment
- Hypotheses:
  - Nourished sediment will have poorer sorting and larger overall grain size than unnourished sediment
  - Nourished sediment will be more organic-rich than unnourished sediment
  - Nourished sediment will have higher carbonate content than unnourished sediment

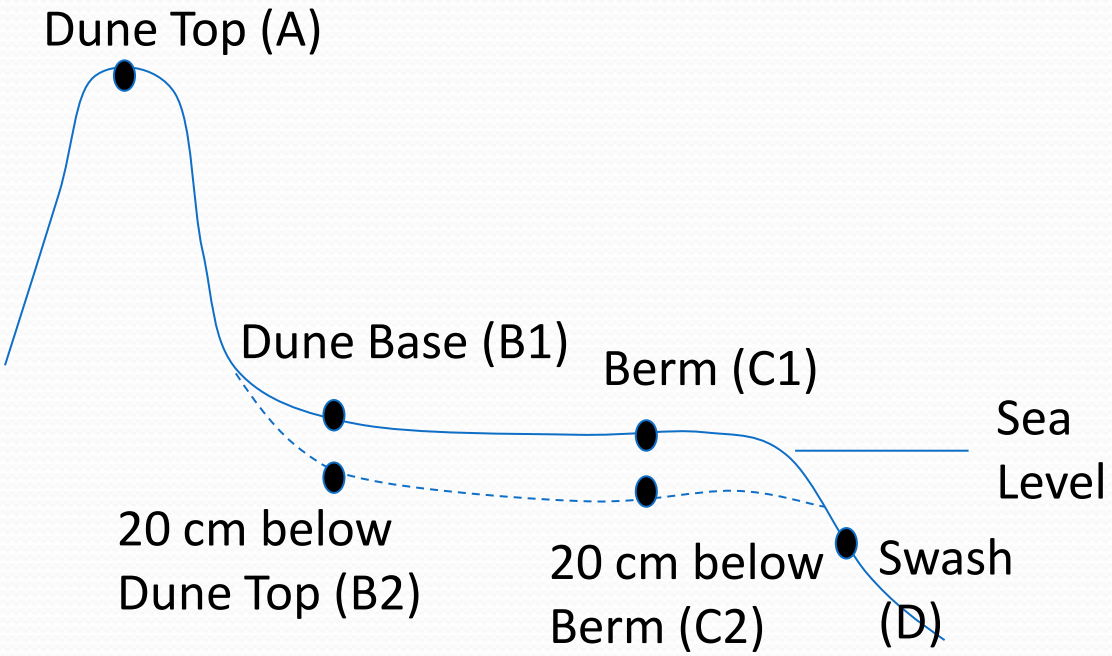
Field/Lab Methods

- 432 sediment samples collected along 72 shore-perpendicular transacts
- 4 regions of study area: North Myrtle Beach, Arcadian Shores, Myrtle Beach, Surfside



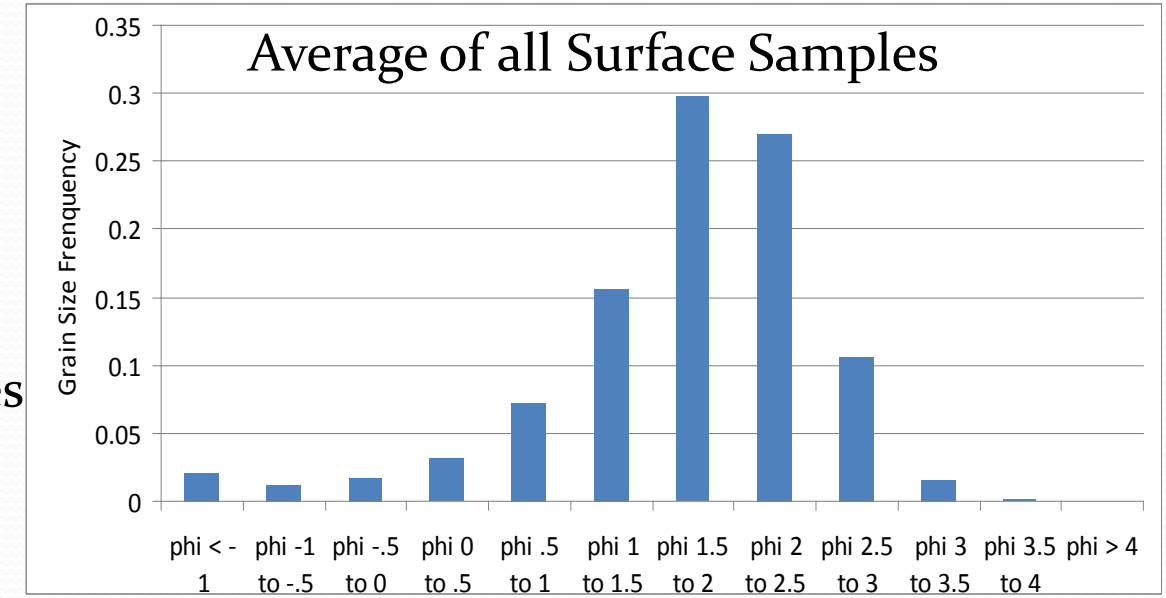
Field Methods Cont'd

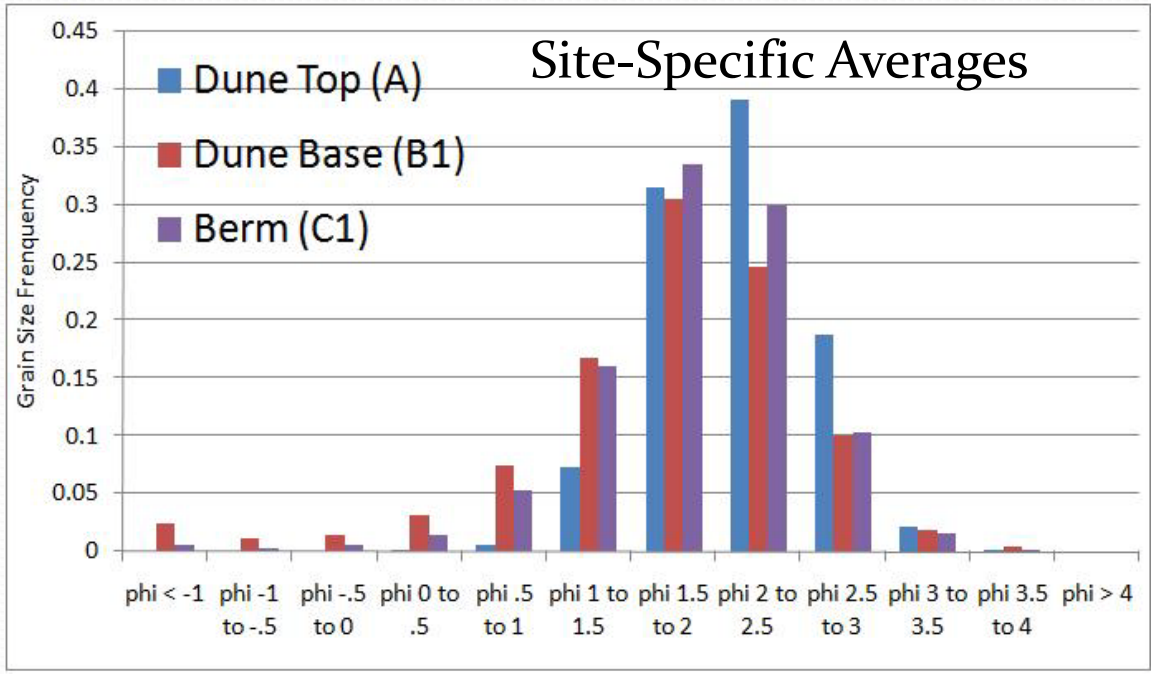
- 6 samples taken at each transact: dune top, dune base, 20 cm below dune base, berm, 20 cm below berm, and swash
- 216 samples analyzed using sieving (every other transact)



Results

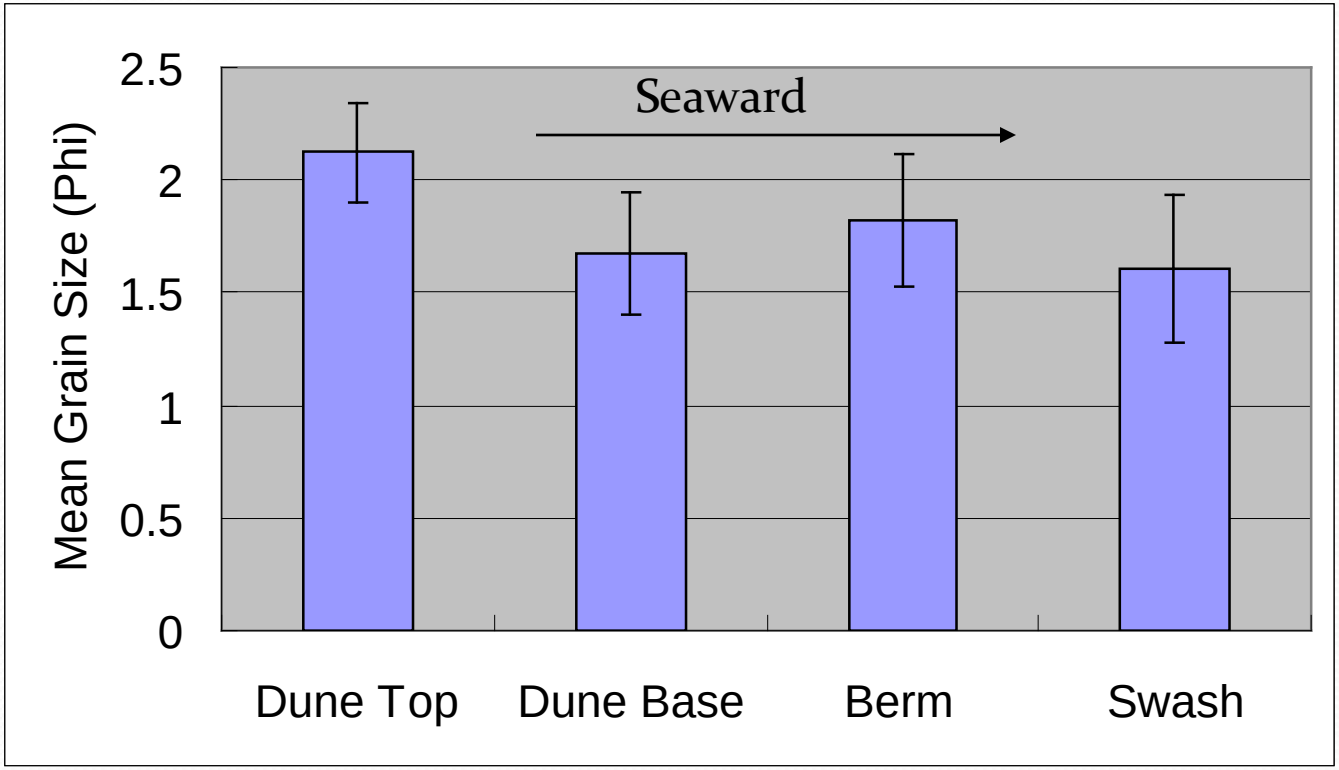
-Grain size distribution (top right) shows avg. grain size of $1.5<\phi<2$, coarse skewness
-Grain size distribution of sites show dune top sediment is finer than berm, dune base
-Large presence of $\phi<-1$ sed in dune base samples indicate presence of shell fragments (below)





Cross-Shore Variations

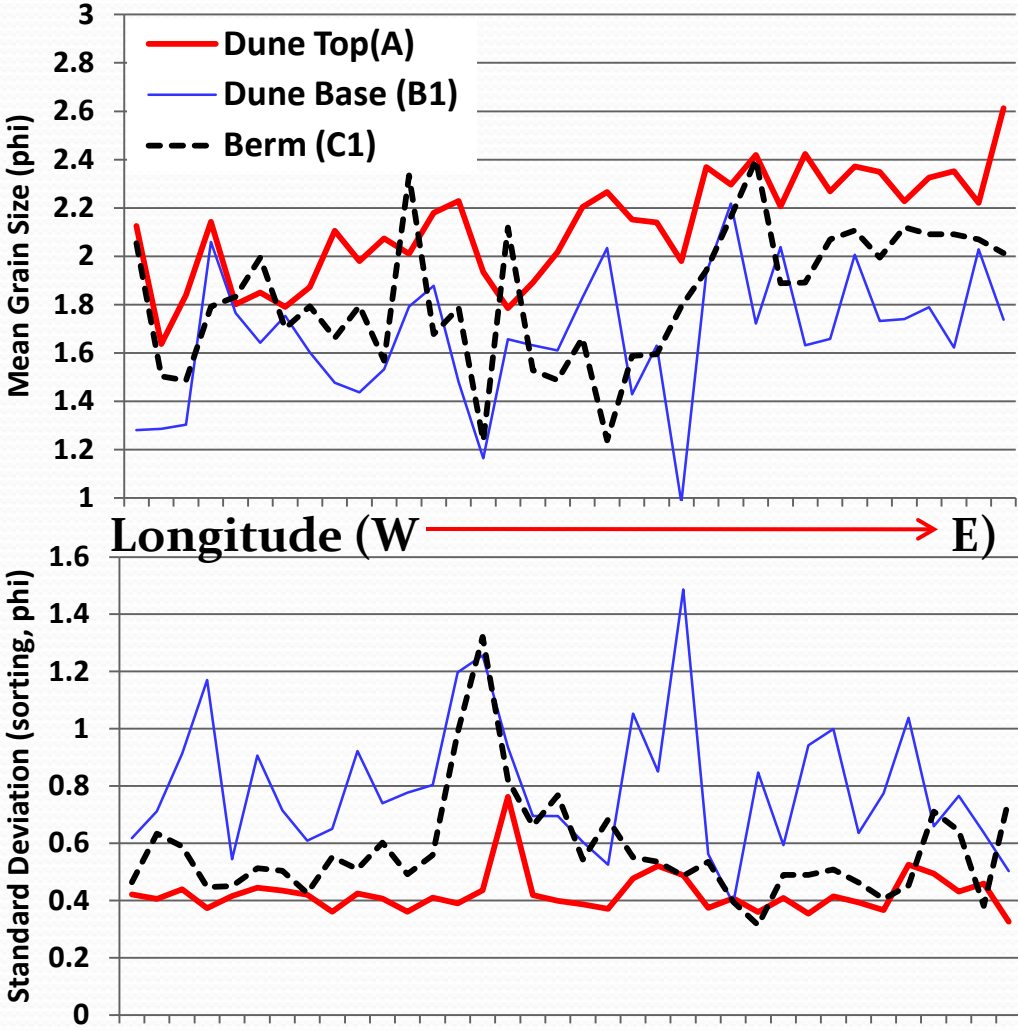
-- Dune top is the finest
-- Dune base and swash are coarse
-- Standard deviations are close



Longshore Variation

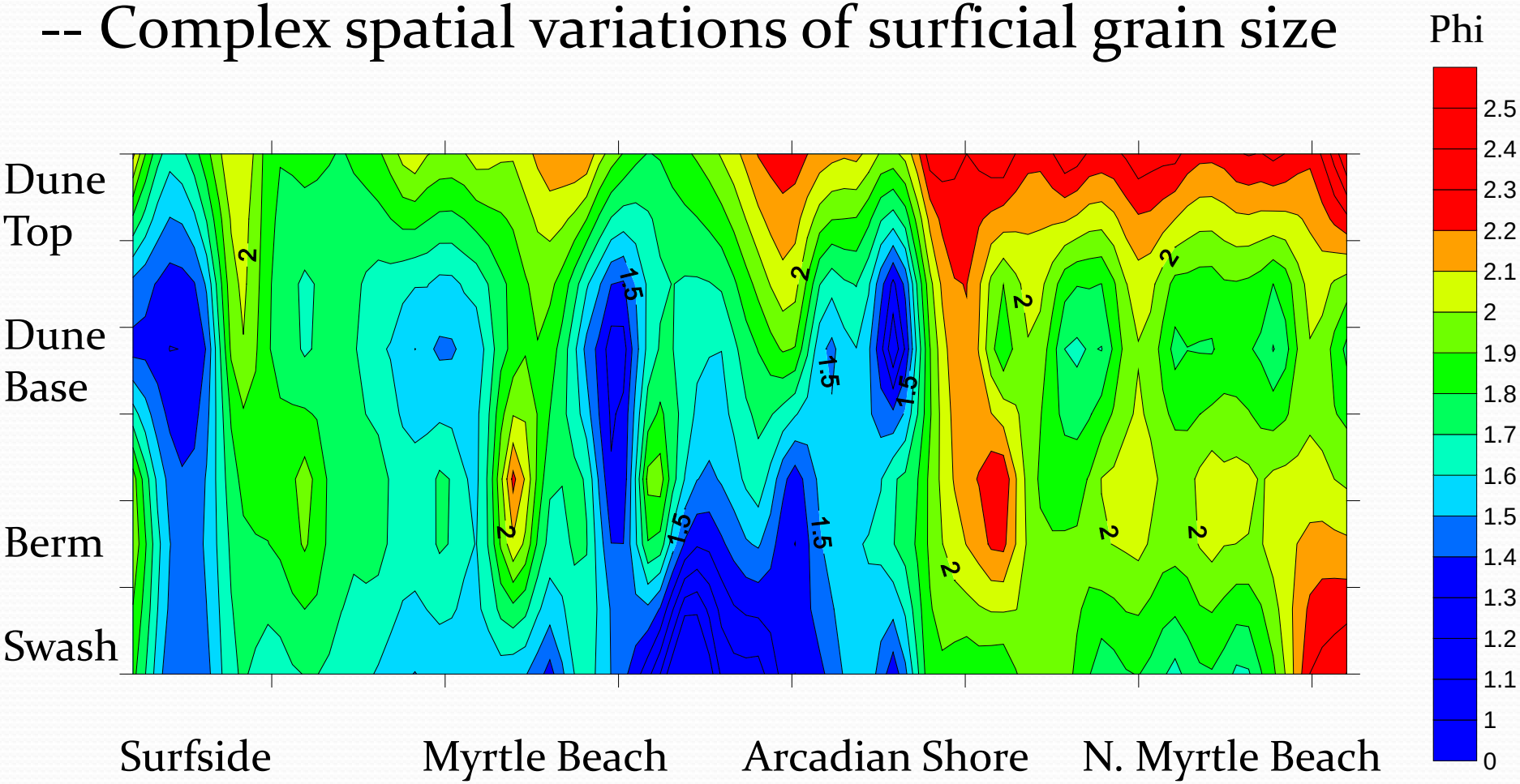
-Mean grain size (top left) greatly varies at dune base and berm; dune top: fine overall, linear decrease from northeast-southwest

-Standard deviation (bottom left) of dune top lower than dune base, berm across study area- eolian transport -> finer grains, better sorting



Spatial Variations

-- Complex spatial variations of surficial grain size



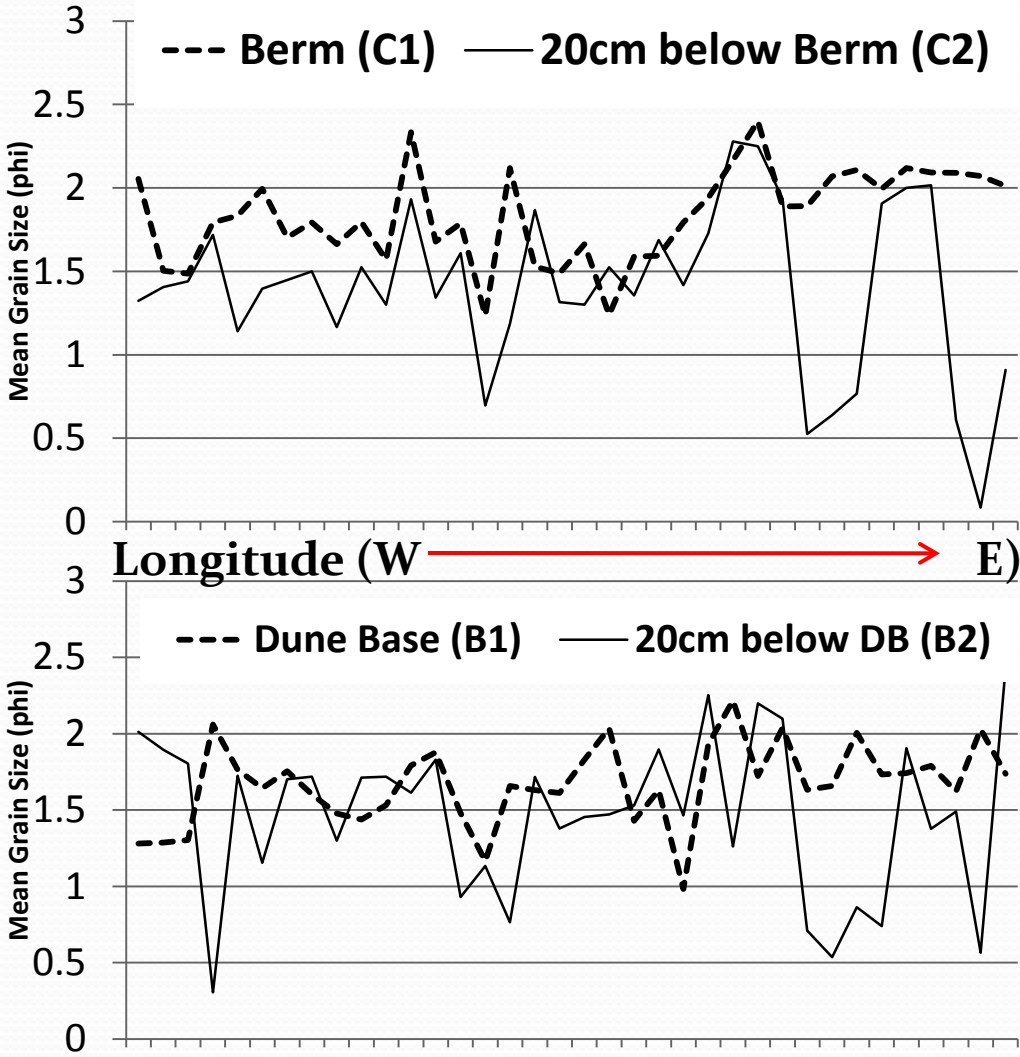
Surface and Subsurface Variations

-Dune base and berm: subsurface samples coarser than surface

-Surface samples: mix of wind-blown seds and offshore sed -> smaller MGS

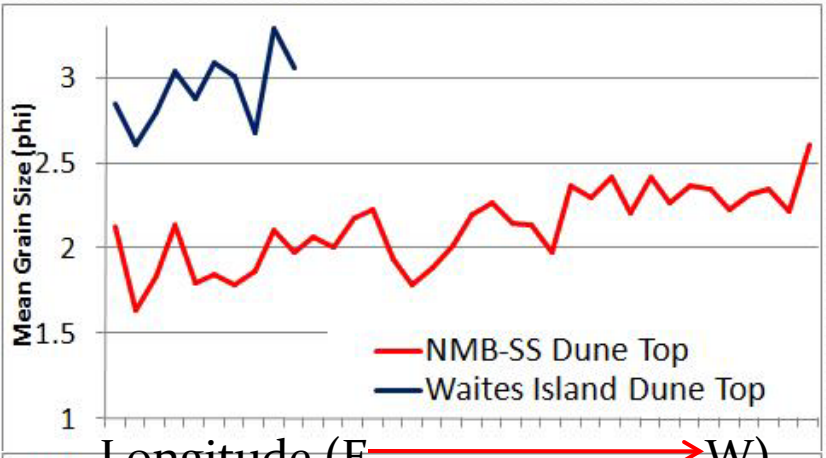
-20 cm samples more offshore seds-larger grain size, poorer sorting

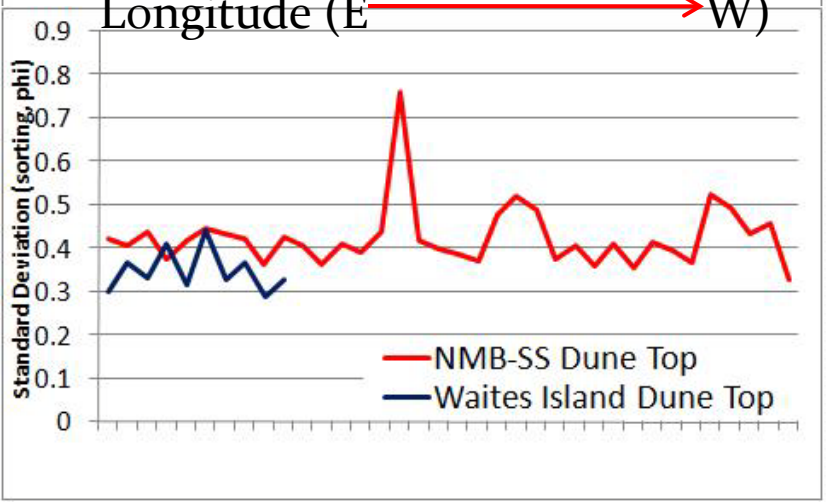
-No apparent significant difference between MGS of DB and berm surface, subsurface samples

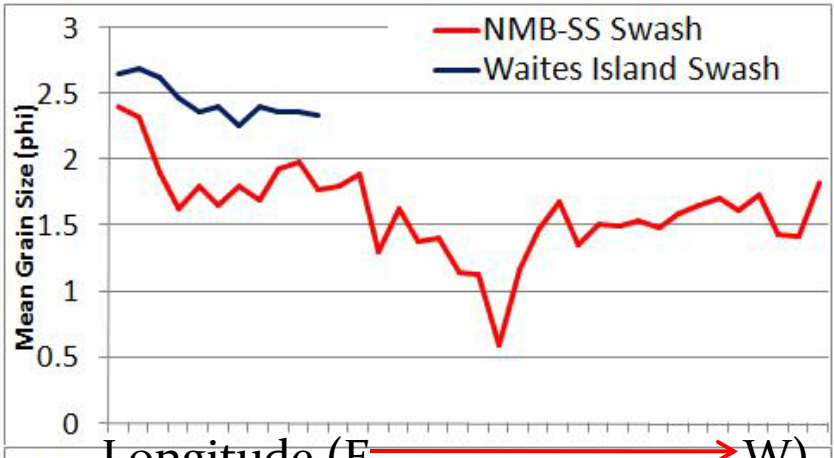


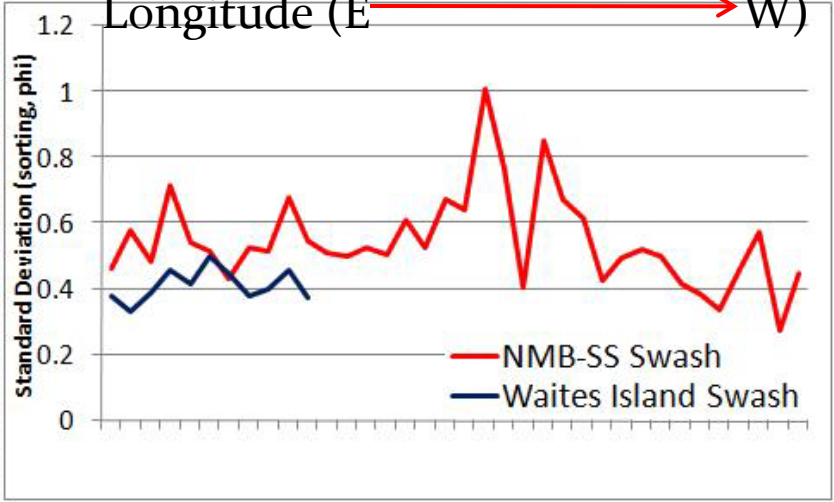
Comparison With Waties Island

- Waties Island: unnourished, north of study site
- Presumed to be natural sediment
- Waties Island samples finer, better sorted at both dune top (left) and swash (right)



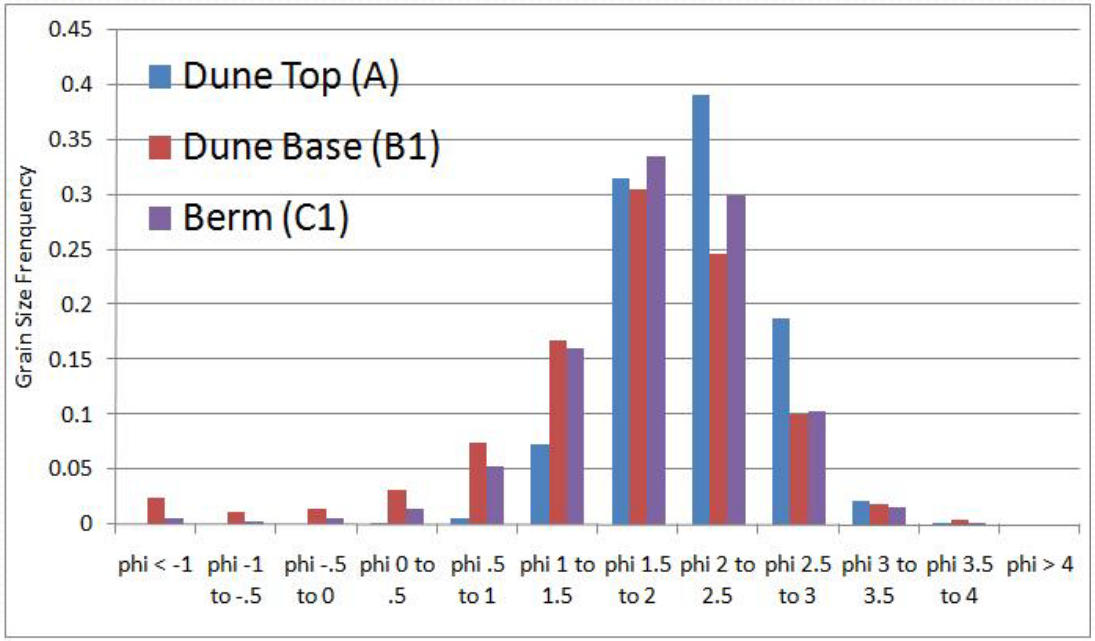




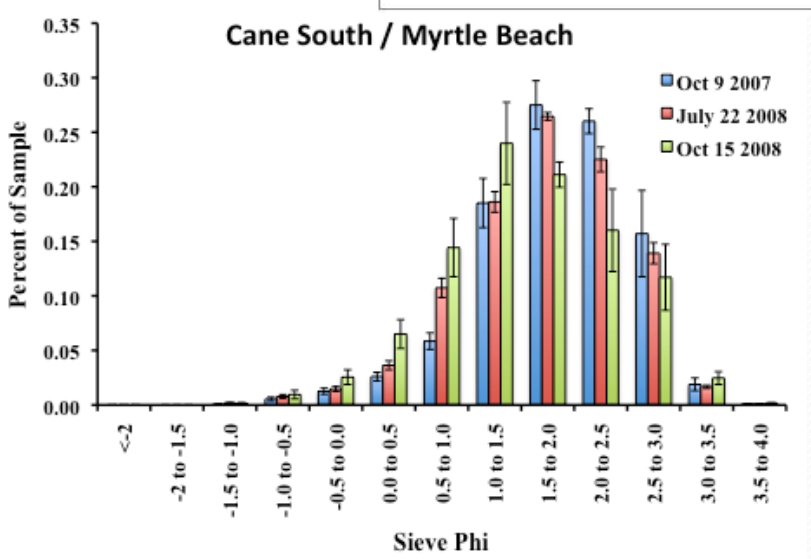


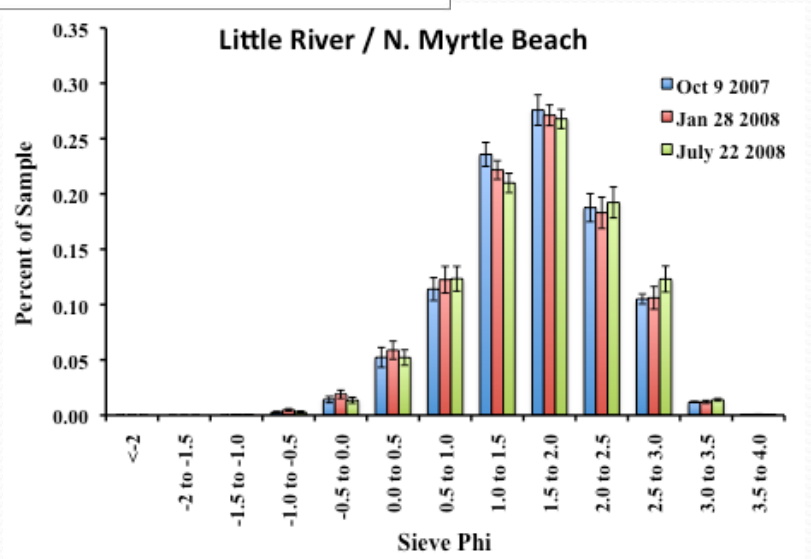
Comparison with Borrow Site Sediments

-Borrow sites coarser than Grand Strand sediment
-Dune base samples have higher shell fragment % than borrow sites



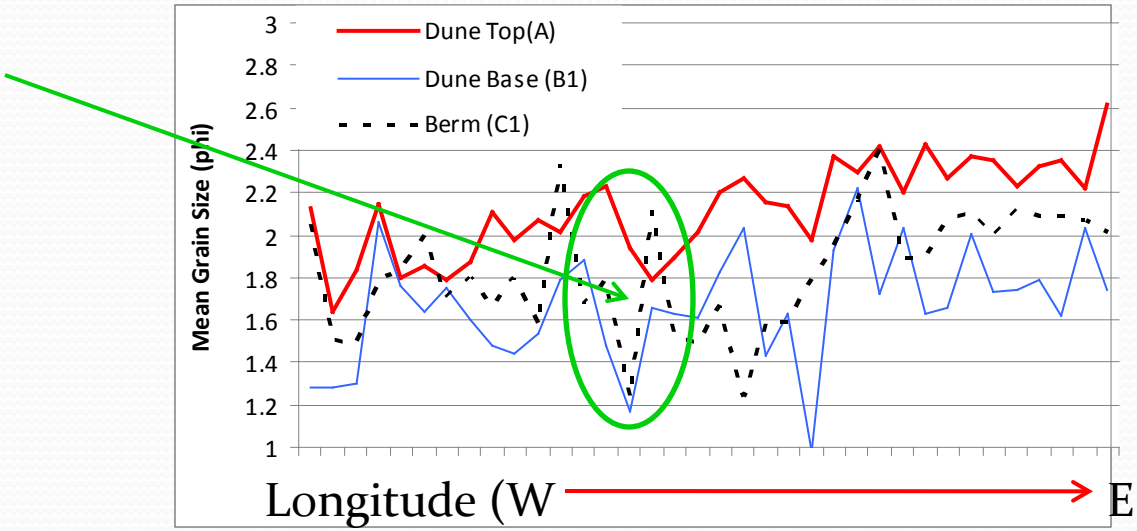
*Borrow site grain size distributions courtesy of Derk Bergquist, SCDNR





Interpreting Results

- Dune base, berm, and swash coarser than dune top-suggests dune tops not affected by nourishment efforts
- More shells in dune base than swash/berm-longshore transport moving nourishing sediment SW
- Linear decrease of grain size from SW-NE at dune top
- Spike in grain size across all transacts-nourished sediment not moving?



Summary

- Grand Strand sed is fine to medium grains, highly variable over region
- Dune tops universally finer, better sorted than other sample sites
- Finer, better sorted seds at surface-eolian seds mixed with offshore seds
- GS sed is ‘middle ground’ between Waites and borrow site seds-suggests integration of borrow sediment

Further Studies

- Analysis of sediments for organic, $CaCO_3$ content: better indicator of dispersal of offshore seds?
- Laser grain size analyses (support by NSF)
- BERM (Beach Erosion Research and Monitoring)
- Numeric modeling of sediment transport (ROMS)

Thanks for your time!

Acknowledgements:

- Professional Enhancement Grants through CCU for funding
- BERM for project background
- Derk Bergquist and SCDNR for borrow site data
- The Burroughs and Chapin Marine and Wetland Center's wonderful faculty and staff!