



**Announcement M13AS00014: Hurricane Sandy Coastal Recovery and Resiliency -  
Resource Identification, Delineation and Management Practices**

**Agreement: M14AC00009 North Carolina Cooperative Agreement;  
North Carolina Offshore Sand Resource Investigation**

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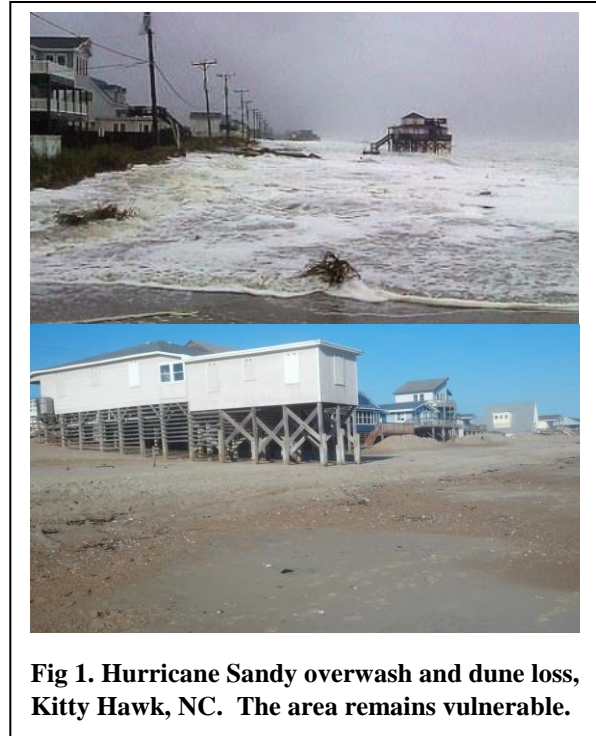
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## Final Summary Report for the North Carolina Offshore Sand Resource Investigation

### A. Cooperative Agreement Outputs including Project Deliverables:

Hurricane Sandy caused massive surf and high water levels that battered North Carolina, especially the northern Outer Banks. Significant erosion, ocean overwash and localized flooding led to costly damage and left portions of this economically important coast in a compromised condition for future storms (Fig. 1). As a result of this and other events, many communities in NC are planning for beach nourishment. But, borrow areas in State waters are limited, and sand in federal waters may be critical. Availability of seismic reflection and sediment data varies along NC, and work was needed to find and database relevant information. The primary objective of this cooperative project was to create an inventory and GIS database of information available on sand resources in the federal Outer Continental Shelf (OCS) offshore (3-8 nautical miles) of North Carolina. In addition to meetings, standard reports and presentations, other deliverables included a prioritization for future research and a reanalysis of existing data in northeastern NC, where Hurricane Sandy had greatest impact.



**Fig 1. Hurricane Sandy overwash and dune loss, Kitty Hawk, NC. The area remains vulnerable.**

### **Walsh, J.P., Conery, I, Garmire, K., Mallinson, D. and C. Freeman. 2016. Synthesis of Geophysical and Geologic Data on the North Carolina Shelf and Future Research Needs, NC-BOEM Cooperative Agreement Technical Report**

Many different entities have conducted seafloor mapping and geological research offshore North Carolina over the last half century. As a result, a wide variety of sediment, seismic, and bathymetric data are available. Much work has focused on the inner shelf within three nautical miles (State waters), and a lesser amount of data is available in the three to eight nautical mile range, the area of federal waters likely utilized for sand resources. The largest data collections (many with large spatial coverage) are available from federal agencies, including the National Oceanic and Atmospheric Administration (e.g., the National Centers for Environmental Information, formerly the National Geophysical Data Center at <https://www.ngdc.noaa.gov/>), the U.S. Army Corps of Engineers (e.g., the Field Research Facility; <http://www.frp.usace.army.mil/>) and the U.S. Geological Survey (<http://walrus.wr.usgs.gov>), including information in usSEABED and from a large cooperative study conducted in the 2000s. Other data sources include information from academic, private, State and other federal efforts. A GIS layer has been obtained or created to map each dataset (**Fig. 2**), and NGDC-consistent metadata has been developed to capture as much related information as possible. In addition to the geodatabase of layers being provided to BOEM for serving through federal outlets, the map layers also will be

served using the NC Coastal Atlas: <https://www.nccoastalatlantlas.org/>. Based on the data, a prioritization was completed in early 2015 to guide the BOEM-funded data collection, and this was re-evaluated at the end of the project in July 2016.

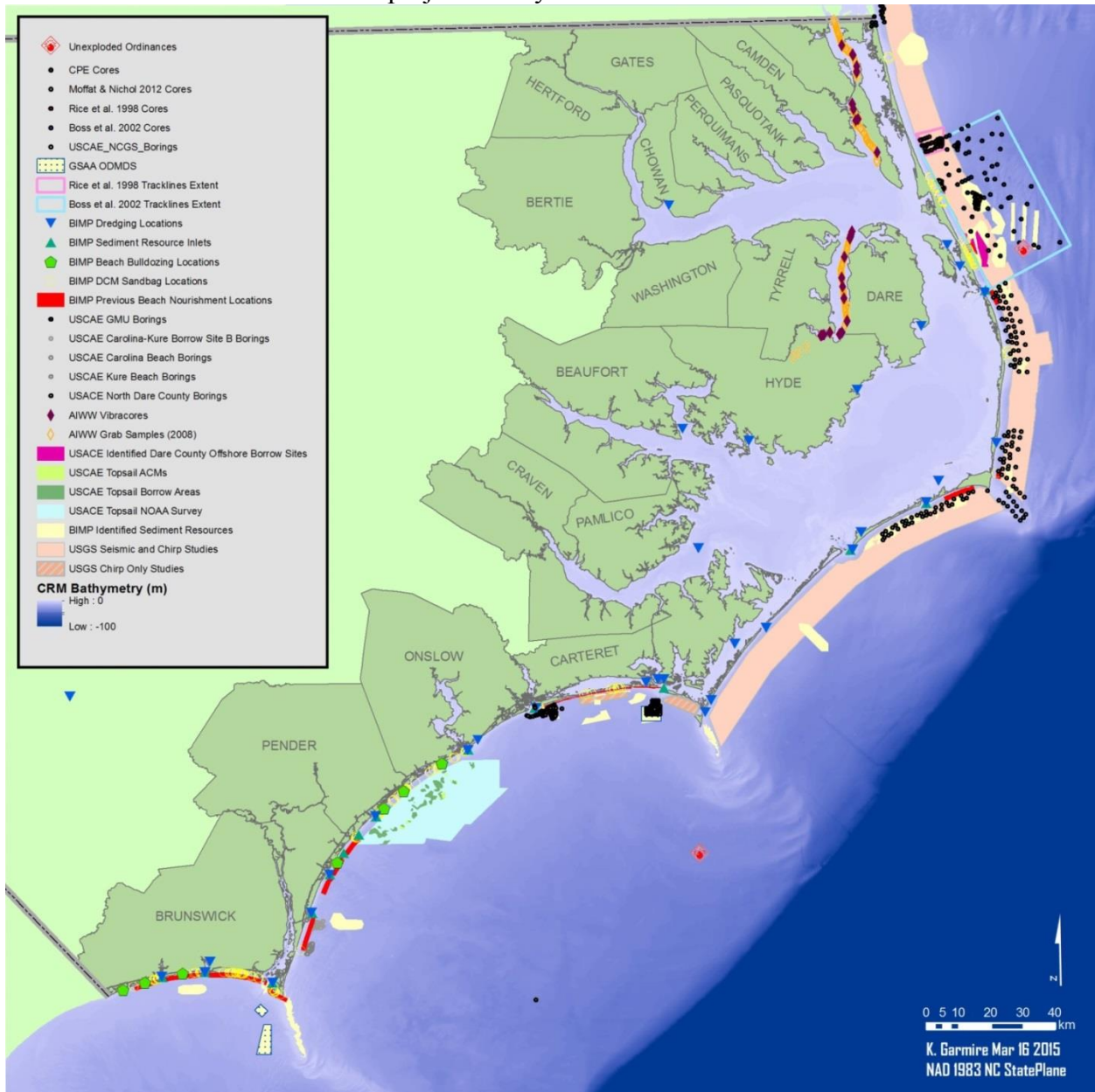


Fig. 2: Geophysical and geological datasets on the NC shelf. Note, some data layers with widespread data (e.g., usSEABED) are excluded to produce a more easily viewed map.

**Walsh, J.P., Conery, I, Garmire, K., Mallinson, D. and C. Freeman. 2016. Database of literature on geological research for the North Carolina shelf, NC-BOEM Mendeley Reference Database available through the NC Coastal Atlas.**

A great diversity of geological research has been conducted offshore North Carolina. While much research has been published in peer-reviewed journals, others studies have been described in agency documents, state reports and other literature. To coalesce this varied work, a

Mendeley reference database was created (**Fig. 3**); the references in this database are provided in the widely used EndNote format (.xml within a zipped file) and will be made available through the NC Coastal Atlas (<https://www.nccoastalatlantlas.org/>). References will be updated as more information becomes available and additional studies are completed.

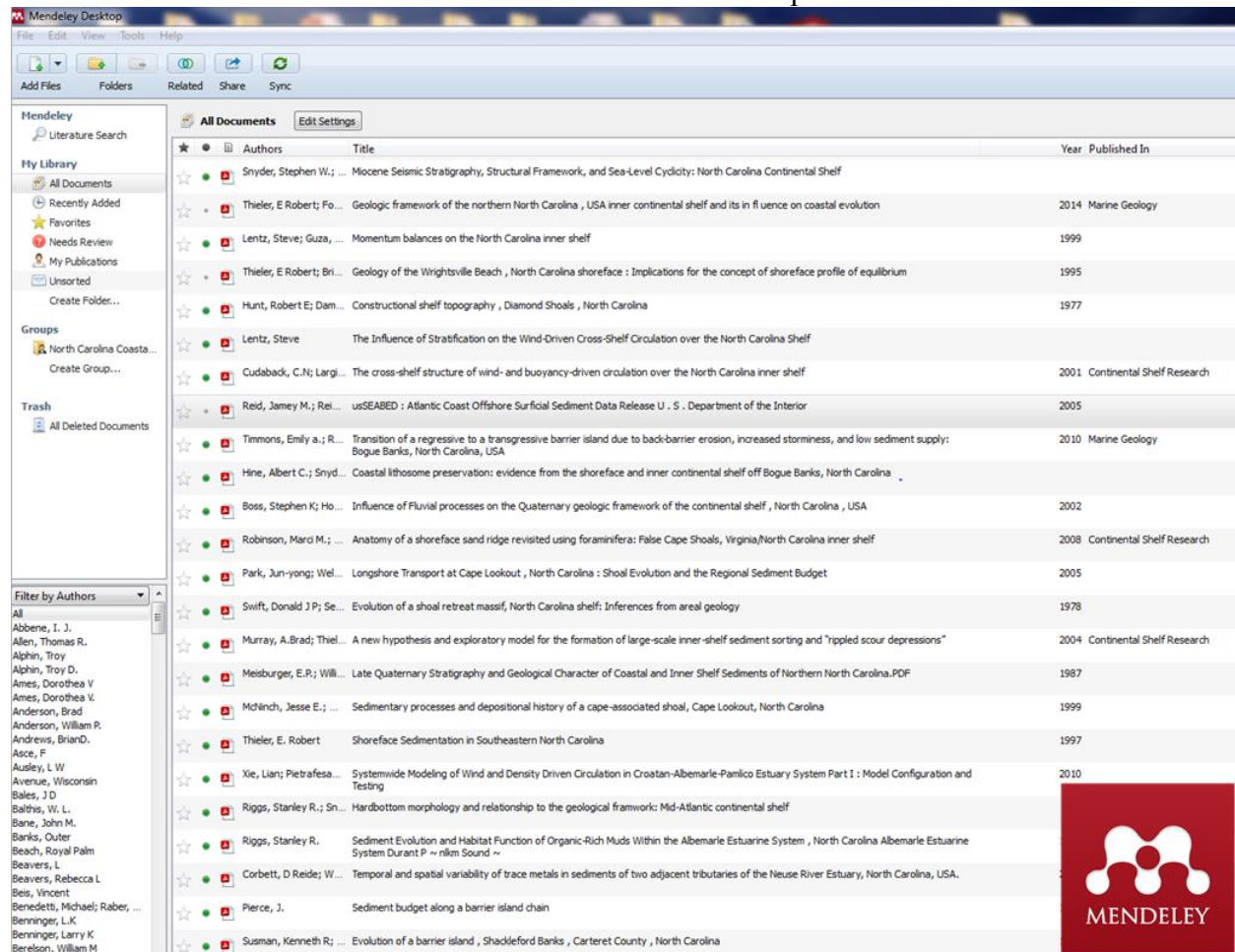


Fig. 3. Screenshot of geological research database in Mendeley.

**Walsh, J.P., Conery, I, Garmire, K., Mallinson, D. and C. Freeman. 2015. Map with prioritization for geophysical and geological surveys in NC, Submitted to CB&I.**

In January 2015, CB&I held a meeting in Charleston to present and discuss the BOEM-funded data collection efforts in 2015. At that time, it was apparent that more data was available and discussion was needed to prioritize collection needs in NC. Lead PI Walsh worked with the NC Division of Coastal Management (Ken Richardson and Mike Lopazanski) and other members of the NC team to have a separate follow up prioritization meeting at the DCM Office in Morehead City. Based on discussions and data obtained from the U.S. Army Corps of Engineers Wilmington Office, a prioritization map was created (**Fig. 4**). Note, it was realized that southern NC lacked much offshore data, so this area was recommended for reconnaissance work. CB&I collected much or all of these data in 2015. A reassessment of priority areas for OCS data collection was completed for the final technical report (see above).

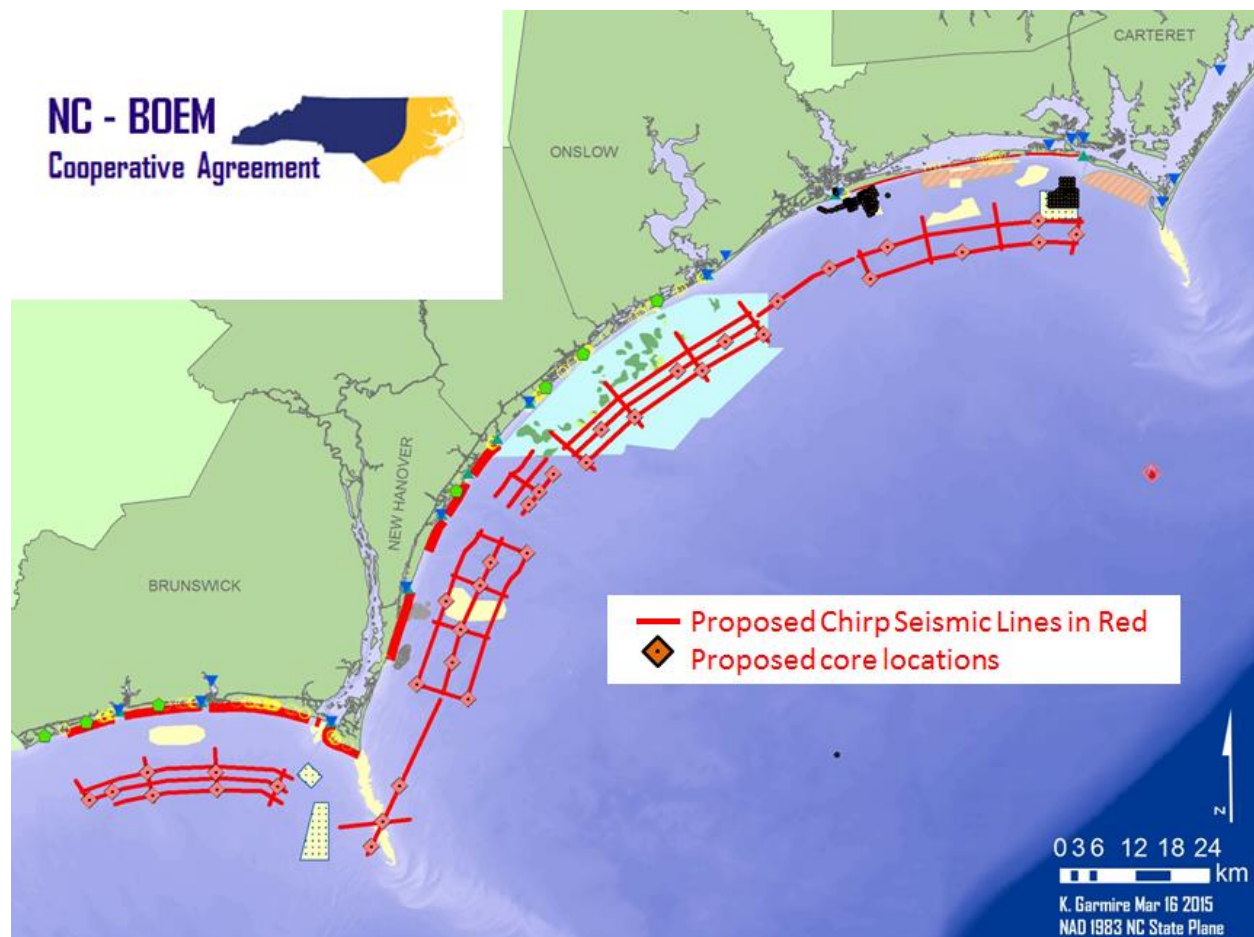


Fig. 4. Map of prioritized seismic and core collection in NC for 2015 CB&I data collection based on existing data availability.

**Walsh, J.P., Conery, I., Gibbons, R., Mallinson, D., Freeman, C. and K. Richardson. 2016. A Re-evaluation of Data and Sand Resource Need, Use, and Availability in Northeastern (Dare County) North Carolina. NC-BOEM Cooperative Agreement Technical Report.**

Hurricane Sandy had a significant impact on northeastern NC, particularly along the Outer Banks north of Cape Hatteras (Fig. 1). Sustained winds of 49 knots (gusts to 60 knots) and wave heights of 6.3 m (at 17-m site) were recorded at the USACE Field Research Facility at Duck, NC. A >2 m storm tide was experienced in this area, and these high water levels coupled with very large waves led to overwash and dune losses that caused flooding and major beach erosion. The Virginia Dare Trail (i.e., the “Beach Road”) was completely undermined in Kitty Hawk, and the Croatan Highway (U.S. Route 158), the main road along the Outer Banks, was deeply flooded, interrupting traffic along the island. Approximately 900 thousand dollars were spent by the State to repair a portion of roadway in Kitty Hawk. Across many areas in Dare County, the dunes and beach system remain in a compromised condition. As a result, several towns and the County are planning for beach nourishment. Since the NC Beach and Inlet Management Plan in

2011, several studies have since collected new data to evaluate sand resources in this area. A compilation, comparison and reassessment of data was conducted to help inform work being planned and future needs (e.g., **Fig. 5**). Data comparison shows that while offshore sand sources are present in State and federal waters, there are discrepancies in the sand estimates.

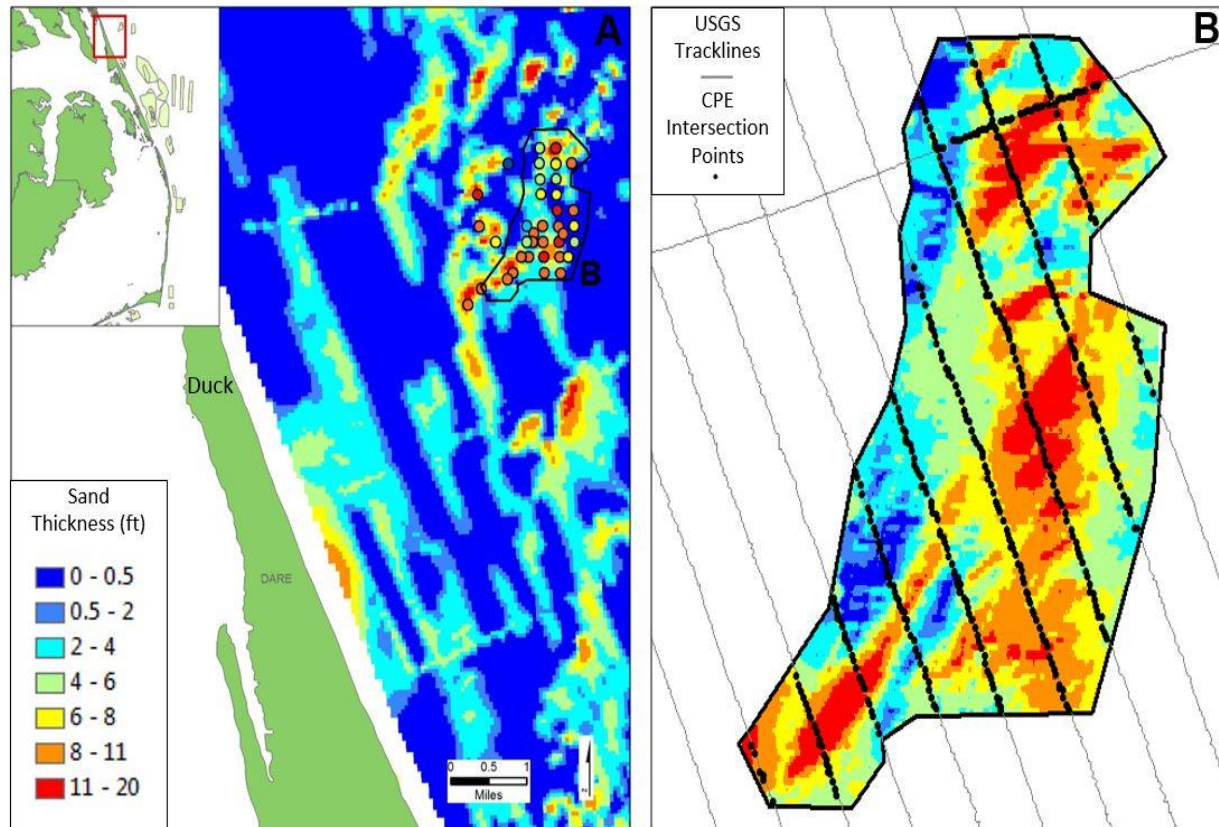


Fig. 5: Spatial comparison of sand resource assessment offshore Duck, NC.

### **B. Associated Cooperative Agreement Outputs (Research Activities and Presentations):**

An overall goal of the NC-BOEM Cooperative Project was to understand sand resource needs, resource availability, and this requires a fundamental knowledge of the geological system and human activities. The NC-BOEM team has conducted and continues related research, such as on nourishment needs, erosion processes, and coastal geology. Below are some associated outputs (presentations) from the NC-BOEM Cooperative Project. Data on nourishments and other relevant information will be included in the synthesis NC-BOEM Cooperative Agreement Technical Report.

Walsh, J. P., Corbett, D. R., Conery, I., Cornette, C.J., Gallagher, B., Garmire, K., Gibbons, R., Kelly, N., and Mallinson, D. 2016. Shoreline and Sediment Dynamics of the Central Outer Banks Barrier Island System, North Carolina, USA. International Meeting of Sedimentology, Marrakech, Morocco.

Conery, I. and J.P. Walsh. 2016. Statewide Offshore Sand Sources for Beach Nourishment and Dynamics of the Beach-Dune System along a Human-modified Coast, Northern Outer Banks, NC, East Carolina University Research and Creativity Week. Greenville, NC.

Walsh, J. P., Conery, I., Corbett, D. R., Mallinson, D., Garmire, K., T. Allen, C. Freeman 2016. Sand resource needs, data availability and beach nourishment projects in North Carolina. SEGSA, Columbia SC.

Walsh, J.P., Corbett, D.R., Mallinson, D., Conery, I., Garmire, K., Cornette, C.J. and N. Kelly. Shoreline and Sediment Dynamics along the Central Outer Banks, North Carolina. Atlantic Estuarine Research Society Spring Meeting 2015, Wanchese, NC.

### **C. Associated Cooperative Agreement Outputs (Education and Outreach):**

An important aspect of the NC-BOEM Cooperative Project was for scientists and managers of the team to connect with and inform coastal communities, citizens and students. In order to make this happen, team members have engaged in various ways. In particular, it is worth noting that Walsh spoke three times to the NC Beach and Inlet Waterways Association, which is an important information-sharing meeting for coastal town managers, private companies and others. Two of these presentations were conducted in collaboration with BOEM (Doug Piatkowski). The list below provides examples of project associated education and outreach:

Walsh, J.P. May 2016. ECU Undergraduate Education. Investigation of Coastal Geoscience class. About one week of program examined coastal processes and management in NC.

Walsh, J.P. March 2016. UNC System Undergraduate Education. Spring break geology class. Week-long class examined sediments and processes on the NC shelf and along the coast. **(Fig. 6)**

Conery, I. May 2016. Life of a Geologist: Islands, Lasers, Sand and Antarctica. Manteo Middle School AIG Scholar Program, May 2016. Manteo, NC. Oral presentation and workshop.

Walsh, J.P. and D. Piatkowski. Fall 2015. Evaluation of Sand Resource Data Needs in Federal OCS Waters Offshore North Carolina: An Update. NC Beach and Inlet Waterways Association Annual Meeting, Wrightsville Beach, NC. Tag-team oral presentation.

Walsh, J.P., Mallinson, D., Conery, I., Garmire, K., Allen, T., Freeman, C. and the NC Division of Coastal Management. Spring 2015. Evaluation of Sand Resource Data Needs in Federal OCS Waters Offshore North Carolina. NC Beach and Inlet Waterways Association Annual Meeting, Pine Knoll Shores, NC. Oral presentation.

Piatkowski, D. and J.P. Walsh. Fall 2014. BOEM's Coastal Resiliency Planning Initiatives and Ongoing Efforts in North Carolina. NC Beach and Inlet Waterways Association Annual Meeting, Wrightsville Beach, NC. Tag-team oral presentation.

Walsh, J.P. November 2015. ECU Undergraduate Education. Sedimentology class trip on coastal processes and beach nourishment.

Walsh, J.P. May 2015. ECU Undergraduate Education. Summer at the Coast trip to study coastal processes and sand resource mapping. (Fig. 7)

Walsh, J.P. April 2015. NC Coastal Research and Issues. OBX Rotary. Ramada Inn, Kill Devil Hills. Oral Presentation.

Walsh, J.P. April 2015. ECU Undergraduate Education. Advanced Oceanography trip to study beach nourishment.

Walsh, J.P. Fall 2014. Continental Margin Sedimentation. UNC Coastal Studies Institute, Wanchese, NC. Oral Presentation.



Fig. 6: UNC System Spring Break class examined sediments and processes on the NC shelf and along the NC coast.





Fig. 7 Summester at the Coast 2015. ECU summer undergraduate education program. Students mapped the seabed, analyzed sands and studied coastal processes.

