NC Living Shoreline Research Update
May 15, 2019

Purpose of this document is to obtain updates on Living Shoreline-related research activities, publications, analyses, and partnerships

Carolyn Currin & Jenny Davis NOAA

- Assembling 10 yr record (08-18) of marsh vegetation, surface elevation and edge erosion/sed volume change from paired LS and natural marshes in NC for analysis of impact of climate-related drivers Plan to present at CERF (JDavis, NERRS collaborators)

-Planning 2019 assessment of sites in study above, mid-July to early August. Includes Pivers Island, PKS, NC Maritime Museum, Middle Marsh and Harkers Island (NOAA, NERRS, Sentinel Site)

-Working with RAE on field trips and agenda for October LS workshop

-Working with Sam Burdick (Duke) on msc assessing impact of bulkheads on fringing marshes

Mariko Polk UNCW (on behalf of Devon Eulie)

- NSF RAPID and NC Sea Grant Core Funding Grant LS Project (with Rachel Gittman, ECU; Carter Smith, UNCCH/Duke; Huili Hao, UNCW) preparing to:
    - Begin sending out 20 Coastal County Shoreline and Hurricane Florence Impact Survey Study
    - Summer: work with homeowners to conduct shore survey and citizen science study on novel cit sci based monitoring of shoreline habitat change
    - Summer: Field survey of LS sites across state
    - Begin analysis and comparison of data collected last season
- Working with Carter Smith at PKS marsh collecting baseline data

Rachel Gittman ECU

- NSF RAPID and NC Sea Grant project described under Mariko Polk
- Carrot Island oyster and marsh restoration experiment (funded by NOAA SARP, USFWS ACFHP, NC Policy Collaboratory) using oyster bags and Oyster Catcher materials (with Brandon Puckett, NC NERR, Lexia Weaver, NCCF, Niels Lindquist and Clammerhead Cesna, Sandbar Oyster Co., April Blakeslee and Chris Moore, ECU) Gittman graduate student lead: Emory Wellman, Postdoc: Chris Baillie
    - Reefs installed in summer 2018, monitoring continuing summer 2019 after pre- and post Florence and Michael monitoring last fall
    - May 2019: planting *Spartina alterniflora* landward of each reef (or along the marsh edge at control sites) with and without nutrient additions to monitor individual marsh plant response to reef presence and nutrients

    - Additional Oyster Catcher materials for future reefs in the Reserve to be seeded on the Sandbar lease this summer, next reef deployment will be spring/summer 2020- **site selection still in progress, welcome ideas!**
- Marsh-oyster clumping experiment at PKS Aquarium (in collaboration with Carol Price, PKS Aquarium, grad student lead: Emory Wellman)
    - Testing the effects of inter-and intra-specific facilitation by combining oyster clumps and marsh plants in dispersed and clumped configurations
    - Deployment scheduled for May 2019
- Evaluating oyster reef condition and ecosystem service delivery as a function of reef age and landscape context (seed grant from ECU for summer 2019 with April Blakeslee, ECU, NC Sea Grant submitted and pending for continuation/expansion of project with April Blakeslee, ECU, Joel Fodrie, UNC IMS, Brandon Puckett, NC NERR, Chris Taylor, NOAA, and Chris Baillie, ECU)
    - Sample oyster reefs in Rachel Carson Reserve of different ages and landscape contexts to assess reef condition and provision of ecosystem services (e.g., fish habitat, biodiversity, shore stabilization, carbon burial, etc.)
    - Sampling scheduled to begin late May and continue through September 2019
- Working with RAE on field trips and agenda for October LS workshop
- Teaching a Conservation and Policy course at DUML July/August 2019 and Coastal Ecological Processes course at ECU fall 2019- **interested in organizing student field trips that can also include living shoreline sampling or building, let me know if you have a project!**

Brandon Puckett NCNERR

- Piloted rapid marsh sill monitoring protocol with DCM regulatory staff from Southport to Edenton in 2019 (including before and after Florence); will continue effort in 2020.
- Participate on DCM's living shorelines workgroup composed of regulatory, policy, and reserve staff
- Developing state-wide marsh sill geodatabase with attributes such as length, base width, permit year, material type, etc.
- LS and natural marsh assessment described under Currin
- Manuscript assessing impact of bulkheads on fringing marshes described under Currin
- Carrot Island oyster and marsh restoration experiment described under Gittman
    - Working with phd student (Melody Thomas) at NCSU's bio and ag engineering to test efficacy of 3-d printed oyster reefs for shoreline stabilization, vegetation enhancement, etc.

(see next page)

Jana Haddad, Johanna Rosman, Rick Luettich UNC-IMS

As part of a project funded by the NOAA Ecological Effects of Sea Level Rise program, we have implemented a model of wave transformation through a marsh that is based on conservation of wave energy flux and accounts for dissipation of wave energy by vegetation, breaking, and bottom friction (e.g., Fig. 1). We have tested and calibrated the model using continuous wave measurements, elevation profiles, and vegetation data from transects across five NC salt

marshes. The measurements and model are being used to understand how wave energy dissipation varies with water depth, wave conditions, and vegetation properties. Both the measurements and model show that wave attenuation increases with smaller water depth, submerged vegetation height, and vegetation density. Both measurements and model also show that percentage reduction in wave height is larger when waves are largest; however, small waves are attenuated more dramatically than predicted by the model. We are currently looking into reasons for this pattern and ways to address it in the model. In the future, we'd like to turn our model into a tool that can be used to evaluate natural and nature-based solutions for shoreline protection, and inform living shoreline design.

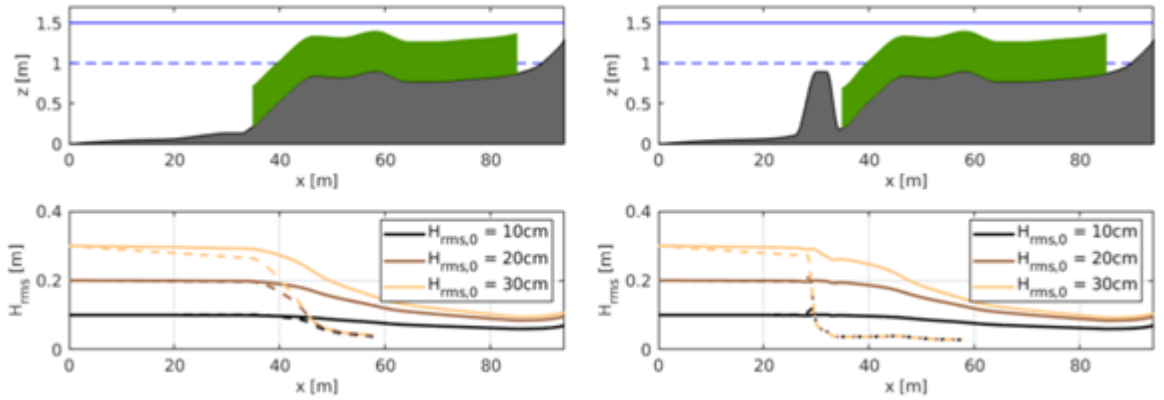

Figure 1: Example model runs for left: a natural marsh, and right: the same marsh with a sill. Top: elevation profiles with marsh location and height. Bottom: predicted rms wave heights. Model predictions are shown for offshore water depths of 1 m (dashed) and 1.5 m (solid) and incident rms wave heights of 10, 20, and 30 cm. Peak period was 1.5 s for all runs shown.