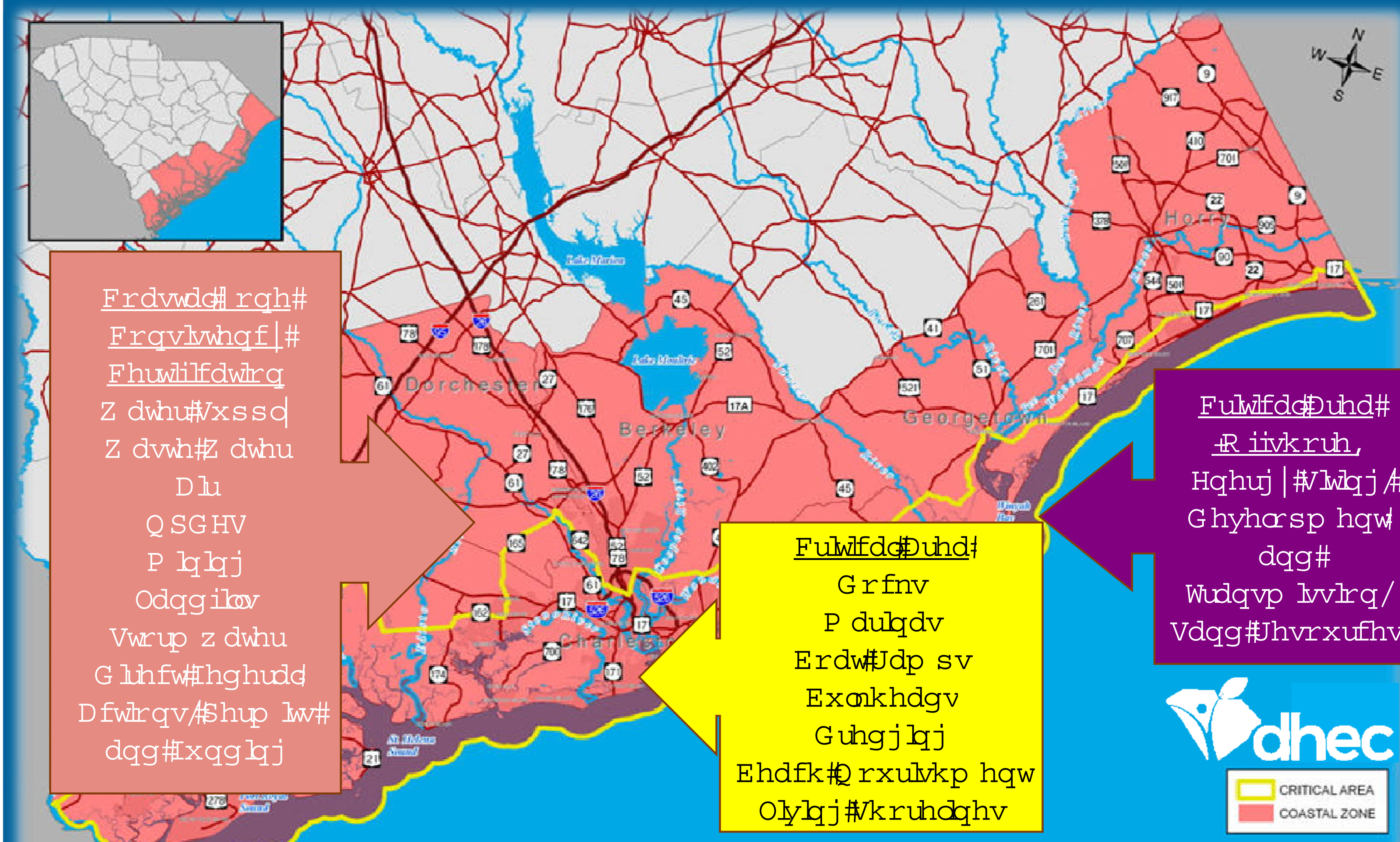
Living Shorelines in SC: Management & Policy Context

Matt Slagel, Permitting Project Manager, DHEC-OCRM



OCRM COASTAL ZONE & CRITICAL AREA JURISDICTION

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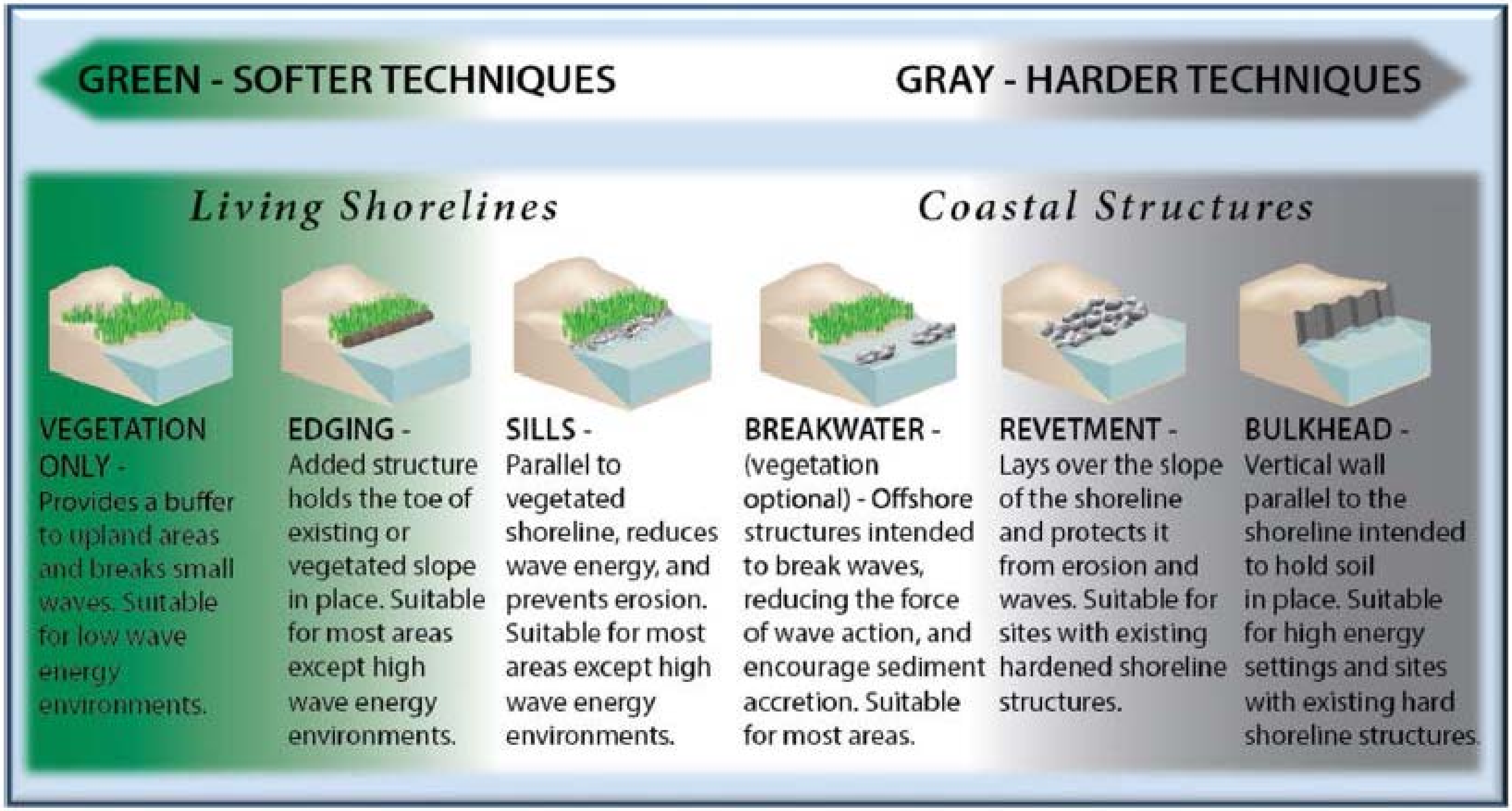
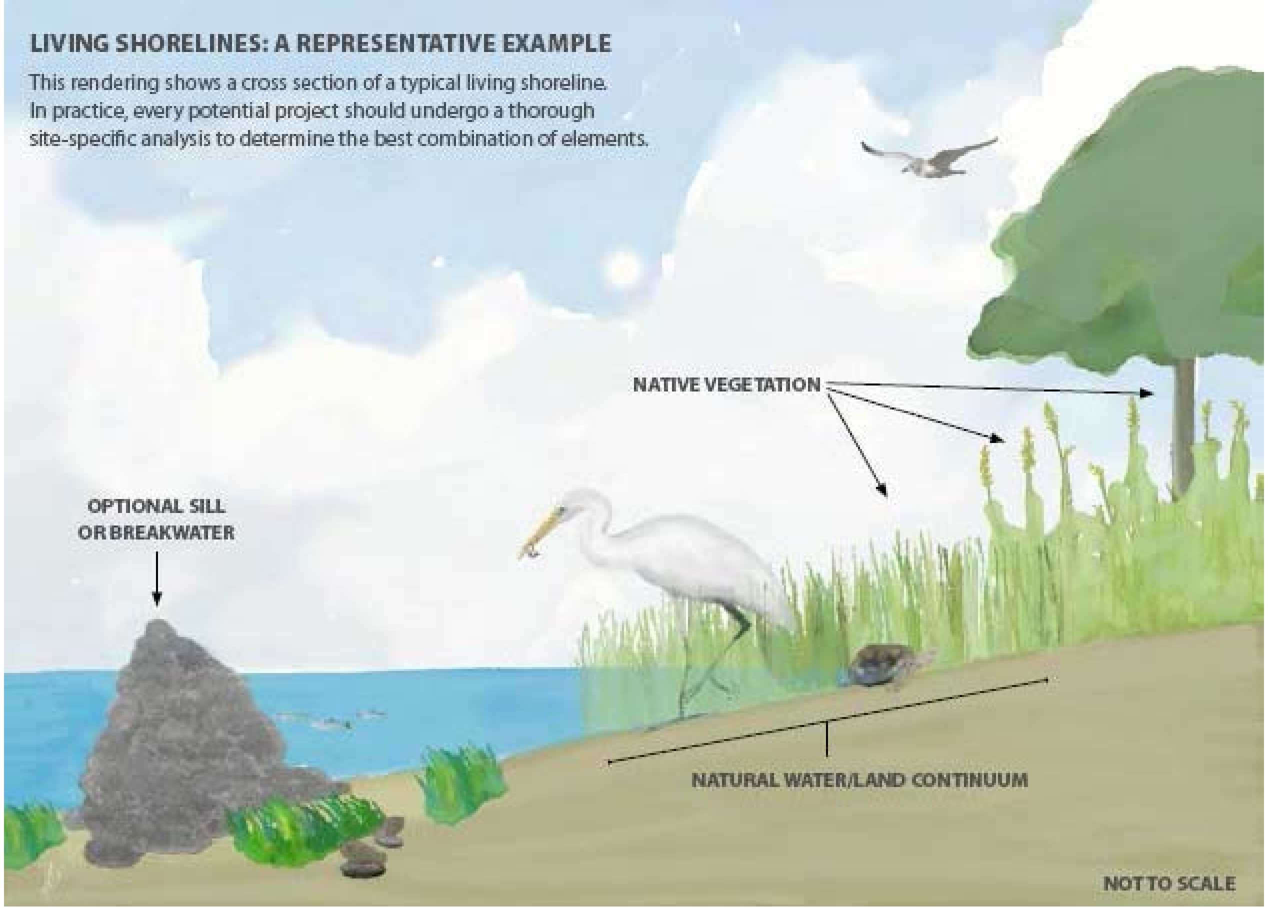


From: NOAA: Guidance for Considering the Use of Living Shorelines, 2015.

What are “Living Shorelines”?



From: RAE: Living Shorelines: From Barriers to Opportunities, 2015.

Maintain Land-Water Connection

Coastal Resilience Benefits

- Recent research in NC after Hurricane Irene (Cat. 1) demonstrated that marshes with and without sills protected estuarine shorelines better than bulkheads.

- Living shorelines can adapt to coastal changes better than hard structures.

- Properly designed living shorelines can reduce shoreline erosion rates while providing habitat benefits.

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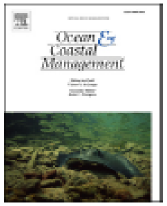

Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane

Rachel K. Gittman [a,*], Alyssa M. Popowich [a,1], John F. Bruno [b], Charles H. Peterson [a,b]

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ABSTRACT

Acting on the perception that they perform better for longer, most property owners in the United States choose hard engineered structures, such as bulkheads or riprap revetments, to protect estuarine shorelines from erosion. Less intrusive alternatives, specifically marsh plantings with and without sills, have the potential to better sustain marsh habitat and support its ecosystem services, yet their shoreline protection capabilities during storms have not been evaluated. In this study, the performances of alternative shoreline protection approaches during Hurricane Irene (Category 1 storm) were compared by 1) classifying resultant damage to shorelines with different types of shoreline protection in three NC coastal regions after Irene; and 2) quantifying shoreline erosion at marshes with and without sills in one NC region by using repeated measurements of marsh surface elevation and marsh vegetation stem density before and after Irene. In the central Outer Banks, NC, where the strongest sustained winds blew across the longest fetch; Irene damaged 76% of bulkheads surveyed, while no damage to other shoreline protection options was detected. Across marsh sites within 25 km of its landfall, Hurricane Irene had no effect on marsh surface elevations behind sills or along marsh shorelines without sills. Although Irene temporarily reduced marsh vegetation density at sites with and without sills, vegetation recovered to pre-hurricane levels within a year. Storm responses suggest that marshes with and without sills are more durable and may protect shorelines from erosion better than the bulkheads in a Category 1 storm. This study is the first to provide data on the shoreline protection capabilities of marshes with and without sills relative to bulkheads during a substantial storm event, and to articulate a research framework to assist in the development of comprehensive policies for climate change adaptation and sustainable management of estuarine shorelines and resources in U.S. and globally.

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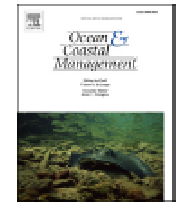

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nature climate change

LETTERS

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Oyster reefs can outpace sea-level rise

Antonio B. Rodriguez[1*], F. Joel Fodrie[1], Justin T. Ridge[1], Niels L. Lindquist[1], Ethan J. Theuerkauf[1], Sara E. Coleman[1], Jonathan H. Grabowski[2], Michelle C. Brodeur[1], Rachel K. Gittman[1], Danielle A. Keller[1] and Matthew D. Kenworthy[1]

In the high-salinity seaward portions of estuaries, oysters seek refuge from predation, competition and disease in intertidal areas[1,2], but this sanctuary will be lost if vertical reef accretion cannot keep pace with sea-level rise (SLR). Oyster-reef abundance has already declined ~85% globally over the past 100 years, mainly from over harvesting[3,4], making any additional losses due to SLR cause for concern. Before any assessment of reef response to accelerated SLR can be made, direct measures of reef growth are necessary. Here, we present direct measurements of intertidal oyster-reef growth from cores and terrestrial lidar-derived digital elevation models. On the basis of our measurements collected within a mid-Atlantic estuary over a 15-year period, we developed a globally testable empirical model of intertidal oyster-reef accretion. We show that previous estimates of vertical reef growth, based on radiocarbon dates and bathymetric maps[5,6], may be greater than one order of magnitude too slow. The intertidal reefs we studied should be able to keep up with any future accelerated rate of SLR (ref. 7) and may even benefit from the additional subaqueous space allowing extended vertical accretion.

conservation success, quantify the ecosystem services provided, and forecast impacts of climate change and SLR on oysters and other reef-forming shellfish species is impeded.

Although an oyster reef hosts a variety of organisms, reef structure is primarily composed of the biogenic sediment of oysters, including skeletal shell material and biodeposits[2,5,18,19] and allogenic sediment (for example, from resuspension, shoreline erosion and river discharge). Reef structure is controlled largely by reef accretion rates and erosion rates. Reef accretion is the result of sediment inputs including oyster-shell production, biodeposition and allogenic sediment, whereas reef erosion is mainly a function of bioerosion, dissolution, predation and hydrodynamic processes (Supplementary Fig. 1). Allogenic sedimentation contributes to reef accretion; however, if the sedimentation rate is too high, reef structure will be lost owing to burial and a decrease in oyster-shell production through a reduction in oyster settlement, survival and growth[20,21].

To investigate reef composition and growth, we examined cores collected in 2010–2011 from five intertidal experimental reefs constructed on sandflats in 1997 ($n=3$) and 2000 ($n=2$) in a coastal marine research reserve (Methods). Experimental reefs developed nature climate change

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Oyster Reefs as Natural Breakwaters Mitigate Shoreline Loss and Facilitate Fisheries

Steven B. Scyphers, Sean P. Powers, Kenneth L. Heck Jr, Dorothy Byron

Published: August 5, 2011 • http://dx.doi.org/10.1371/journal.pone.0022396

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Abstract

Shorelines at the interface of marine, estuarine and terrestrial biomes are among the most degraded and threatened habitats in the coastal zone because of their sensitivity to sea level rise, storms and increased human utilization. Previous efforts to protect shorelines have largely involved constructing bulkheads and seawalls which can detrimentally affect nearshore habitats. Recently, efforts have shifted towards "living shoreline" approaches that include biogenic breakwater reefs. Our study experimentally tested the efficacy of breakwater reefs constructed of oyster shell for protecting eroding coastal shorelines and their effect on nearshore fish and shellfish communities. Along two different stretches of eroding shoreline, we created replicated pairs of subtidal breakwater reefs and established unaltered reference areas as controls. At both sites we measured shoreline and bathymetric change and quantified oyster recruitment, fish and mobile macro-invertebrate abundances. Breakwater reef treatments mitigated shoreline retreat by more than 40% at one site, but overall vegetation retreat and erosion rates were high across all treatments and at both sites. Oyster settlement and subsequent survival were observed at both sites, with mean adult densities reaching more than eighty oysters m^{-2} at one site. We found the corridor between intertidal marsh and oyster reef breakwaters supported higher abundances and different communities of fishes than control plots without oyster reef habitat. Among the fishes and mobile invertebrates that appeared to be strongly enhanced were several economically-important species. Blue crabs (*Callinectes sapidus*) were the most clearly enhanced (+297%) by the presence of breakwater reefs, while red drum (*Sciaenops ocellatus*) (+108%), spotted seatrout (*Cynoscion nebulosus*) (+88%) and flounder (*Paralichthys* sp.) (+79%) also benefited. Although the vertical relief of the breakwater reefs was reduced over the course of our study and this compromised the shoreline protection capacity, the observed habitat value demonstrates ecological justification for future, more robust shoreline protection projects.

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Review

Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems

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[b] *University of Maryland, Cooperative Institute for Climate and Satellites, Earth System Science Interdisciplinary Center and National Ocean Service, NOAA, Silver Spring, MD 20910, United States*
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ABSTRACT

There is substantial evidence that natural infrastructure (i.e., healthy ecosystems) and combinations of natural and built infrastructure ("hybrid" approaches) enhance coastal resilience by providing important storm and coastal flooding protection, while also providing other benefits. There is growing interest in the U.S., as well as around the world, to use natural infrastructure to help coastal communities become more resilient to extreme events and reduce the risk of coastal flooding. Here we highlight strengths and weaknesses of the coastal protection benefits provided by built infrastructure, natural ecosystems, and the innovative opportunities to combine the two into hybrid approaches for coastal protection. We also examine some case studies where hybrid approaches are being implemented to improve coastal resilience as well as some of the policy challenges that can make implementation of these approaches more difficult. The case studies we examine are largely in the U.S. but also include a couple of international examples as well. Based on this analysis, we conclude that coastal communities and other decision makers need better information in order to incorporate ecosystem protection and restoration into coastal resilience planning efforts. As additional projects are developed, it is important to capitalize on every opportunity to learn more about the cost of natural and hybrid infrastructure projects, the value of the storm and erosion protection benefits provided, and the full suite of co-benefits provided by healthy coastal ecosystems. We highlight top priorities for research, investment in, and application of natural and hybrid approaches. These data are critical to facilitate adoption of these approaches in planning and decision-making at all levels to enhance the resilience of our coasts.

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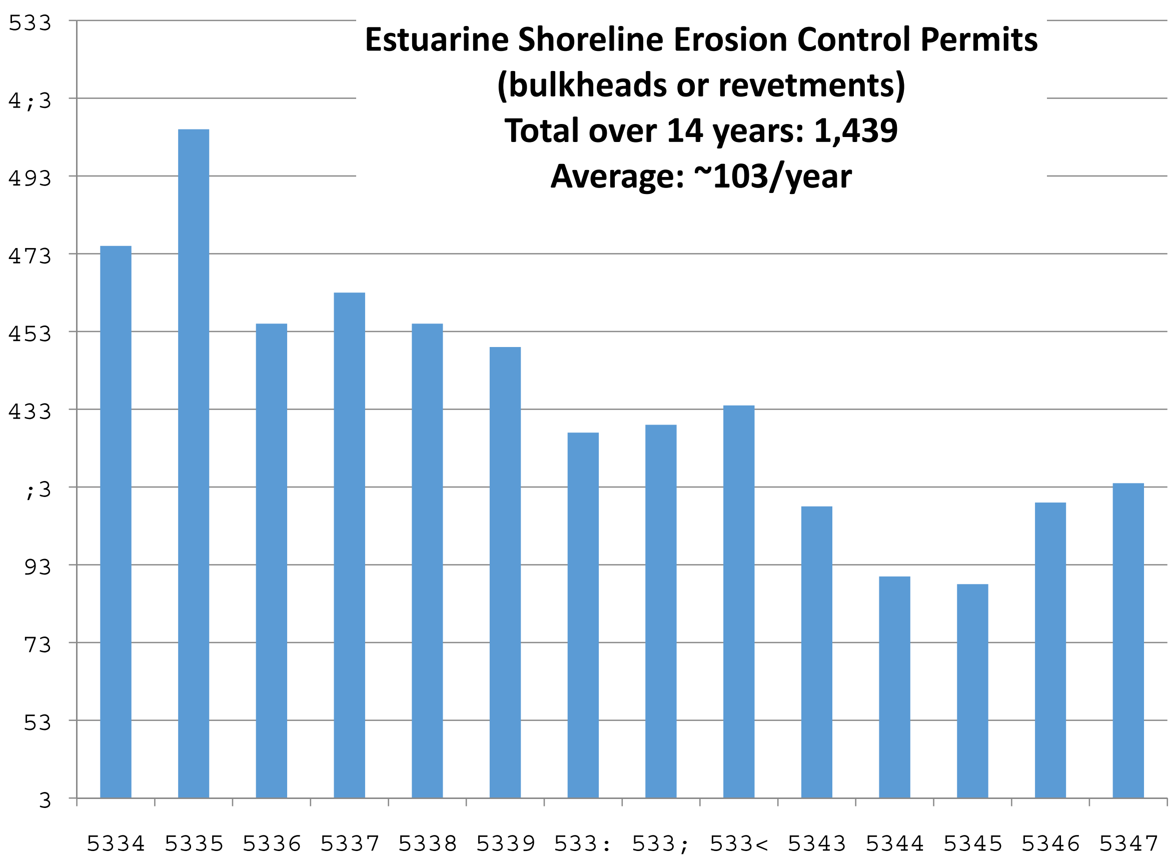
State Permitting (DHEC-OCRM)

- Currently in SC, no regulations or guidance specific to living shorelines
- Lack of regulations results in longer review times and uncertainties about project performance (reviewed under erosion control structure regulations)
- Bulkhead and revetment permits can be obtained relatively easily because design criteria are well-known
- No permit required for research activities of State agencies and educational institutions

Shoreline Armoring Trends



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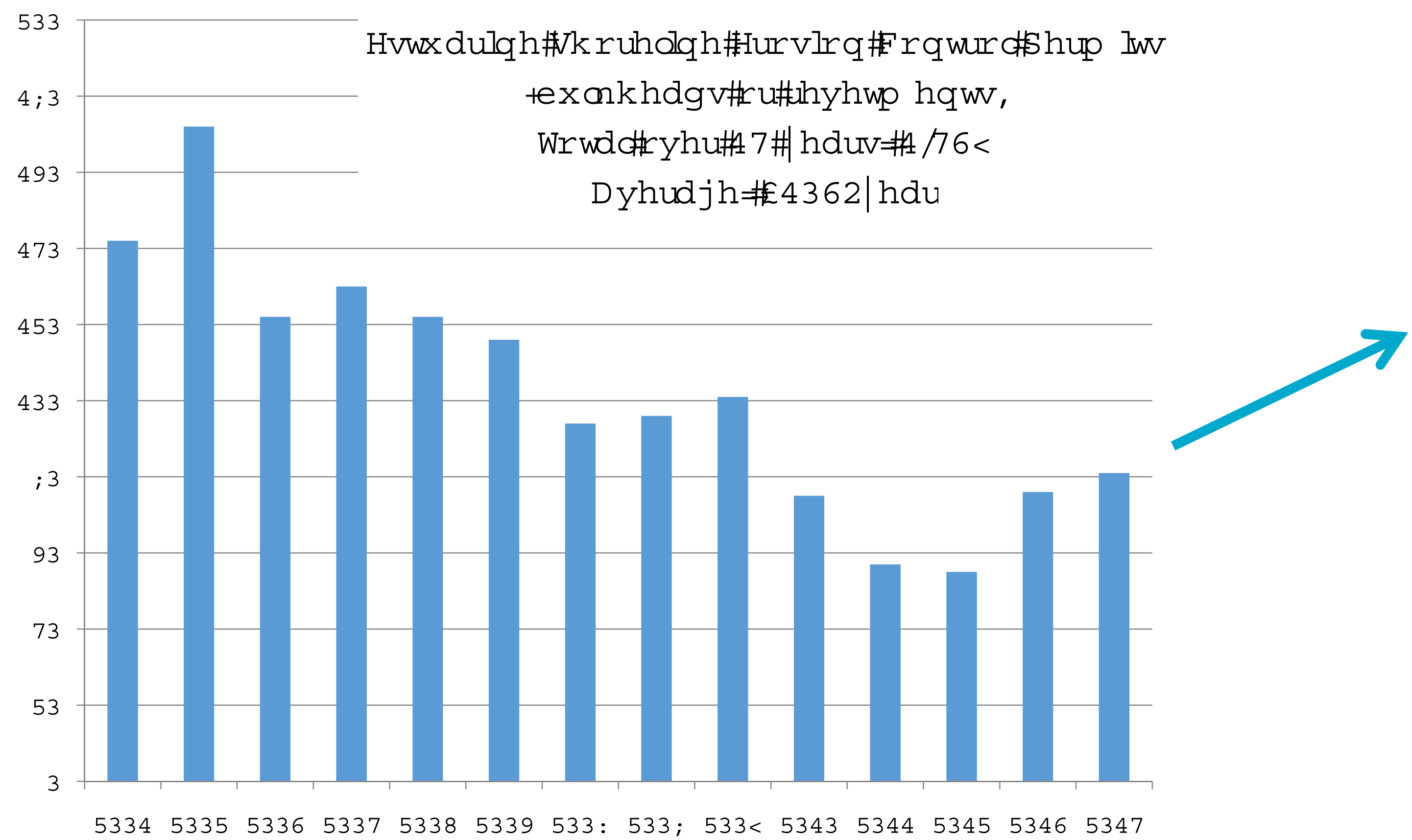

Increasing Interest in Living Shorelines

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Increasing Interest in Living Shorelines

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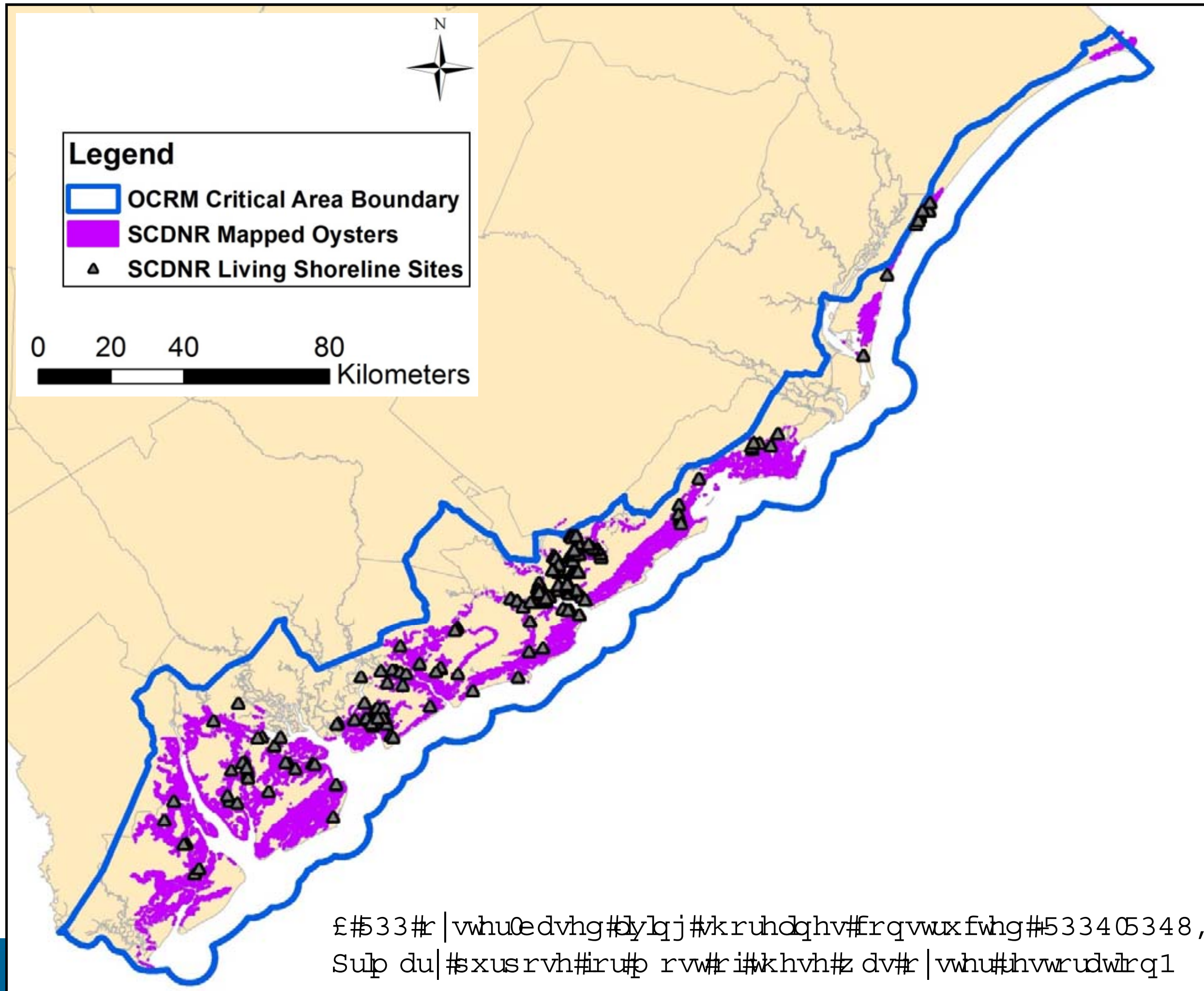
SC DNR Living Shoreline Sites



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