Sustainable shorescapes: reconnecting land and water

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Shoreline management

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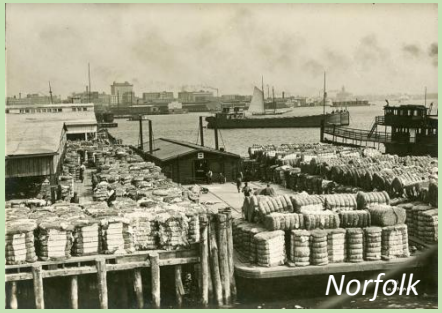
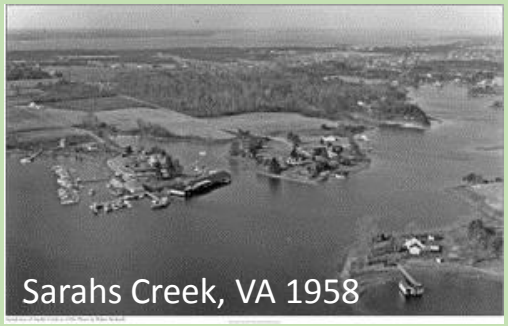
Estuarine shoreline management – Chesapeake Bay

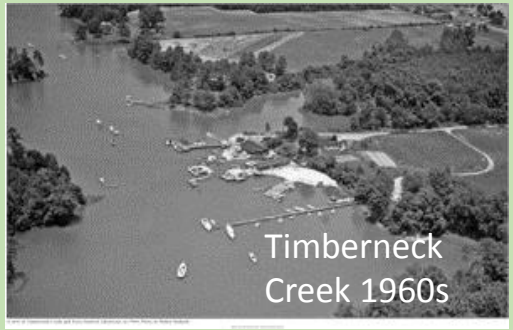
Anything goes:

- Post-colonial: Shoreline development was largely restricted to urban centers or wharves/ports



- Post-WWII: More leisure time and people began creating cottage communities along the Bay shores. With homes on the shore, shoreline protection became a need.



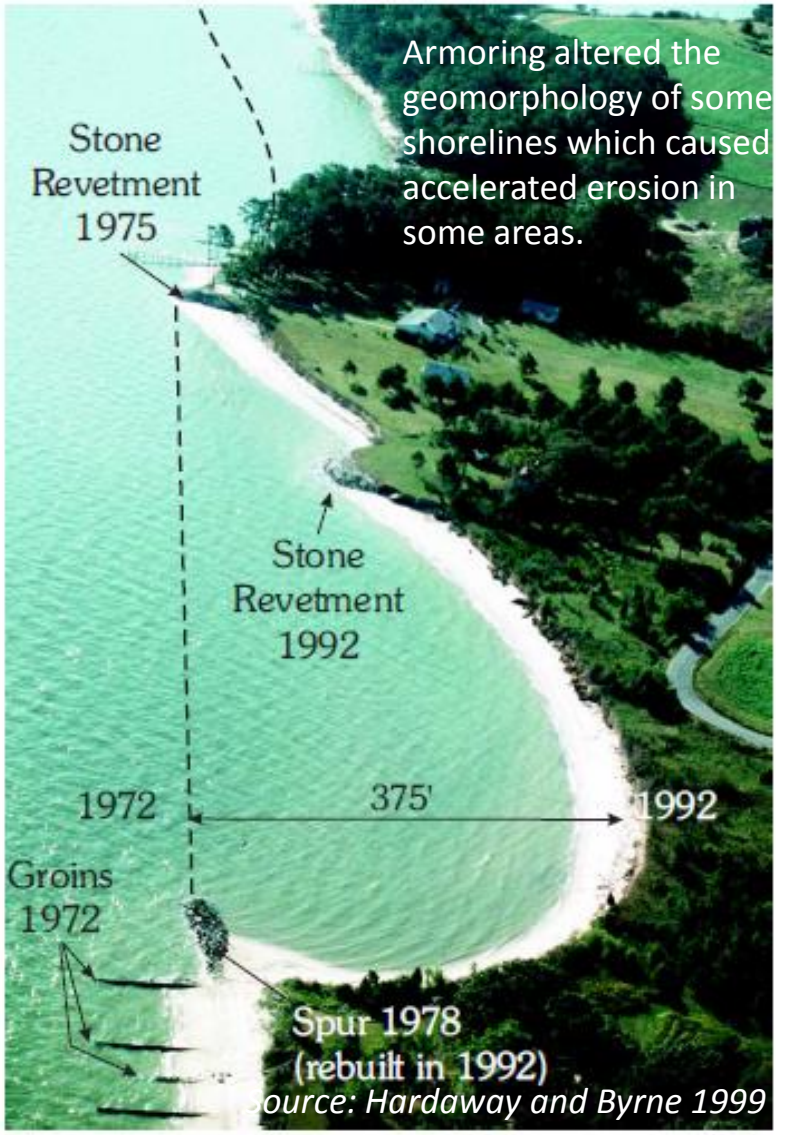


Some things no longer go:

1970s: Environmental movement – big shift with Tidal Wetlands Acts

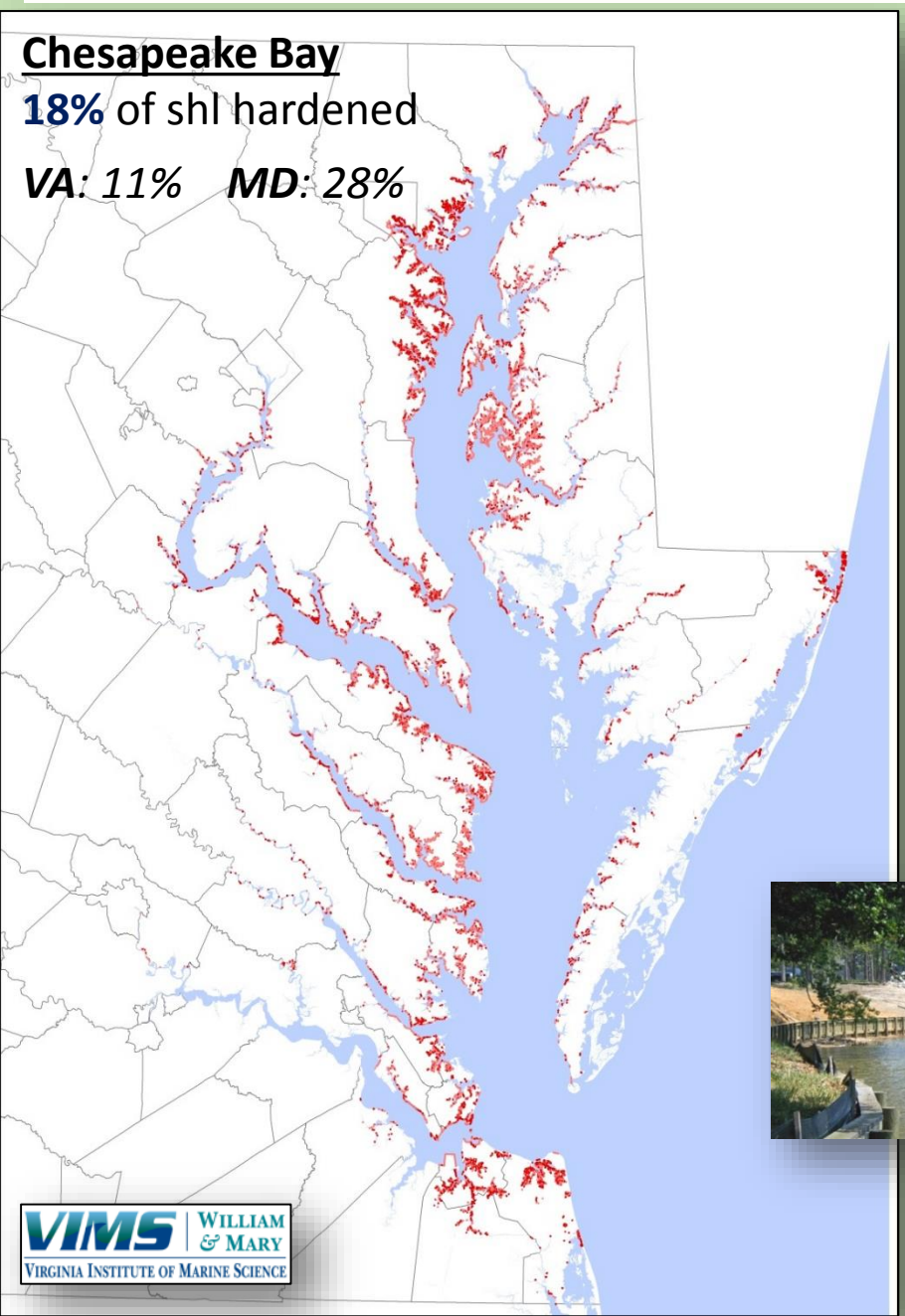
2008 (MD), 2011 (VA): Living Shorelines Acts

2015-now: General permits & low interest loan programs developed to incentivize Living shorelines



Shoreline evolution in Northumberland County, Va. Note: Groin field in foreground was upland in early 1970s. Spiral shaped embayment formed between the groin field built in 1972 and a revetment installed in 1975 such that the maximum offset was 375 feet by 1992.

The problem with shoreline armoring



- Habitat loss & fragmentation – forest, wetlands [1]
- Sediment supply & transport altered, increased scouring, turbidity [2]
- Increase in invasive species [3]
- Declines in fish, invertebrate, & marsh bird diversity, terrapin presence [4]
- Prevents natural migration of habitats with SLR
- Decline in seagrass resilience [5]

[1] Peterson and Lowe 2009; Dugan et al 2011, [2] Bozek and Burdick 2005, NRC 2007, [3] Chambers et al 1999, [4] Peterson et al 2000, Chapman 2003, King et al 2005, Bilkovic et al 2006, Seitz et al 2006, Bilkovic & Roggero 2008, Morley et al 2012, Isdell et al. 2015, Kornis et al. 2017a,b [5]Patrick et al. 2014

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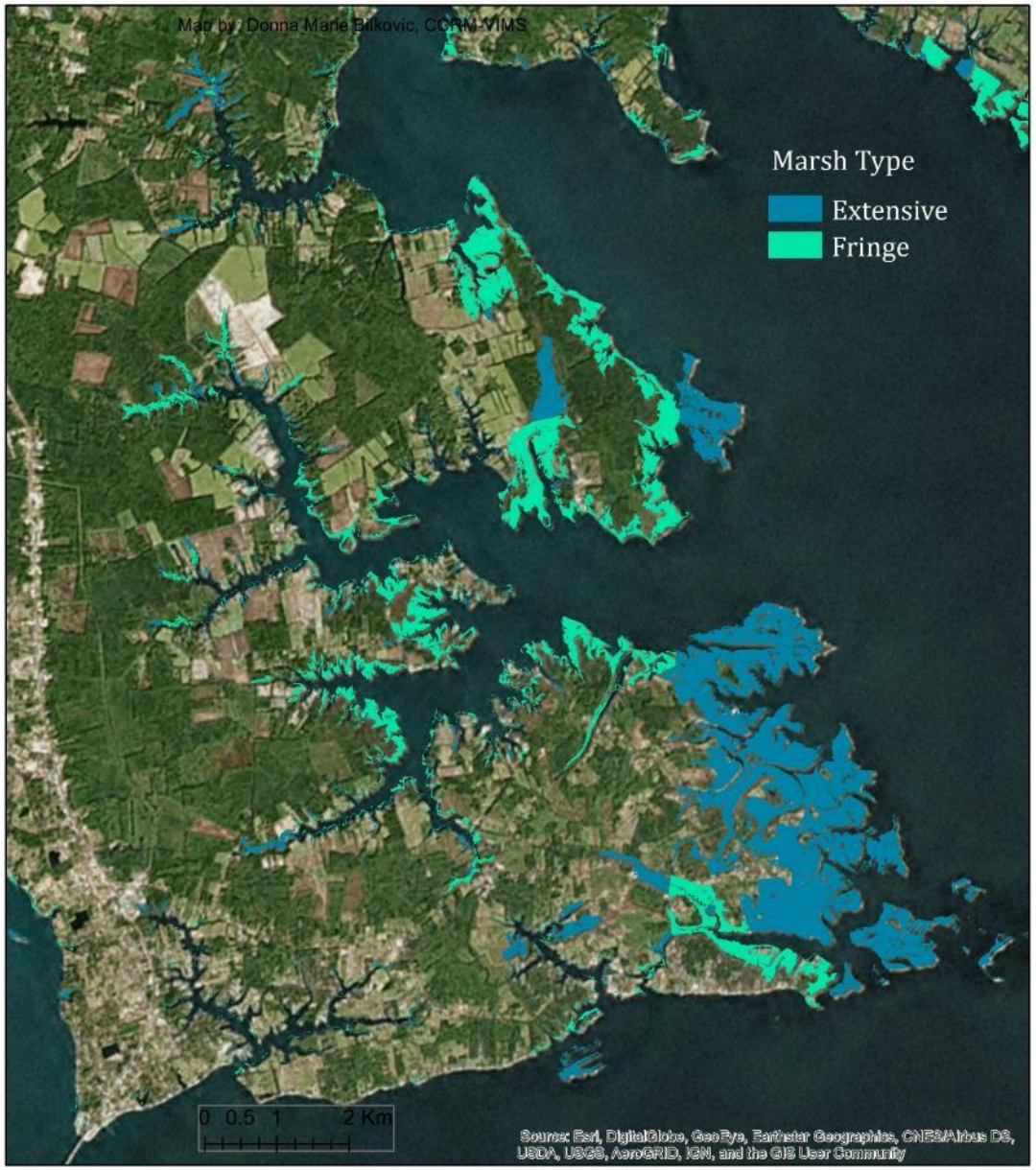
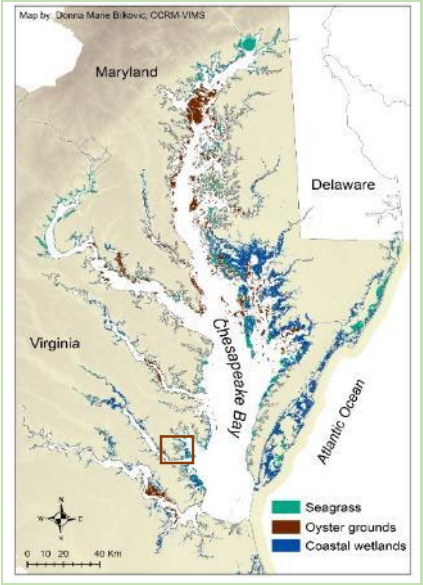
Fringing marsh vulnerability and value



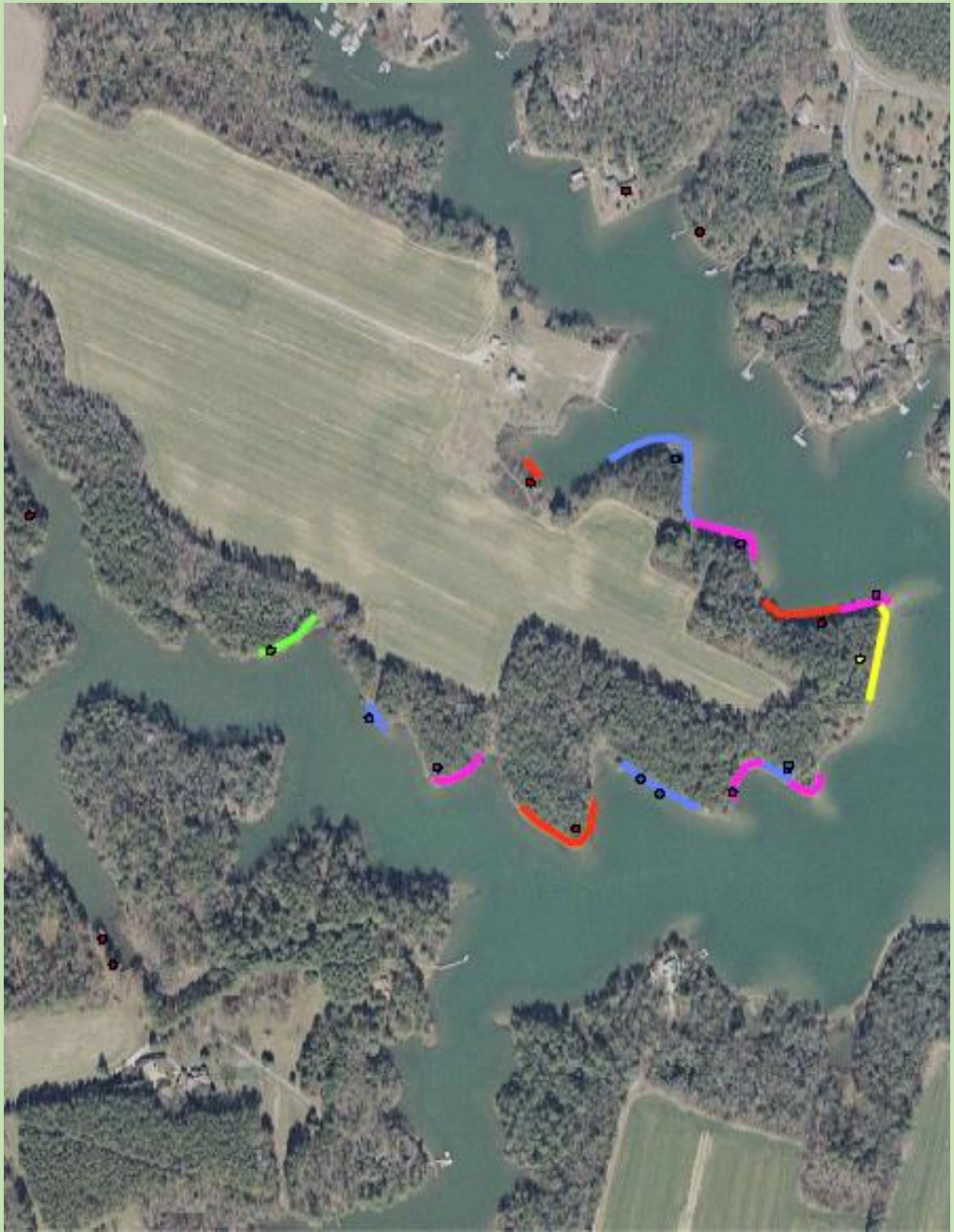


Ecosystem services include:

Attenuate waves
Trap sediment
Support fish & invertebrates
Nitrogen removal
Connectivity

Cumulative impacts of shorescape development

Permit requests for shoreline armoring



2003

2004

2005

2006

2007

A total of 18 Joint Permit Applications received

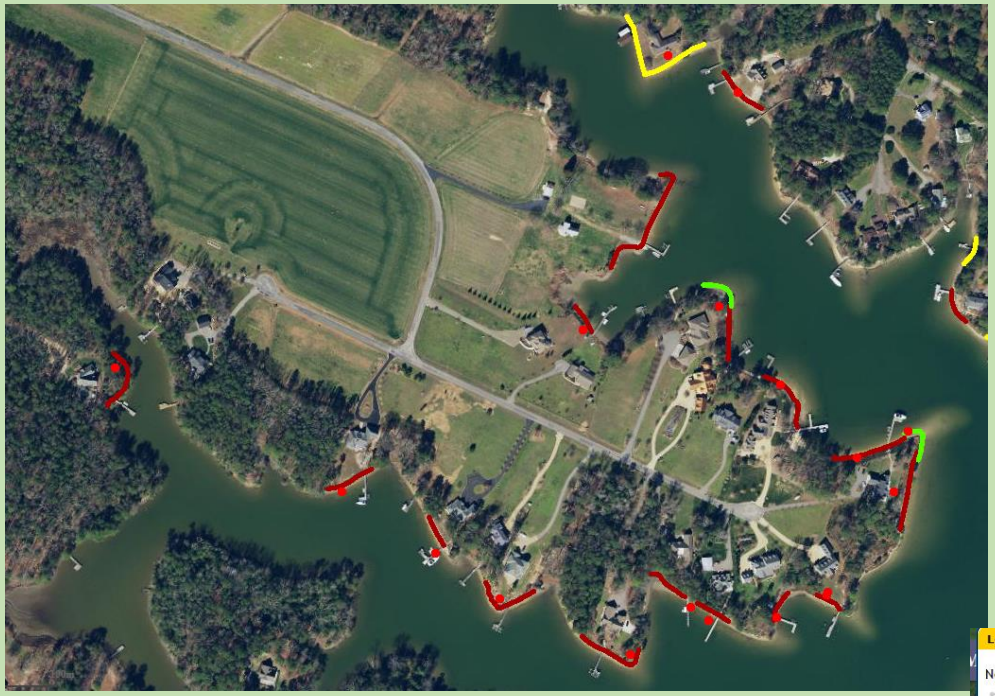
Cumulative habitat loss and shoreline fragmentation

Hardened shoreline = 3,218 ft

Wetland loss: 1158 ft^2 vegetated, 5000 ft^2 non-vegetated

Functional loss is unknown

Must pro-actively plan entire communities

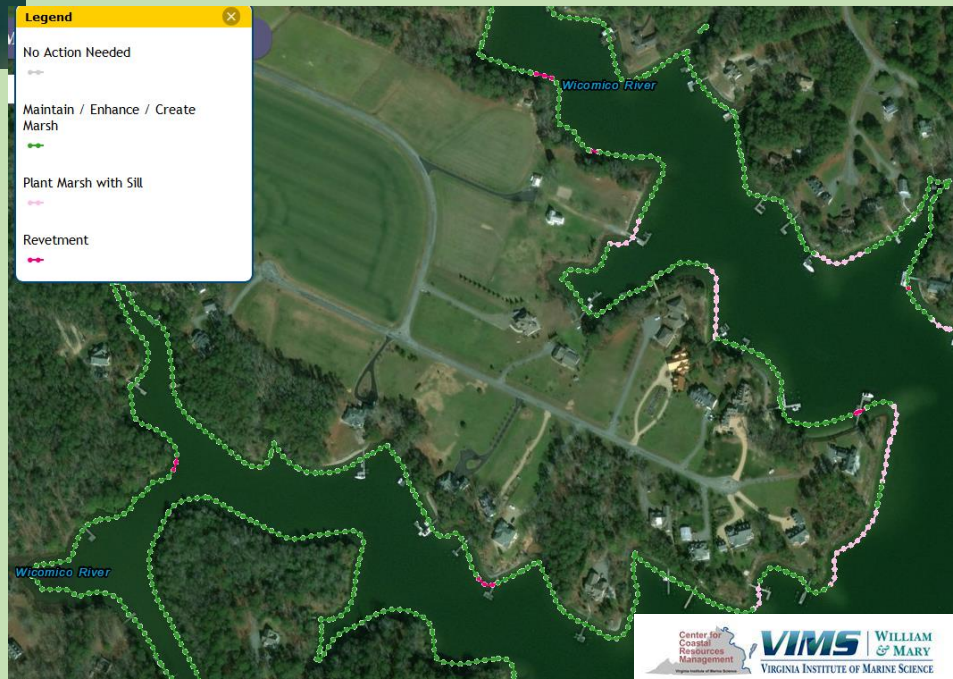


Traditional shoreline management approach

- 0.6 mi of armoring
- loss of tidal marsh over the majority of the peninsula
- Loss of current and future load reduction opportunities

Preferred shoreline management approach

- Living shorelines – created or maintained marshes were suitable for the vast majority of the shoreline that was armored
- Conservation and/or gain of load reduction opportunities



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Continuum of shoreline protection approaches

Estuarine & coastal shorelines


Eastern Shore: The Virginia Coast Reserve


Tabbs Creek, VA

Nature-based protection


Created marsh


Oyster-sill


Marsh-sill

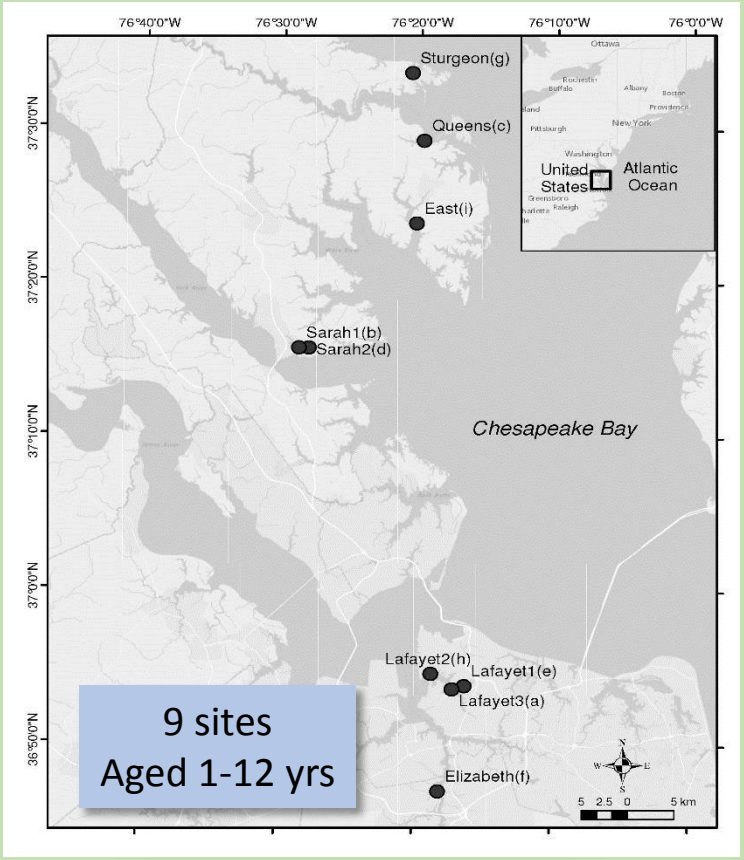

Breakwater-beach

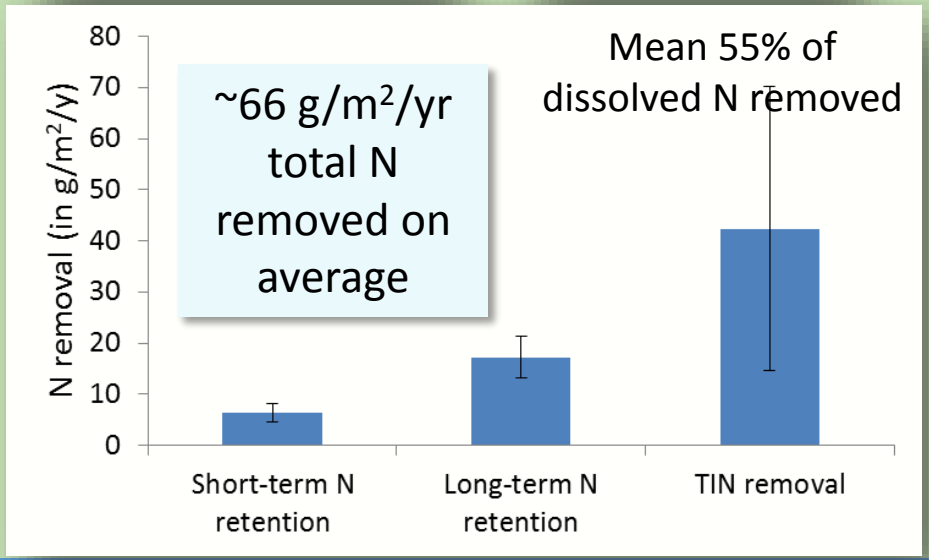
Hardened shorelines


Bulkhead

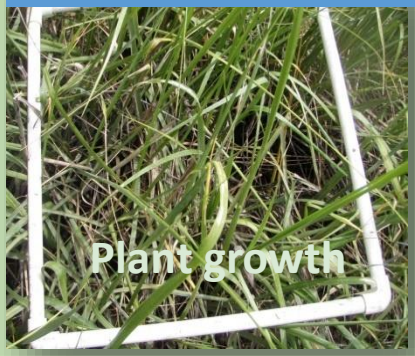

Riprap Revetment

Living shorelines and TMDL reductions in nutrients



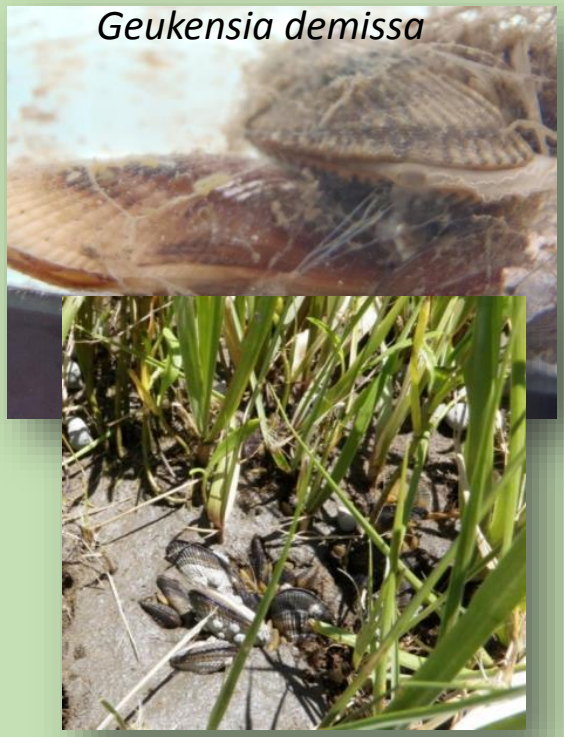


Ways marshes remove nutrients

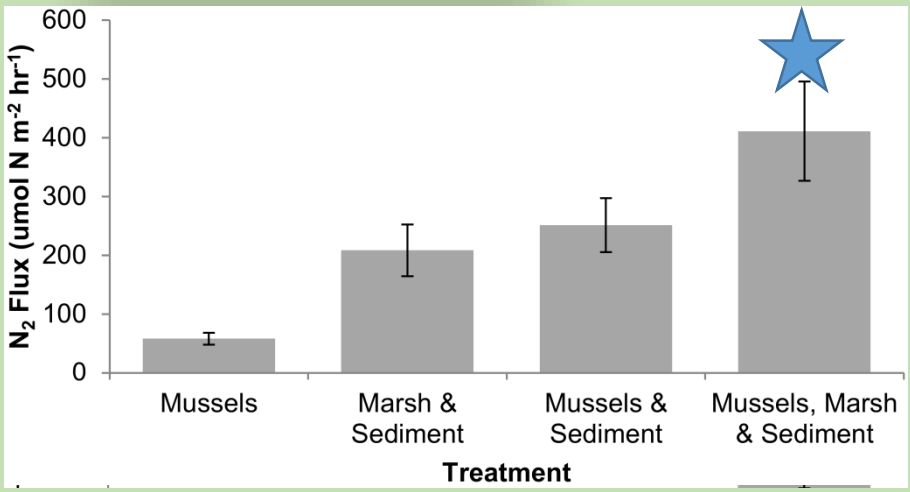


Beck et al. 2017

Predominant salt marsh bivalve, ribbed mussel, enhances nitrogen removal



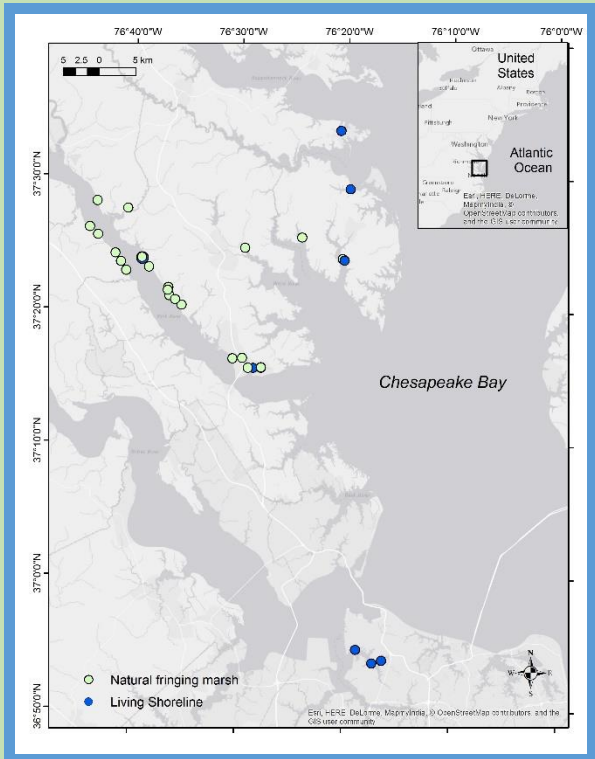
- Widespread: MA to FL
- Salinity preference ~8-30ppt
- Settle in aggregates around marsh plants
- Accrete sediment
- Promote growth in indigenous marsh plants (*Spartina alterniflora*)
- Efficient filter feeders- able to forage on small bacterioplankton
- *Enhance marsh nitrogen removal?*



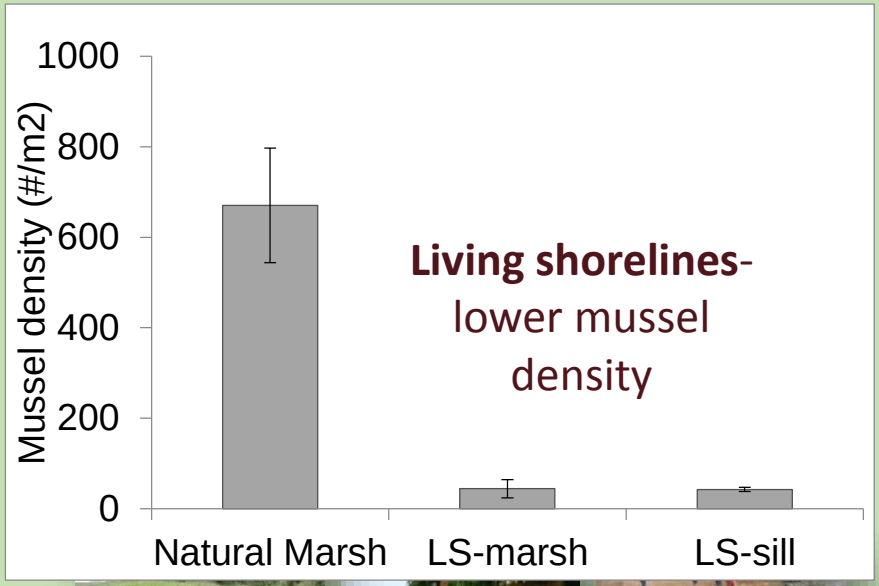
Mean N_2 fluxes (net denitrification) were significantly higher in the "whole ecosystem"

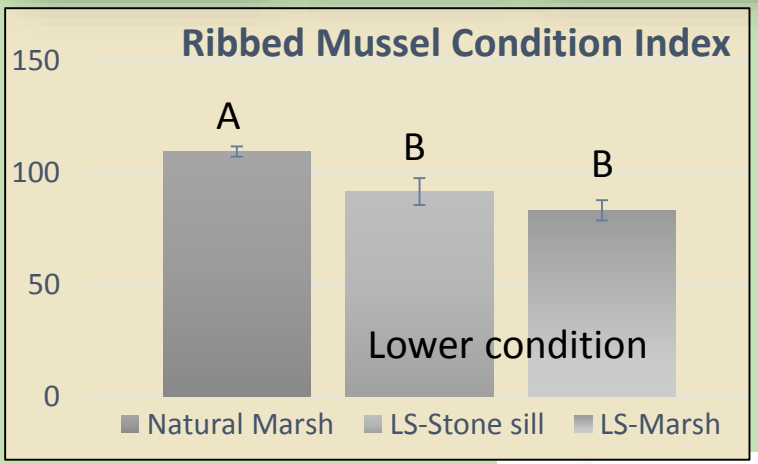
Bilkovic et al. 2017, Ecosphere

Ribbed mussels and living shorelines



Surveyed 9 marsh-stone sills & 15 natural fringing marshes (2012-2016)





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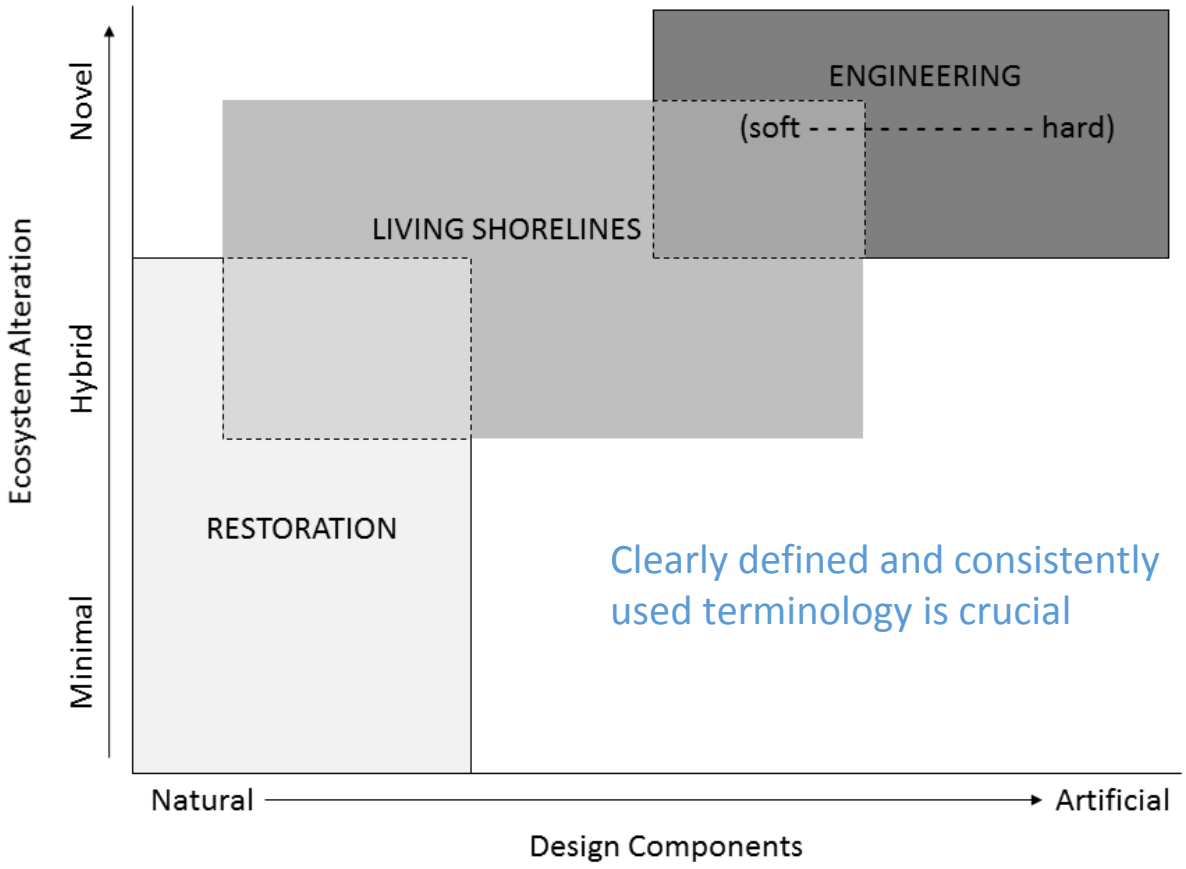
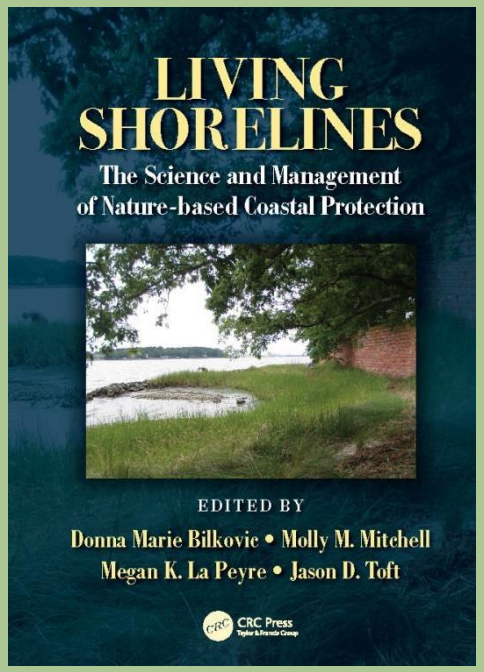
Living shorelines' place in restoration



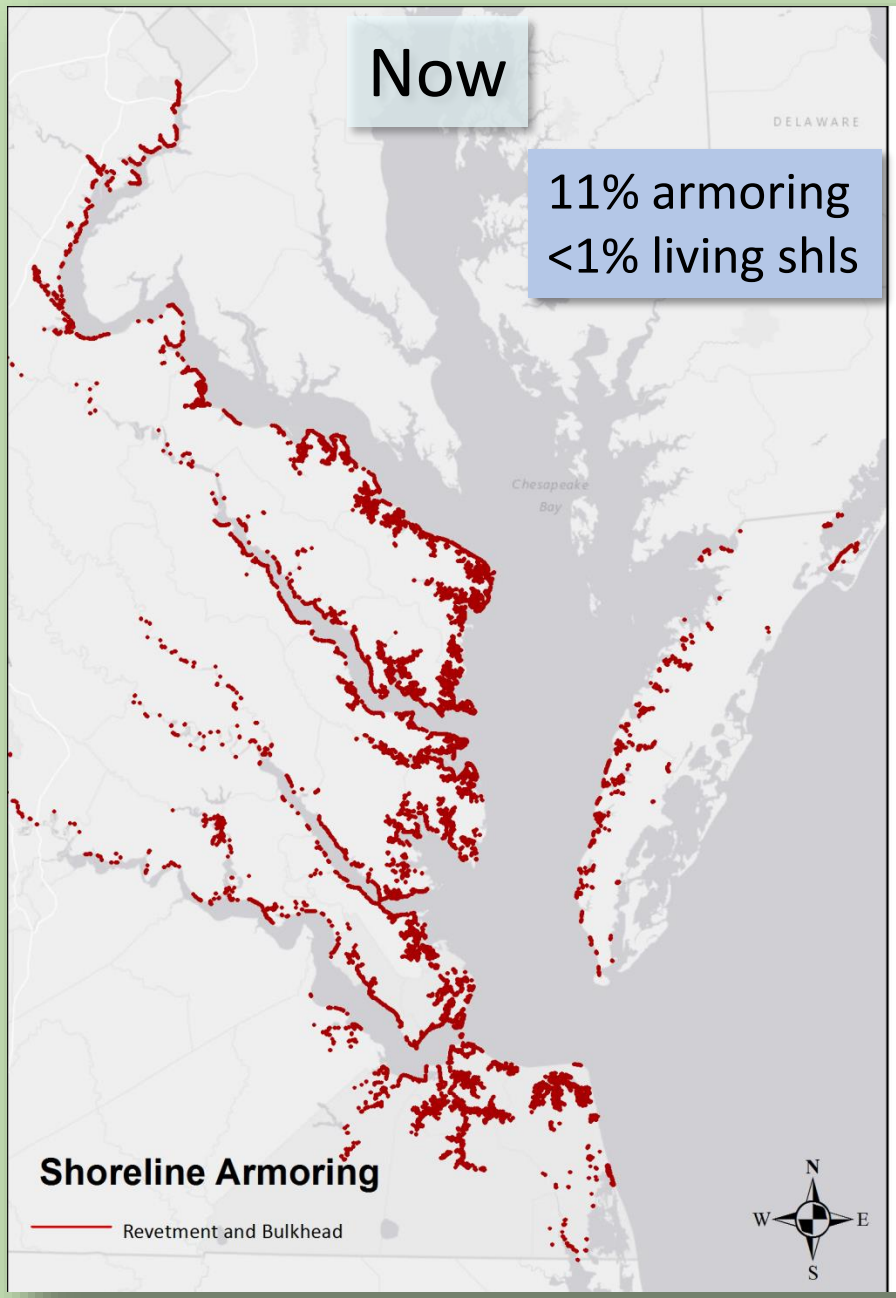
Clearly defined and consistently used terminology is crucial

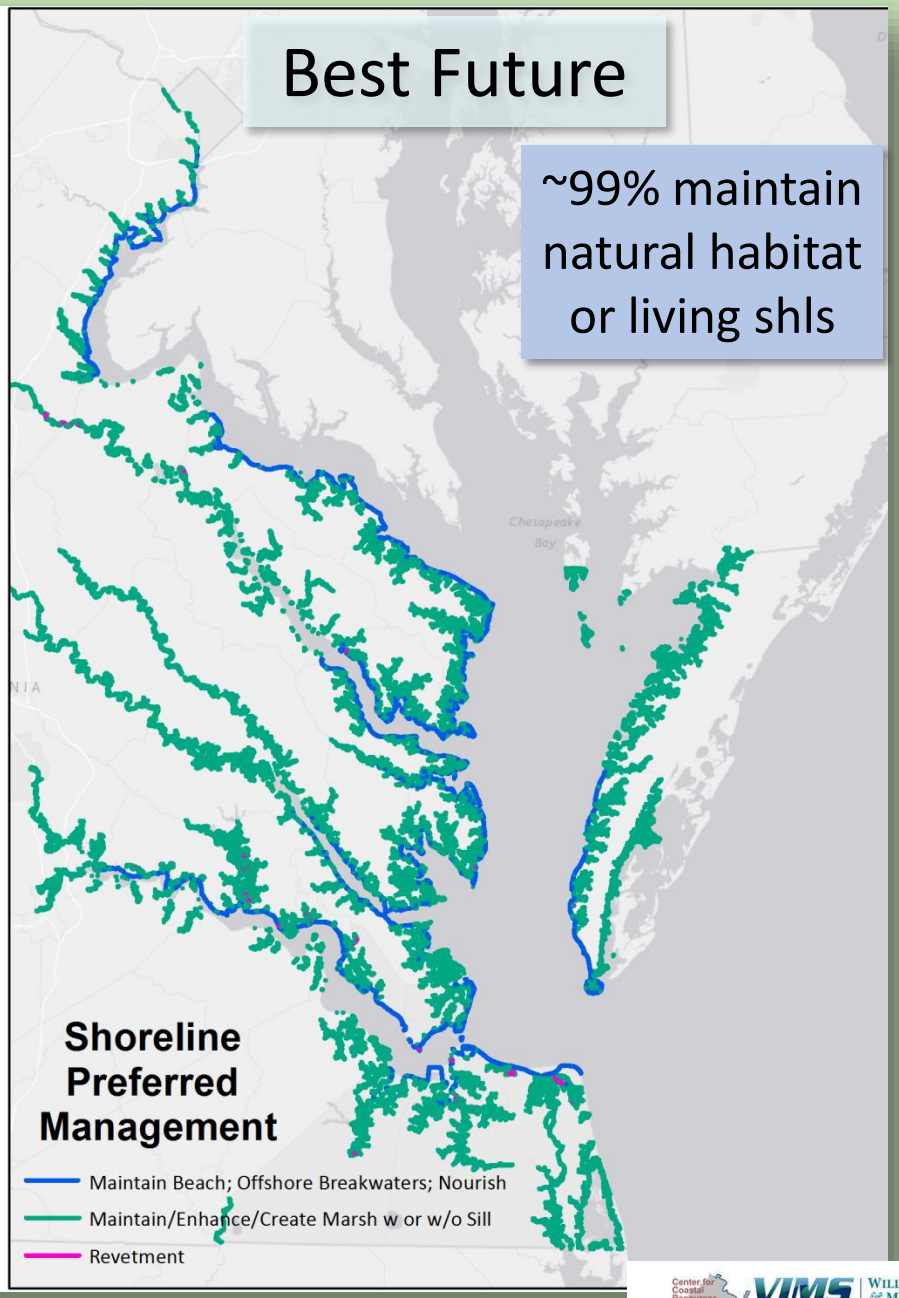


Toft et al. 2017. A synthesis of living shoreline perspectives. In *Living Shorelines: The Science and Management of Nature-based Coastal Protection, CRC Press*

Robert Isdell

Potential regional reach





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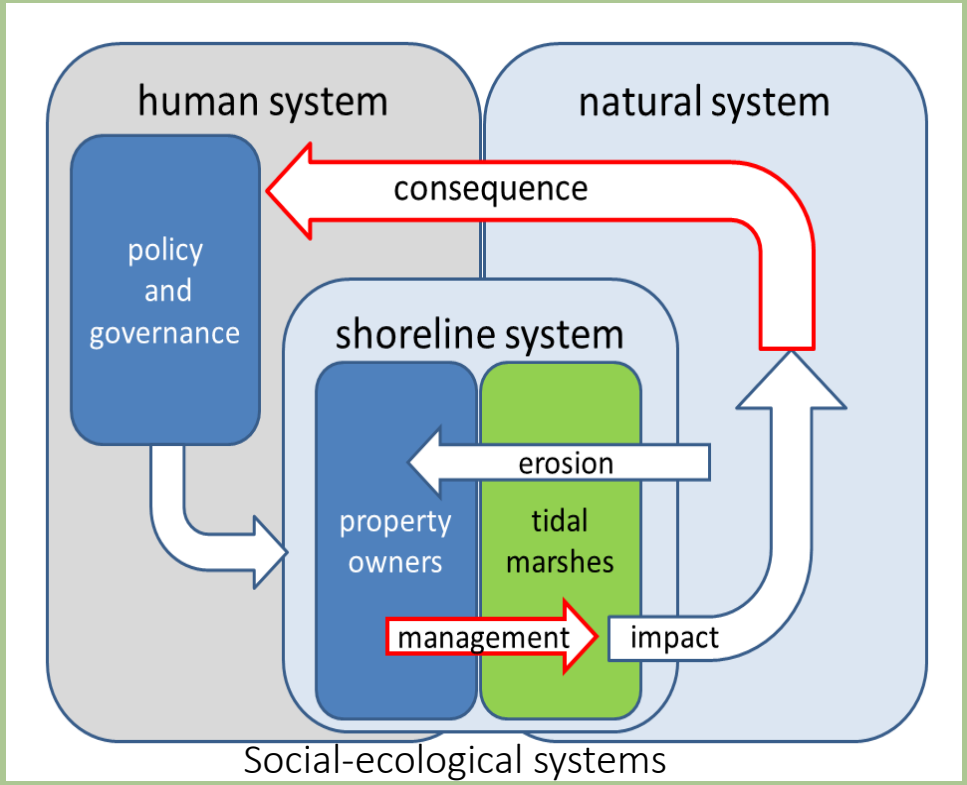
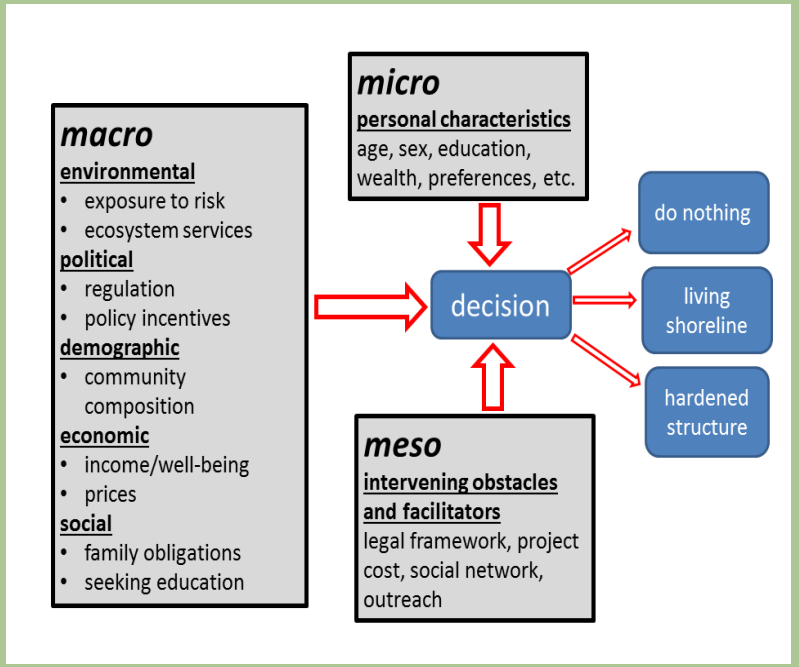
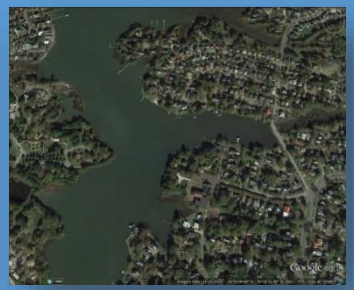
Sustainability in Chesapeake Bay shorescapes: climate change, management decisions, and ecological functions



Social-ecological systems

Identify the decision factors influencing both shoreline property owners and the policy/management personnel governing property owners





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What Drives Property Owners' Shoreline Management Choices?

Revealed preference shoreline management models

Analyze the property owners' management choice using Logit models combining: permit data, cadastral data, geographic features such as exposure to wind energy & storm surge

A Few First Findings:

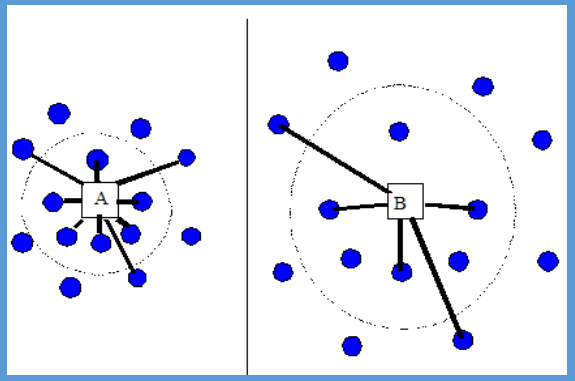
- Higher property value increases the likelihood of a modification, as do threats from hurricane storm surge and higher levels of wave energy

- Neighbor Effect: Property owners are more likely to install a specific type of modification if their neighbors have already installed that type.

Sarah Stafford, W&M

Social Network Modeling:

- Identify the networks of individual property owners (Egocentric model)
- Track flow of information (contractors, neighbors, etc)
- Use multi-level nested logit model to assess network and alter/ego characteristics that relate to shoreline decision making

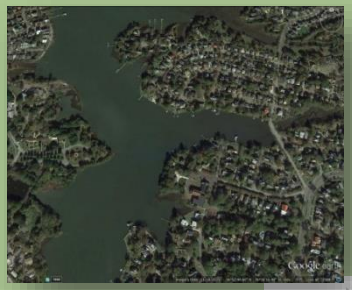


Amanda Guthrie, VIMS

Managing Shorescapes for Bay Restoration

Final triblet-related thoughts

- Shoreline management choices primarily occur at local scales, but cumulative local decisions likely to influence water quality and estuarine communities at larger scales
- Living shorelines can offset some marsh loss and improve water quality, particularly those populated with filter feeders
- The potential application of living shorelines is extensive, covering the majority of Bay shores.



Questions?

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THANK YOU!

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