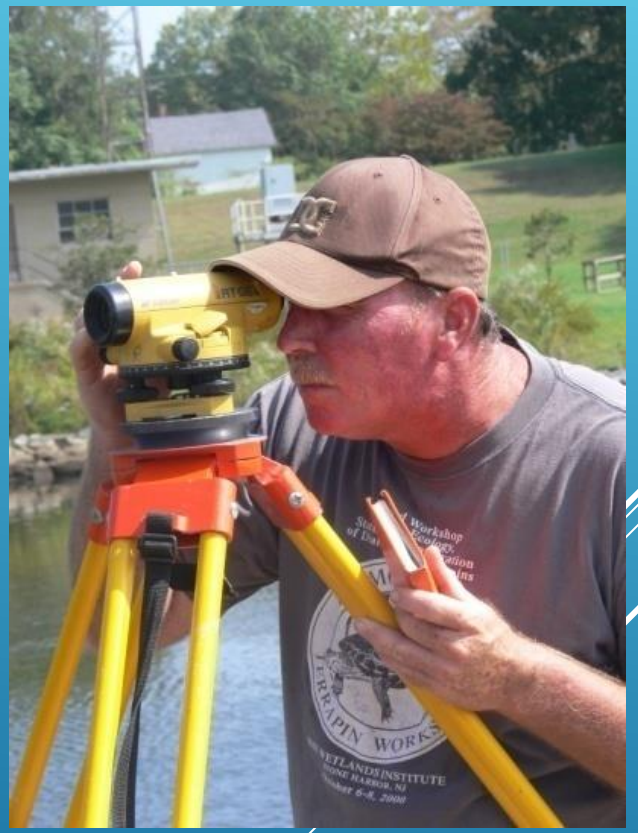
Monitoring Nature-Based Projects in Maryland

Bhaskaran Subramanian

May 25, 2022

THREE MONITORING EFFORTS…

- 2006-07: Monitoring Living Shoreline Projects
  - 200+ LS projects were monitored
  - Biological and physical assessment
  - Findings were incorporated into the Living Shorelines Law of Maryland
- SAGE Community of Practice (CoP)
  - Post-Superstorm Sandy (2012-till now)
  - Natural Infrastructure Metrics Workgroup
- Resiliency through Restoration Initiative
  - 2017- Maryland's efforts
  - Community resiliency projects



MONITORING LIVING SHORELINE PROJECTS IN MARYLAND

Living Shorelines

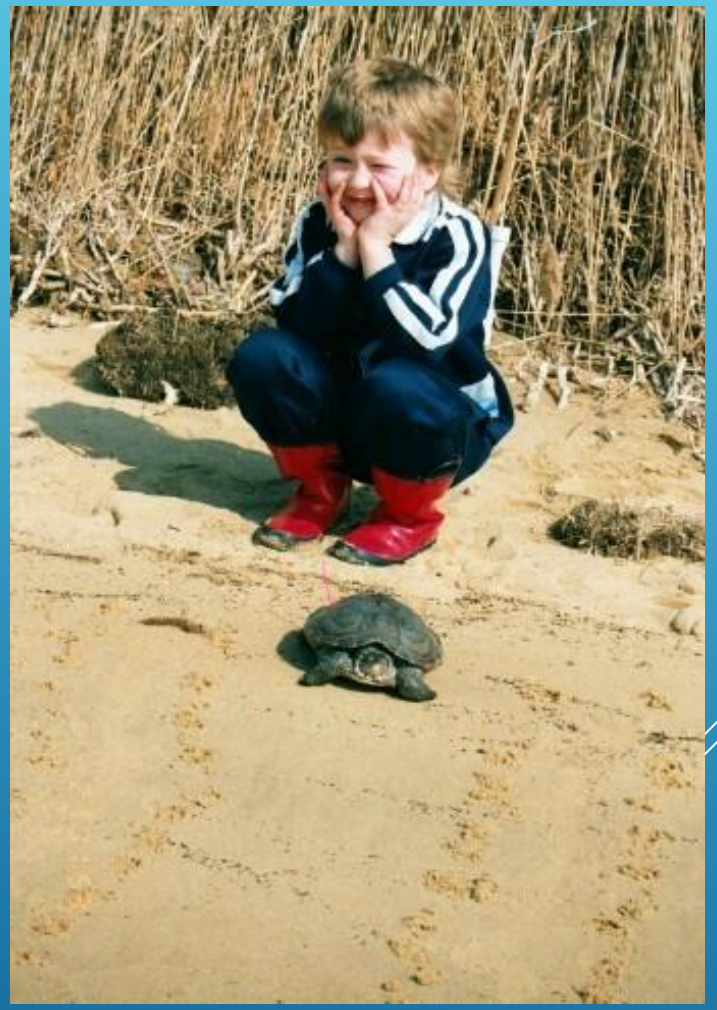
*"…… a suite of techniques which can be used to **minimize** coastal erosion and **maintain** coastal process".- MD DNR*

Techniques may include the use of fiber coir logs, sills, groins, breakwaters or other natural components used in combination with sand, other natural materials and/or marsh plantings.

These techniques are used to **protect**, **restore**, **enhance** or **create** natural shoreline habitat.

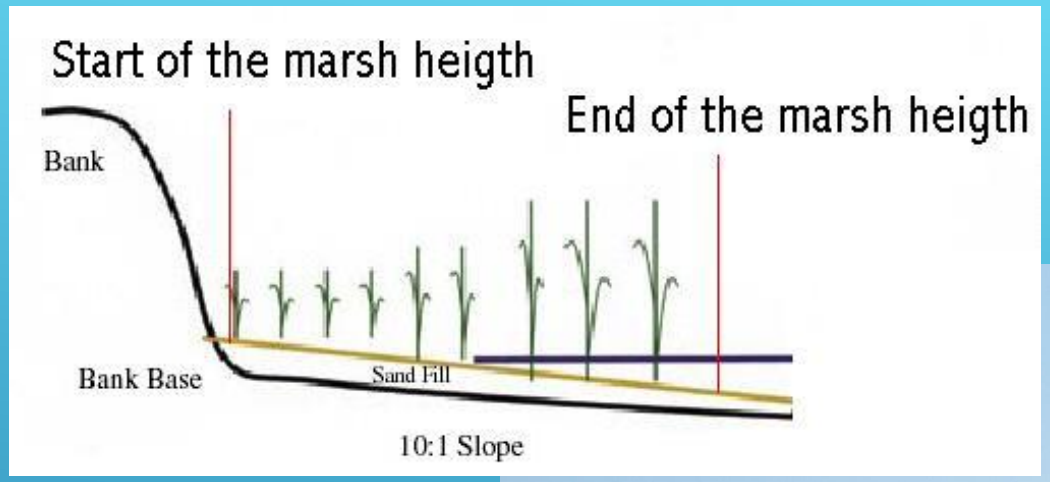
ASSESSMENT STUDY

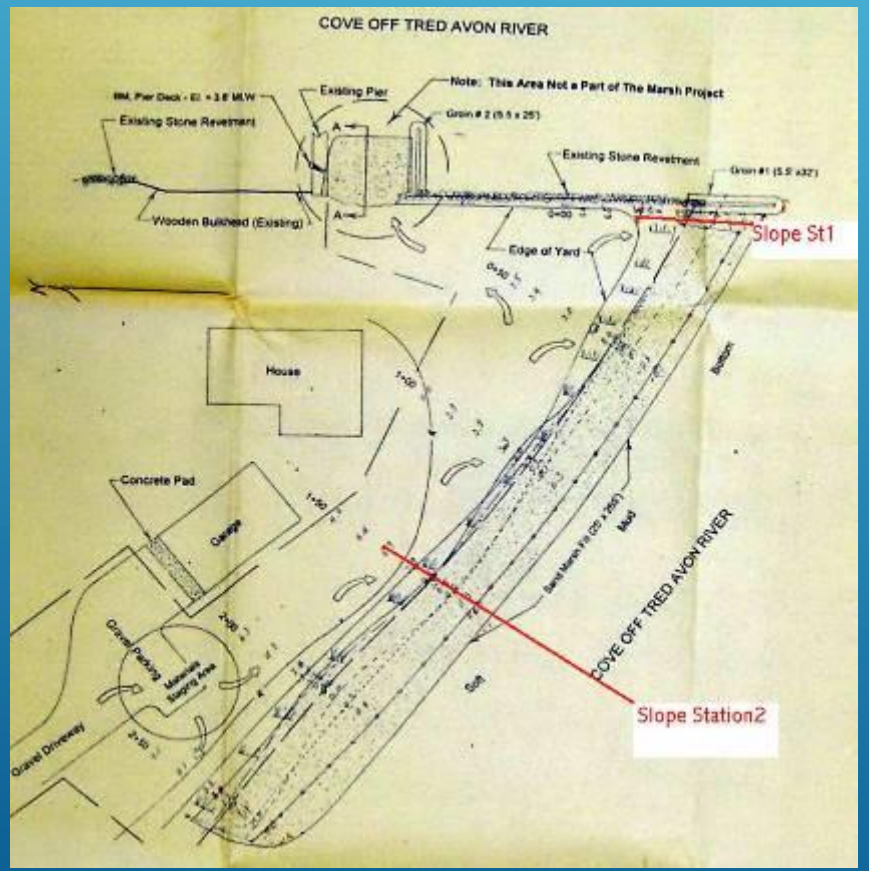
- Attributes analyzed:
  - Marsh erosion
  - Structure condition
  - Non-planted vegetation



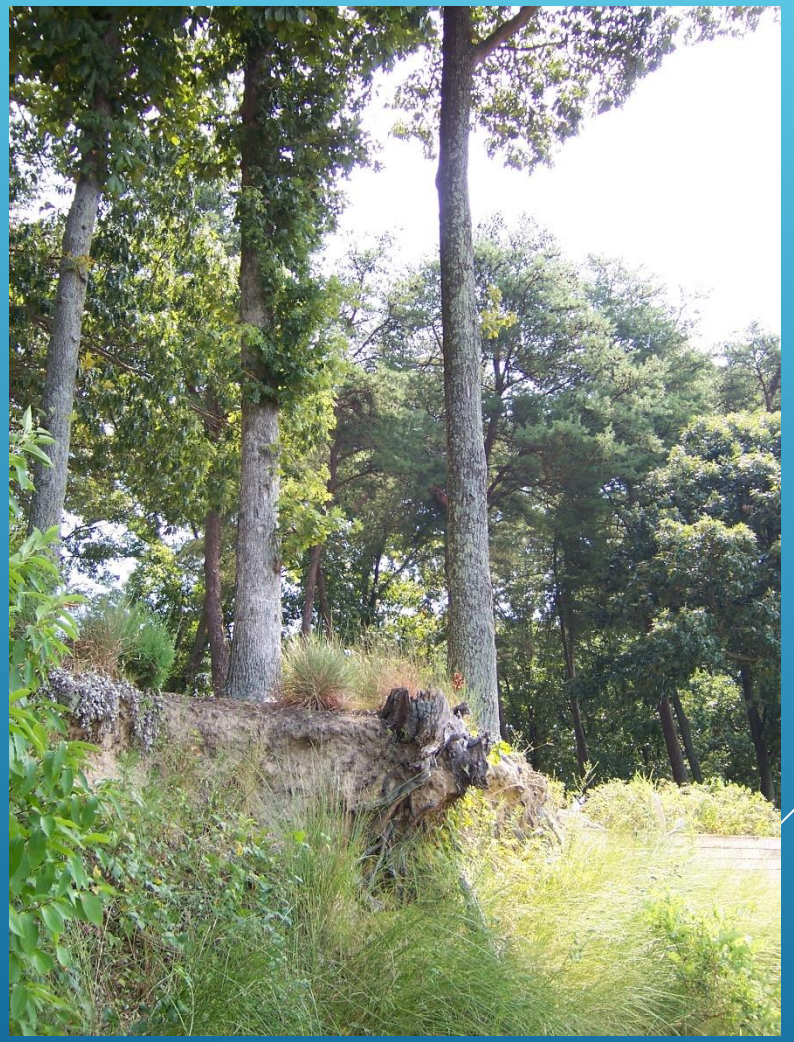
FIELD ASSESSMENT

- **Bank condition**: Undercut, Slumping or Stable
- **Percentage affected by the Bank condition**: 0-25, 25-50, 50-75 or 75-100%.
- **Marsh erosion**: Percentage of linear feet of the marsh which is being eroded currently: 0-25, 25-50, 50-75 or 75-100%.
- **Slope stations**: measure of the current slope at a particular point.
- **Slope difference**: Conclusion after comparing current and as-built slope
- **Structure condition**: Poor, fair, Good, Very good and Excellent Sinking or None.
- **Specific conditions of the structure**: Sinking, displacement or none.
- **Evaluation**: Conclusion after all these considerations: Poor, Fair, Good, Very good or Excellent.

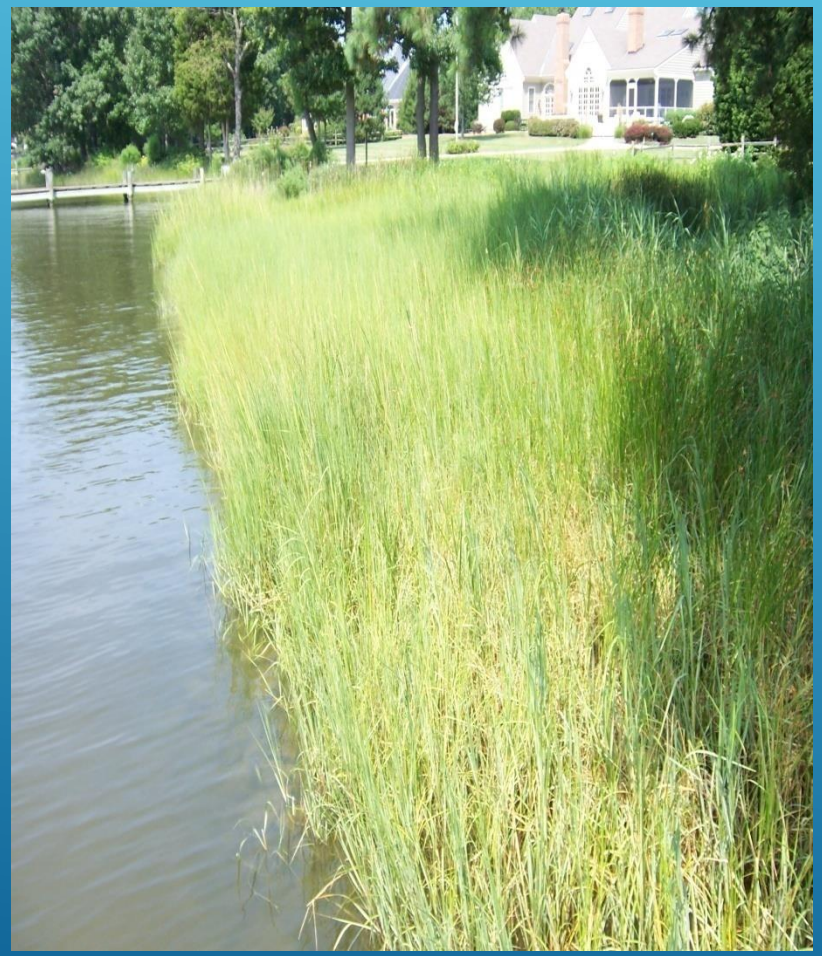

Start of the marsh heigth
End of the marsh heigth
Bank
Bank Base
Sand Fill
10:1 Slope


COVE OFF TRED AVON RIVER
Existing Pier
Note: This Area Not a Part of The Marsh Project
Existing Stone Revetment
Existing Stone Revetment
Wooden Bulkhead (Existing)
Slope St1
Edge of Yard
House
Concrete Pad
Garage
Gravel Parking
Gravel Driveway
COVE OFF TRED AVON RIVER
Slope Station2

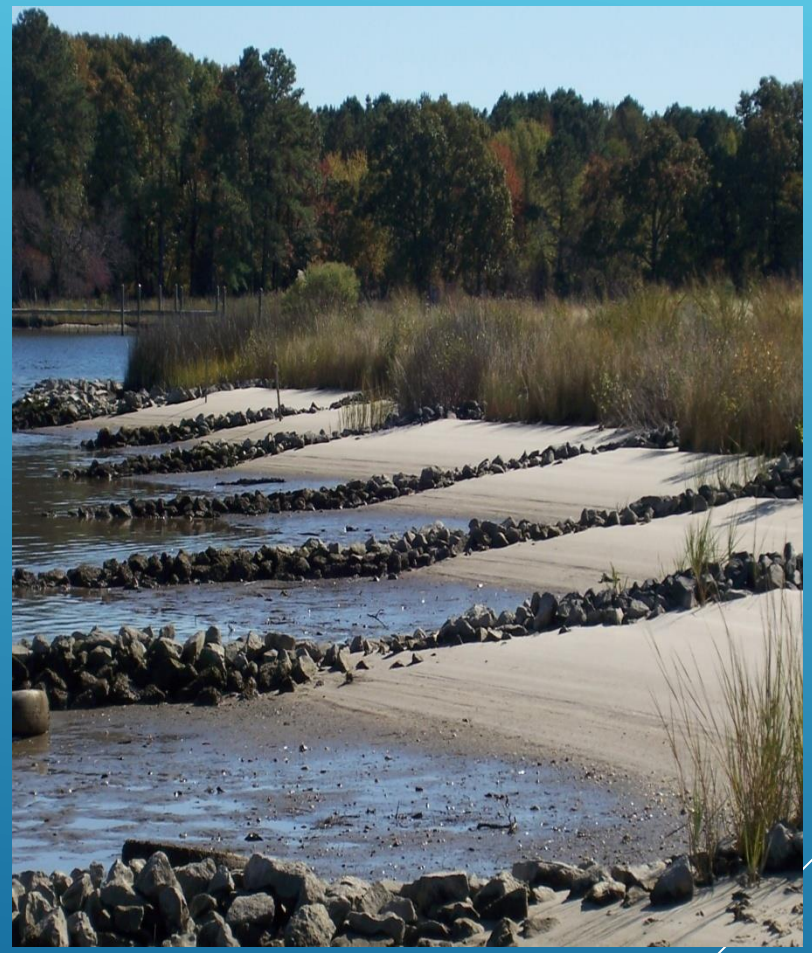
BANK EROSION



MARSH EROSION



No erosion



> 50% erosion

STRUCTURE DISPLACEMENT

Excellent

Displacement

NON-PLANTED VEGETATION

Excellent

Poor

BIOLOGICAL ASSESSMENT

- To analyze the difference between these shorelines and natural marshes.
- To study the effects of living shorelines projects on the biological community.
- Twelve projects were selected from the monitoring study.
- All the sites selected were rated “excellent” in the assessment study.

BIOLOGICAL FINDINGS

- Most predominant species: silver side, bay anchovies, white perch, spot, blue crab, striped bass, mummichog, and grass shrimp.
- The total number of species (population) was not significantly different among the project types.
- The diversity in the system was very high in the sill projects with the window or openings.

RESULTS

- Out of 177 projects, **131** of them were good or better.
- Maintenance- Crucial for the success of a project.

PROBABLE CAUSES OF DECREASED PERFORMANCE

- Poor engineering and/ construction.
- Poor execution of Plans.
- “Incorrect” planting.
- Choice of marsh grasses.
- Boat wake.
- Lack of maintenance.

SYSTEMS APPROACH TO GEOMORPHIC ENGINEERING (SAGE)

COMMUNITY OF PRACTICE'S APPROACH

NATURAL INFRASTRUCTURE METRICS WORKGROUP (NIM)

- Goal: Develop core metrics that cut across agency missions, supporting efficiencies and knowledge base that demonstrate ability of natural infrastructure as:
- Effective
- Resilience
- Cost Effective
- Audience: agencies, practitioners, academics, and other stakeholders

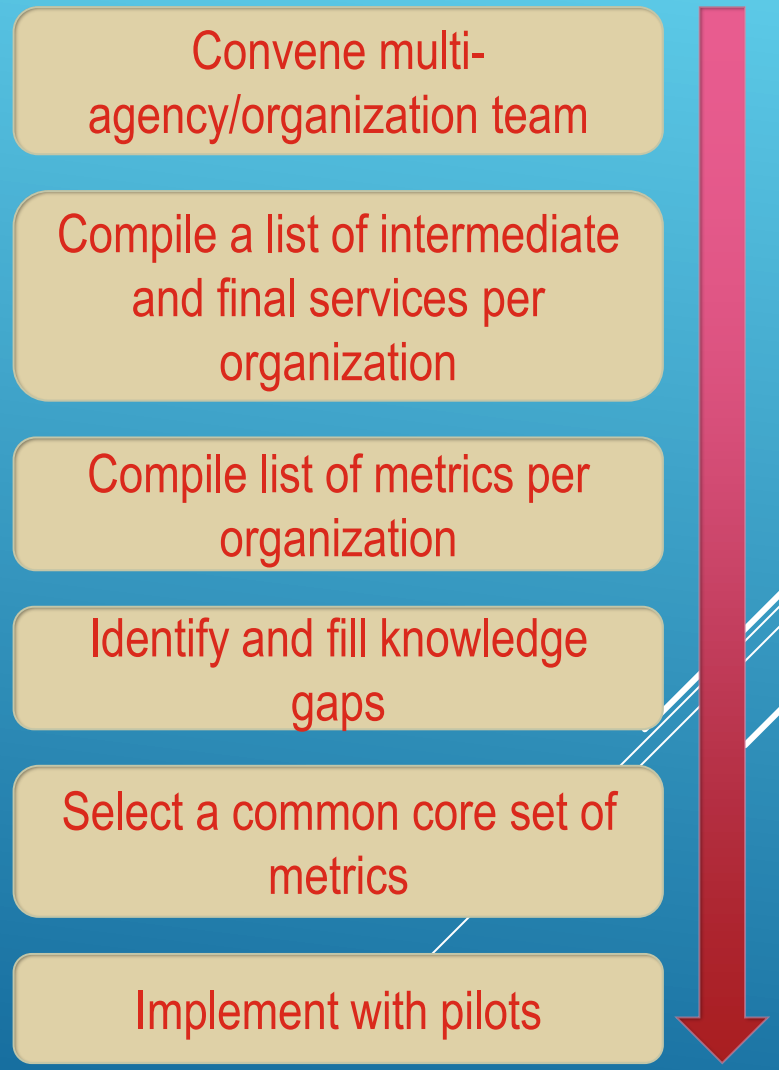
NIM APPROACH

Evolution of Thinking:

1. Develop a set of metrics to measure the success of NI projects (by Agency mission). Metrics would ideally be tested in cost-benefit analyses.

2. Identify the ecosystem services you (your organization) wants from NI that addresses your agency mission. Then provide the metric.

3. Organize metrics by ecosystem services and by landscape feature.



NIM SERVICES

Ecological	Provide Habitat; Maintain Biodiversity; Protect TES; Buffer Ocean Acidification
Sociological	Provide Recreation; Provide & Support Navigation; Produce-Provide Food, Feed, etc.; Provide & Improve Aesthetics; Promote Environmental Justice; Protect Property Value; Protect Cultural Heritage; Provide & Support Education; Provide-Support Scientific Research
Hydrological	Reduce Storm Surge & Flooding; Provide Flood Storage; Attenuate Waves; Provide and Store Groundwater; Reduce Overtopping; Reduce Current - Wave Velocity; Restore Functional Hydrology
Geological	Reduce & Control Erosion; Protect & Enhance Healthy Soils
Biogeochemical	Improve Water Quality; Sequester & Convert Nutrients; Reduce Hazardous-Toxic Materials
Climatological	Regulate Microclimate; Sequester Carbon
Other	Reduce Wildfire Potential; Protect Against Wind Shear; Attenuate Drought

31 total [draft] services (intermediate and final)
12 Features

NIMS TABLE

	ECOLOGICAL	SOCIOLOGICAL			HYDROLOGICAL	
Good or Service:	Maintain Biodiversity	Provide Recreation	Protect Property Value	Protect Cultural Heritage	Reduce Storm Surge & Flooding	Provide Flood Storage
Features					Metrics	
Nearshore Shallow and Nearshore Deep (includes submerged aquatic vegetation and/or aquatic vegetation bed both fresh and saline)	density of each species of species group (individuals/unit area of measurement)	number of visitors to the site	number of homes within walking distance that would benefit from open space, which could be assessed using GIS software	social;/cultural value that individuals place on the resource, which can be valued using a stated preference method such as contingent valuation or a choice experiment	SEAGRASS BEDS: Area of Seagrass	
	CONNECTIVITY: 1)is connectivty needed and type of connectivity required; 2) importance of the connectivity (area/zone/system) for habitat persistence; 3) importance of the connectivity (area/zone/system) for ecosystem service provision; 4) protection of connectivity, including if it can be protected	value that visitors place on the recreational experience	change in property values due to an increase in natural space, analyzed through a hedonic valuation study	cultural indicators can be developed based upon feedback from residents through focus groups, interviews or surveys. These indicators may fall into a variety of categories, such as quality of life, shoreline activities, sense of place, or sommunity well-being and will vary depending upon habitat type, project, and relevance to the community	SEAGRASS BEDS: species composition	
			change in property values due to a perceived decrease in flood risk, analyzed through a hedonic valuation study		SEAGRASS BEDS: mean shoot density	
			change in property values due to an improvement in water clarity, analyzed through a hedonic valuation study		SEAGRASS BEDS: mean shoot height	

MD DNR'S RESILIENCY THROUGH RESTORATION INITIATIVE

COMMON RTR PROJECT GOALS

- Shoreline Erosion Control
- Protection of Community Infrastructure
- Increase of Marsh Health and Integrity
- Decrease in Presence of Invasive Species
- Increase in Public Access
- Increase in Biodiversity

All projects- monitored according to a consistent Before, After, Control, Impact (BACI) monitoring design.

Goal Type	Attribute	Metric	Methods	Tier
Core	Physical	Structure Positon	RTK GPS	Three
			Aerial Photos	Two
			Handheld GPS	Two
			Distance from Fixed Point	One
		Structure Integrity	Visual Inspection	NA
		Shoreline Position	RTK GPS	Three
			Aerial Photos	Two
			Handheld GPS	Two
			Distance from Fixed Point	One
		Marsh and Shoreline Elevation	RTK GPS	Three
			Sprinter Level and Handheld GPS	Two
			Graduated Rod	One

Biological	Vegetation Structure	% Cover/m^2 Estimate	Two
		Stem Height	Two
		Stem Density	Three
		General Characterization	One
	Vegetation Community	Species Identification	Three
		General Characterization	One

POINTS TO PONDER

- Efforts should be made to maintain a **consistent sampling intensity** from project to project.
- Long term transects should be sampled- fall and spring
  - 1 year pre-construction;
  - At least 3 years post-construction.
- Monitoring should probably be done **before and after extreme events** (hurricanes, nor'easters, etc) to understand how projects respond

PARTING REMARKS…

- Agencies and organizations vary with definitions of resilience and mission focus
- Monitoring – no funding, no consistency, etc…
- Overarching needs: Performance and cost-effectiveness

- **Monitoring is CRITICAL!!**

Bhaskar Subramanian

Program Manager,

NOAA Adaptation Science (AdSci)

E-MAIL:

BHASKAR.SUBRAMANIAN@NOAA.GOV