# Tools for Monitoring, Modeling, & Planning

A Regional Approach to Data Synthesis and Information Sharing

Joshua Moody, Kimberly McKenna, & Bill Shadel Restore America's Estuaries 2021 Living Shoreline Tech Transfer Workshop October 19-20, 2021 Cape May, NJ

## Session Structure

- 1. Data Collection & Interpretation Josh
  - Regional efforts overview
  - Site evaluation and living shoreline feasibility
  - Living shoreline monitoring
- 2. The NJ Bay Islands Restoration Planner Kim & Bill
  - Developing a regional team
  - Compiling and visualizing data
  - Tool walk-through

## 3. Discussion

- General comments
- Regional comparisons
- Lessons learned intra and inter-regional
- Future directions

## Informed decision-making relies on understanding



## Effective restoration: informed & integrated practitioners



## DE & NJ have been developing data sets & support tools

### Data/Monitoring

Mid-Atlantic Coastal Wetland Assessment

NJ Reference Wetland Database

Site Evaluation for Living Shorelines Guidance and Worksheet

> Steven's Living Shoreline Engineering Guidelines

DE & NJ Living Shoreline Monitoring Frameworks

### Modeling

Where to work? CERAP

What is the problem? WATCH

Will NNBI work? Restoration Explorer

What will effects be of different tactics? Marsh Futures

What are my primary considerations? Living Shoreline Feasibility Model **Evaluation** 

#### Intervention

## Tools organize data and inform intervention methodologies

Level 1: Site selection/prioritization Where should we focus our efforts?

Level 2: Site-specific issue diagnosis What is the problem & where is it located?

Level 3: Issue-specific tactic selection What method will address the issue?

Level 4: Tracking progress towards goals Is the method working? Site Evaluation Living Shoreline Feasibility



## How do we use data? What does it mean?



![](_page_6_Picture_2.jpeg)

## Site evaluation & living shoreline feasibility

![](_page_7_Picture_1.jpeg)

#### Data Collection Guidance

Site Evaluation for Living Shoreline Projects in Delaware

**Guidance and Worksheet** 

![](_page_7_Picture_5.jpeg)

Delaware Living Shoreline Committee - Design and Engineering Subcommittee April 2020

- -Orientation
- -Change Rate
- -Bank Position
- -Fetch Wind
- -Wave Climate
- -Flooding
- -Tide
- -Ownership
- -Flora/Fauna

-Soils

![](_page_7_Picture_17.jpeg)

#### Living Shoreline feasibility Model

![](_page_7_Figure_19.jpeg)

# Where to work: compare multiple sites

• Low hanging fruit

• Site aligns with abilities

![](_page_8_Figure_3.jpeg)

![](_page_8_Figure_4.jpeg)

# Comparing perspectives: team building

• Who is concerned about what?

• Gather the correct skill set

• Who is needed at the table

![](_page_9_Figure_4.jpeg)

![](_page_9_Figure_5.jpeg)

# Phase planning: how to get from A to B

• One issue at a time

• Multiple funding streams

• Achieving goals

![](_page_10_Figure_4.jpeg)

![](_page_10_Figure_5.jpeg)

## Monitoring is the foundation of understanding

![](_page_11_Figure_1.jpeg)

Relative ecological uplift is required Then vs. Now

## A Goal-based framework: Overview

## Standardize Monitoring

• Track the changing levels of function

Quantitative

Systematic (cross-site comparisons)

Multi-sector Input

Regulatory

O Public

Private

Academic

Developing Monitoring Plans for Living Shoreline Projects in Delaware: A Goal-Based Framework

A step-wire procedure for the selection of relevant metrics and appropriate methods to assess performance and aduptive management needs of tidal abaretine restaration projects.

![](_page_12_Picture_12.jpeg)

A Framework for Developing Monitoring Plans for Coastal Wetland Restoration and Living Shoreline Projects in New Jersey

Recommended data collection and evaluation of project performance to facilitate adaptive management and improve future project designs

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## A Goal-based Framework: Overview

- Guides the user in identifying:

   Project-specific objectives from pre-defined goals
   Relevant metrics for each goal
   Appropriate methods to collect data for each metric
- Facilitates a structured monitoring plan
   Objective-> Metrics ->Analysis
   Monitoring Timeline
   Progress Tracking
- 3. Templates

• Monitoring Plan or Independent Tables

O Transferrable over time

![](_page_13_Picture_6.jpeg)

A step-wise procedure for the selectors of relevant extrics and appropriate methods to assess performance and adoptive management needs of tidal shoreline resolatation projects

![](_page_13_Picture_8.jpeg)

#### A Framework for Developing Monitoring Plans for Coastal Wetland Restoration and Living Shoreline Projects in New Jersey

Recommended data codection and evaluation of project performance to facilitate adaptive management and improve future project designs

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## What am I comparing?

Am I seeing effects I desired......

....and how do I know they are caused by the installation?

## Two Possible Monitoring Plan Designs

- 1. Before After Design (BA)
  - Compare changes in metrics on installation over time
  - Am I seeing desired changes over time?
  - Teases out time effects (1-Way ANOVA; Paired T-test)
  - How do we know the change would have not occurred anyways?
- 2. Before After Control Impact (BACI)
  - Are the changes I am seeing over time different than on an untreated area?
  - If so, implies difference due to installation (assumption all else equal)
  - Teases out time and treatment effects (2-Way ANOVA)
  - Controls in natural setting are difficult to identify if available

![](_page_14_Picture_14.jpeg)

## Metrics & Methods

#### Metrics

o Core

- "Required"
- Essential to evaluate

#### Conditional

- Project-specific: non-vegetated , no vegetation metrics
- User specific: expertise dependent, wave measurements
- Budget-specific: survey equipment

## <u>Methods per Metric</u>

• Spans a technical gradient

Goal: Sł	Soal: Shoreline Position					
Class	Metric	Methods	Additional User Considerations			
	Visual Discription	Photo from Permanent Marker	Suited For All User Groups			
		RTK-GP5	Technical Expertise; Cost			
ē		Aerial Photograph	Technical Expertise; Cost			
8	Horizontal Position	LIDAR	Technical Expertise; Cost			
		Surveying Instrument (barcode leveling)	Technical Expertise; Cost			
		Distance from Permanent Post of Other Structure to Shoreline	Suited For All User Groups			
		Rtk.gps	Technical Expertise; Cost			
	Vertical Position (Elevation)	Lidar	Technical Expertise; Cost			
		Surveying Instrument (Barcode Leveling)	Technical Expertise; Cost			
		Laser Level Height Relative to Position on Permanent Post or Other Structure	Suited For All User Groups			
	Foreshore Slope (Area Between High and Low Water)	RTK-GP5	Technical Expertise; Cost			
		LIDAR	Technical Expertise; Cost			
		Laser Level Height Relative to Position on Permanent Post or Other Structure	Suited For All User Groups			
		Thermal Imaging	Technical Expertise; Temporal Requirements; Collection Time Investment; Cost			
	A construction for the const	Surveying Instrument (Barcode Leveling)	Technical expertise; Cost			
_	vccreace (myyear)	Sedimentation Disc/Tile/Plate/ Marker Horizon	Temporal Requirements; Collection Time Investment; Cost			
onal		Measuring Stick/Monuments	Suited For All User Groups			
Conditi	Wave Energy or Height and Amplitude	Gauges and Buoys (e.g., Acoustic Doppier Current Profilers for Wave Energy and Stream/Creek Flow)	Technical Expertise; Collection Time Investment; Cost			
•		Water Level Loggers	Technical Expertise; Collection Time Investment; Cost			
	(wind/wake)	Graduated SurveyRod	Temporal Requirements; Collection Time Investment; Cost			
		Plaster or Gypsum Ball/ Clod Card Dissolution	Technical Expertise; Temporal Requirements; Collection Time Investment; Cost			
	Vegetation	Blom as (Abran and/or Balmanound)	Tachole al Expartine: Tamoved Baradeamante: Follartion Time Investment: Fost			

## Metric organization

![](_page_16_Picture_1.jpeg)

Goal	Objective	Metric		Methods	<b>Temporal Resolution</b>	Spatial Resolution	Analysis Question		Analysis Method
Shoreline Position	Vegetated edge moves waterward from original position	Horizontal Position of Vegetated Edge	1. 2. 3.	Photo-Doc RTK-GPS Survey Distance from permanent marker	Annual: Spring and Late Summer/Fall	Collected along the contiguous vegetated edge (~1m) Three equally spaced transects	Did the horizontal position of the marsh change; in what direction?	1. 2. 3.	PhotoPoint-FixedPoint DSAS (Timeseries) ArcGiS 3D Analyst Average change in position per year
Shoreline Position	Marsh surface elevates to be between mean water and mean high water	Vertical Position of Marsh	1. 2. 3.	Photo-Doc RTK-GPS Survey Elevation above a permanent marker	Annual: Spring and Late Summer/Fall	Collected along each transect (~1m) and in each monitoring plot (n=15)	Is the vertical position of the marsh appropriate for marsh vegetation?	1. 2. 3.	PhotoPint-FeatureBased BACI ArcGIS 3D Analyst Average change in vertical position

![](_page_16_Picture_3.jpeg)

## Progress tracking: Is the living shoreline working?

![](_page_17_Picture_1.jpeg)

Goal	Objective	Metric	Analysis Question	Baseline	As-Built	After-B	uilt 1	After-E	Built 2	After-B	uilt 3
Shoreline	Vegetated edge	Horizontal	Did the horizontal	Measured Value	Measured Value	Measured	Change	Measured	Change	Measured	Change
Position	moves waterward	Position of	position of the marsh								
	from original	Vegetated	change; in what								
	position	Edge	direction?								
Shoreline	Marsh surface is	Vertical	Is the vertical position of	Measured Value	Measured Value	Measured	Change	Measured	Change	Measured	Change
Position	between mean	Position of	the marsh appropriate								
	water and mean	Marsh	for marsh vegetation?								
	high water										

## Questions before the NJ Bay Islands Restoration Planner?

## Data/Monitoring

Mid-Atlantic Coastal Wetland Assessment

NJ Reference Wetland Database

#### Site Evaluation for Living Shorelines Guidance and Worksheet

Steven's Living Shoreline Engineering Guidelines

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## Modeling

Where to work? CERAP

What is the problem? WATCH

Will NNBI work? Restoration Explorer

What will effects be of different tactics? Marsh Futures

#### What are my primary considerations? Living Shoreline Feasibility Model

## Evaluation

Intervention

## Example: What is the problem?

#### Wetlands Assessment Tool for Condition & Health (WATCH)

#### **Reference Data: Comparative**

- 1. <u>Mid-Atlantic Coastal Wetland</u> <u>Assessment</u>
  - a. X Sites DE/NJ
- 2. <u>Reference Wetlands Database</u>
  - a. Organized

#### **Evaluation: Holistic evaluation**

- 1. Multiple fundamental attributes
- 2. Scientifically defensible methods
- 3. Integrated outcomes

![](_page_19_Figure_11.jpeg)

## Example: What should I do?

#### Coastal Resilience Mapping Portal, NJ: Marsh, Living Shoreline, & Risk Explorers

#### Data Collection Guidance

![](_page_20_Picture_3.jpeg)

Prepared for:

New Jersey Department of Environmental Protection

Prepared by:

Jon K. Miller, Andrew Rella, Amy Williams, and Erin Sproule

![](_page_20_Picture_8.jpeg)

Data Integration & Visualization

### **Appendix B: Description of Metrics**

#### **Goal: Shoreline Position**

Class	Metric	Methods	Additional User Considerations
	Visual Discription	Photo from Permanent Marker	Suited For All User Groups
		RTK-GPS	Technical Expertise; Cost
Core	Horizontal Position	Aerial Photograph	Technical Expertise; Cost
		LIDAR	Technical Expertise; Cost
		Surveying Instrument (barcode leveling)	Technical Expertise; Cost
		Distance from Permanent Post of Other Structure to Shoreline	Suited For All User Groups

Habitat						
Metric	Method	Additional User Considerations				
Visual Discription	Photo from Permanent Marker	Suited For All User Groups				
Vegetation Community Composition	List Species Found At Site (Plants)	Suited For All User Groups, Temporal Requirements				
	Observations/Counts (E.G., Horseshoe Crabs, Terrapins)	Suited For All User Groups, Temporal Requirements				
	Biomass (Wet Weight Or Dry Weight/ M2) (E.G., Plants, Nekton, Mussels)	Technical Expertise: Temporal Requirements: Collection Time Investment: Cost; Permitting				
	Cover Per M2 Or # Per M2 (E.G., Percent Cover Of Sav, # Of Fiddler Crab Boroughs, # Of Fish In A Sample, Ribbed Mussel Up Counts)	Suited For All User Groups, Temporal Requirements				
Target Species (Flora	Morphometric (E.G., Length Of Nekton Or Dysters)	Technical Expertise; Temporal Requirements; Collection Time Investment; Cost; Permitting				
and/or Paunaj	Health (E.G., Condition Index, Of Bivalves)	Technical Expertise; Temporal Requirements; Collection Time Investment; Cost; Permitting				
	List Of Species Found At Site (E.G., Nekton Or Benthic Infauna)	Suited For All User Groups, Temporal Requirements				
	Recruitment (E.G., Oysters)	Suited For All User Groups, Temporal Requirements				
	Feeding And Breeding Behavior (For Avian Target Species)	Technical Expertise: Temporal Requirements: Collection Time Investment; Cost; Permitting				
	Horizontal Light Obstruction	Temporal Requirements; Cost				
	Vertical Light Attenuation	Temporal Requirements; Cost				
Manufation Residence	Cover Per M2 (For Each Plant Species Or Total Cover By Plant Species)	Suited For All User Groups; Temporal Requirements				
vegetation structure	Stem Heights Of Dominant Species	Temporal Requirements; Collection Time Investment				
	Number Of Stems Per M2	Temporal Requirements; Collection Time Investment				
	Habitat Type %, 50M Radius (E.G., High Marsh, Low Marsh, Invasives, Pannes And Pools Etc.)	Temporal Requirements; Collection Time Investment				