Coastal Systems Resilience (CSR) and Regional Sediment Management

Julie Dean Rosati

USACE Coastal & Hydraulics Laboratory

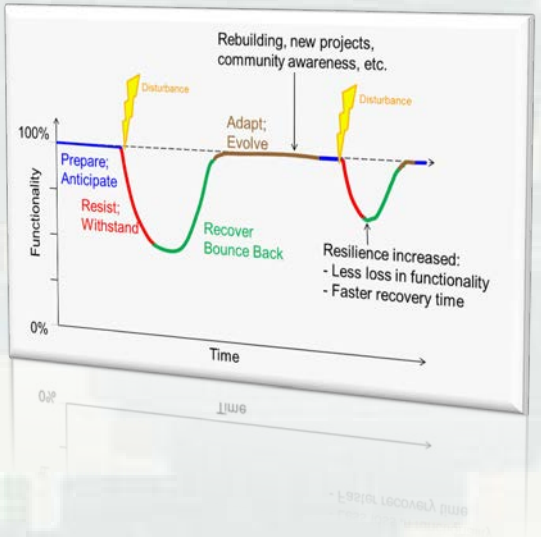
Engineer Research and Development Center

U.S. Army Corps of Engineers

Coastal Delaware & RSM
Beaches, Nav, & Ecosystem Restoration
Dover, Delaware, 29-30 August 2016

Outline

- What is resilience?
- What does it mean for a coastal system to be resilient?
- What is sustainability vs. resilience?
- What are some best practices for coastal resilience?
- How could we quantify coastal resilience?
- How does RSM support resilience and sustainability?
- Conclusions



Definitions of Resilience

Study	Definition
American Society of Civil Engineers (2006) http://www.asce.org/Content.aspx?id=8478	"Resilience refers to the capability to mitigate against significant all-hazards risks and incidents and to expeditiously recover and reconstitute critical services with minimum damage to public safety and health, the ... national security."
National Disaster Recovery Framework, Strengthening Disaster Recovery for the Nation (FEMA 2011) http://www.fema.gov/media-library/assets/documents/24647?fromSearch=fromsearch&id=5124	A resilient community has ... respond to and recover from disasters."
The Infrastructure Security Partnership and Society of Military Engineers (SAME). "Understanding Resilience – Disaster Resilience Begins with You" (2012	Disaster Resilienc... with limited damage."
Disas... 2012)	'Resilience i... successfully adapt to ad...
Hurric... Regio... http://... df	'The abili... over rapidly fr...
Infras... http://... pdf	'Ability ... otion due to e...
Coast... Army ... http://... S_20...	'The ab... withstan... and to
Urban... Resili... Docu...	'The capac... before the event."
Presi... http://... prepa...	'Resilience me... conditions and withstand, respon...
Rockefeller Foundation (2013) http://www.rockefellerfoundation.org/blog/city-resilient	"The capacity of indivi... pt, and grow in the face of changes, even cata...
Community and Regional Resilience Institute (CARRI) (2013) http://www.resilientus.org/wp-content/uploads/2013/08/definitions-of-community-resilience.pdf	"Community resilience is the capa... mit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change"
U.S. Army Corps of Engineers Safety of Dams, Policy and Procedures, ER 1110-2-1156 (2014) http://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-1156.pdf	"The ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances of use."
Intergovernmental Panel on Climate Change Fifth Assessment Report, "Climate Change 2014: Impacts, Adaptation, and Vulnerability" (2014) http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Glossary_FGD.pdf	"The capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation."

Key words:

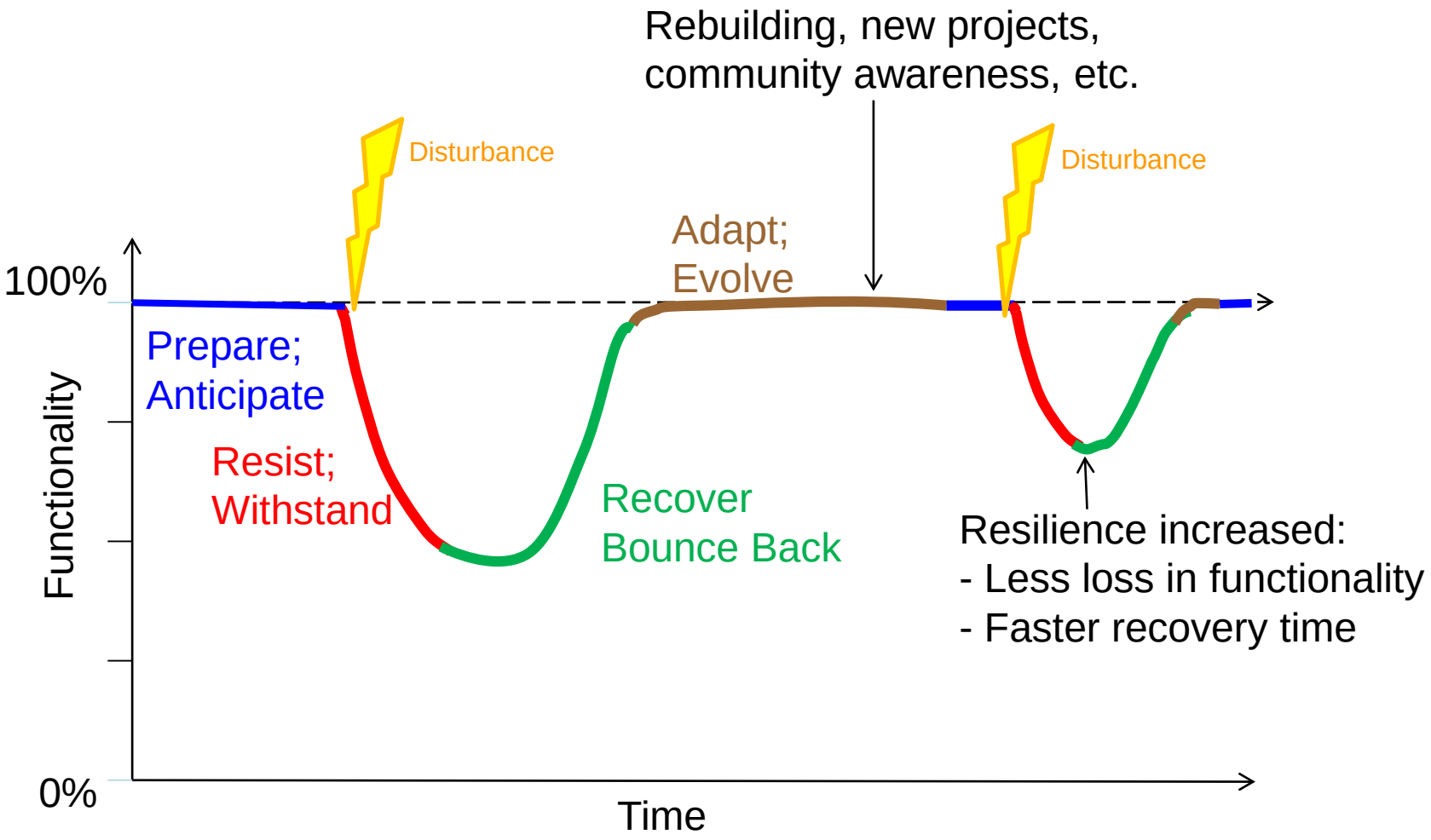
Prepare

Resist or Absorb

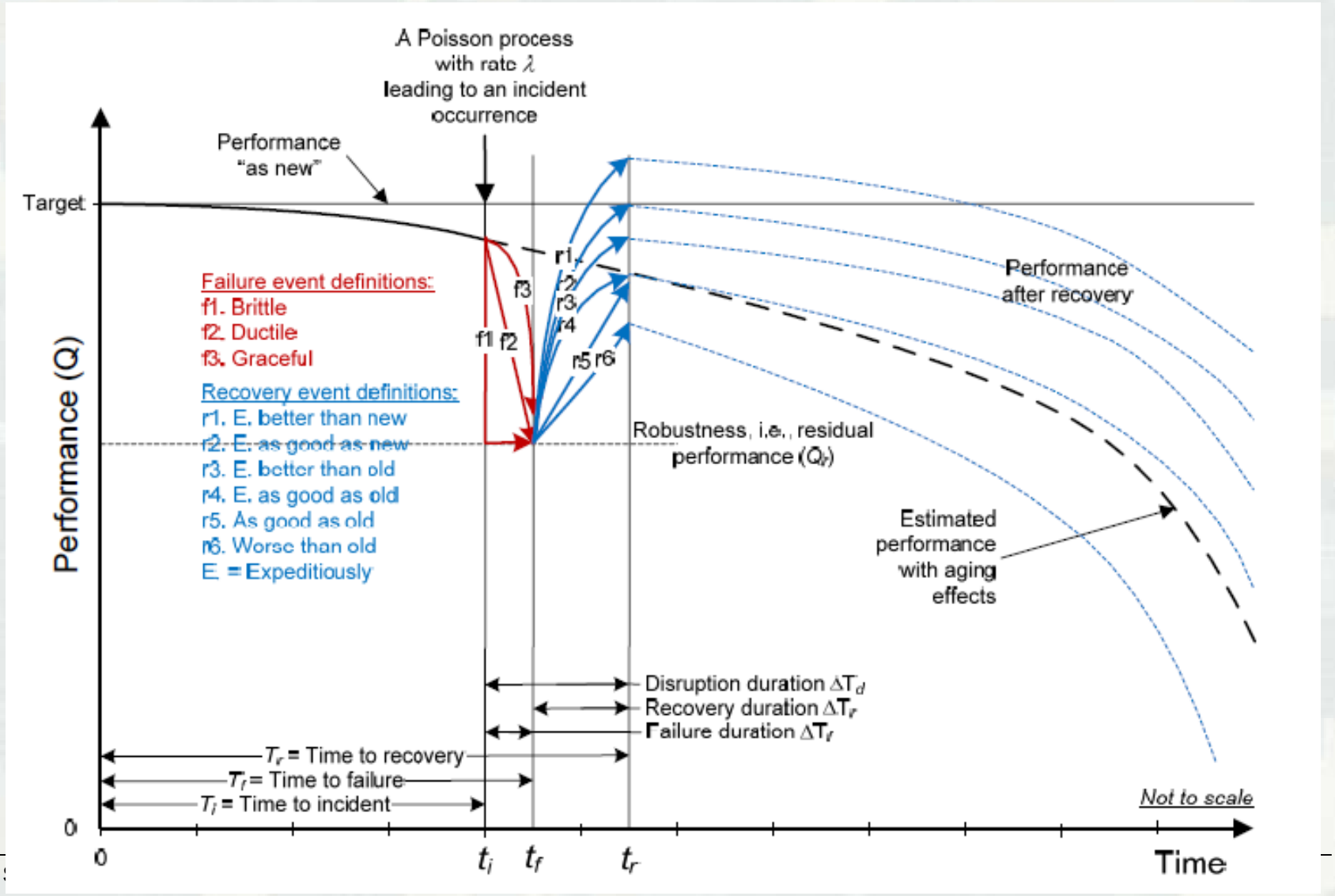
Recover

Adapt

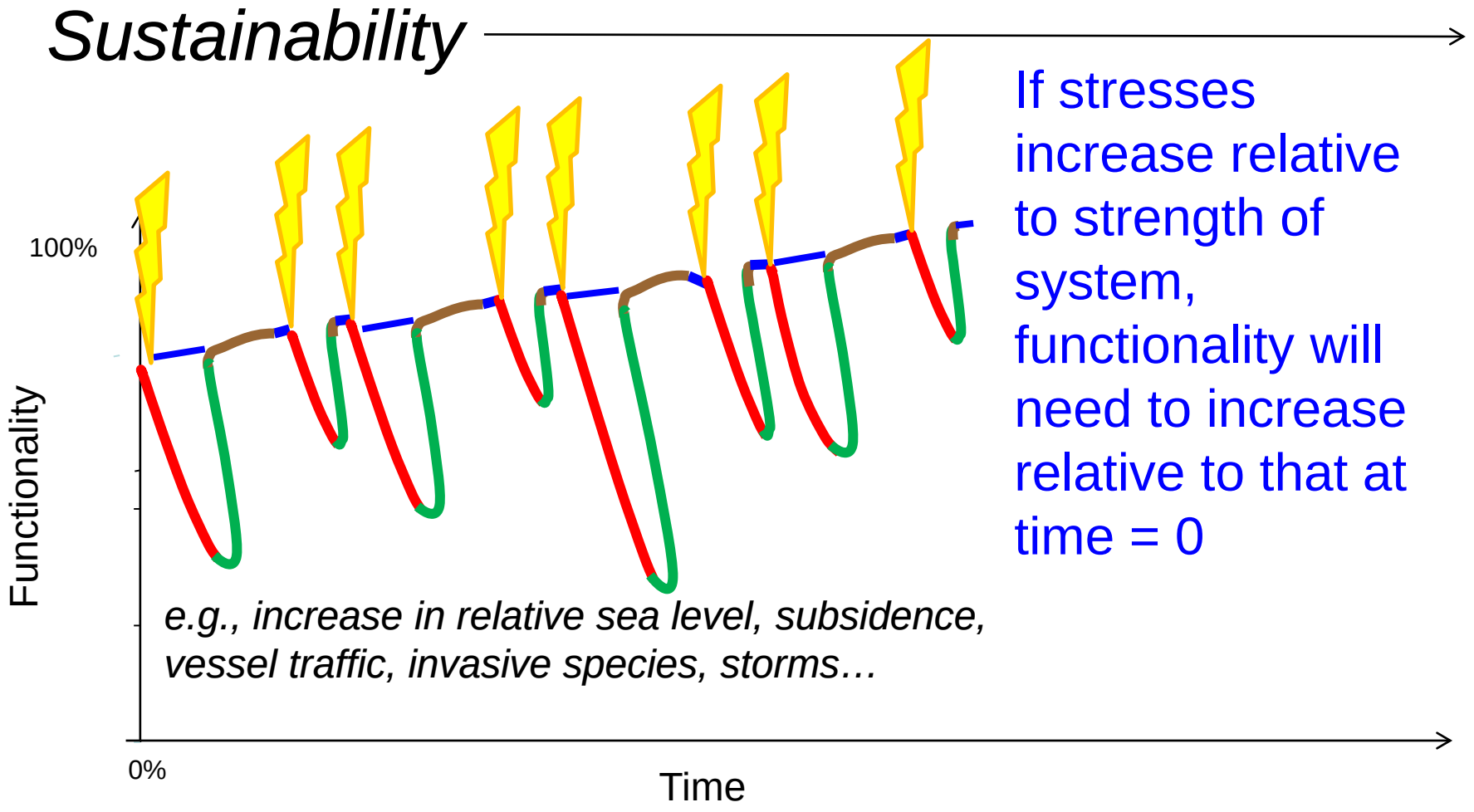
Concepts: Resilience Timeline



Concepts: Resilience Timeline (Ayyub 2014)



Sustainability: Adaptation through Time



What does it mean for a coastal system to be resilient?

Prepare, Anticipate

- *Build partnerships*
- *Assess existing and future vulnerabilities in system*
- *Develop strategies & contingency plans*

Resist, Absorb

- *Utilize features with adaptive capacities that can be modified and will absorb impacts and resist damage*
- *Provide diverse and redundant protection*

Recover, Bounce Back

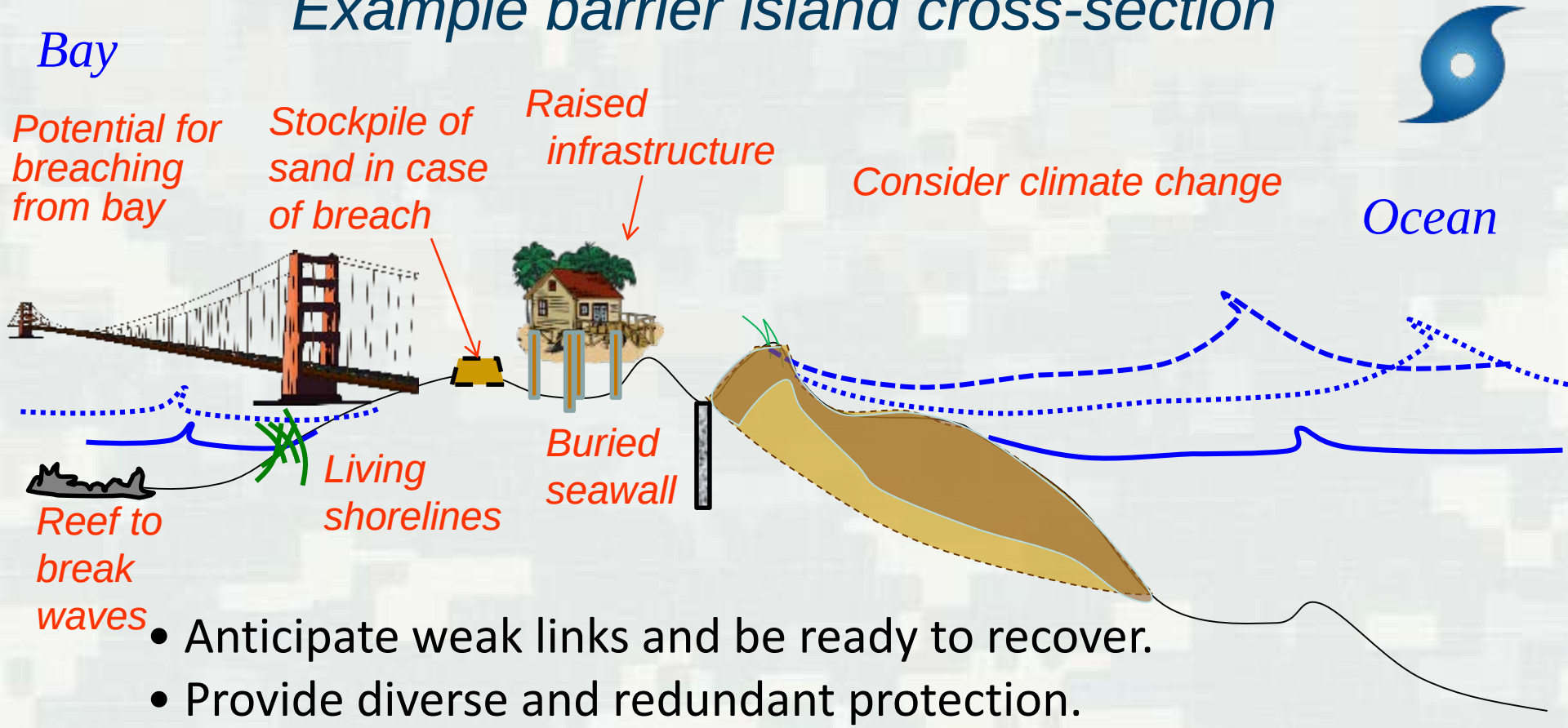
- *Ensure availability of alternate networks –components are independent of, and complement each other*
- *Implement operations for rapid recovery*

Adapt, Evolve

- *Foster natural and human actions for natural, nature-based, and hybrid features to facilitate adaptation*
- *Consider non-structural measures (e.g., relocation, zoning, education and advanced alerts, etc.)*

Best Practices: CSR

Example barrier island cross-section



- Anticipate weak links and be ready to recover.
- Provide diverse and redundant protection.
- Ensure availability of alternate networks –components are independent of, and complement each other.
- Provide accessible information for rapid decision-making.

How do we know if an engineering action is resilient? (1/2)

Philly Example:
Stone Harbor and Avalon Marsh Restoration

Photo: NJ Fish & Wildlife

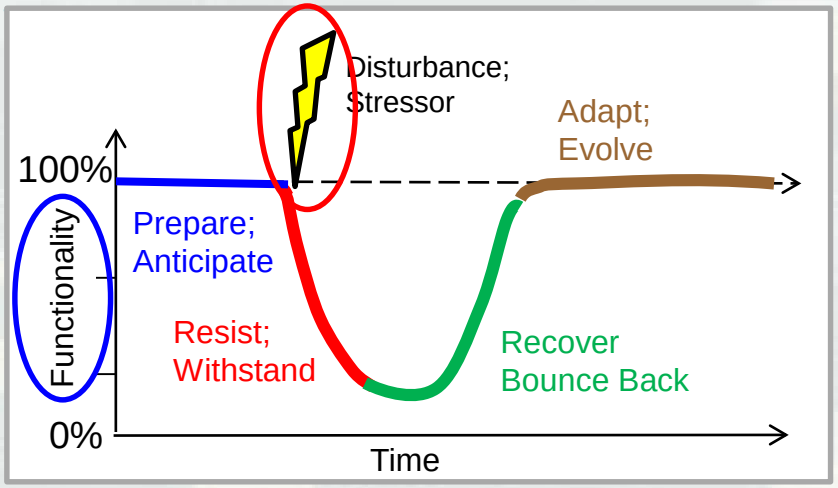
Restored degraded marsh and created habitat for birds near Stone Harbor, New Jersey

To understand resiliency, need to establish:

- System Framework - Wetlands, navigation channels, inlet and barrier islands

- Purpose(s) or Function(s) of Project – ENV and NAV Provide bird habitat WITHOUT inducing channel shoaling

- System Stressors and Vulnerabilities – ….Currents, vessel wake, subsidence, storms, invasive species, dredging, sea level rise, +….



How do we know if an engineering action is resilient? (2/2)

System Framework - Wetlands, navigation channels, inlet and barrier islands

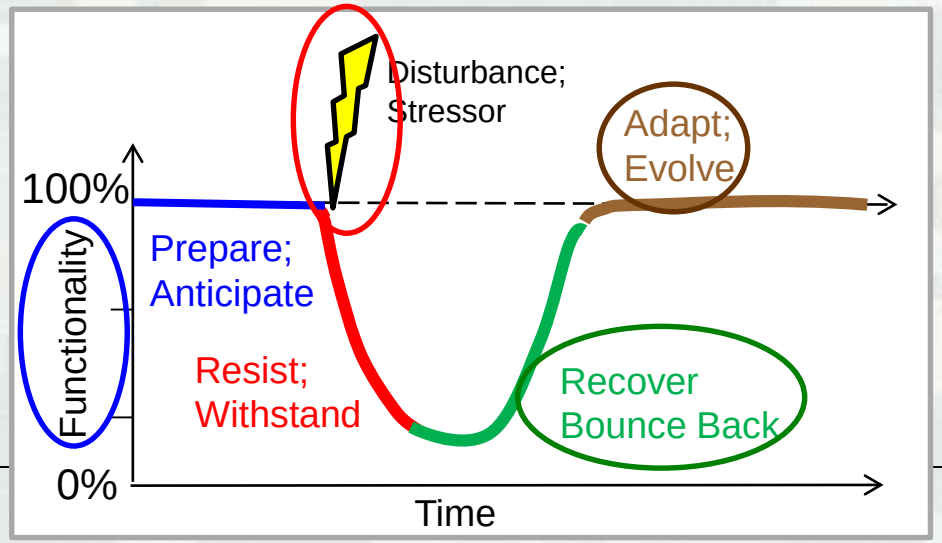
Function → Bird habitat 0.5 acre; maintain existing dredging 100 cy/year

Disturbance or Stressor → ? ….Currents, vessel wake, subsidence, storms, invasive species, dredging, sea level rise, …Define magnitudes

Recover → Can natural and/or humans actions restore habitat acreage in time required, say 6 months?

→ Will storms increase dredging, and if so, will channel depth & width be restored within 1 month?

Adapt → Will recovery actions continue to keep pace with future stressors: e.g., sea level rise - ~3 mm/year?



Philly Example: Stone Harbor and Avalon Marsh Restoration

R&D: Assessing CSR

Environmental, Engineering, Community

4. What is the capacity of the system to adapt in advance of future hazards?

1. How prepared is the system to withstand a disturbance?

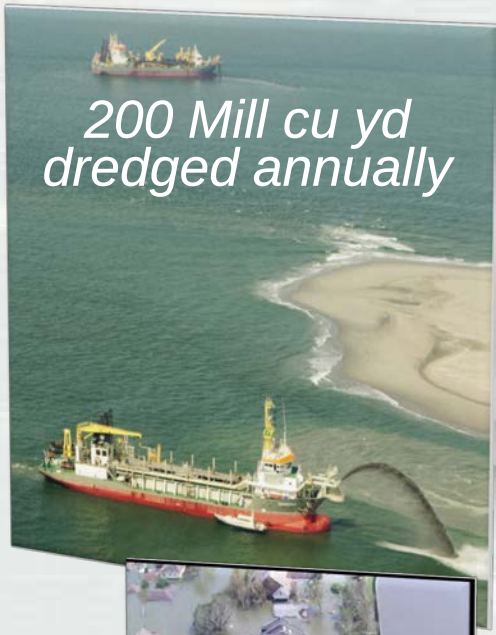
3. Has recovery been adequate to restore functioning in a desirable timeframe?

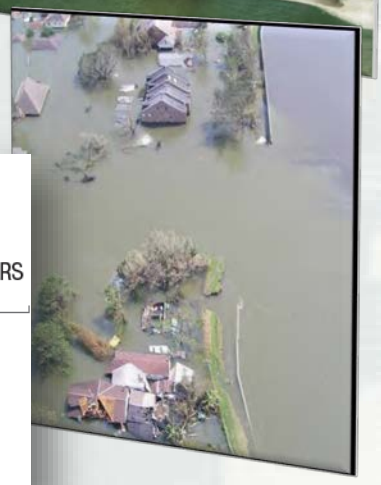
2. Has the system been able to absorb damages and resist loss in functioning during disturbances?

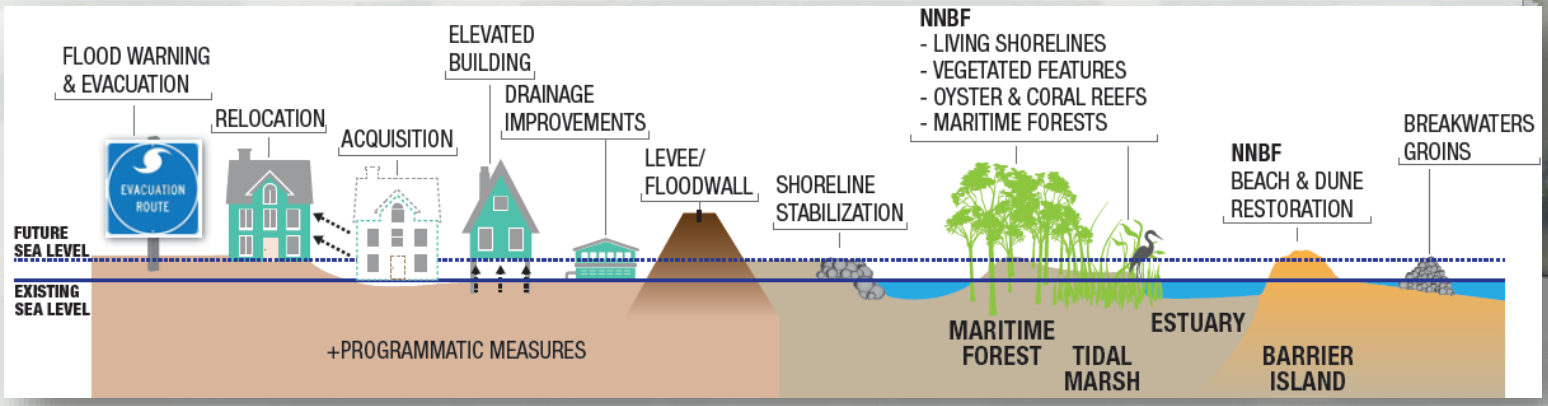
Integrated Solutions: Coastal Restoration

Environmental, Engineering, Community

- Coastal Flood & Storm Damage Reduction
  - ► Beaches & Dunes; Coastal Structures; Islands; Levees; Floodwalls
- Navigation
  - ► Dredging & placing 200 Mill cu yd/year; Coastal navigation structures
- Environmental Restoration
  - ► Wetlands; Living shorelines; Reefs; Maritime forests







Conclusions

- Determining resiliency requires understanding *system context, function and purpose, present and future stressors, time required and potential for recovery, and the capacity for adaptation
- Many RSM engineering actions and projects can increase resiliency
- Demonstration studies with defined parameters and forcing data are required to refine and validate methods

Feedback and Discussion: Julie Rosati, Katherine Touzinsky; Alex Renaud