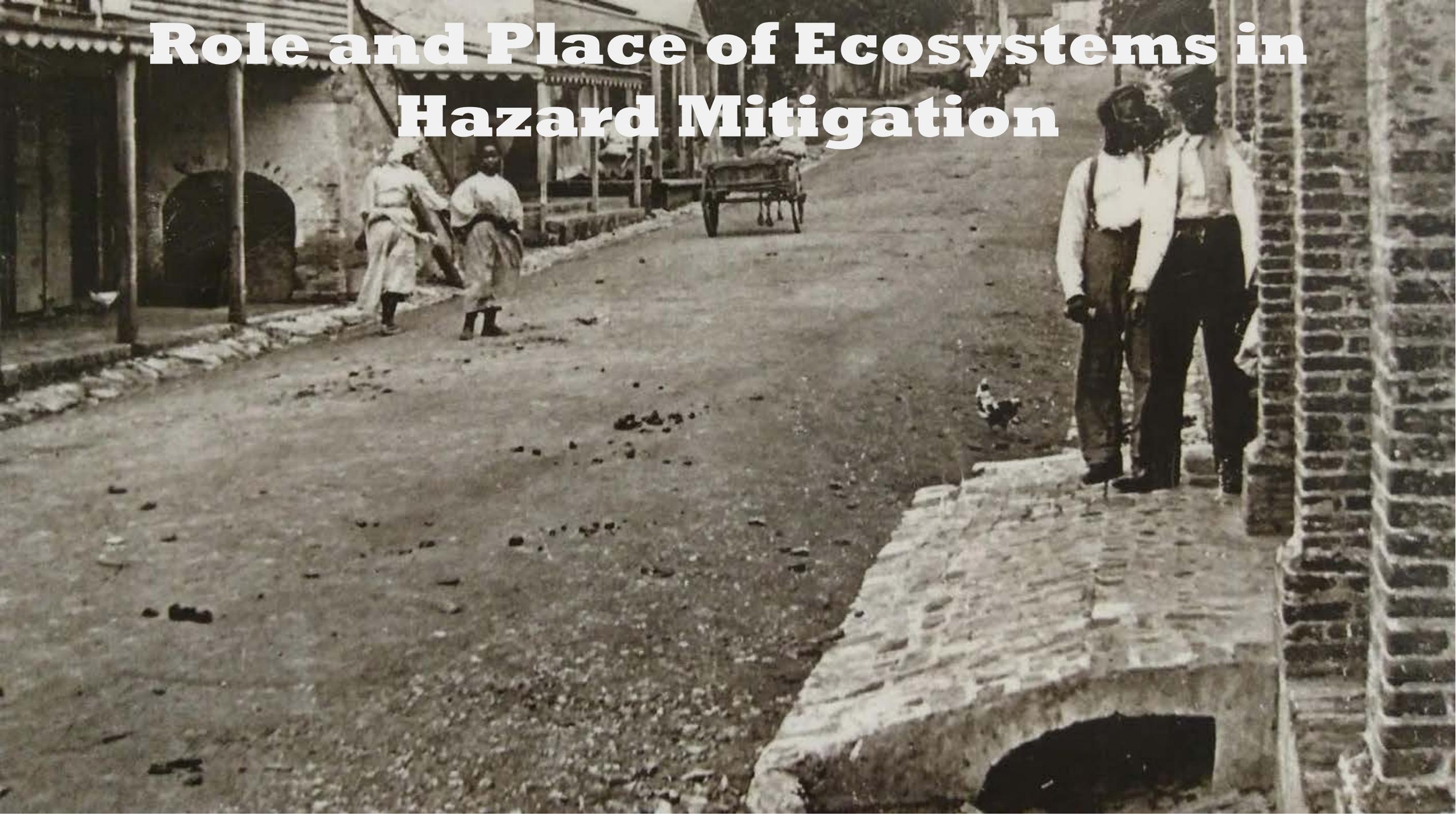


Role and Place of Ecosystems in Hazard Mitigation



Natural Systems Fully Incorporated Into Coastal Protection Strategies

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.

- Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.
- Living shorelines improve **water quality**, provide **fisheries habitat**, increase **biodiversity**, and promote **ecosystem services**.
- Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of wave energy.
- Living shorelines are **more resilient** against storms than bulkheads.
- 33%** of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.
- Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.

Coastal Risk Reduction and Resilience: Using the Full Array of Measures



US Army Corps of Engineers

Directorate of Civil Works



US Army Corps of Engineers
BUILDING STRONG.

September 2013

CWTS 2013-3

RESEARCH ARTICLE

The Power of Three: Coral Reefs, Seagrasses and Mangroves Protect Coastal Regions and Increase Their Resilience

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Abstract

Natural habitats have the ability to absorb waves and storms, yet it is unclear how to reduce those impacts. Here, we investigate how impacts are supplied by live corals on reefs.

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Incorporating Natural Infrastructure and Ecosystem Services in Federal Decision-Making

OCTOBER 7, 2015 AT 2:30 PM ET BY ALI ZAIDI, TAMARA DICKINSON, TIMOTHY MALE



Summary: Today, the Administration released a new memorandum directing Federal agencies to factor the value of ecosystem services into Federal planning and decision-making.

Our natural world provides critical contributions that support and protect our communities and economy. For instance, Louisiana's coastal wetlands provide [billions of dollars worth of flood protection](#) and other benefits. [Preserving and restoring forests](#) in the Catskill Mountains enables New York City to access clean water at a cost several times less than the cost of building a new water-filtration plant. And [current efforts to plant trees](#) along Oregon's salmon-rich rivers will improve local water quality – saving costs associated with installing expensive



Coastal Science | coastalscience.noaa.gov
University of Maryland Center for Environmental Science (an.umces.edu/symbols/)

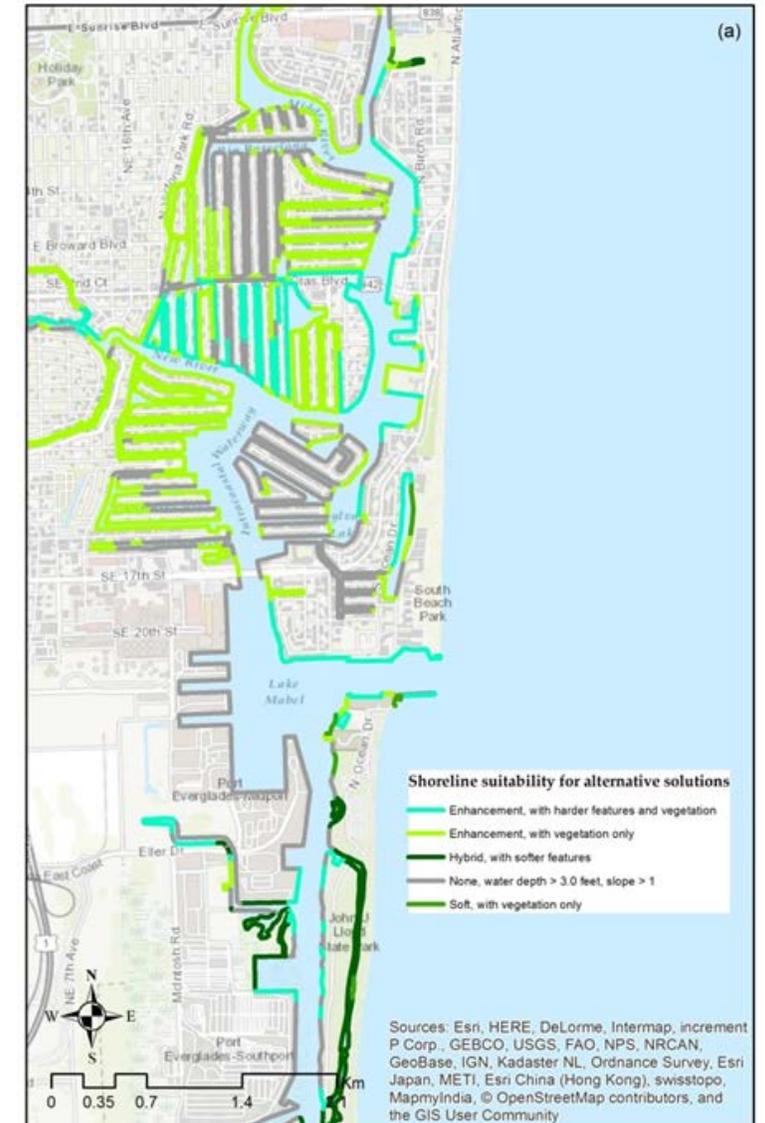
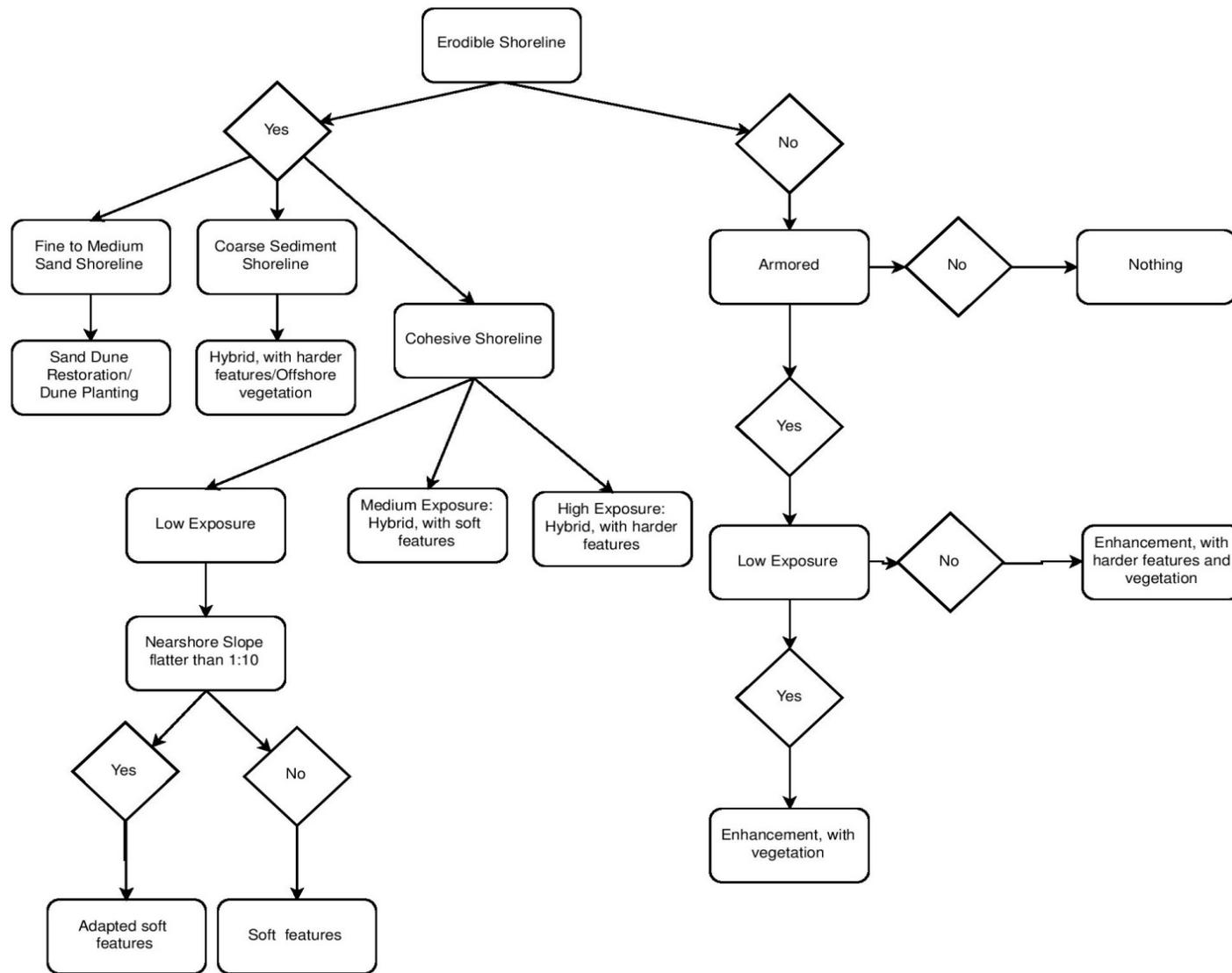
IrMaria Revealed the Vulnerability of our Coastal Assets



We Want Natural Systems to Play a Role



Methods Exist to Identify Living Shorelines Possibilities



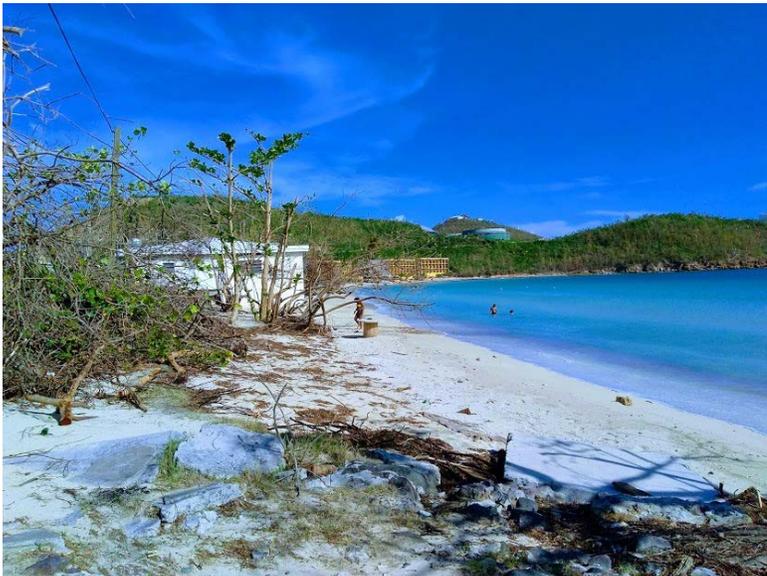
Are Living Shorelines a Solution for All Our Hazards?

20% Shores are Sandy Beaches
17% Mangroves
9% Armored



Development Reduces Delivery of Services and Increase Hazards Impacts

- Reduced mobility and services because coastal structures close to coast and waterways severely damaged
- Increased flooding because roads blocked waterways
- Increased flooding because lack of waste management strategies



Important Ecosystem Services Delivered Post-IrMaria

- Mangroves stored enormous amount of water
- Forests limited landslides
- Aquifers provided much needed water
- Beaches provided recreation services
- Beaches protected infrastructure



Important Ecosystem Services Missed Post-IrMaria

- It felt hotter: loss of tree cover increased temperatures
- It felt wetter: loss of tree cover increased amount of rain hitting the ground
- We got hungry: fallen trees and erosion destroyed crops
- We loss access to the water: water quality impaired

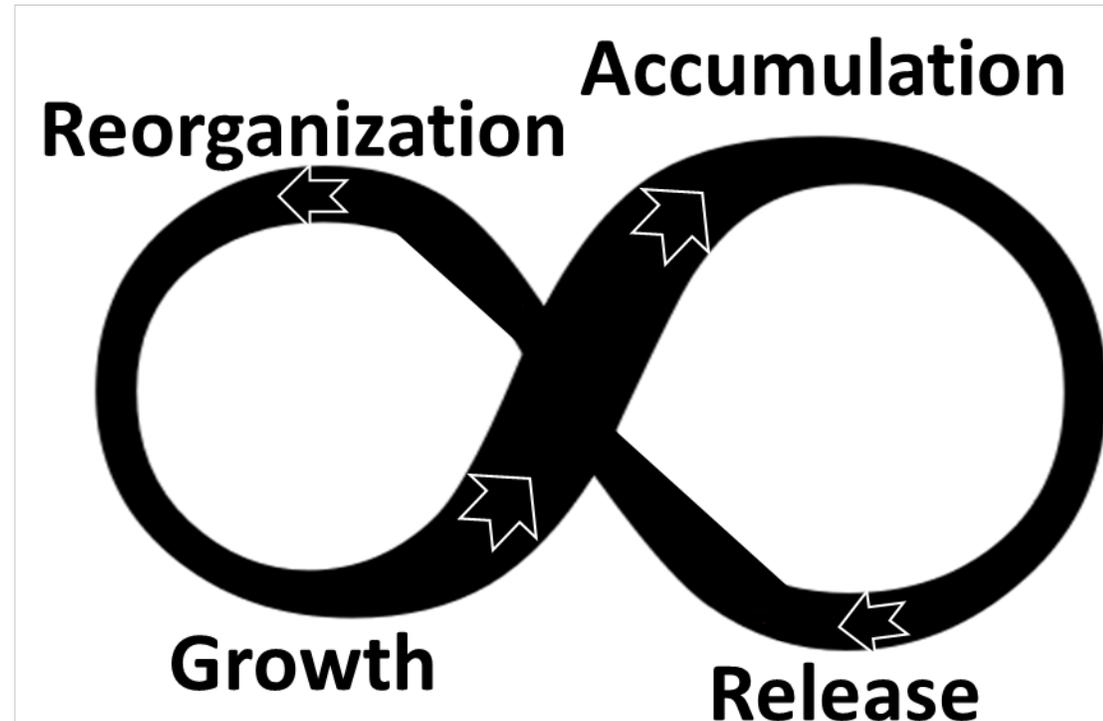


Implications for Coastal Systems

- Beaches erode
- Trees fall
- Corals break

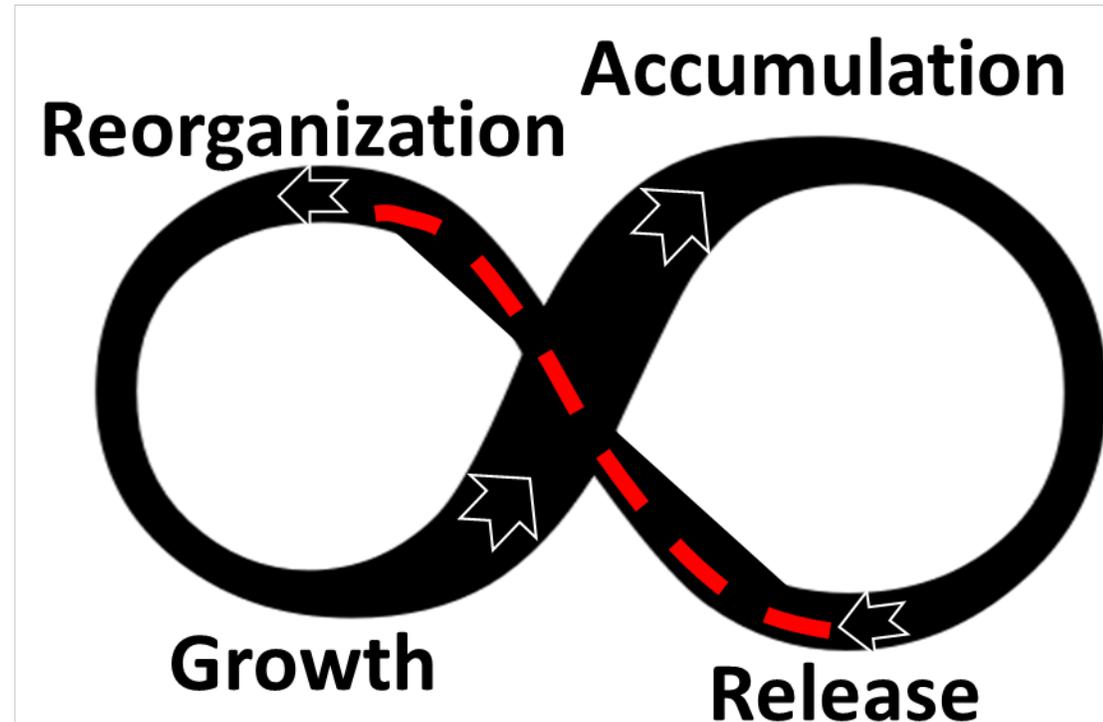


What Does it All Mean?

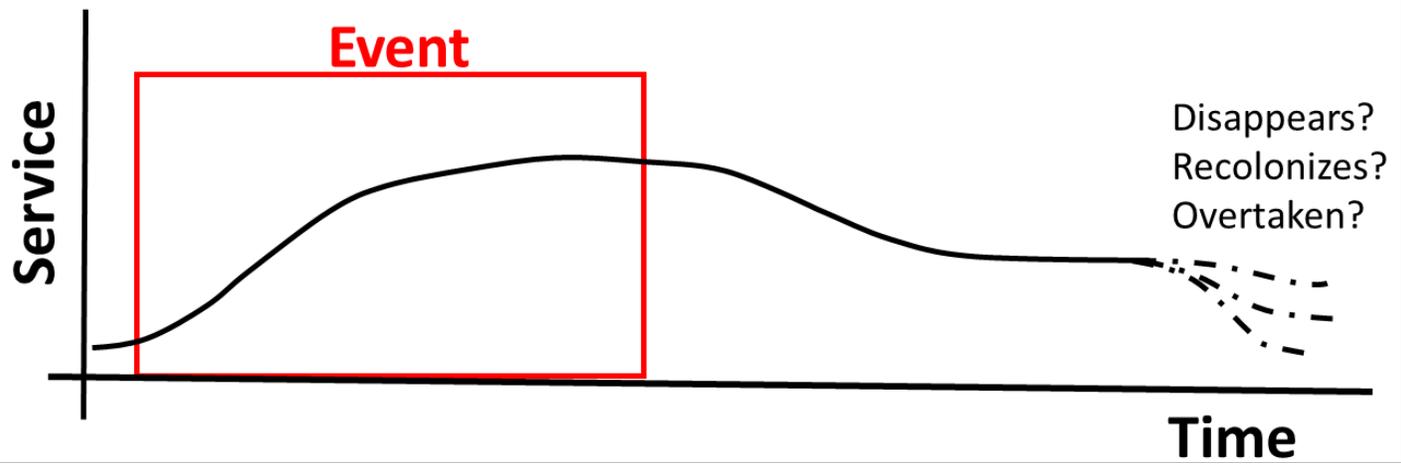


Ecosystems are living systems

What Does it All Mean?



Ecosystems are living systems: they can fail, but they'll recover through time.

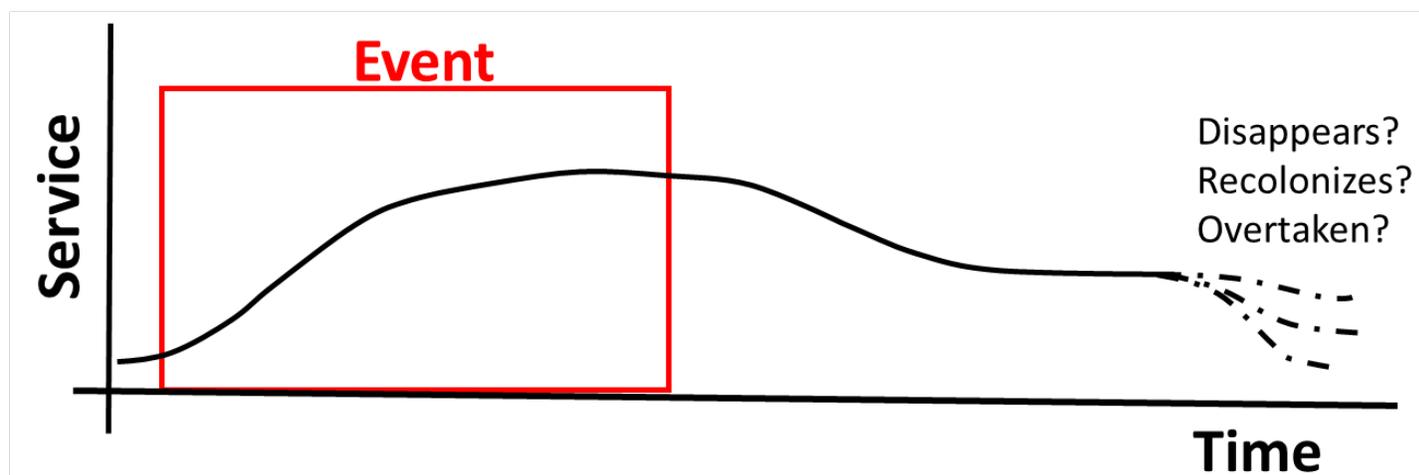


What Does it All Mean?

- Future state of ecosystem hard to predict

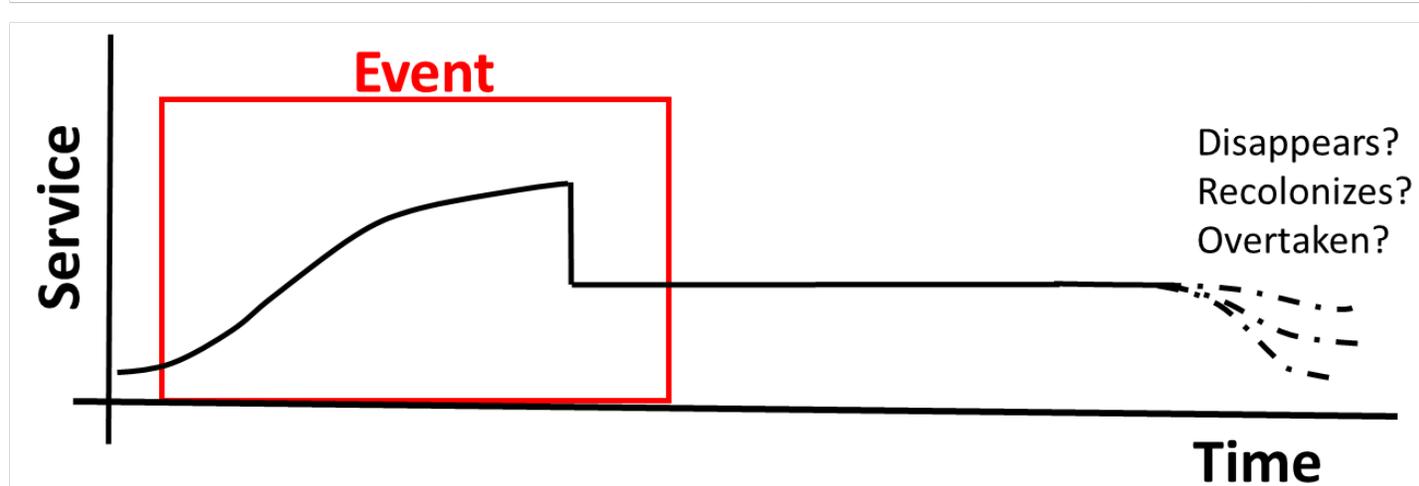
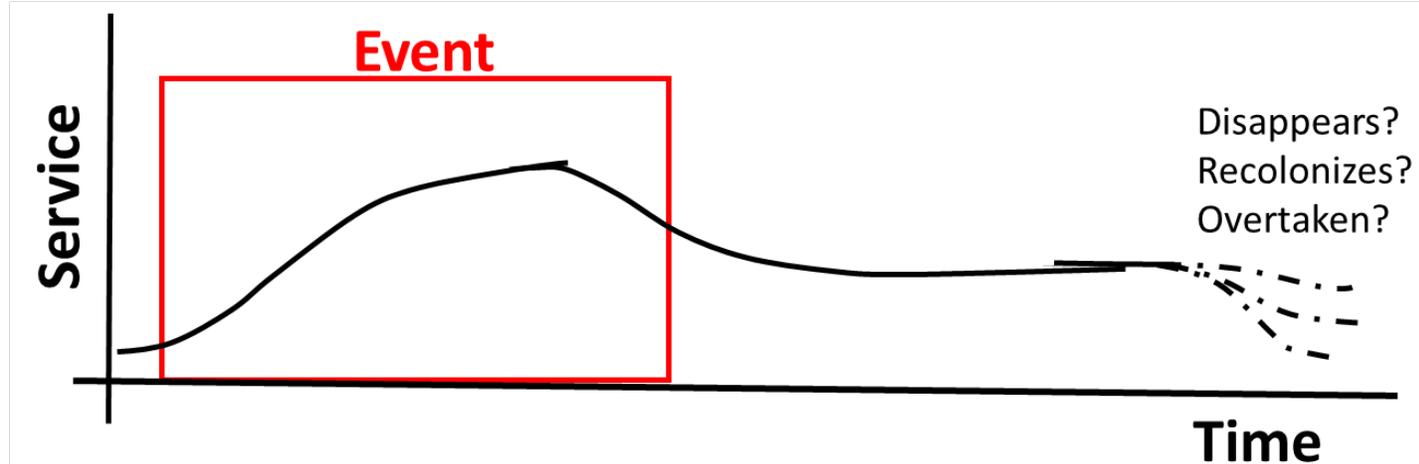
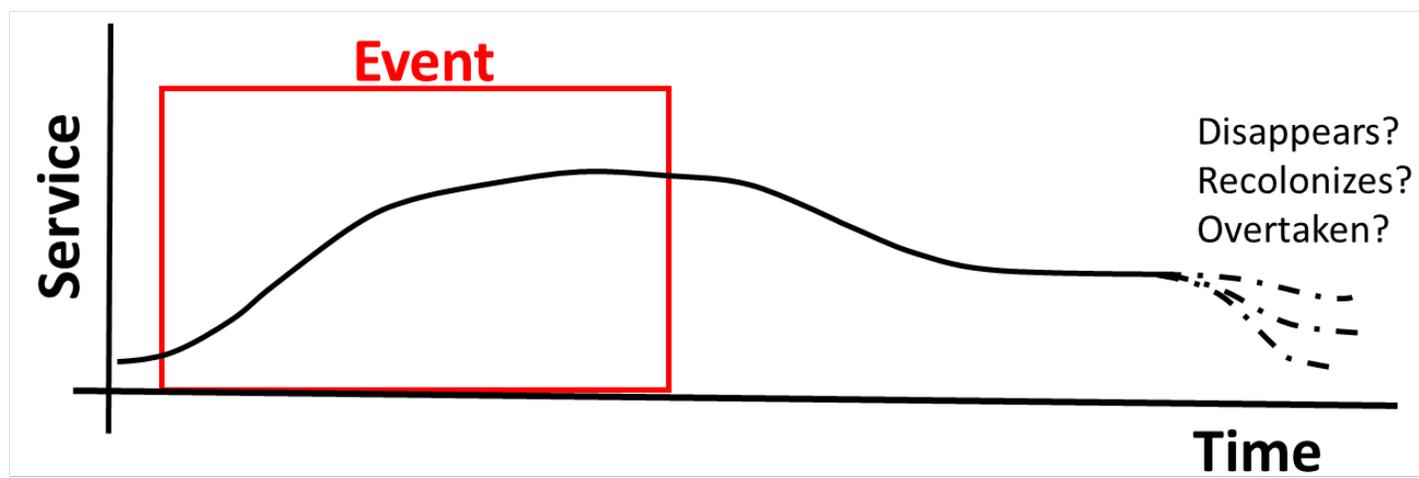
What Does it All Mean?

- Future state of ecosystem hard to predict
- Service delivery contingent to state of ecosystem



What Does it All Mean?

- Future state of ecosystem hard to predict
- Service delivery contingent to state of ecosystem
- It is not an engineering project



Conclusion

- Ecosystems deliver important suite of services after disasters
- Human activities severely impact ability of ecosystems to deliver services
- Some “blue sky” services lost post-disaster
- Some important “dark sky” services also impaired post-disaster
- Recovery of ecosystems critical to delivery of services, but hard to predict

How to balance ecosystem stewardship and hazard risk reduction?