Resilience In Coastal Communities Along the South Atlantic Coast

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resilience

Physical Definition - the ability of a material to absorb energy when it is deformed elastically , and release that energy upon unloading. **Proof resilience** is defined as the maximum energy that can be absorbed within the elastic limit, without creating a permanent distortion. The **modulus of resilience** is defined as the maximum energy that can be absorbed per unit volume without creating a permanent distortion. From *Wikipedia*

General Definition - the ability of a substance or object to spring back into shape; elasticity. *GOOGLE Dictionary*

Ecological – Ability to resist changes from disturbance or return to previous state following disturbance. R.L. Smith, *Ecology & Field Biology.*

Proof resilience is equivalent to what is called the “tipping point” in ecological thinking.

Ecological Levels: What is most important?

- Species
  - Is the loss of an individuals species significant
  - What about Keystone species?
- Community
  - If community function remains the same does loss of a species matter?
- Ecosystem
  - Alteration of structure and/or function is a “tipping point.
  - What determines the resiliency of an ecosystem?

Coastal Swamps

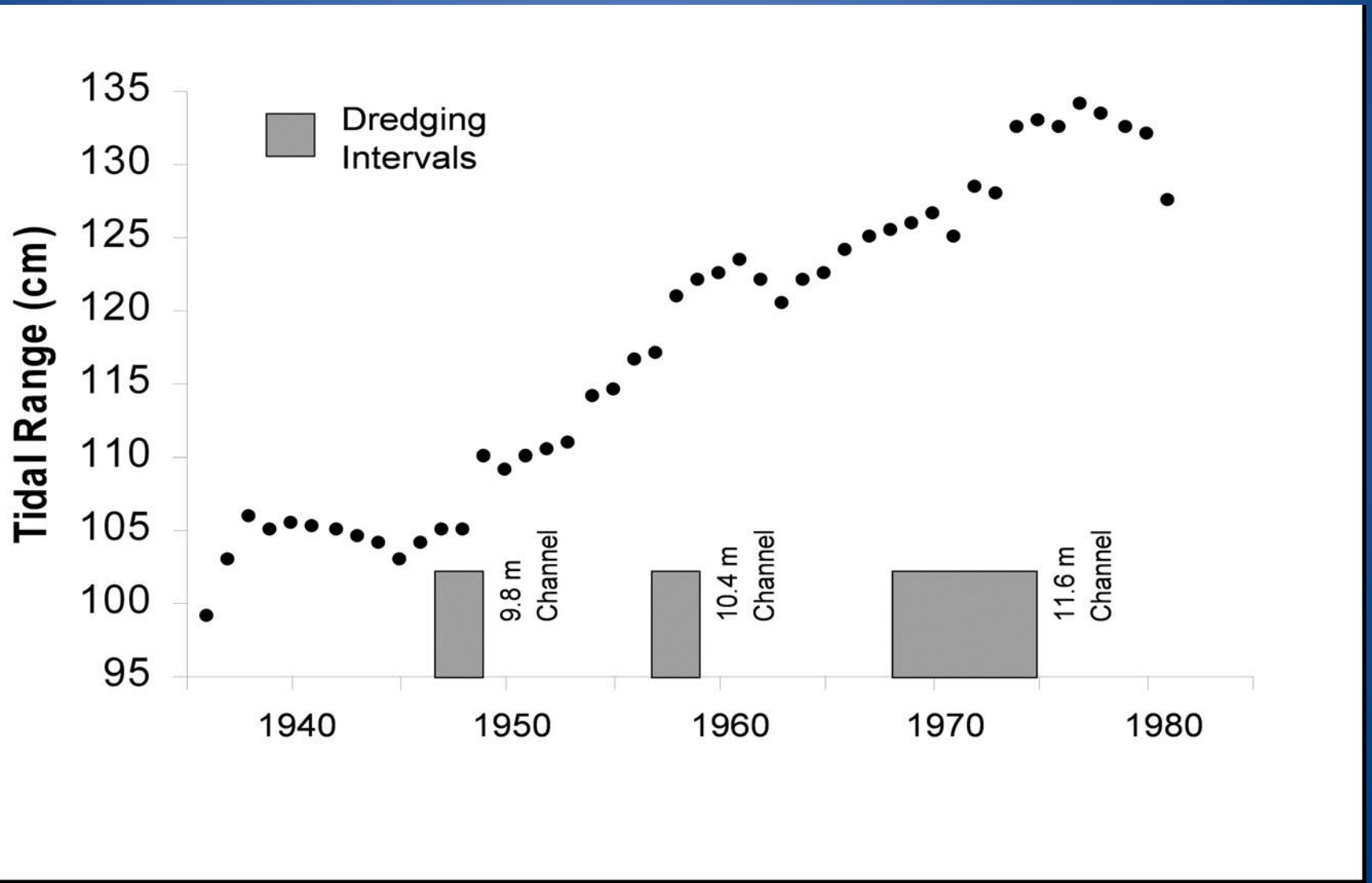
- Largely Cypress/Tupelo swamps along the SE Atlantic Coast of the U.S.
- Extensive within the Coastal Plain, typically found wherever there are tides.
- Usually found upstream to the fall line or lowest dam on a river.
- Typically adjacent to a similar habitat type, bottomland hardwood or overflow swamps

Resilience to What?

- Change is a constant in nature, although the rate may vary.
- Episotic forces are capable of altering ecosystems, e.g. fire, hurricanes.
  - Ecosystems are capable of repair through various successional processes, ultimately returning to the same state.
- Cyclic change, e.g. beach erosion-deposition cycles.
  - Unless these are new cycles, the ecosystem is already adapted to these changes.
- Directional Change, e.g. sea level rise or climate change.
  - Complex ecosystems employ various feedback measures to maintain some degree of stability.

Artificial Sea Level Rise

Change in the Tidal Range at Wilmington, NC

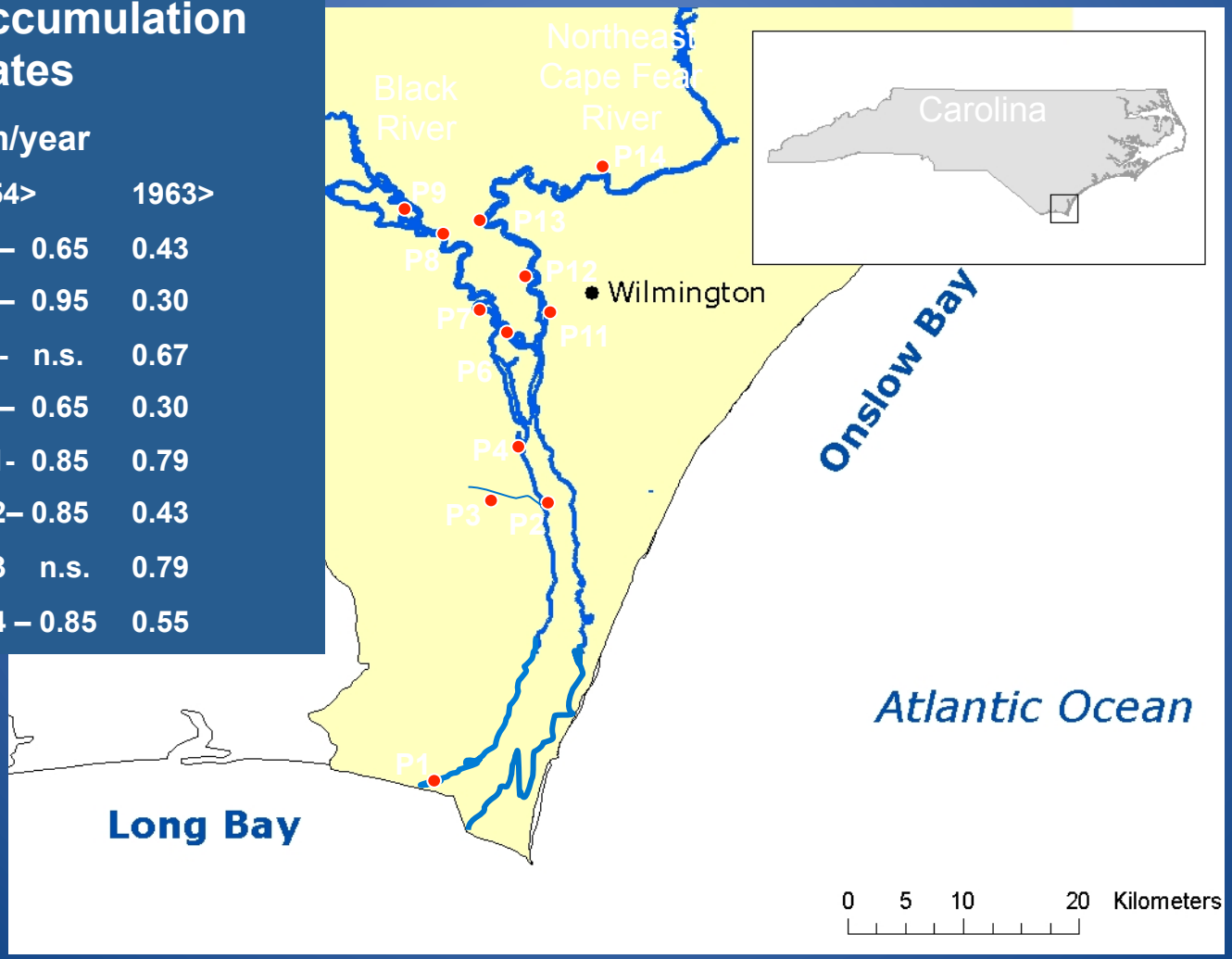


Ecosystem Response was to Increase Rate of Sedimentation via Feedback, i.e. longer and deeper flooding allows more sediment to accumulate. Ave rate of sea level rise 0.22 cm/yr

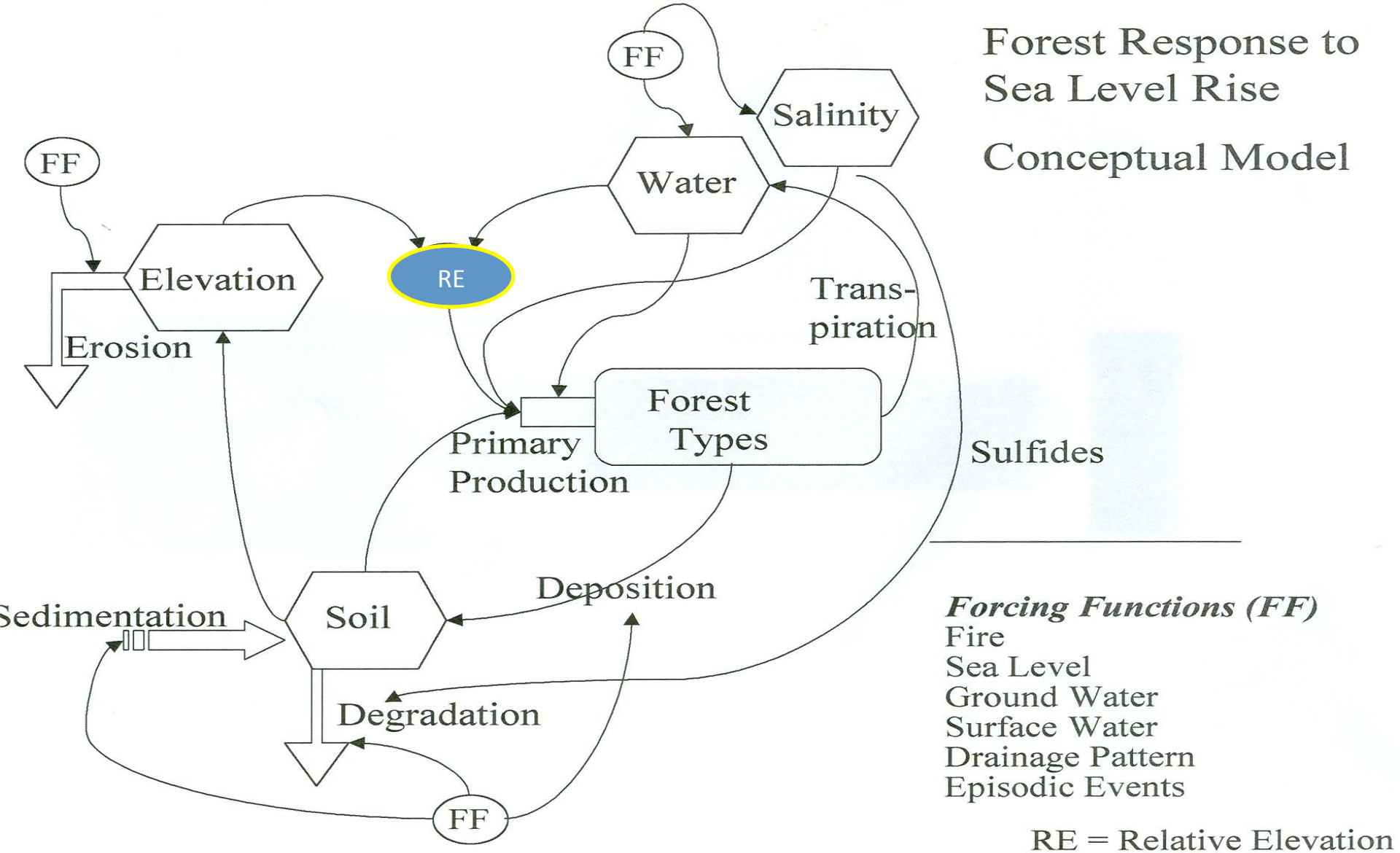
Accumulation Rates

Cm/year

	1954>	1963>
P6 –	0.65	0.43
P7 –	0.95	0.30
P8 -	n.s.	0.67
P9 –	0.65	0.30
P11-	0.85	0.79
P12–	0.85	0.43
P13	n.s.	0.79
P14 –	0.85	0.55



LANDSCAPES RESPOND TO A VARIETY OF DISTURBANCES, INCLUDING SEA LEVEL RISE, IN A COMPLEX FASHION



System Was Resilient to an Increase in Water Level and Readjusted the Soil Suface Level to Return to a Homeostatic State for this Ecosystem

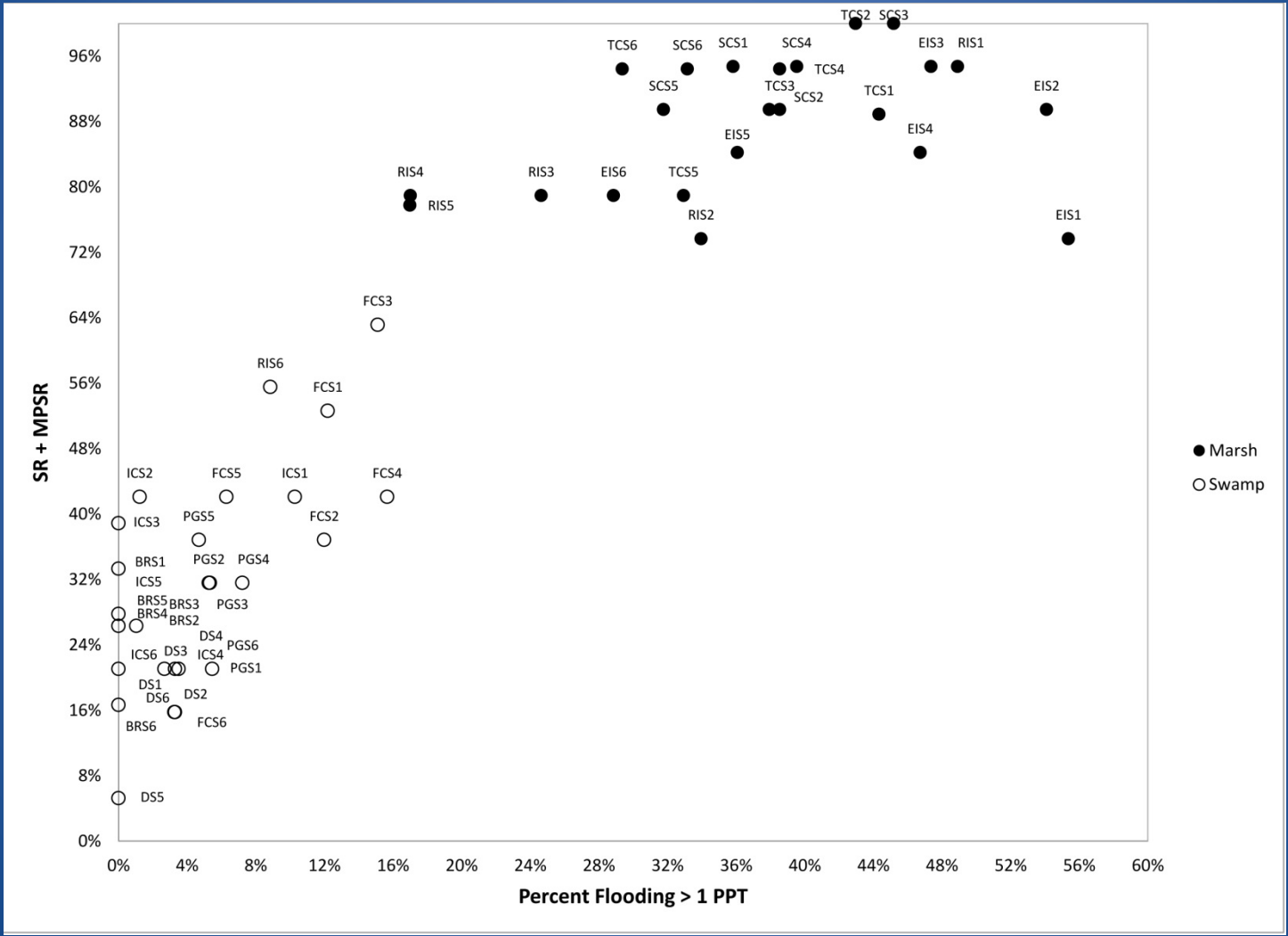
- Species displaced or lost during recovery.
- Conversion of bottomland hardwood to tidal swamp in higher elevations.
- The rate of increase in water level was within the tolerance of keystone species, i.e. Cypress & Gum
- Little change in ecosystem structure.

Why was the ecosystem not resilient in some part of the system?

NORTH CAROLINA TIDAL SWAMP

Degraded Tidal Swamp

Soil Pore Water State



The addition of Sulfate that Accompanied Increased Water Levels Altered the Competitive Interactions of Microbiota

- In the presence of increased levels of sulfate, sulfate reducing bacteria outcompete methanogenic bacteria for critical substrate causing:
  - Increased decomposition of organic soils, which reduces surface soil elevation,
  - Production of hydrogen sulfide, toxic to plant roots and most freshwater fauna,
  - Leads to reverse or hydrarch succession.

Are There Lessons for Coastal Development From Nature

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