

# Spatial Variation in Mangrove Community Zonation in the Lower Florida Keys

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L A F A Y E T T E

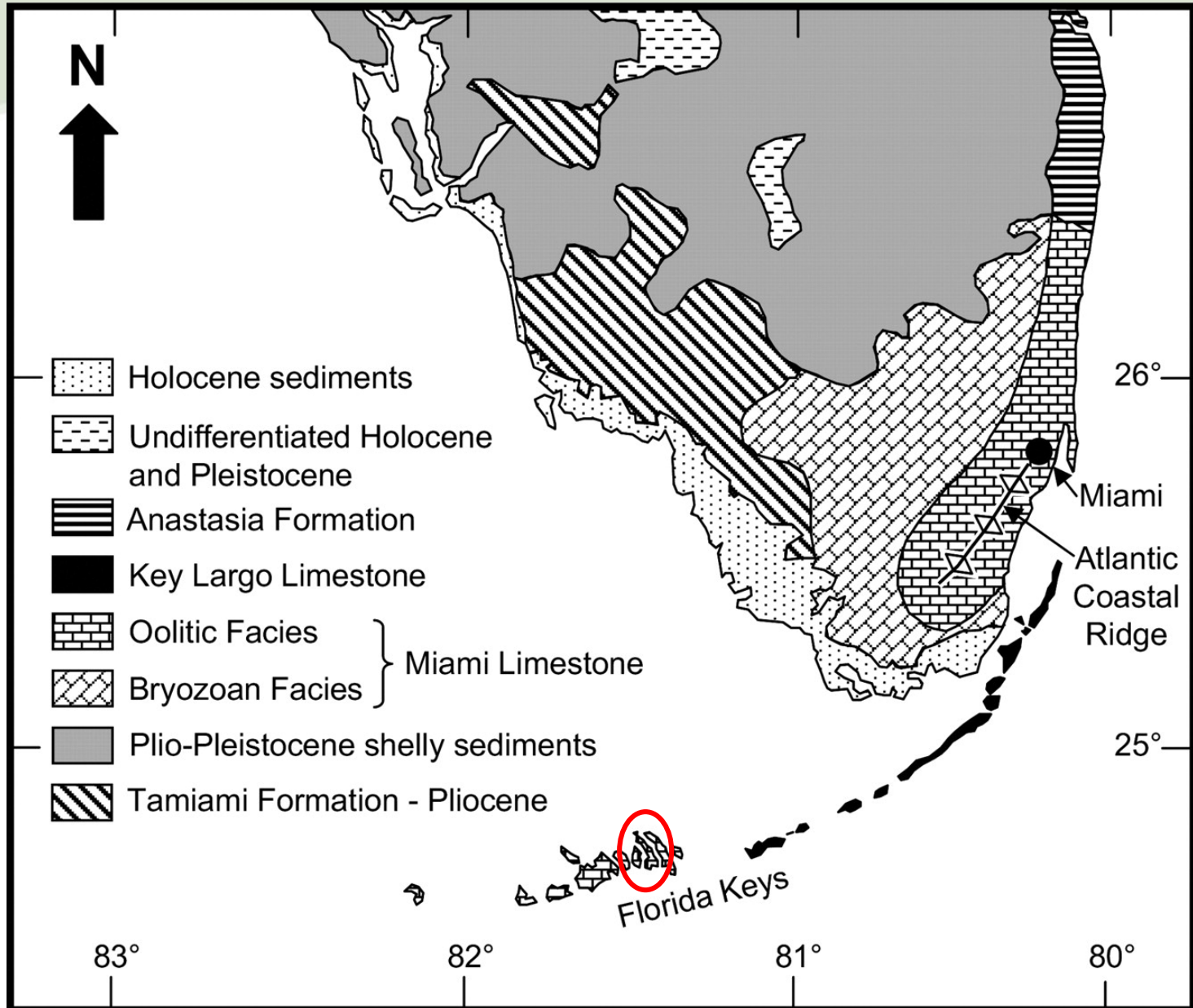
**Institute for Coastal  
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Research Funding provided by the US Fish and Wildlife Service



Florida Keys

# Florida Keys





# Sea-Level Rise

- Sea-level rise will impact Florida Keys
  - Low elevation islands (1.5 m – 3.5 m)
  - Limited area for mangrove upslope migration
  - Sea-level rise of >60 cm by 2100
- Mangrove habitats provide valuable ecosystem services
- Habitat for multiple endangered species

# Key Deer

## *Odocoileus virginianus clavium*

- Occur only on a few islands within the Florida Keys
- Population size of 700 - 800 (mostly on Big Pine Key)
- Upland forest Slash Pine (*Pinus elliottii*)
  - Preferred habitat
  - Declining from sea-level rise; salinization of water table





# Research Questions

- Which environmental factors currently structure lower Florida Keys mangrove communities?
- How do soil factors, surface elevation and sediment accretion vary
  - between sites (hydrogeomorphic setting)?
  - across habitats within sites?
- How will mangrove communities respond to accelerated rates of sea-level rise?
  - vertical accretion?
  - upslope migration?
  - importance of tropical storms and hurricanes?

# Transect-Based Approach

- Two sites
  - Big Pine Key
  - Sugarloaf Key
- Two hydrogeomorphic settings
  - Oceanic
  - Lagoonal
- Each transect spanned 4 habitat zones
  - Red Mangrove
  - Red/Black Mangrove Transition
  - Black Mangrove
  - High (White/Black) Mangrove limit





Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



# Sugarloaf Oceanic: Red Mangrove



# Sugarloaf Lagoon: Red Mangrove



# Big Pine Oceanic: Red Mangrove



# Big Pine Lagoon: Red Mangrove



# Big Pine Lagoon: Red/Black Transition



# Big Pine Lagoon: High Black/White



# Transects Sampled Every 10 m

- 10 m<sup>2</sup> circular plots (66 plots)
- Vegetation characterization
  - Plant community composition
  - Vegetation cover by species
  - Canopy height
- Soil characterization
  - Soil depth
  - Soil organic matter
  - Extractable soil salinity
  - Extractable soil nutrients



# Elevation

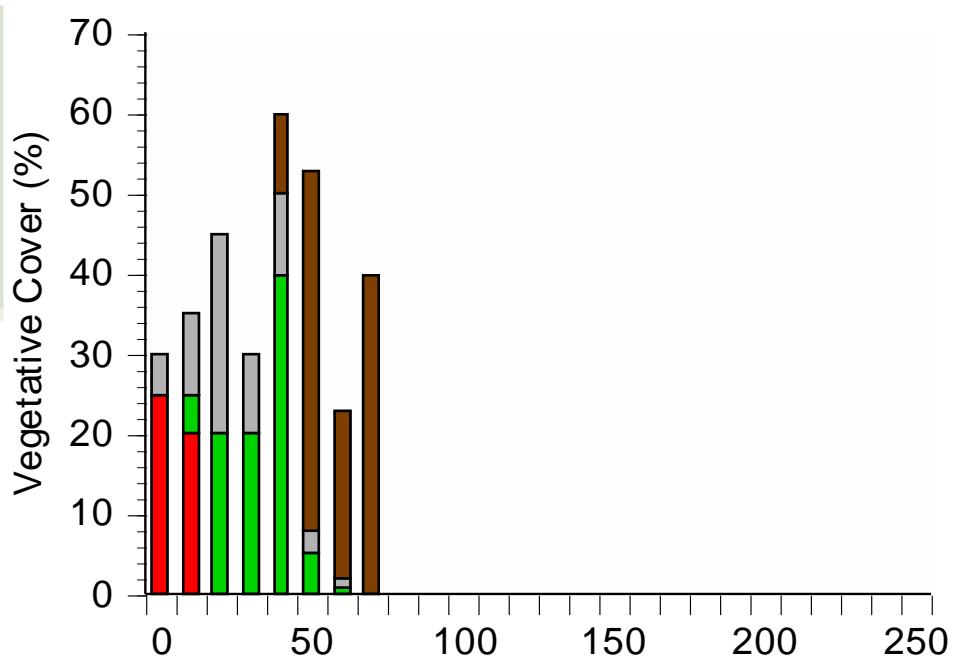
- Transect elevation surveys
  - Laser level 2012
  - RTK (NAVD88) 2014
- Mangrove elevation limits 2014
  - 1,699 additional RTK survey points
  - 2,086 total survey points
- Elevation & accretion dynamics
  - Rod Surface Elevation Tables (RSETs) in each transect habitat type (16 total)
  - 2011, (2012), 2013, 2014, 2016



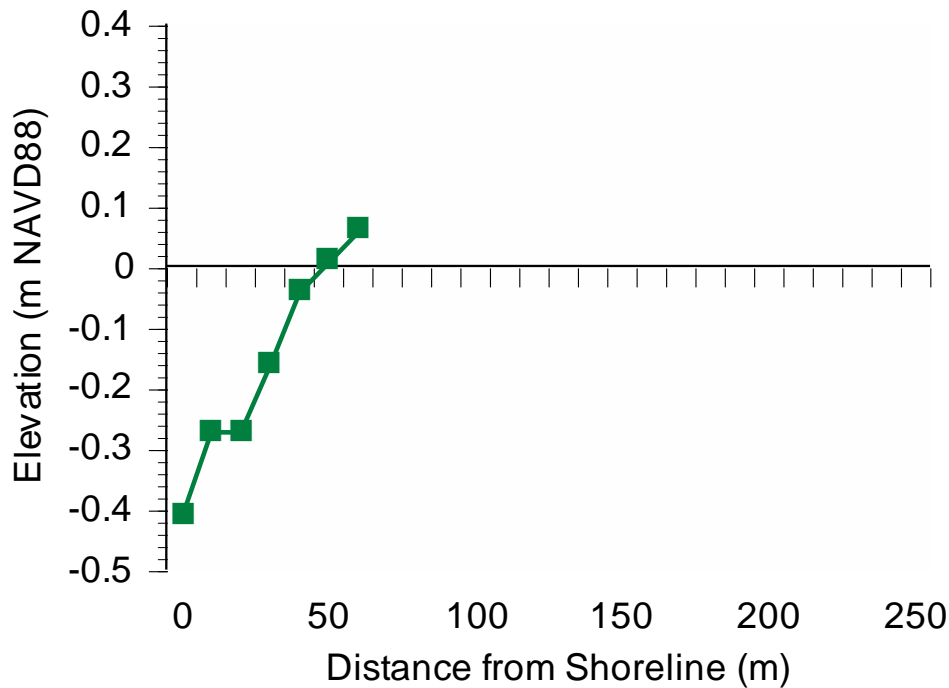


# Results

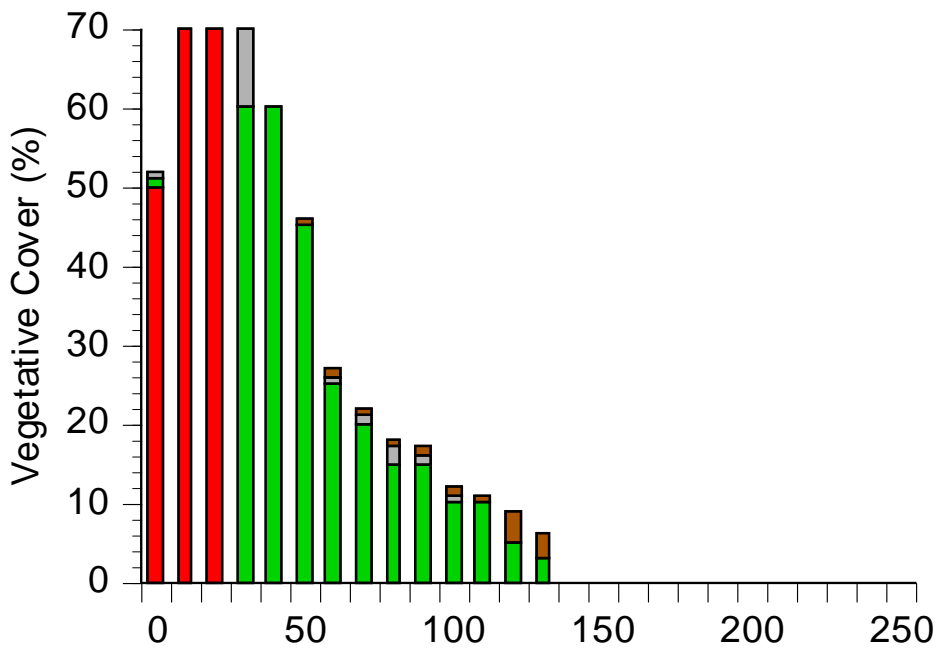




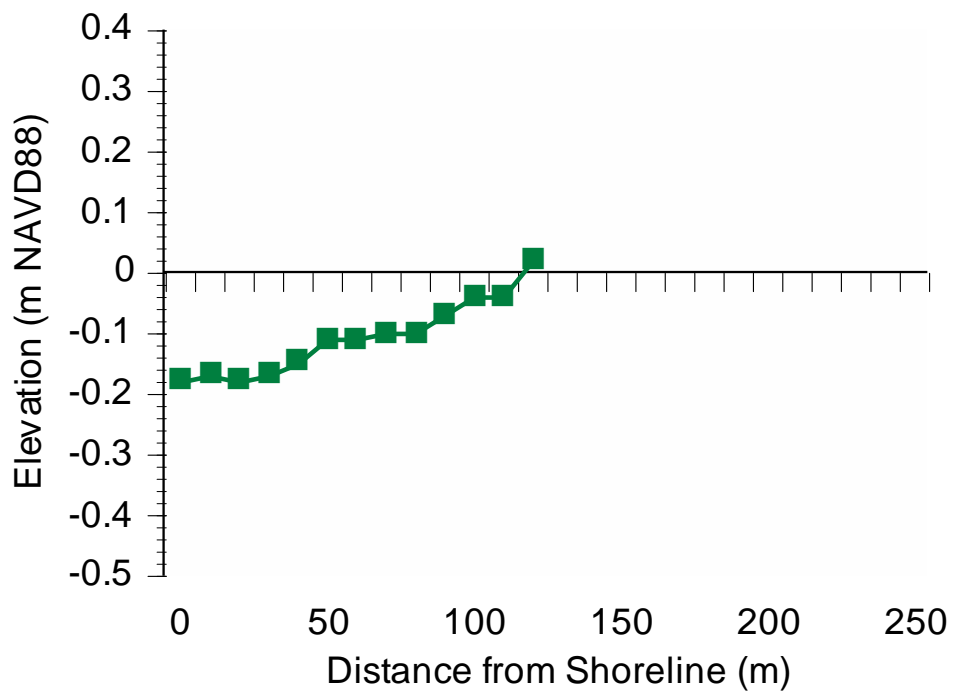
- Herbaceous
- White Mangrove
- Black Mangrove
- Red Mangrove



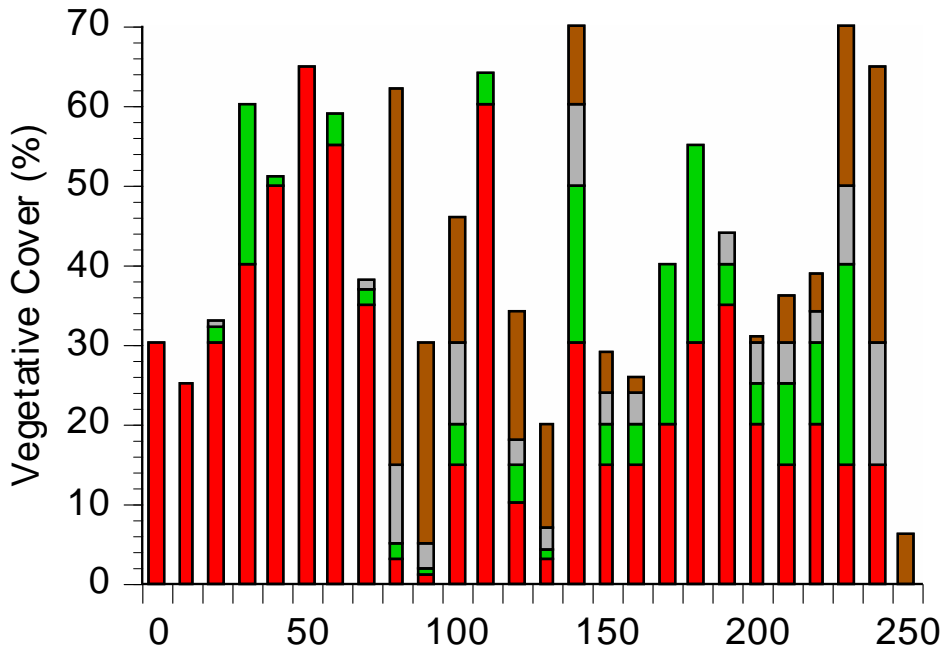
# Big Pine Oceanic



- Herbaceous
- White Mangrove
- Black Mangrove
- Red Mangrove

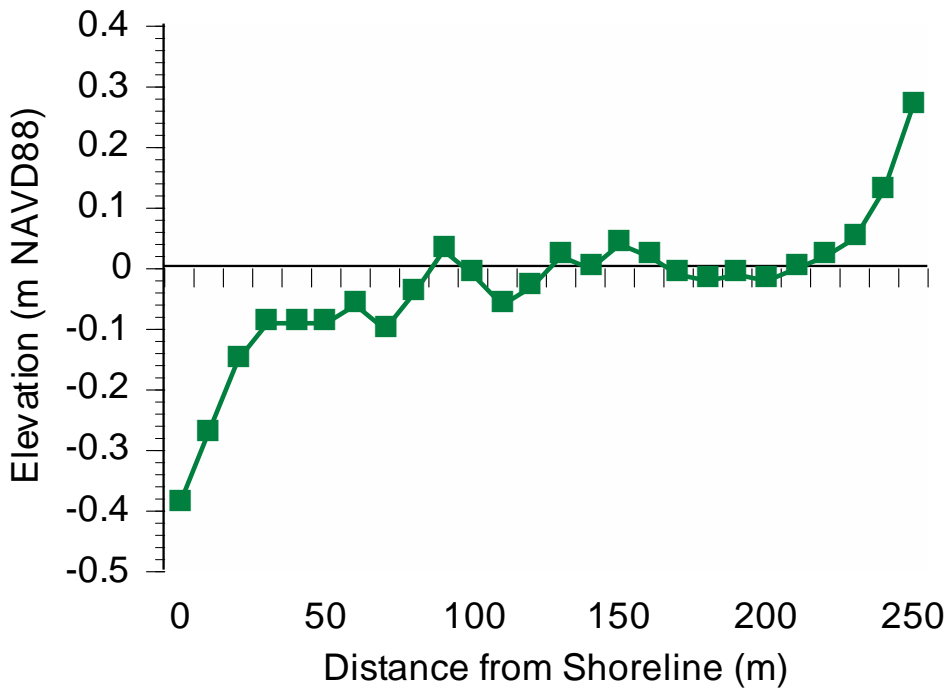


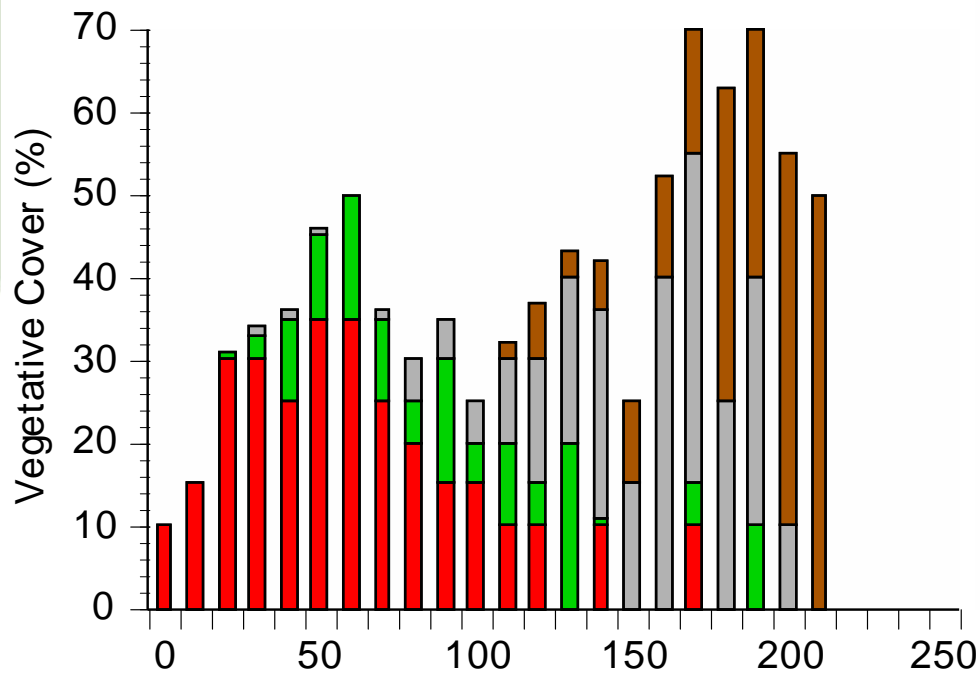
# Big Pine Lagoon



- Herbaceous
- White Mangrove
- Black Mangrove
- Red Mangrove

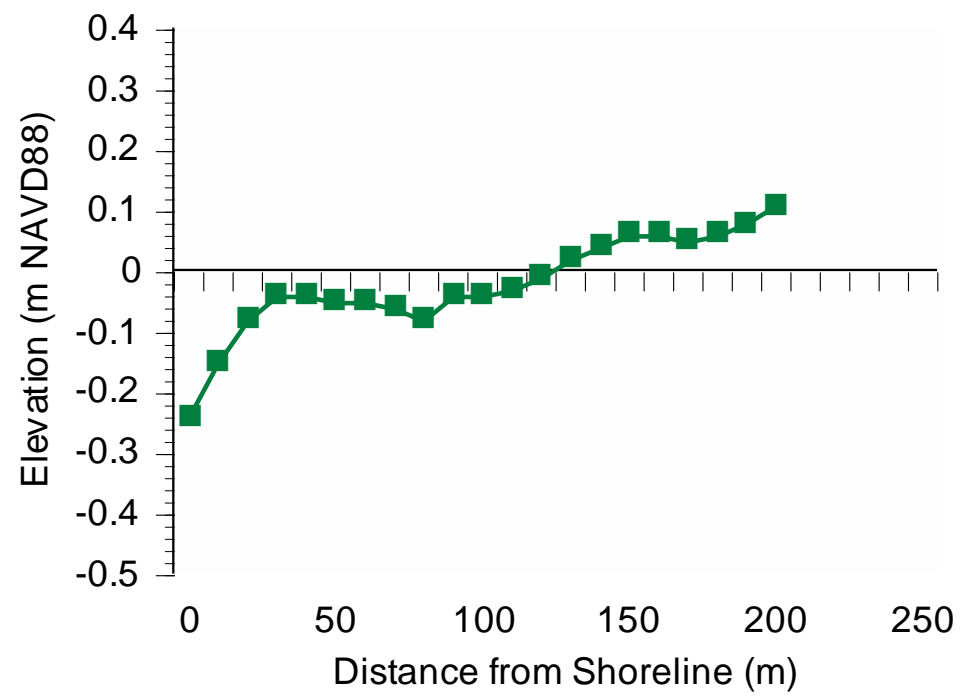
# Sugarloaf Oceanic



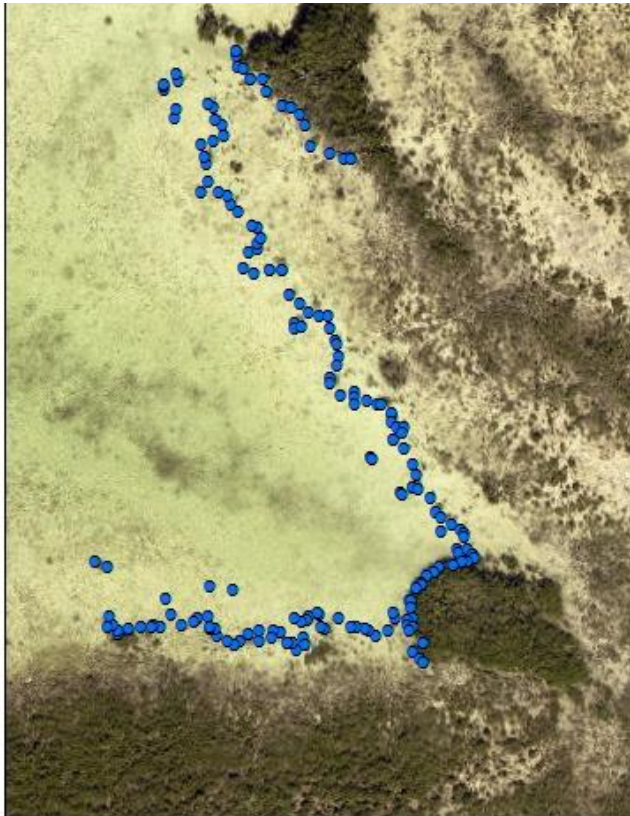
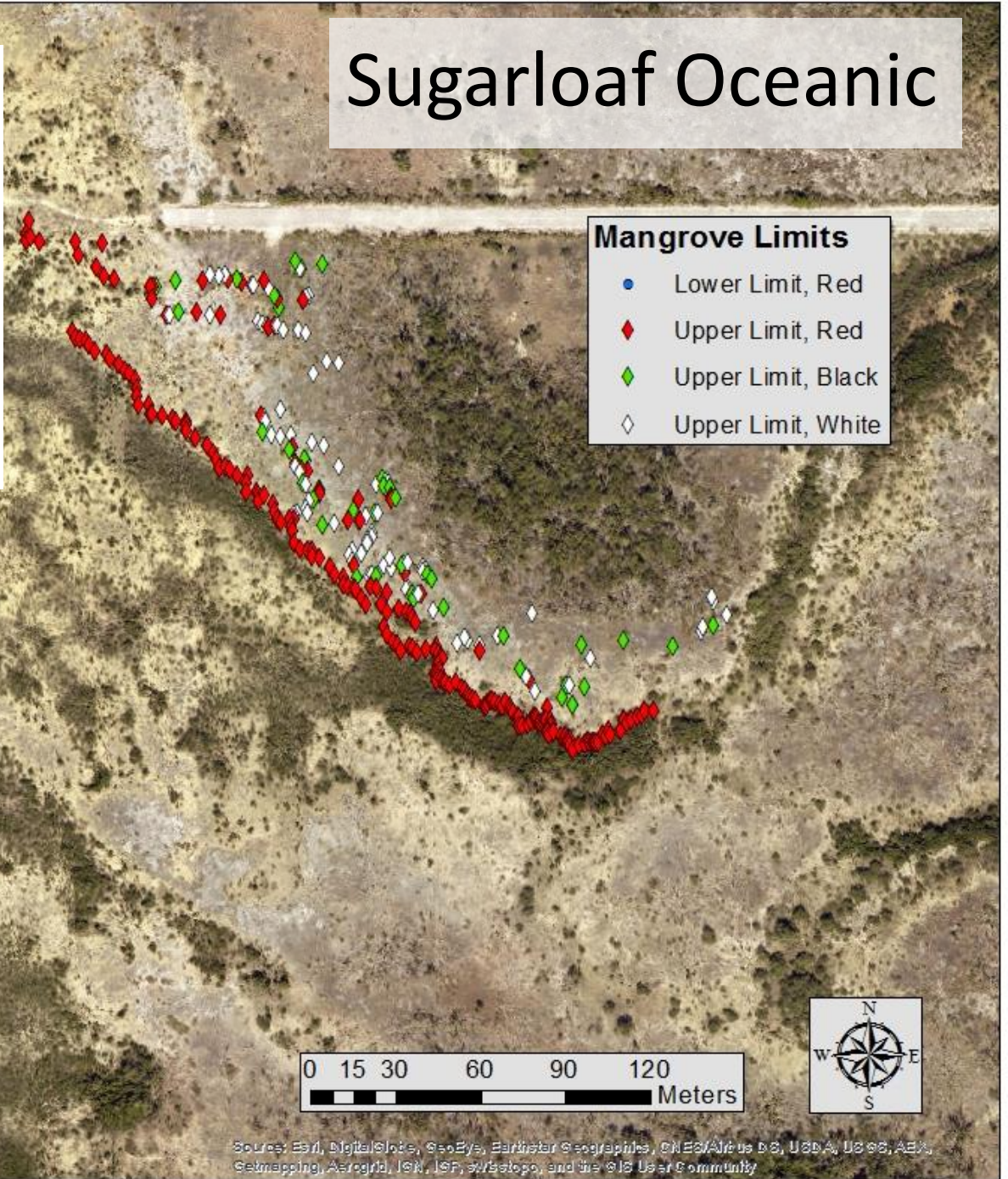
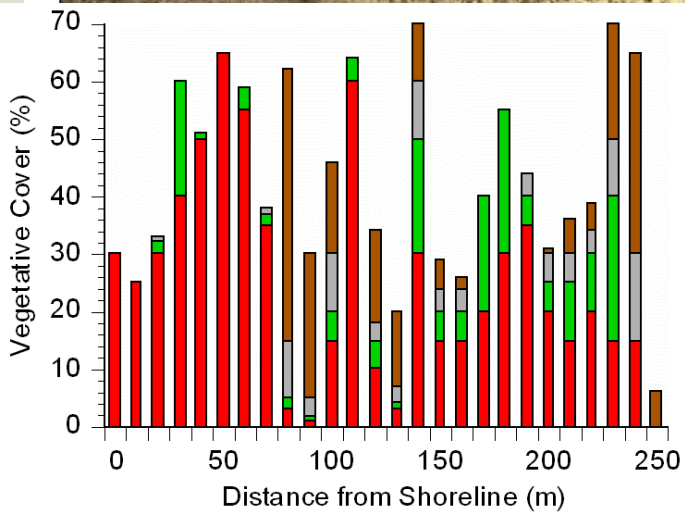


- Herbaceous
- White Mangrove
- Black Mangrove
- Red Mangrove

# Sugarloaf Lagoon



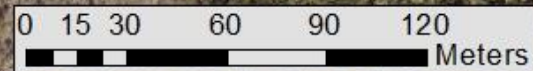
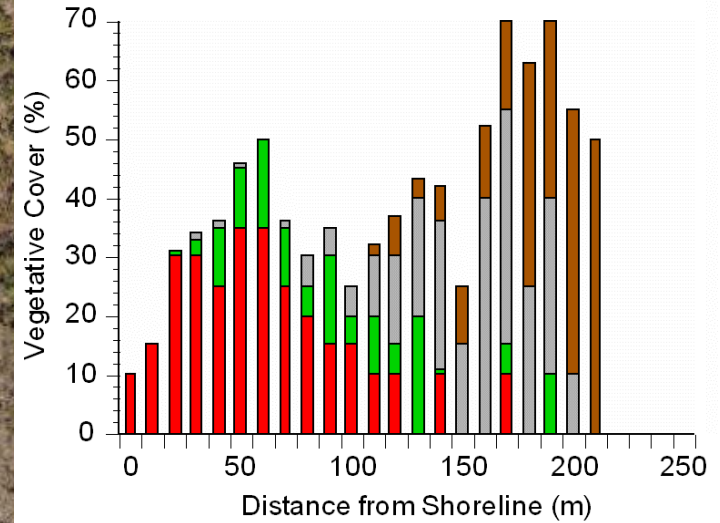
# Sugarloaf Oceanic



# Sugarloaf Lagoon

## Mangrove Limits

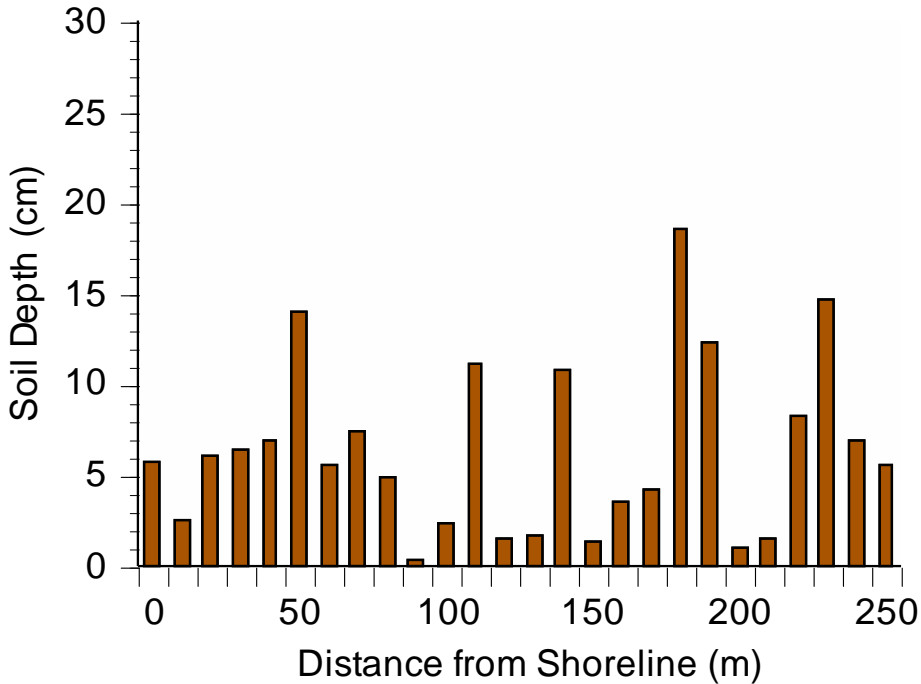
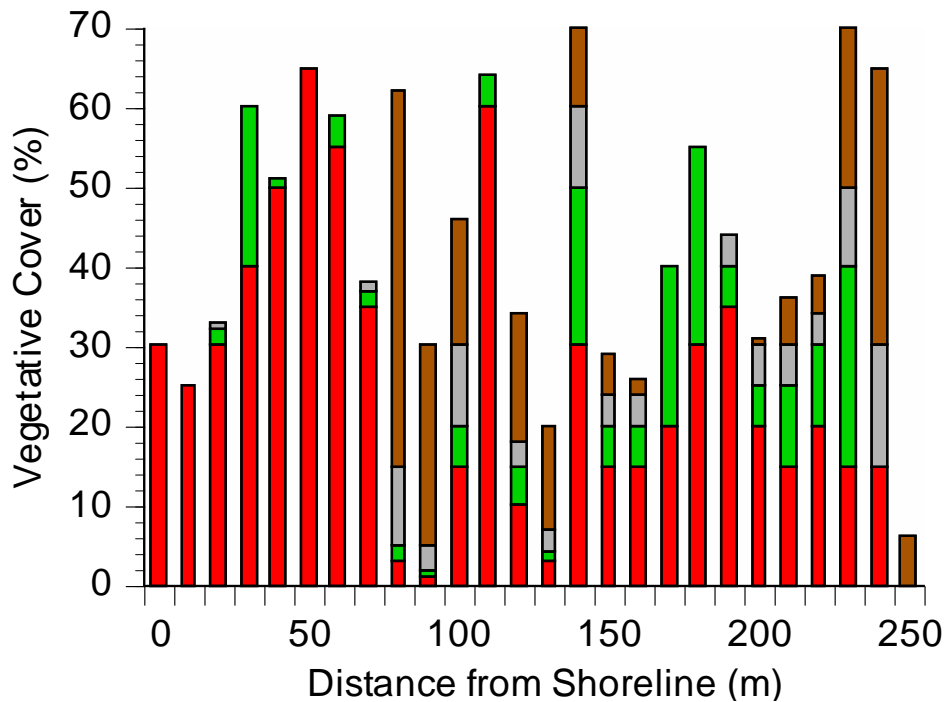
- Lower Limit, Red
- ◆ Upper Limit, Red
- ◆ Upper Limit, Black
- ◇ Upper Limit, White



# Principal Components Analysis

	Comp. 1	Comp. 2	Comp. 3
Soil Organic Matter	0.123	<b>0.752</b>	0.254
Soil Salinity	-0.341	0.098	<b>0.483</b>
Soil Depth	-0.159	<b>0.788</b>	-0.043
Elevation	<b>0.702</b>	-0.154	-0.366
RM cover	<b>-0.543</b>	<b>0.625</b>	-0.393
BM cover	0.020	0.000	<b>0.843</b>
WM cover	<b>0.650</b>	-0.048	0.113
Herb. cover	<b>0.802</b>	0.012	-0.172





# Sugarloaf Oceanic

# What is controlling soil development and surface elevation change?



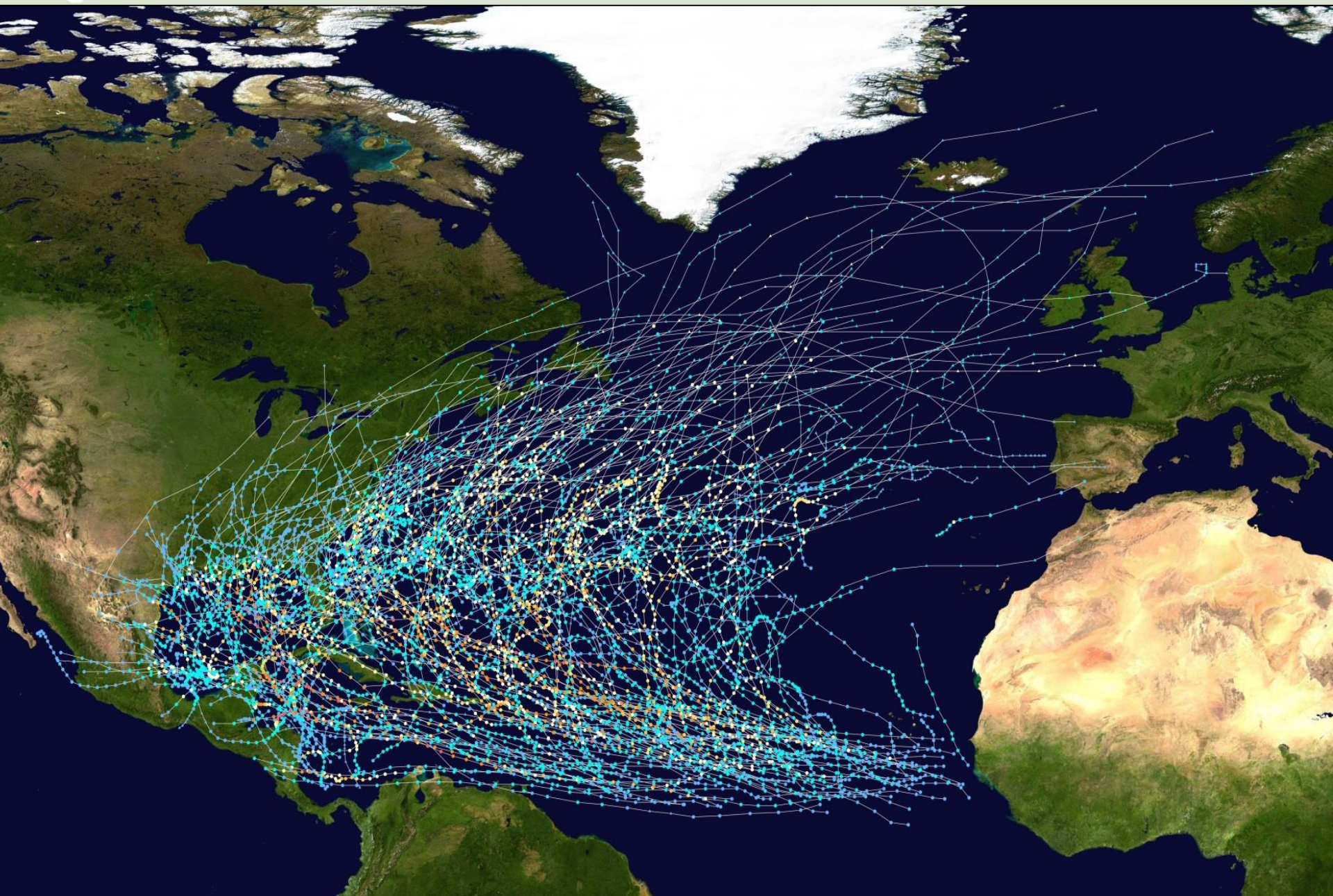




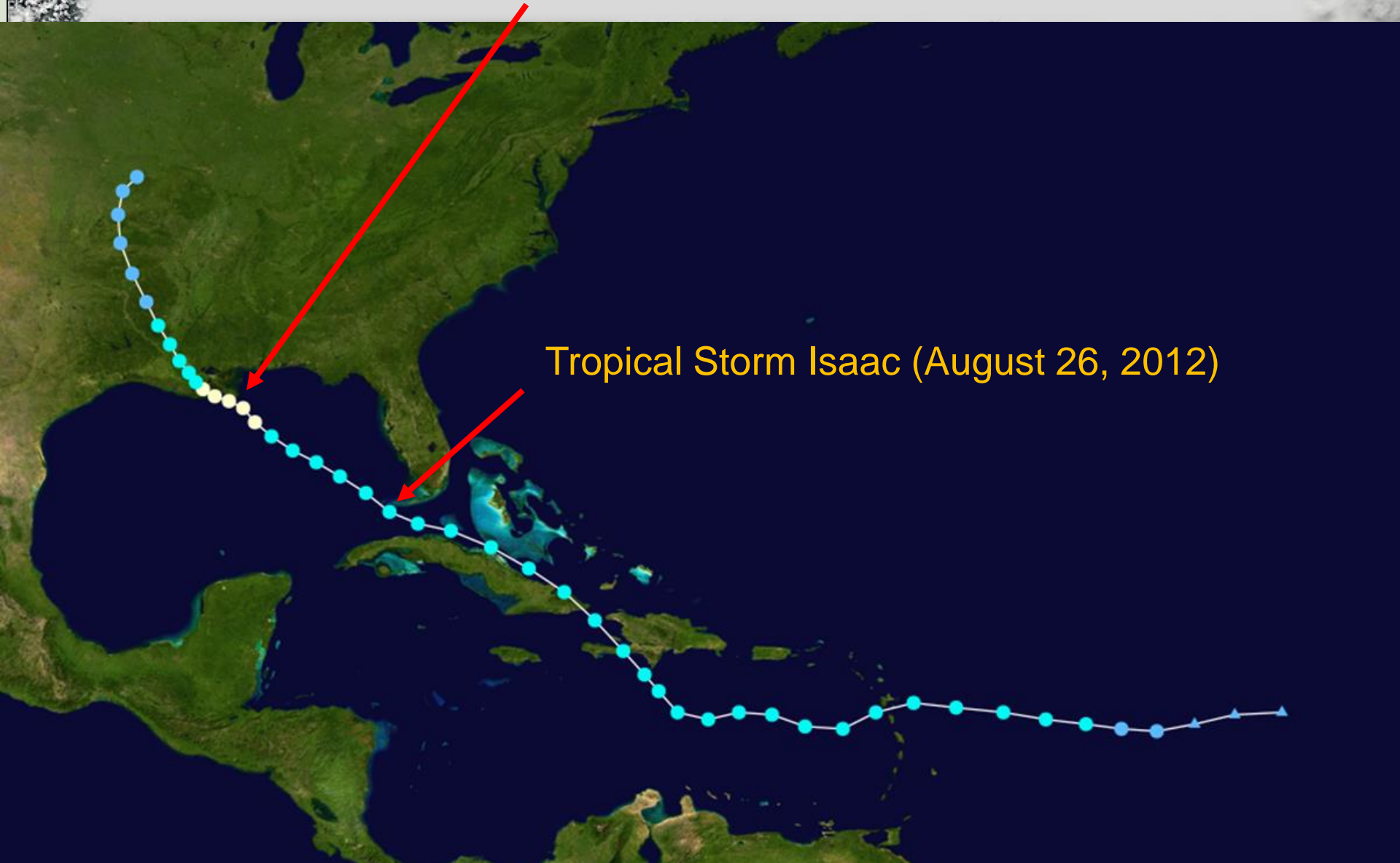




# Tropical Storms and Hurricanes (1851 – 2004)



# Hurricane Isaac (August 28, 2012)



Tropical Storm Isaac (August 26, 2012)



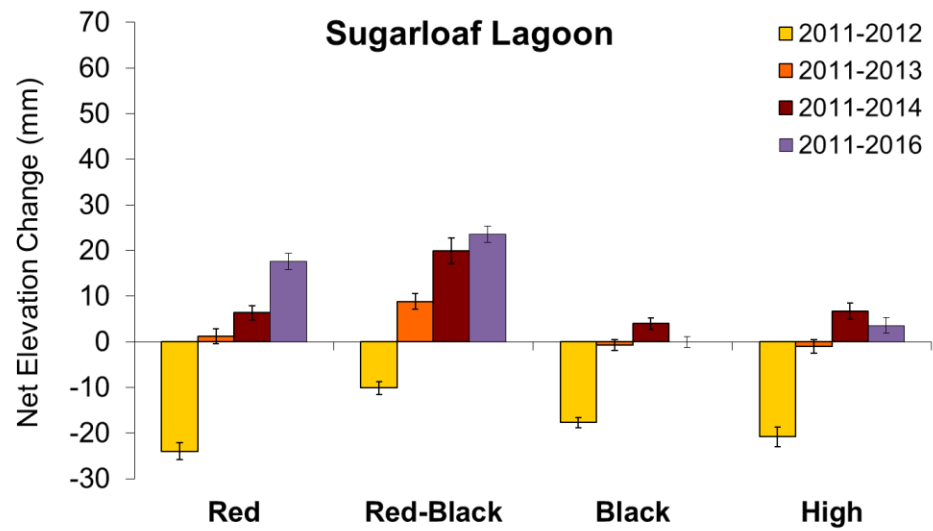
# Sugarloaf Oceanic

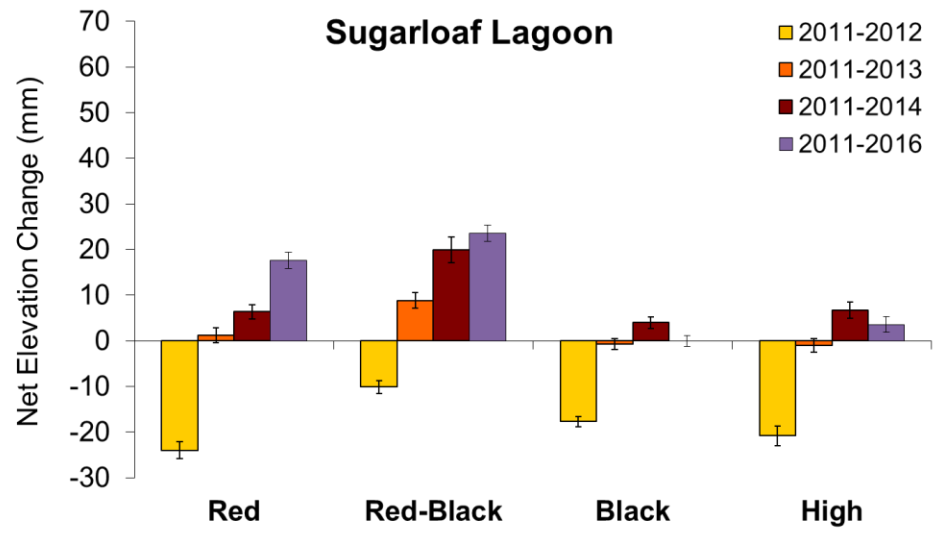
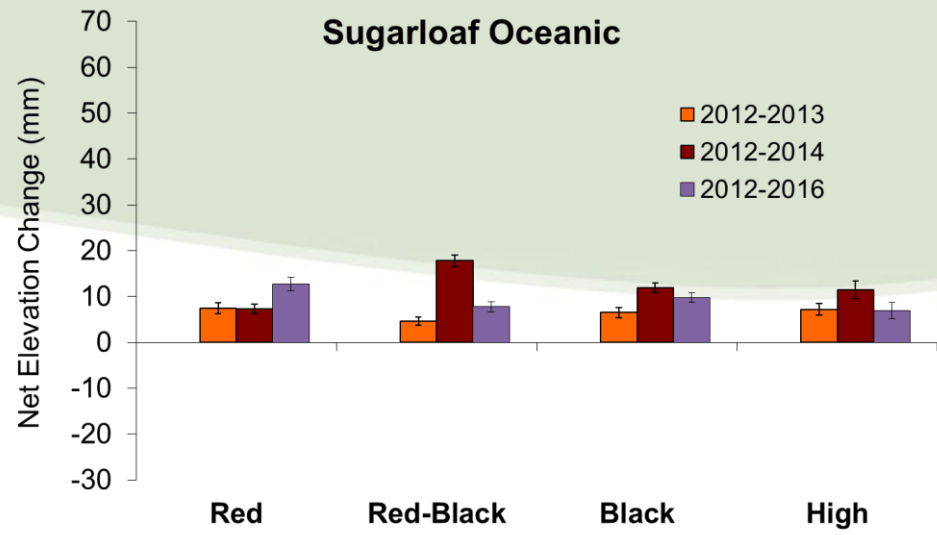
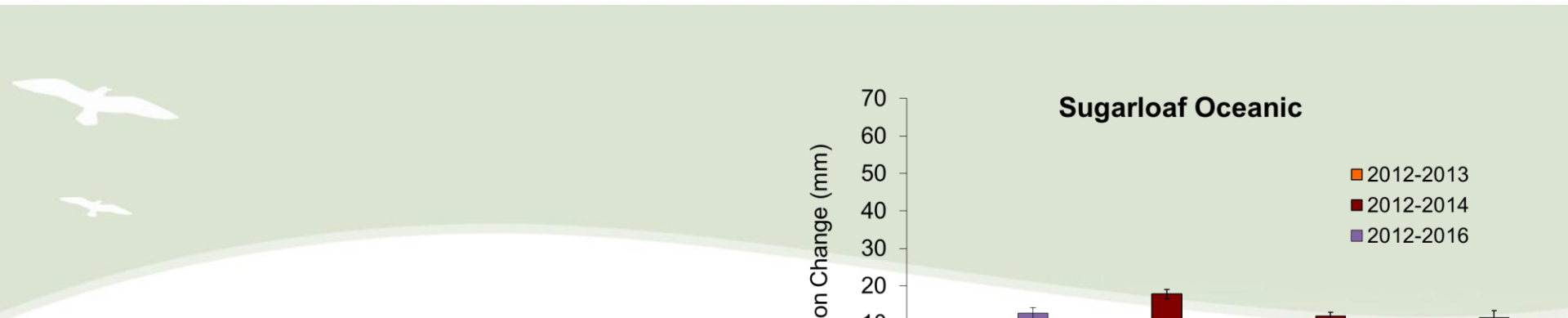
May 2013  
(10 months post TS Isaac)



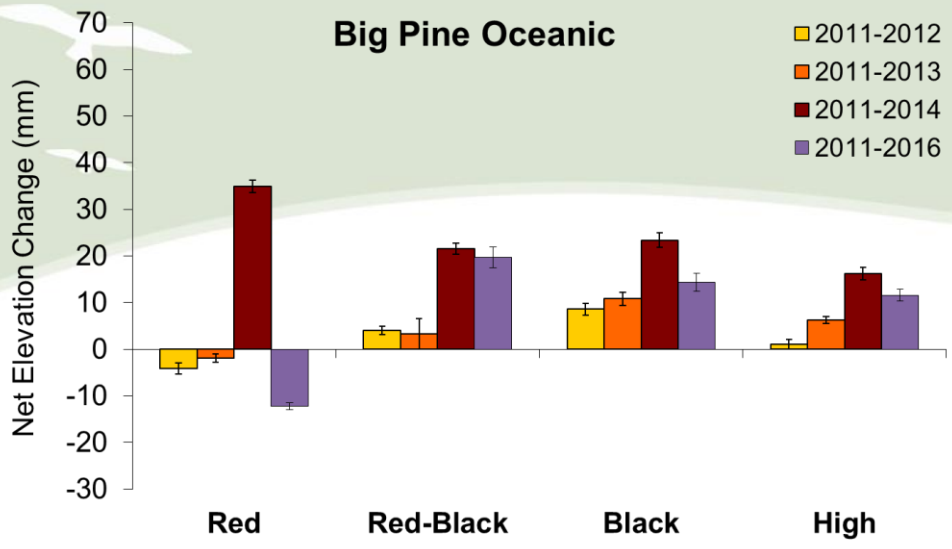
# Sugarloaf Lagoon



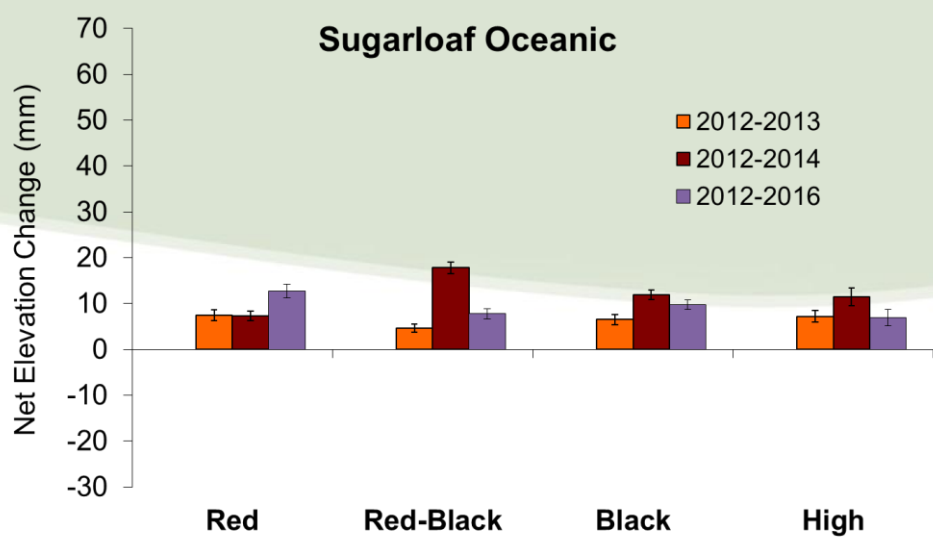




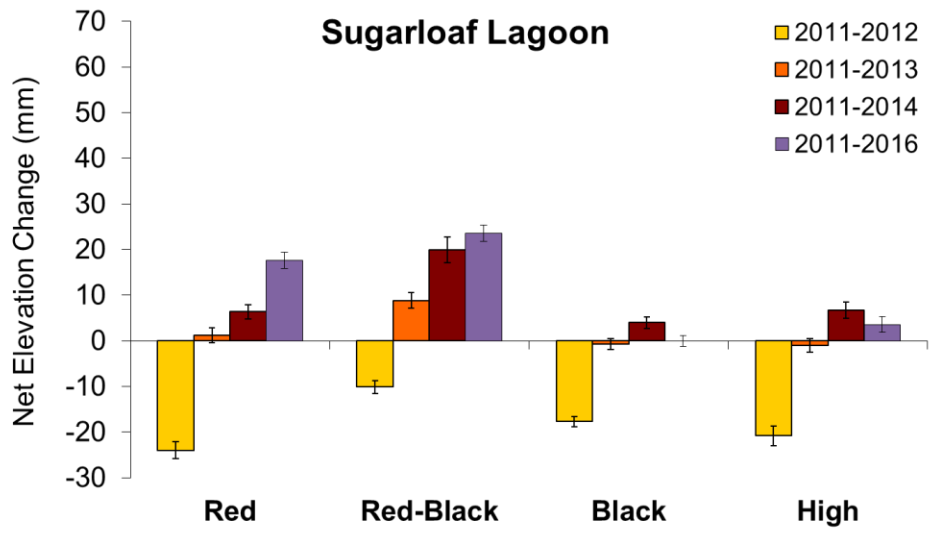
### Big Pine Oceanic

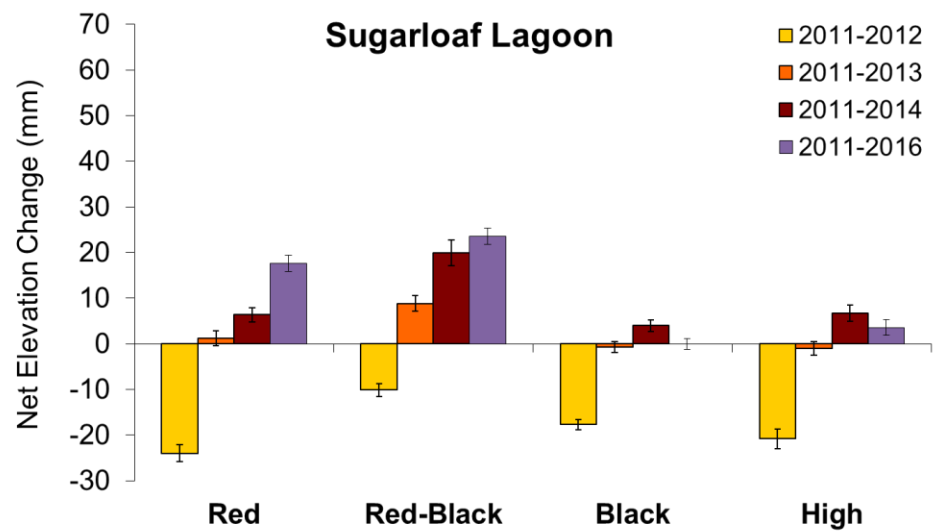
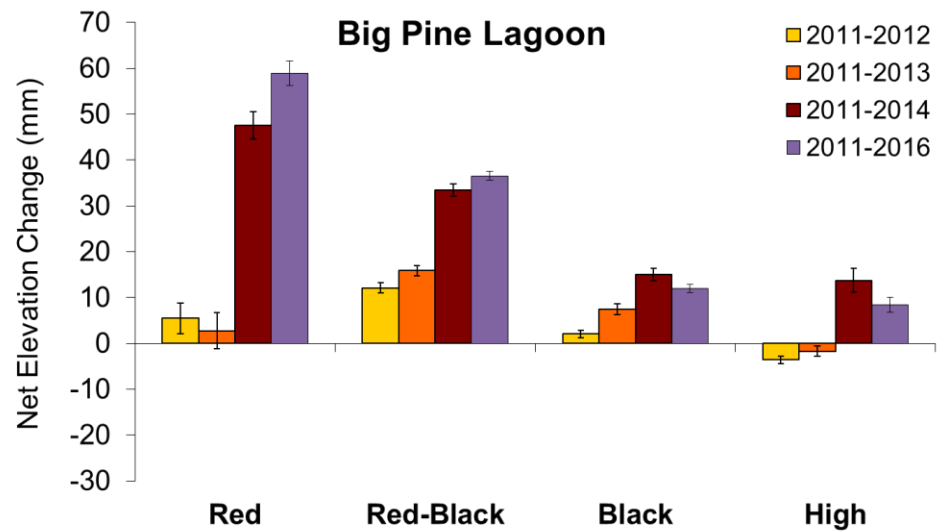
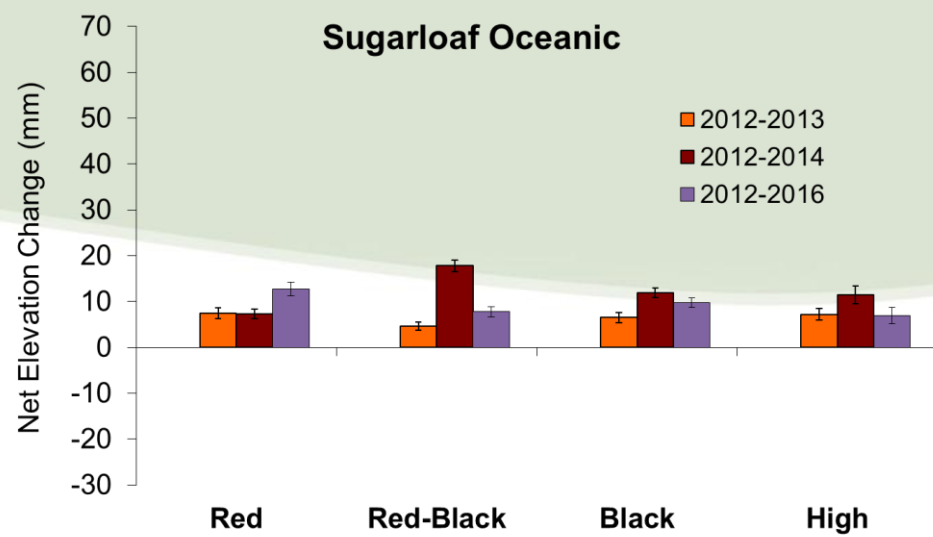
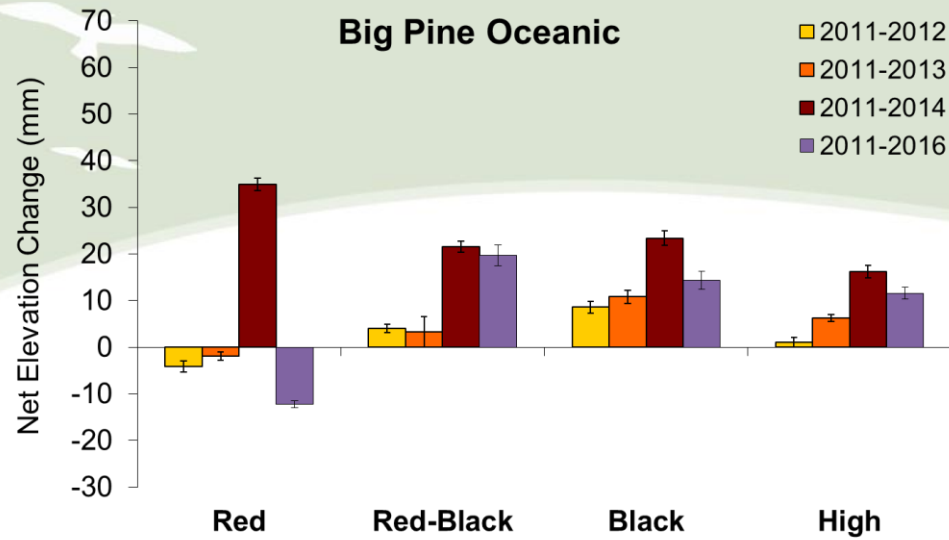


### Sugarloaf Oceanic



### Sugarloaf Lagoon







# Conclusions

- Mangrove community structure strongly influenced by elevation, soil depth, and soil salinity
- Organic matter input and mechanism of soil development vary by habitat
- Sediment accretion is dynamic and can be transient
- Successful upslope migration with accelerated sea-level rise
  - modulated by sediment deposition
  - facilitated by primary succession and soil development
- Pulsed disturbance events will likely play a crucial role in mangrove community response to rising sea levels



**Questions?**