

The difficulty of finding smoking gun evidence:  
High salinity and other threats to the Endangered Key  
Tree Cactus (*Pilosocereus robinii*) in the Florida Keys

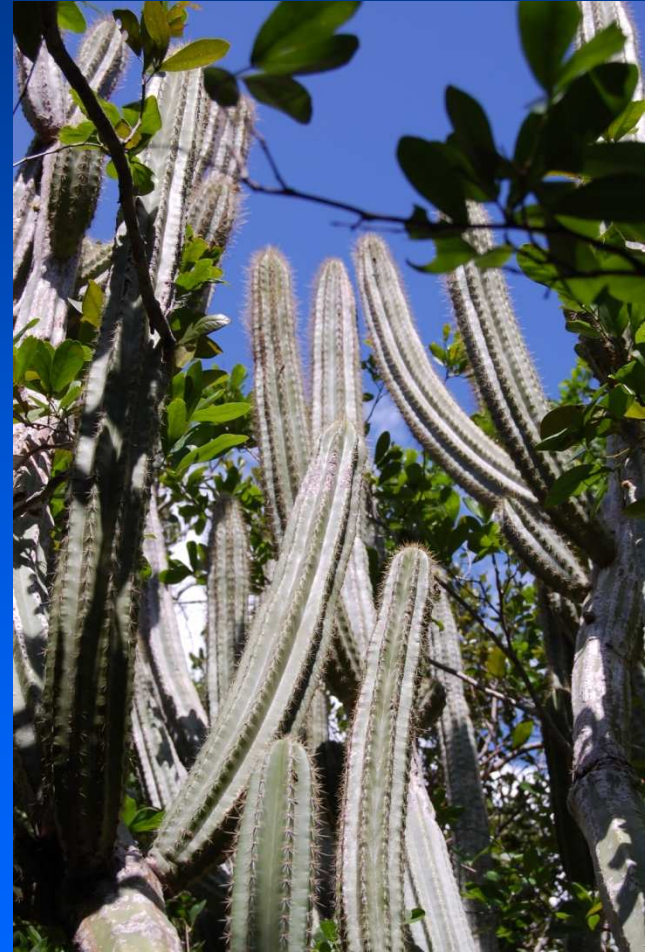
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McAuliffe, Kathy Rice, and Julissa Roncal

FAIRCHILD TROPICAL BOTANIC GARDEN

# Key Tree Cactus (*Pilosocereus robinii*)

- Range: Florida Keys and Cuba (9 populations in FL, unknown status in Cuba)
- Habitat: low rockland hammock
- Height: up to 30 feet!
- Conservation Status: U.S. listed endangered



**Key Tree Cactus locations  
in the Florida Keys**



Monroe County

Miami-Dade County

Upper Keys

Middle Keys

Lower Keys



# Key Tree Cactus in Florida Keys circa 1970

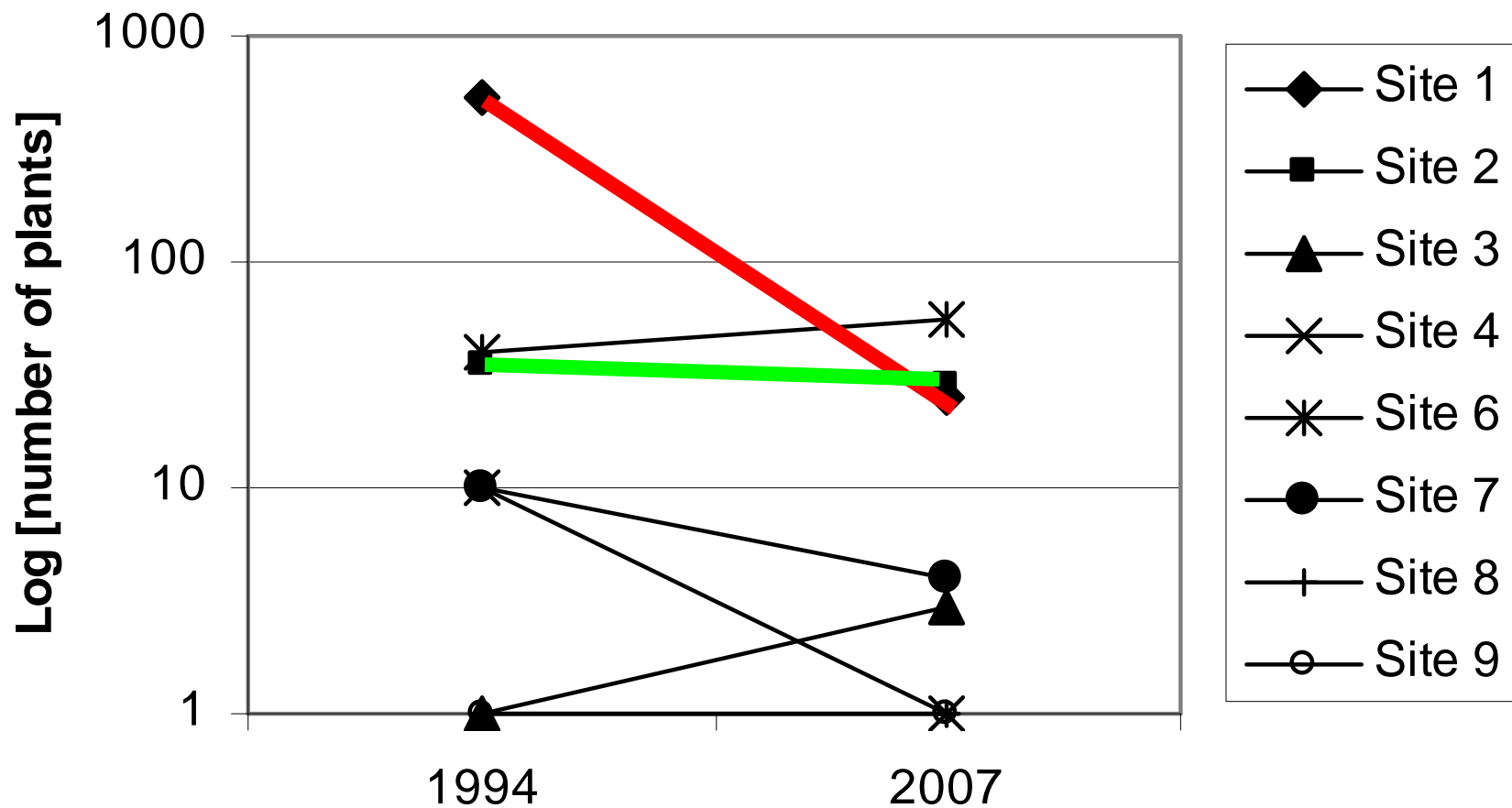


## Key Tree Cactus 2005

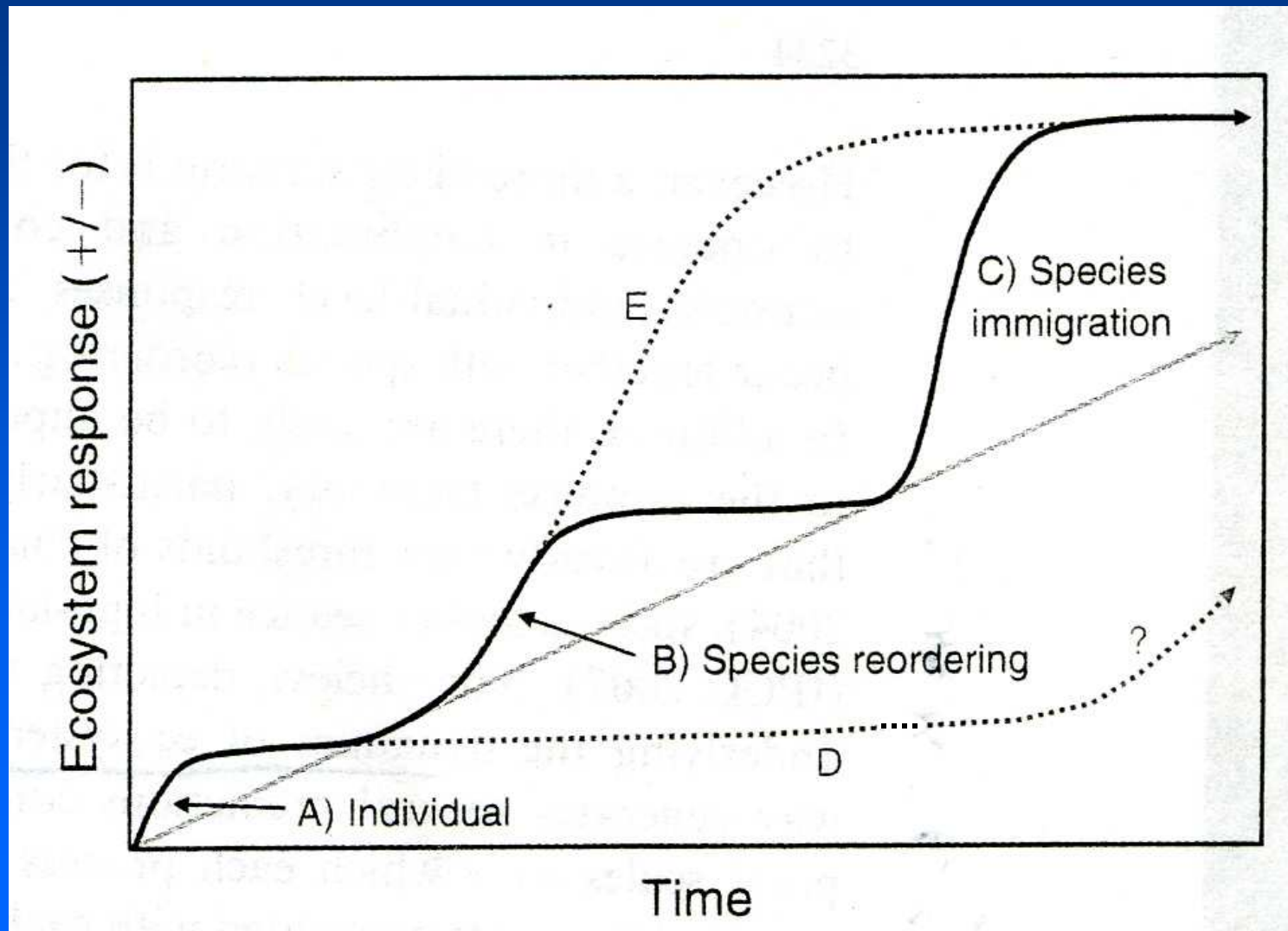


- Greater canopy cover of other woody sp.
- Decreased cactus stem density
- More development and fragmentation

# Change in Population Size



# Hierarchical Response Framework



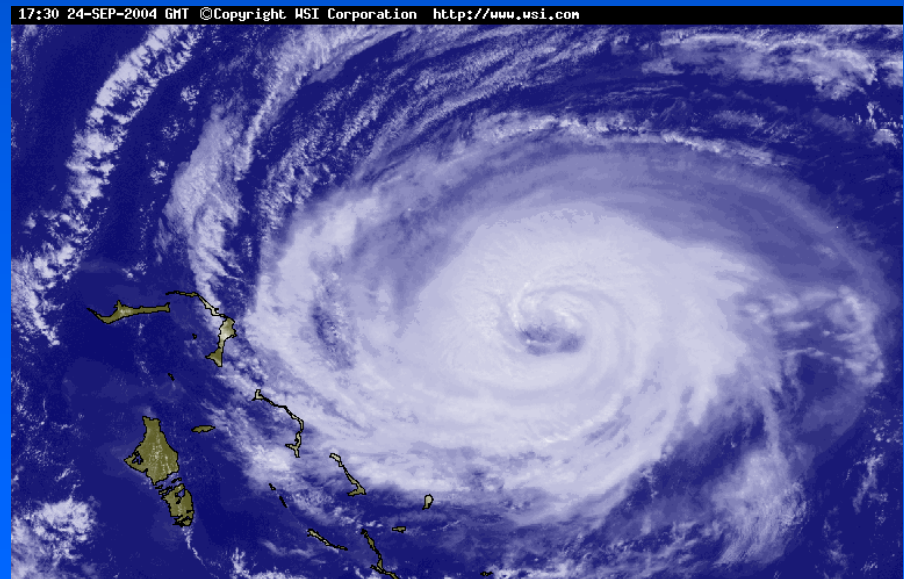
# Research Questions Addressed

1. Comparing adjacent sites 1 & 2 with high and low mortality, which factors differed significantly between sites? (Variables tested: canopy cover, habitat structure, physical damage, soil salinity and elevation)
2. Which variables differed significantly between living and dead cacti?



Is mortality related to:

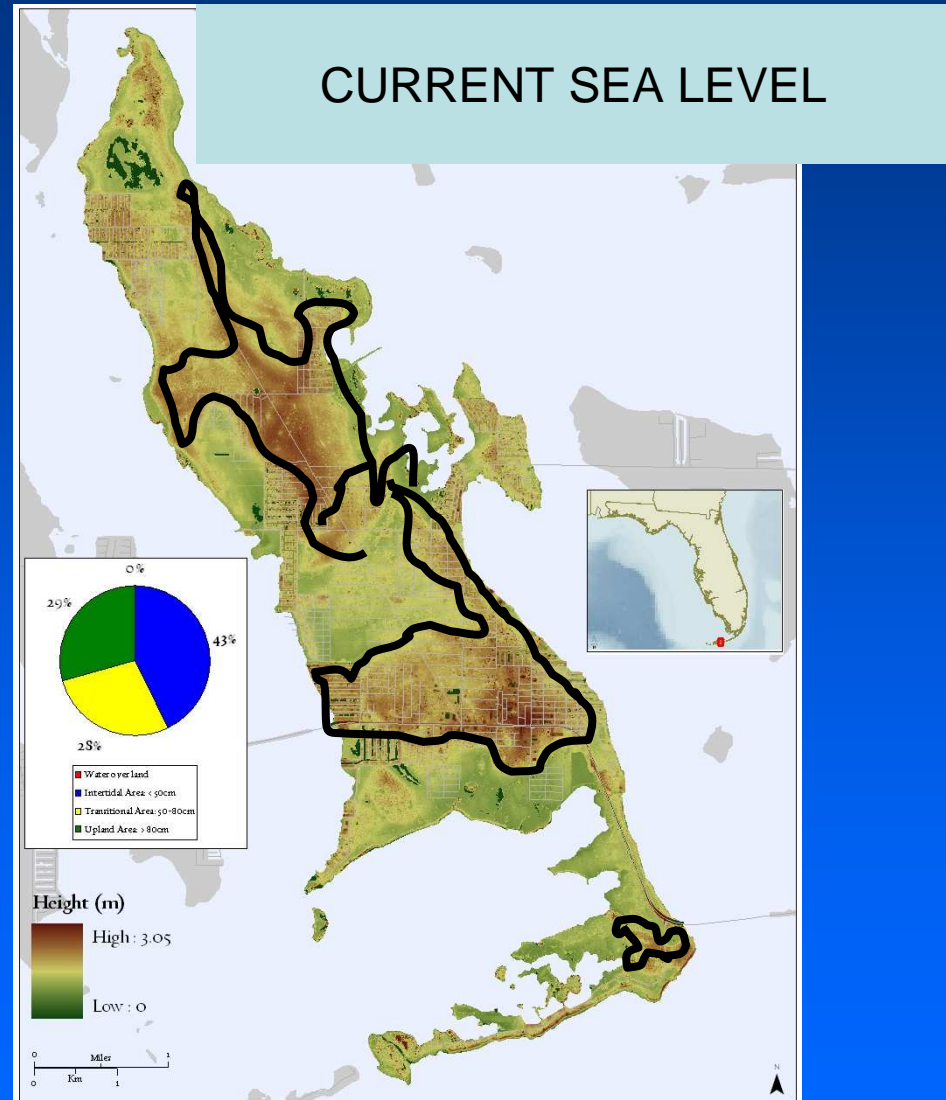
- Climate change
- Management
- Natural Process



# Hypothesis : Soil Salinity is Increasing



# Sea-Level Rise in the Lower Florida Keys



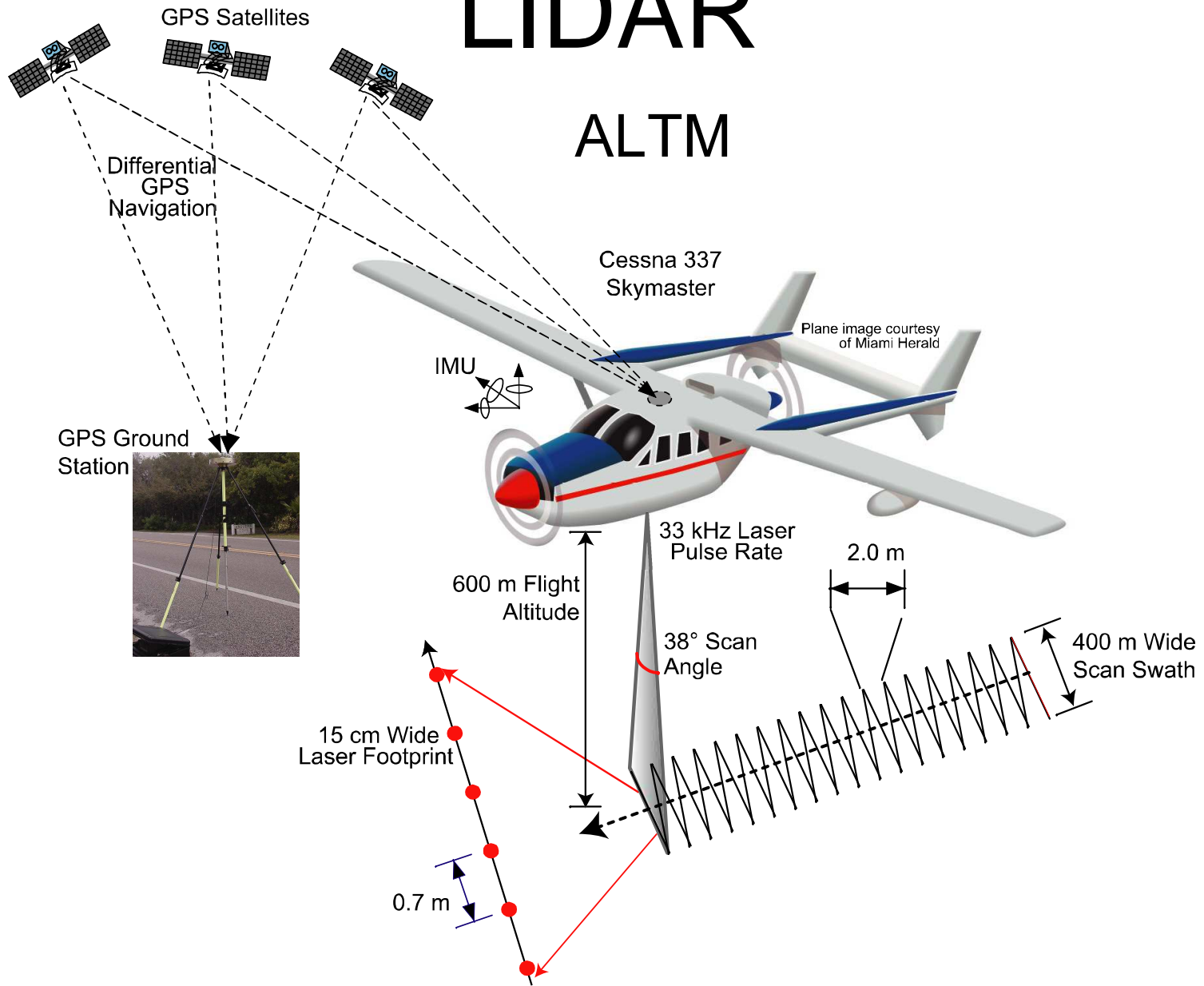
# Topographic Perspective



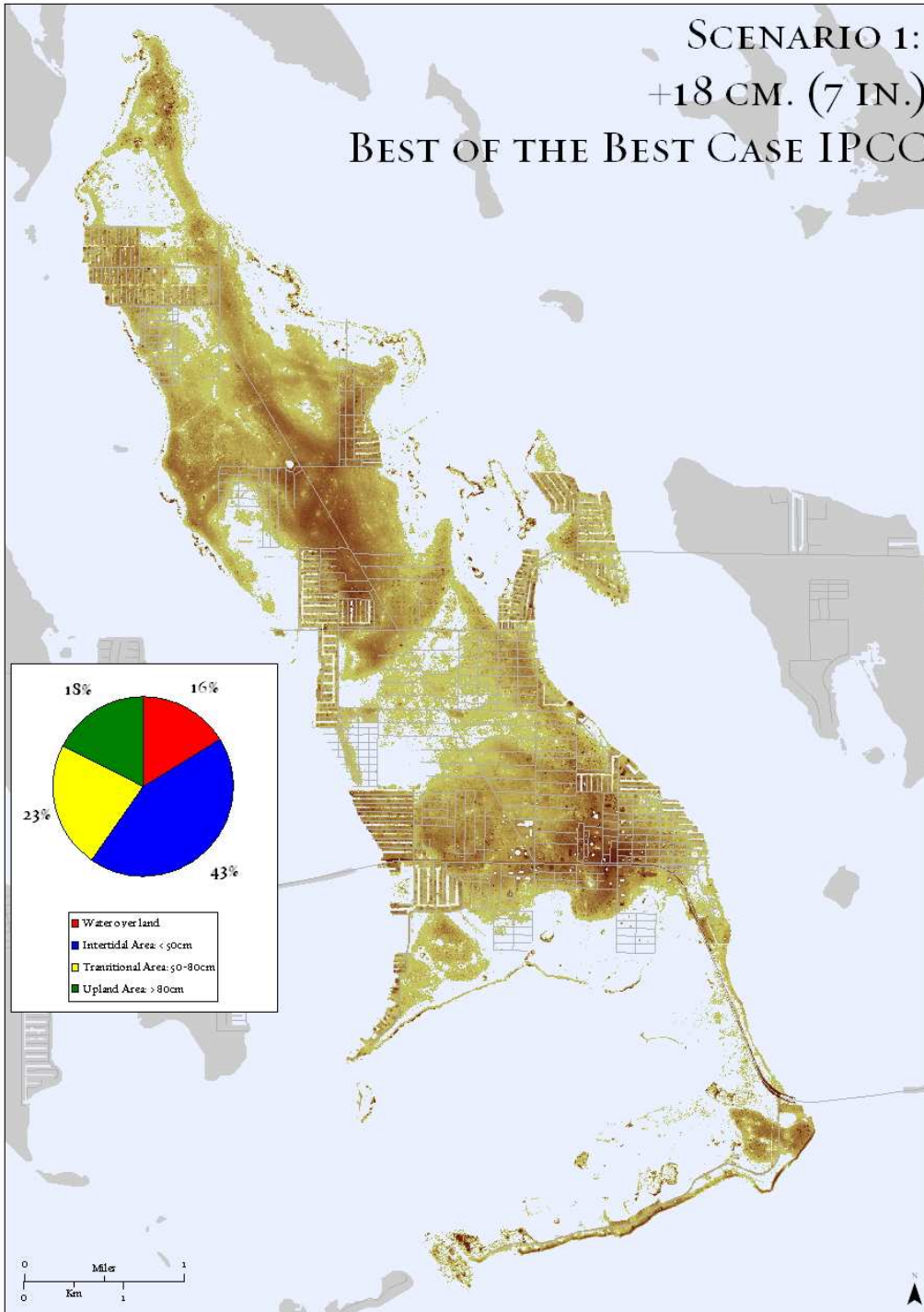
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# LIDAR

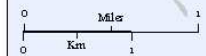
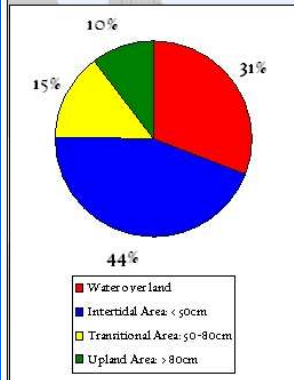
## ALTM



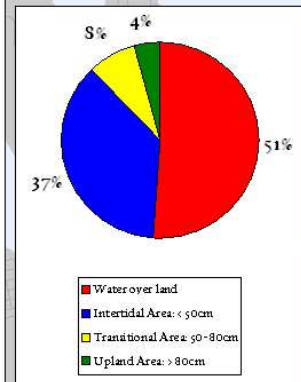
SCENARIO 1:  
+18 CM. (7 IN.)  
BEST OF THE BEST CASE IPCC



SCENARIO 2:  
+35 CM. (13.7 IN.)  
MID RANGE IPCC

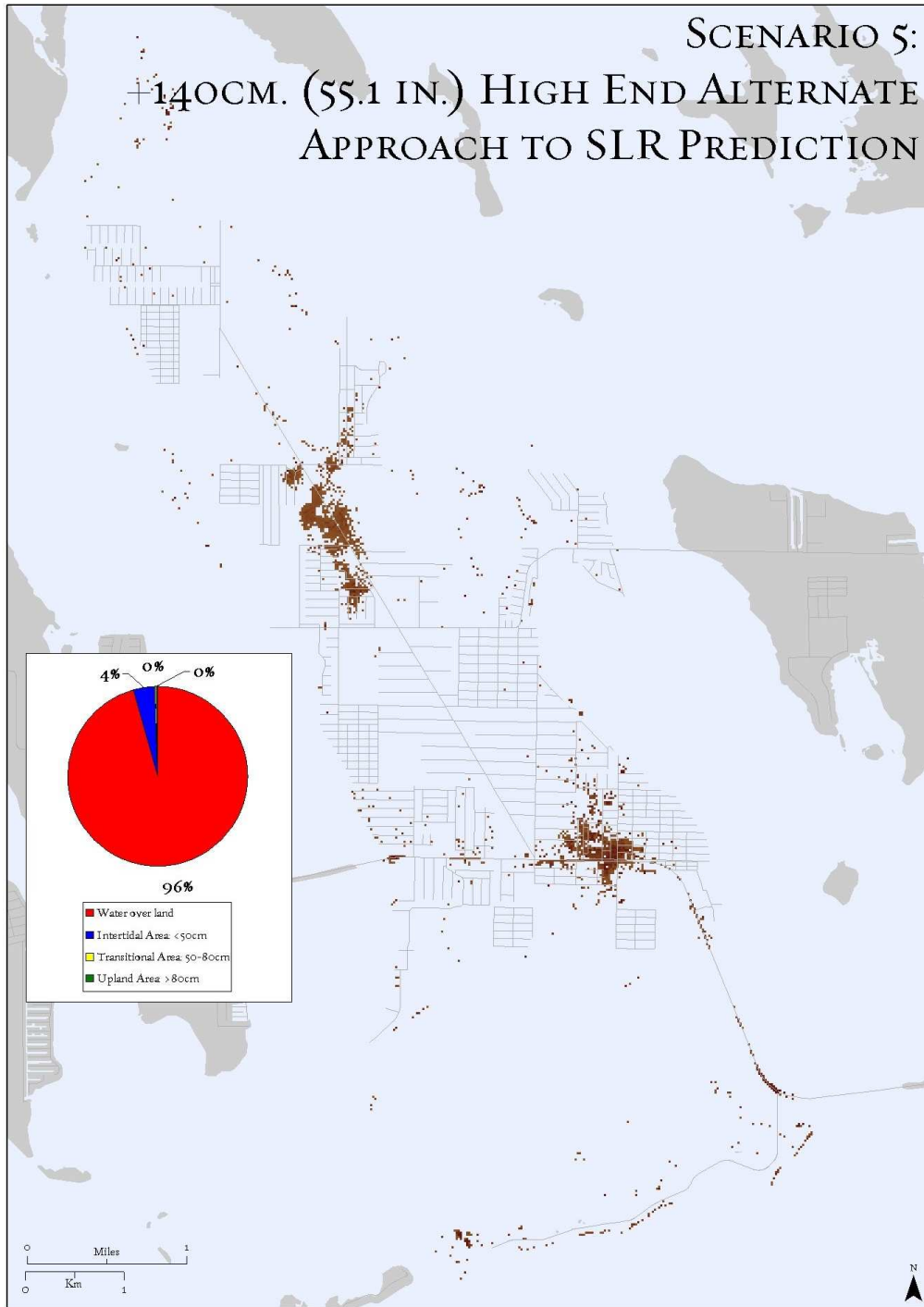


SCENARIO 3:  
+59 CM. (23.2 IN.)  
WORST OF THE WORST IPCC



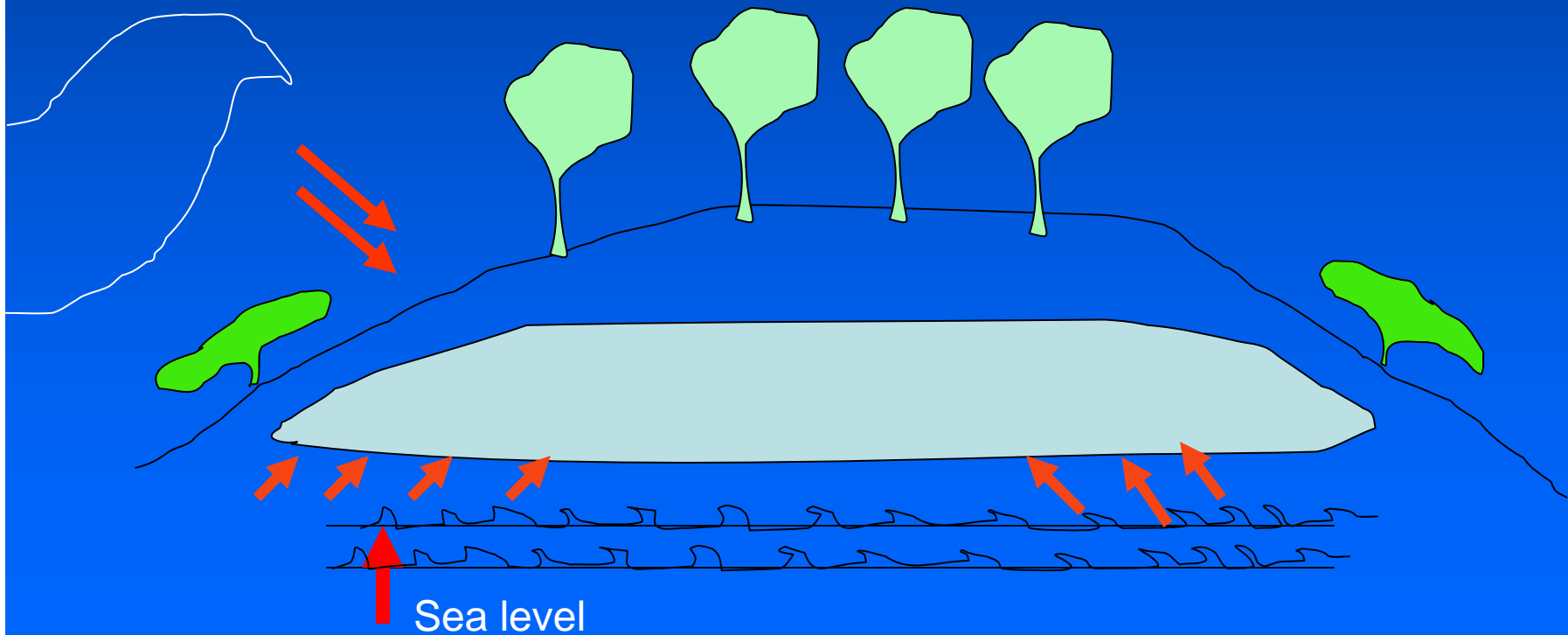


# SCENARIO 5: +140CM. (55.1 IN.) HIGH END ALTERNATE APPROACH TO SLR PREDICTION



# Sea Level Rising & Storm Surge Shrinks Fresh Water Lens

- Only plants with salt tolerance can be supported.



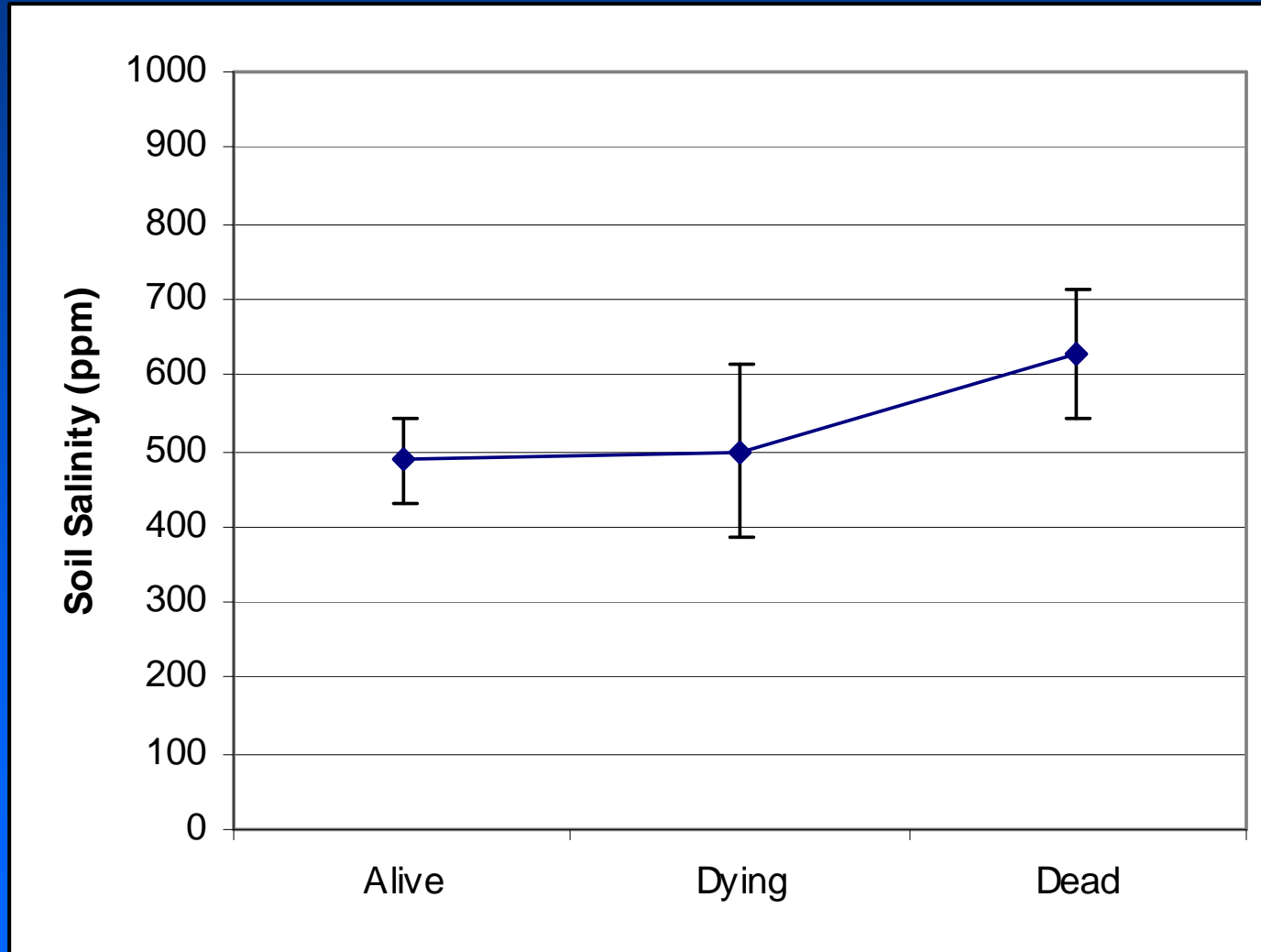
(Ross et al. 1994; 2009)

# Comparison of Elevation, Canopy Cover and Soil Salinity

Site	Area (ha)	Mean Elevation (m)	% Mean Canopy Cover	Mean Soil Salinity
1 (95% loss)	10.6	0.86 ± 0.03	38.14 ± 3.89	647 ± 84*
2	2.4	1.17 ± 0.04*	55.2 ± 3.48*	424 ± 42

$AIC_c = \text{elevation} + \text{canopy} + \text{elevation} \times \text{canopy} = 45.99$ ,  $\Delta AIC_c = 0$ ,  $w_i = 0.53$   
 (ANOVA soil salinity =  $F = 8.39$ ,  $p = 0.005$ )

# Soil Salinity Tended to be Greater Around Dead Plants

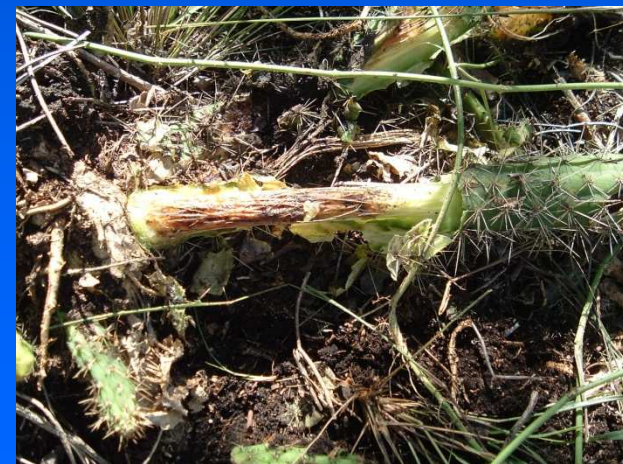


# Why is the largest Key Tree Cactus population in such great decline?

Hypothesis: Herbivory and Antler Rubbing are causing Key Tree Cactus mortality.



Endangered Key Deer



# Impact of Herbivory

- Wounding occurred in areas where Key Deer are present
- Mean Ht of Damage  
Site 1 =  $66 \pm 11$  cm  
Site 2 =  $79 \pm 10$  cm
- Neither degree nor height of wounding significantly different between sites
- Thus, wounding alone does not account for 95% decline at Site 1.



	Damaged Plants
Site 1 (95% loss)	87%
Site 2	71%

# Hypothesis: Canopy Closure is causing Key Tree Cactus mortality

Site	Area (ha)	Mean elevation (m)	Mean canopy cover (%)	#Plants 2008	Mean soil salinity (ppm)
1	10.62	0.86 ±0.03	38.14 ±3.89	14	647.05 ±84.07
2	2.36	1.17 ±0.04	55.20 ±3.48	19	423.63 ±42.29
4	0.33	0.44*	73.24 ±5.80	13	718.98 ±161.26
6	0.18	1.55*	76.55 ±1.88	58	637.82 ±229.38

## Conclusions:

- 1) Differences between Sites 1 and 2 were stronger predictors of mortality than differences in the conditions near dying and live trees.
- 2) Increased salinity, lower elevation, lower canopy cover are associated with the site with the greatest mortality.
- 3) Was it Climate change-related factors or the bad storm season that explain the mortality?



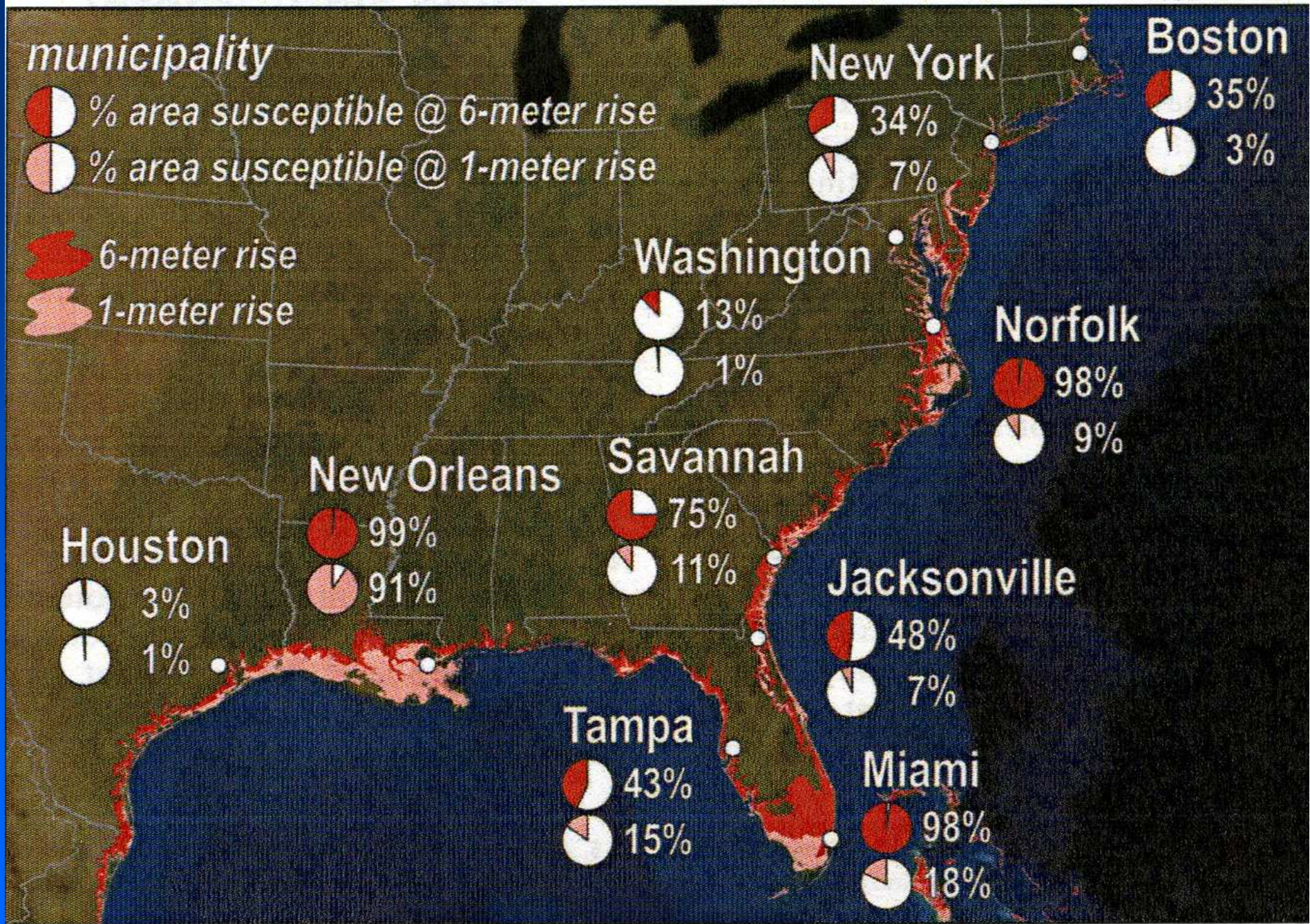


# What can be done to prevent species' extinction?

Steps for species conservation:

- 1) Make collections for long-term storage ex situ.
  - Rescue populations if necessary.
  - Spread the risk by reintroducing plants to the wild (increasing total numbers of plants and populations).





Overpeck and Weiss (2009)

# Acknowledgements

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