

Mangrove Damage and Recovery Following Hurricane Irma in the Florida Keys

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Florida Mangrove Species & Adaptations

- Red mangrove (*Rhizophora mangle*): prop roots



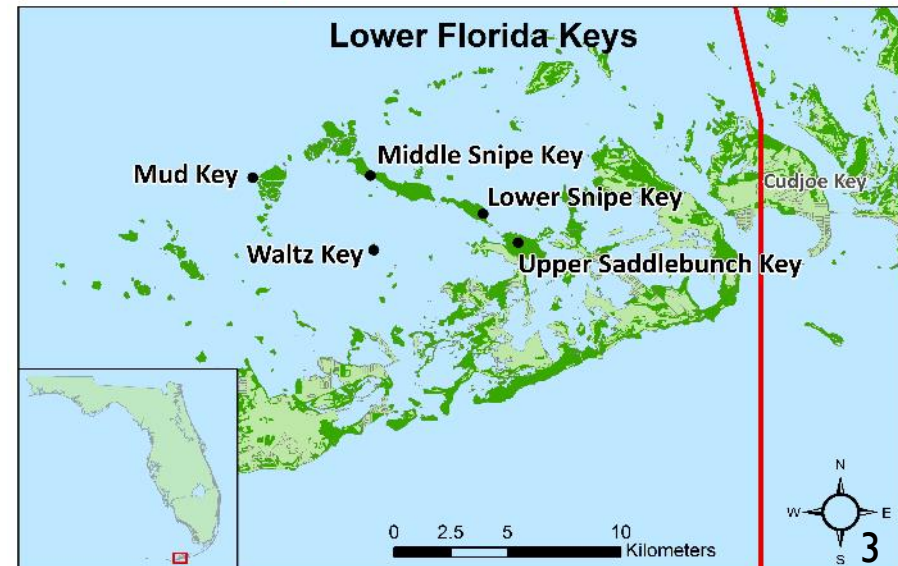
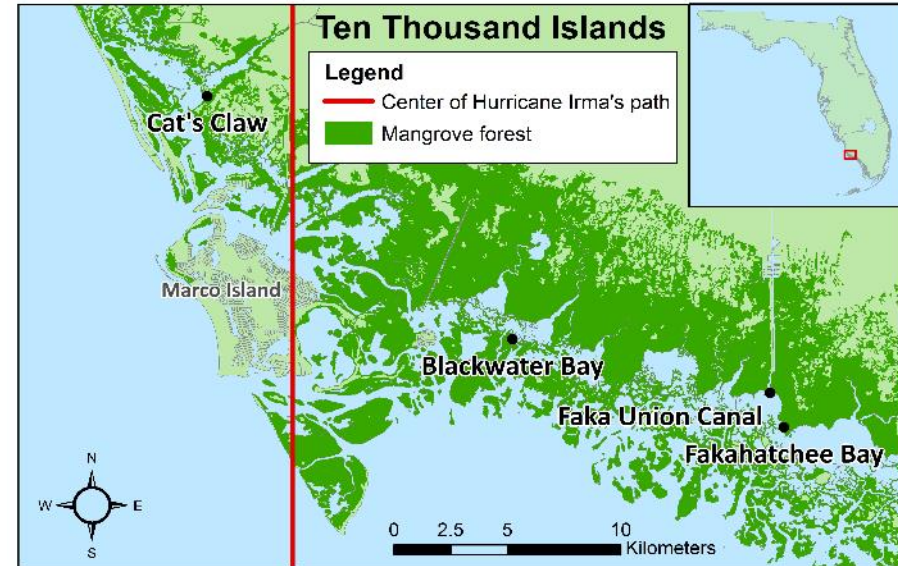
- Black mangrove (*Avicennia germinans*): pneumatophores



- White mangrove (*Laguncularia racemosa*): optional pneumatophores

Post-Irma Mangrove Assessments & Monitoring

- Post-Irma monitoring conducted in Lower Florida Keys and Ten Thousand Islands
- Sites monitored 3 times each thus far, 2 – 9 months post-storm



Canopy Damage and Regrowth

- Extensive canopy damage from high winds
- Black and white mangroves can grow stems and leaves directly from trunk (epicormic growth)
- Red mangroves have minimal epicormic growth

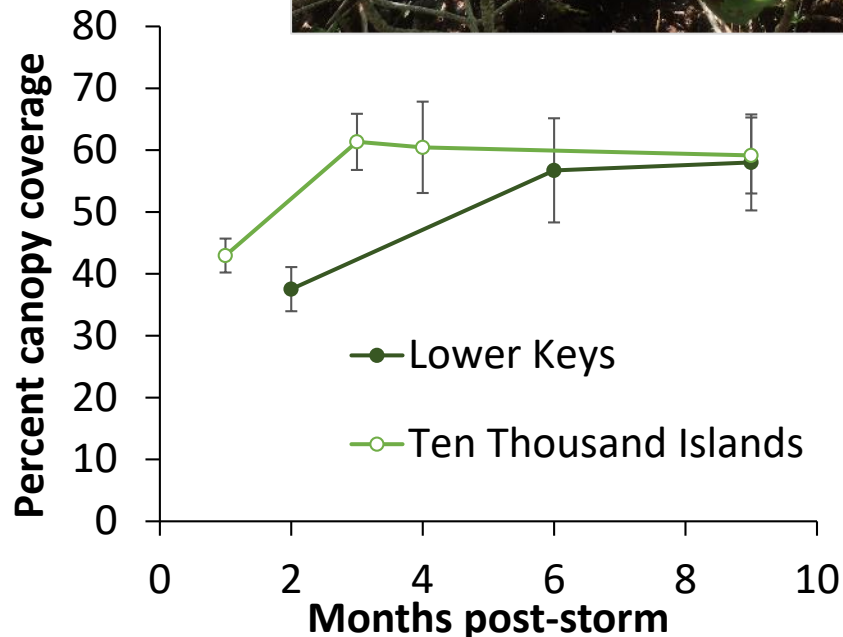


Canopy Damage and Regrowth

Pre-Irma (July 2017)



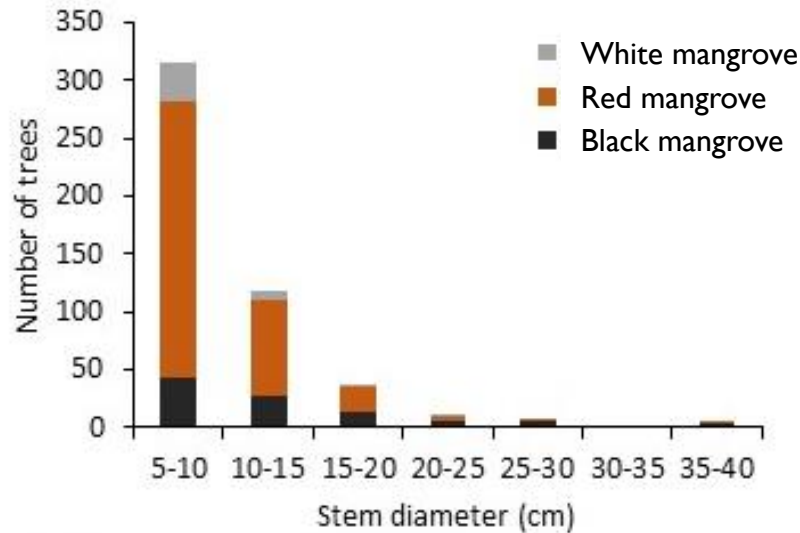
Post-Irma (Oct. 2017)



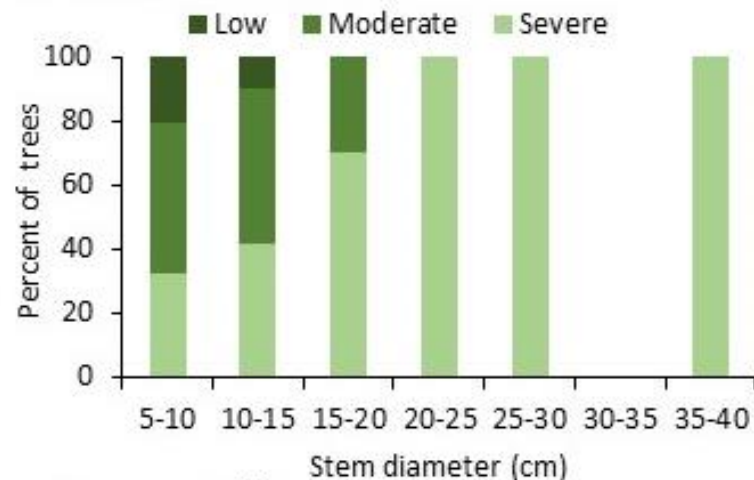
- Typical canopy cover in a healthy forest is 85-100%
- Canopy cover recovered from 40% to 60% within 2 – 4 months, but recovery plateaued

Canopy Damage & Delayed Mortality

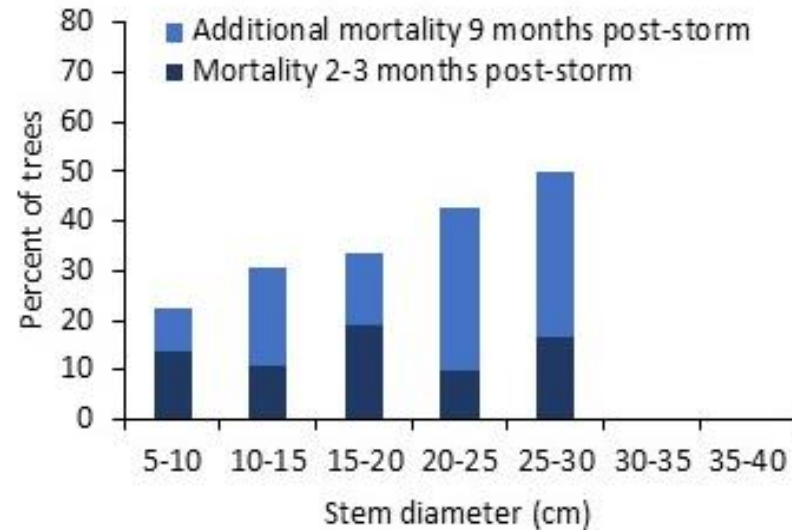
a. Tree species composition



b. Tree canopy damage



c. Tree mortality



- Greater canopy damage in larger trees
- No initial trend in mortality as a result of size, but delayed mortality was greater in larger trees

Understory Growth

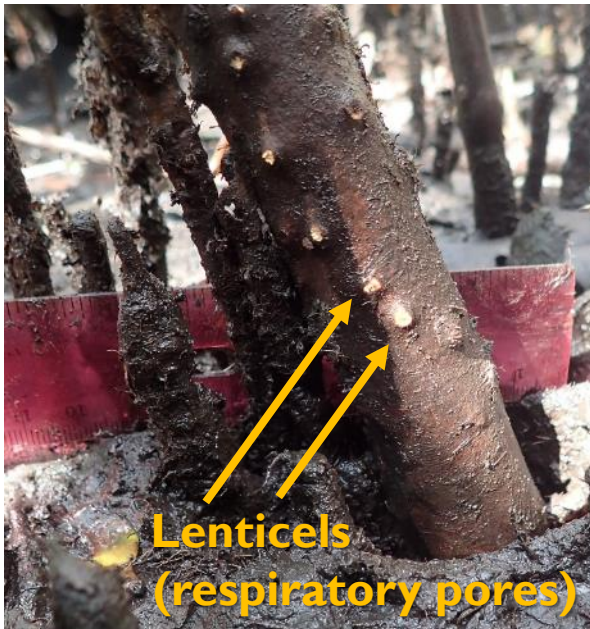


- Extensive growth of established seedlings and saplings
- Not all sites have seedling growth...

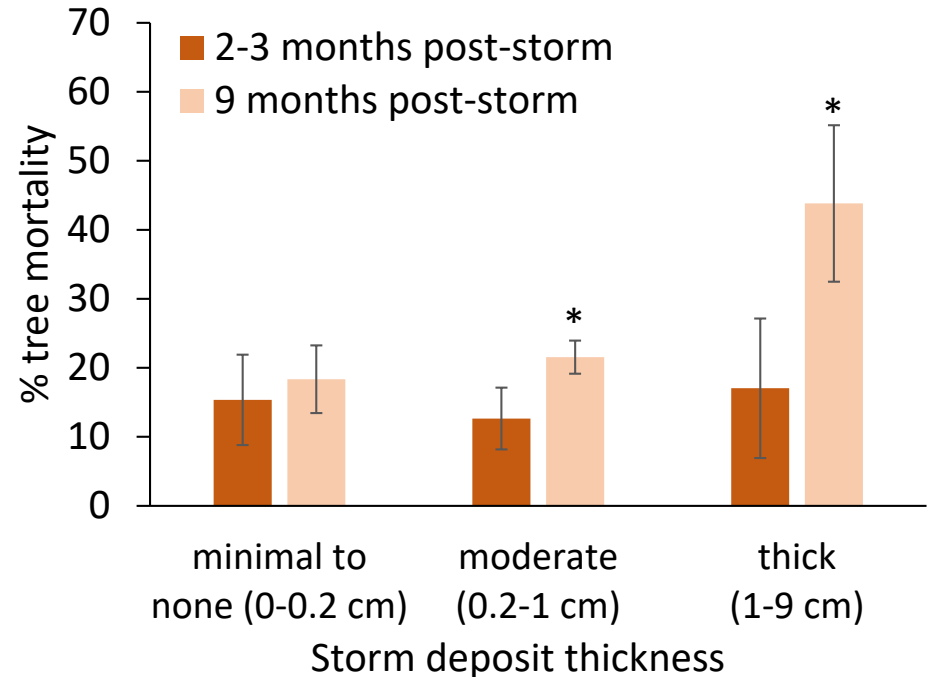


Storm Surge Deposit

- Storm surge deposited a layer of gray carbonate mud in mangroves
- Mud smothers soil and roots, preventing oxygen exchange



Storm Surge Deposit



- Trees that initially survive the storm may die due to smothering by the storm deposit
- Storm deposits help the elevation of a forest keep pace with sea-level rise

Other storm impacts

- Coastal erosion



Other storm impacts

- Altered hydrology (water flow)
 - A lack of water or excess water (water cannot exit at low tide) can *both* kill mangroves
 - Example in Jensen Beach: Irma blocked the only tidal connection for a mangrove forest
 - If hydrology is restored, problem can be fixed (Lewis et al. 2016)

2017
Pre-Irma



2018
Post-Irma



Do mangrove forests recover?

- Forests with appropriate elevation, hydrology, and a source of propagules should recover
- Good signs:
 - Living seedlings
 - No standing water at low tide, flooded at high tide
- Can take 10 – 15 years for a mangrove forest to recover and mature



Do mangrove forests recover?

- Bad signs:
 - Standing water at low tide
 - No water at high tide
 - Complete mortality, no seedlings
- Forests with high mortality are at risk of peat collapse
 - Dead trees do not grow roots. The soil sinks as it decomposes, decreasing the elevation of the forest.

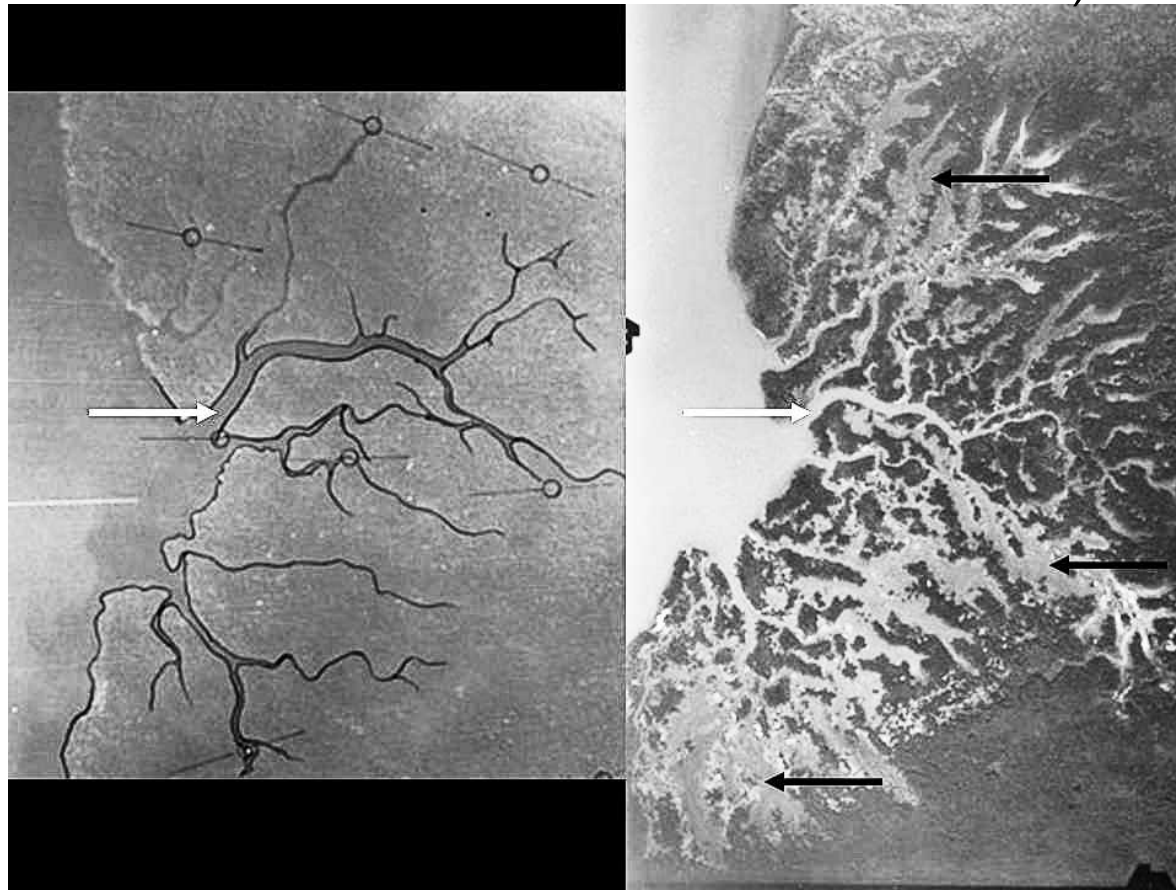


Do mangrove forests recover?

- Some mangrove forests may not recover and become mud flats

1928

1952 (After 1935
Cat 5 Hurricane)



Smith et al. 2009:
Big Sable Creek,
Everglades

Summary

- Types of damage:
 - Wind damage to canopy
 - Storm surge deposits
 - Erosion
 - Altered hydrology
- Possible types of recovery:
 - Epicormic growth & canopy recovery
 - Understory growth
 - Mangrove die-off, conversion to mud flats

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Questions?



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