# A Decade+ of Submerged Aquatic Vegetation Dynamics in Mangrove Lakes Affected by Altered Freshwater Deliveries

Thomas A. Frankovich<sup>1</sup>, David T. Rudnick<sup>2</sup>, James W. Fourgurean<sup>1</sup> And Stephen Kelly<sup>3</sup>

> <sup>1</sup>Florida International University <sup>2</sup>Everglades National Park <sup>3</sup>South Florida Water Management District

Greater Everglades Ecosystem Restoration Conference April 22 - 25, 2019 Coral Springs, FL Long-term trends and Event-driven Changes in Everglades Southern Estuaries

Events - Hurricane Irma September 10 2017



Hurricane Irma killed large areas of surrounding mangroves

Long-term Trends and Event-driven Changes in Everglades Southern Estuaries

Events - C-111 Spreader Canal (C111SC) June 2012



Water diversions began June 21 2012

C111SC aims to increase freshwater delivery to southern estuaries Long-term Trends and Event-driven Changes in Everglades Southern Estuaries

Changes - West Lake - Chara, Terrapin Bay - Halodule



100% Chara cover

Ecosystem change from phytoplankton domination to benthic algal domination

# Mean SAV Distribution 2006 - 2019 by predominant macrophyte



C = Chara H = Halodule T = Thalassia B = Batophora Low = cover <5%

Large bold = Cover > 40%

SAV distributed along salinity gradient Low cover in central lakes Previous Findings - Mangrove Lakes

Salinity separates Chara from Halodule

Light and sediment depth explain spatial distribution of *Chara* cover in upstream lakes

Light (Alligator subestuary) and salinity (McCormick subestuary) explain temporal *Chara* distribution

Underwater light environment often unsuitable for SAV.

CDOM largest contributor









ECCS 184: 191-201

Methods

SAV % cover, quarterly - by species



WQ monitoring, monthly to quarterly - temperature, salinity

- TotN, TotP, Phytoplankton Chl-a
- Light attenuation ( $K_d$ ), water depth  $\longrightarrow$  %Light@bottom
- Turbidity, CDOM







Chara cover increased with increased light availability and proved resilient following Hurricane Irma



Chara appears in Cuthbert Lake following C111S start



Extended loss of Halodule following Hurricane Irma



Increased minimum water levels following water diversion

Trends

Datasource: EDEN Wet = May - Oct Dry = Nov - Apr





Decreased salinity in upstream lakes following 2012









West Lake hunting camp, late 1930s. Courtesy Alexander Sprunt IV.

#### Simmons and Ogden, 1998

Other – Redhead, American Widgeon, Shoveler, Blue-winged Teal

Mangrove Lakes support wintering waterfowl

Methods - Waterfowl abundance

10 overflights Dec - Mar, 2016 - 2019

In-flight estimation of flock size

Photography

Individual counts within images







Waterfowl abundance = in-flight flock size + individual counts

# Waterfowl distribution



Waterfowl limited to areas of high Chara abundance

## Waterfowl Trends





Redhead, 2019



Ring-necked duck, 2019



Lesser Scaup, 2016

Up to 3X difference in waterfowl abundance since 2016

#### Conclusions



Mangrove Lakes ecosystem is dynamic

Phytoplankton dominance to SAV dominance

Events coincident with SAV and WQ changes

Increased water levels and decreased salinities beneficial

Increased WQ and SAV

Waterfowl where Chara is abundant

Mechanisms for ecosystem change still being evaluated

# Acknowledgments

## For 13 years of field help and data sharing, we thank:

Jeff Absten, Josh Allen, Michelle Blaha, Christy Carmichael, Mark Cook, Kevin Cunniff, Cody Eggenberger, Brad Furman, Zach Fratto, Michael Jordan, Michael Kiflai, Christian Lopes, Kai Lopez, Frank Marshall, Doug Morrison, Lori Oberhoter, Jason Osborne, Bill Perry, Rene Price, Bob Showler, Jennifer Rehage, Amy Renshaw, Fabiola Santamaria, Sonja Smith, Theresa Strasizar, Dave Ward, Sara Wilson, Mark Zucker

# Thank you!

Funding provided by Everglades National Park