

Crocodiles and Alligators as Indicators of Ecological Responses to Everglades Restoration



Venetia Briggs-Gonzalez, Michiko Squires, Seth Farris, Caitlin Hackett, Mathieu Basille, Frank Mazzotti

University of Florida – Fort Lauderdale Research & Education Center

Mike Cherkiss, Brian Smith, Kristin Hart

USGS- Wetland and Aquatic Research Center, Davie, FL

Hardin Waddle

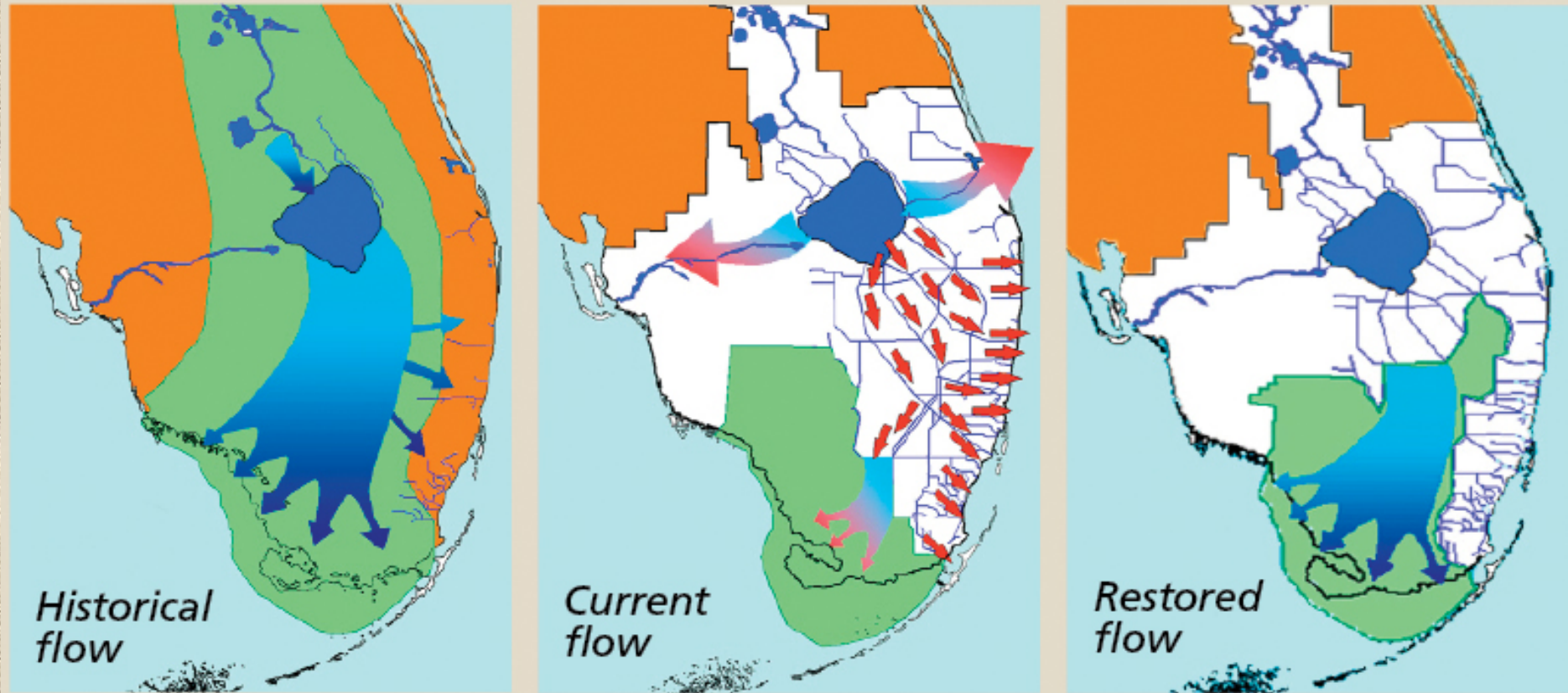
USGS - Wetland and Aquatic Research Center, Gainesville, FL

Laura Brandt

U.S. Fish and Wildlife Service, Davie, FL



Greater Everglades Ecosystem Restoration



Increase the delivery, timing, quantity, quality and volume of freshwater flow

REstoration COordination & VERification Monitoring and Assessment Plan (MAP) Hypotheses for Central Everglades Restoration Plan (CERP)

Availability of freshwater limits the distribution and abundance of reptiles in estuaries.

Increased
salinity



Decreased growth,
survival, density and body
condition of **crocodiles**



Objectives:

Determine short- and long-term responses of crocodiles to hydrological restoration in Everglades

- Nesting
- Body condition
- Growth
- Survival
- Relative Density

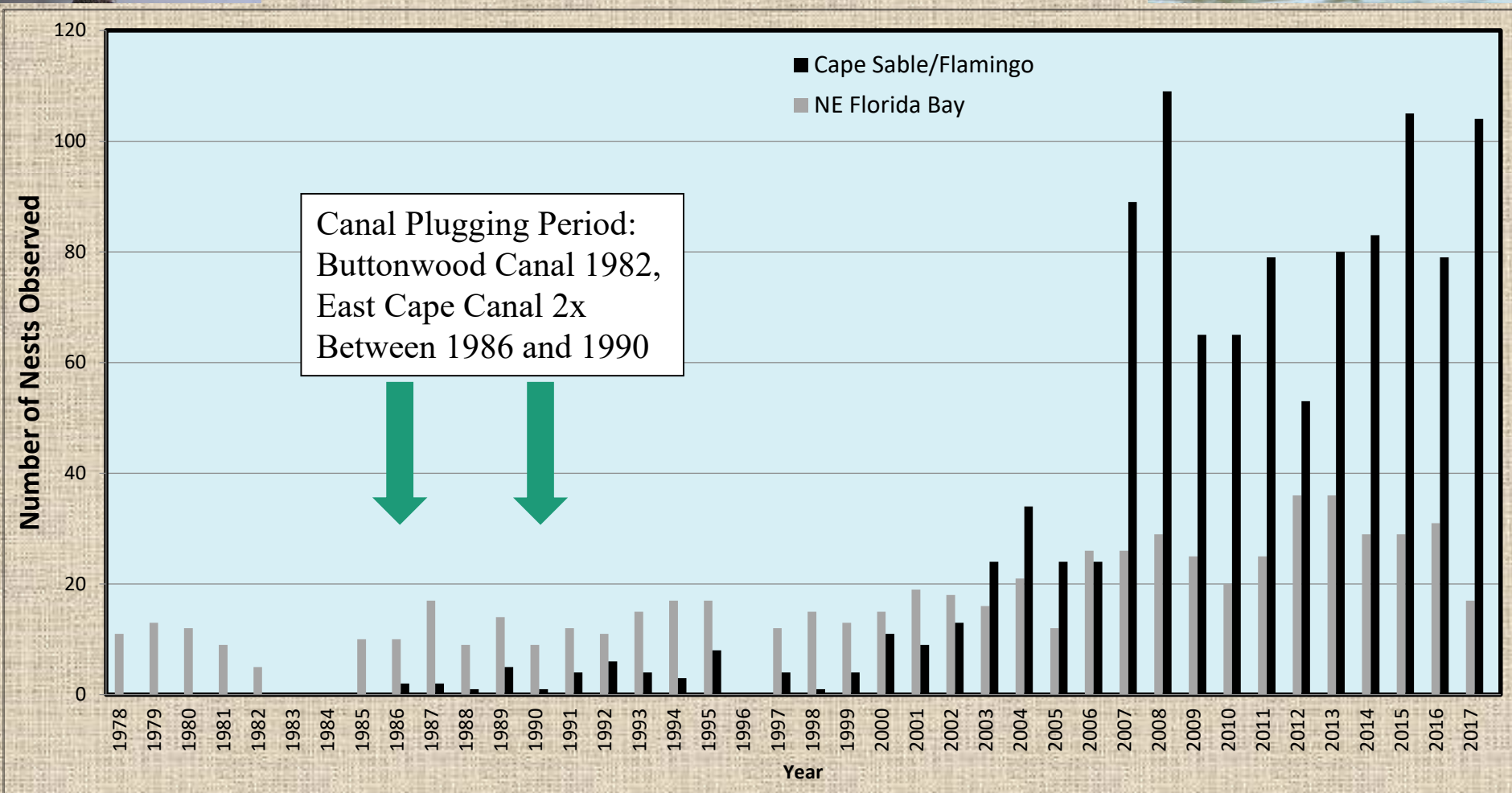


The American crocodile, a flagship federally threatened species, represents the importance of freshwater inflow to estuarine health and productivity - Mazzotti et al. (2007)



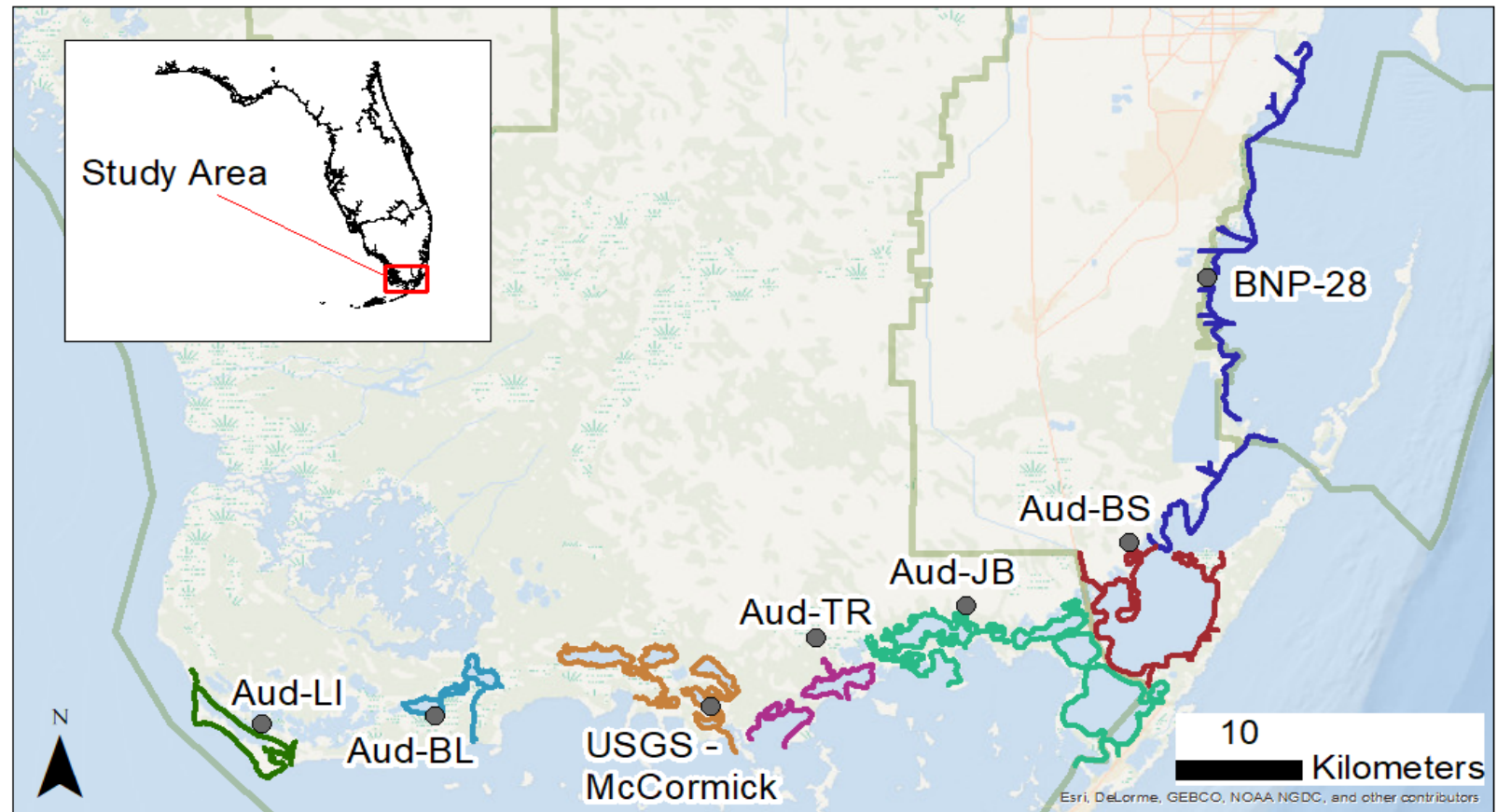
Crocodile Nesting

10-15 Years



Population Monitoring

- 1978-2015, hatchlings marked, weighed, and measured (June-August)
- Non-hatchling crocodiles captured (Oct-Dec, Jan-March)



Body Condition

- Fulton's K: $(\text{mass}/\text{SVL}^3) \times 10^2$
- 1978-2015: 859 captures
- Short-term response

Feb 2014



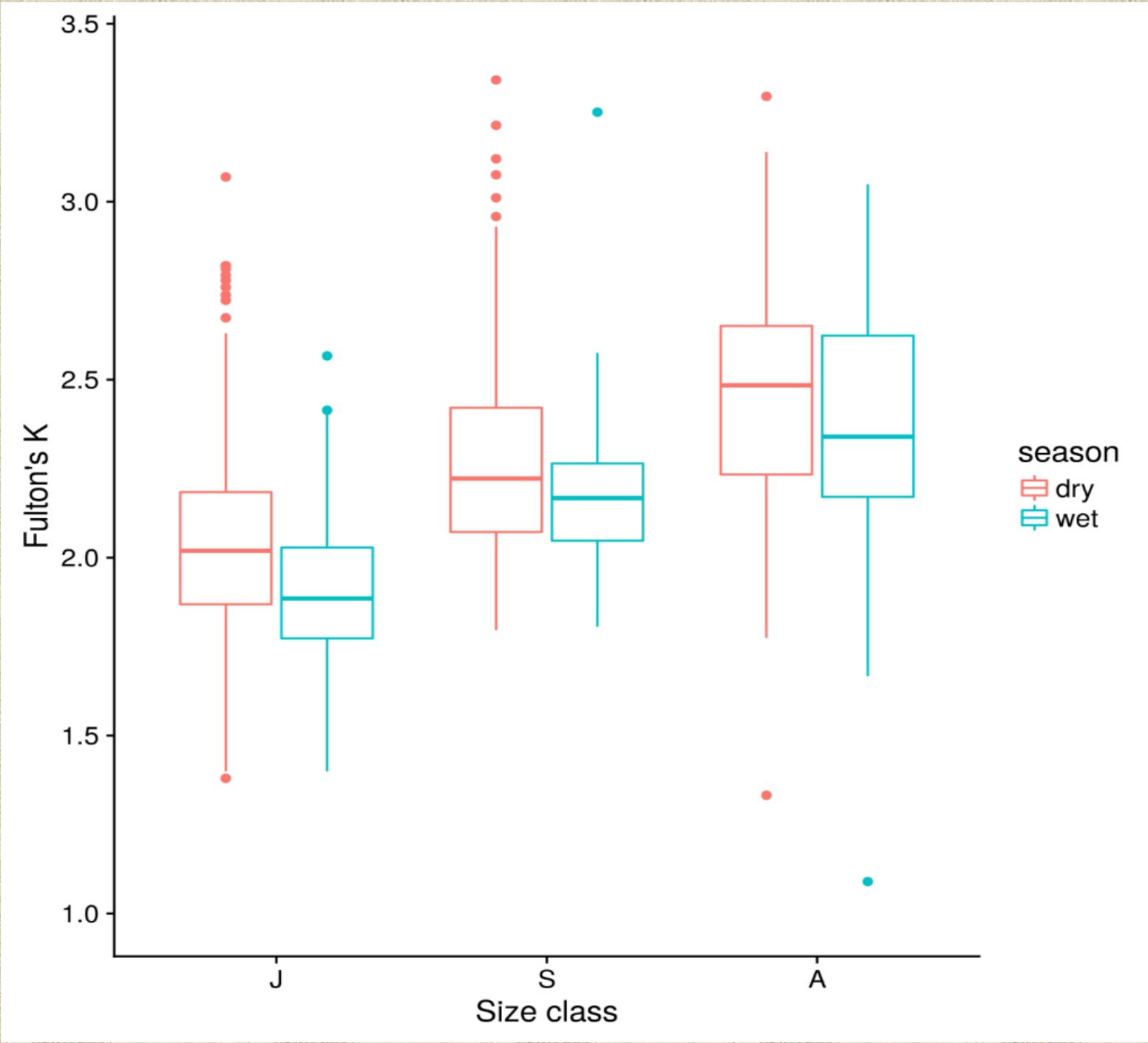
Healthy condition

Feb 2015

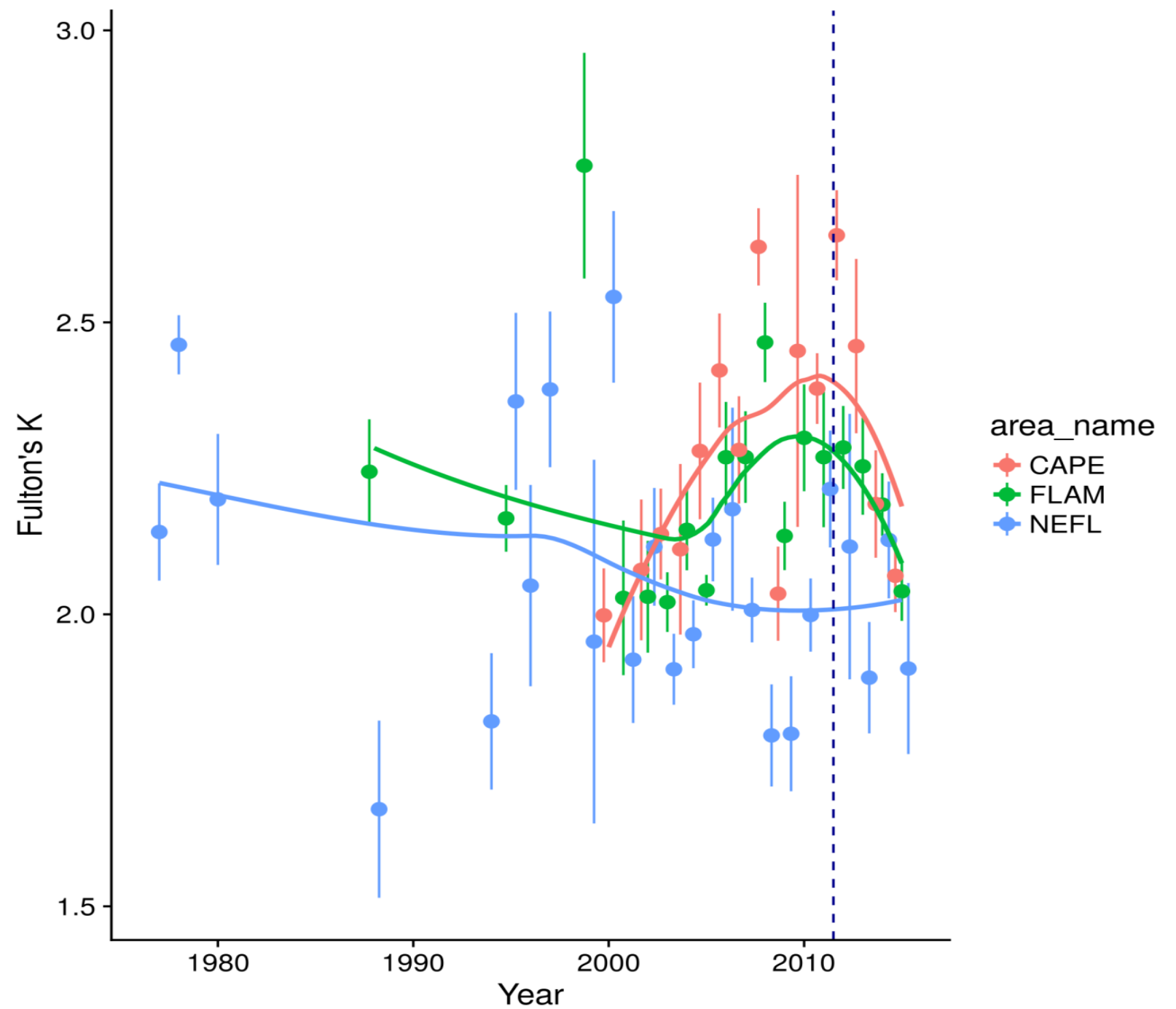


Poor condition

Body Condition



Body Condition



Growth

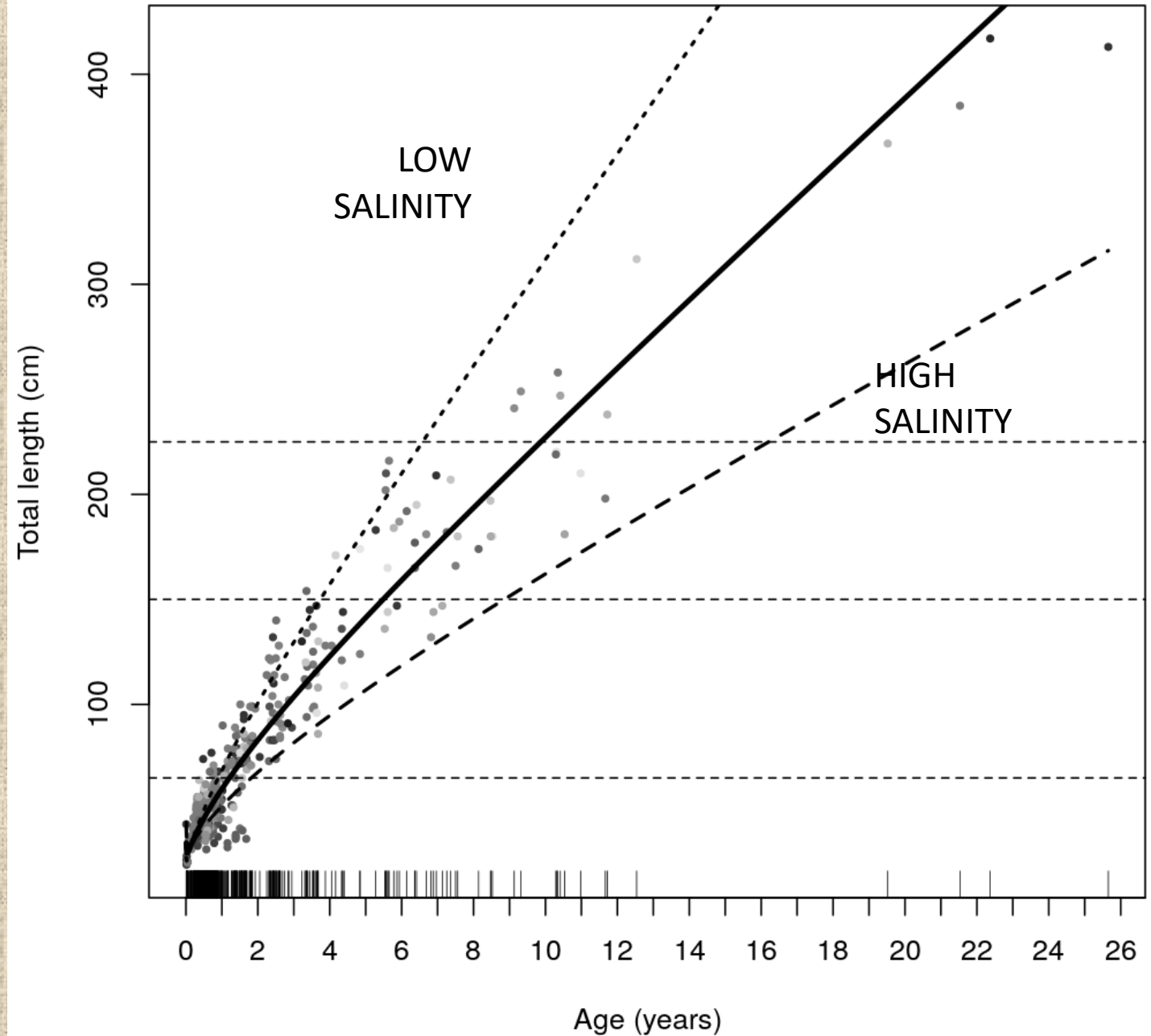
- Growth models
- 1978-2015: 573 captures (N=376 crocs)
- Mid/Long-term response



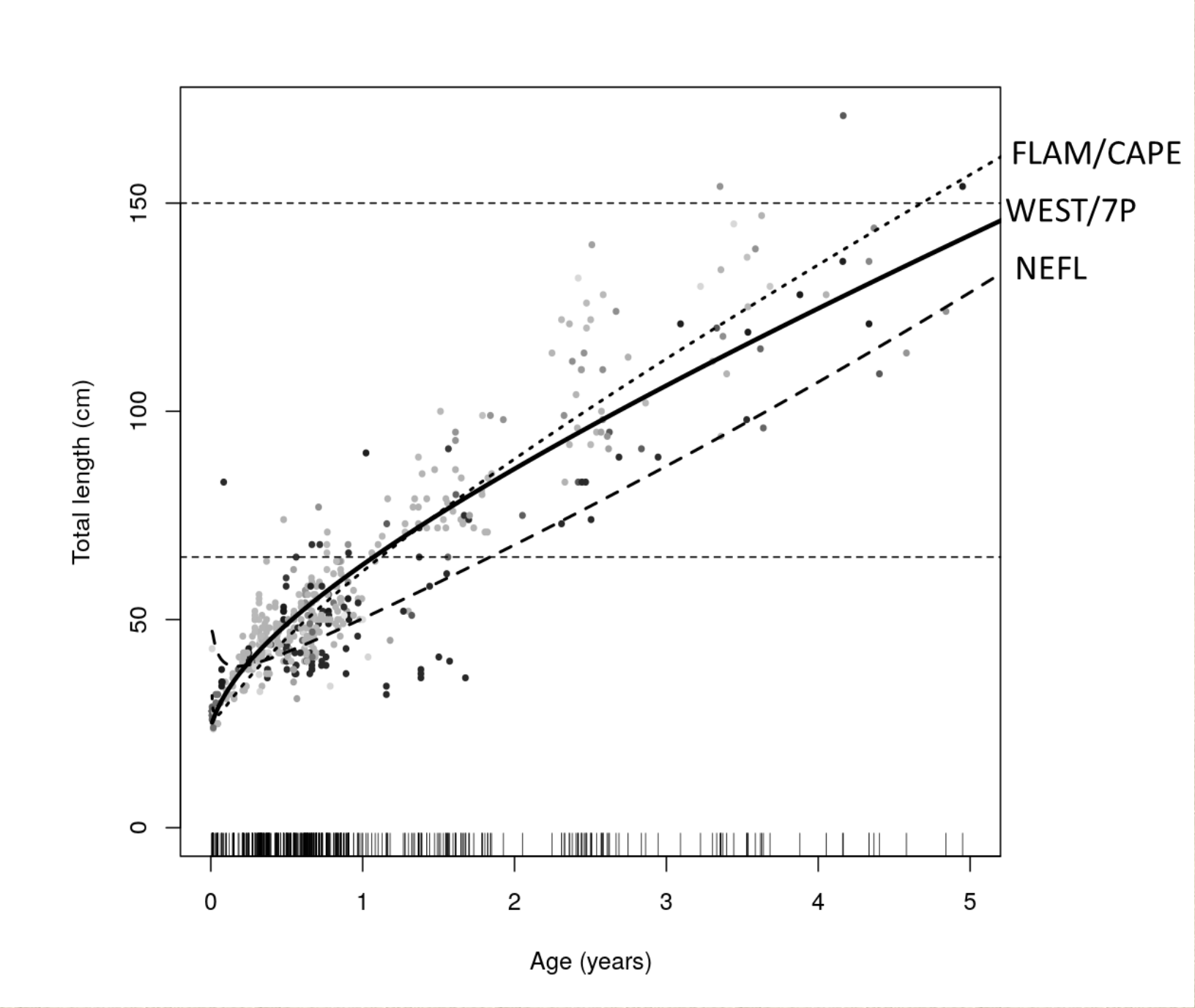
Growth

High salinity (>40ppt)
during dry season reduced
growth rate

- 13% after 1yr
- 24% after 5yrs
- 29% at 10yrs



Growth



Survival

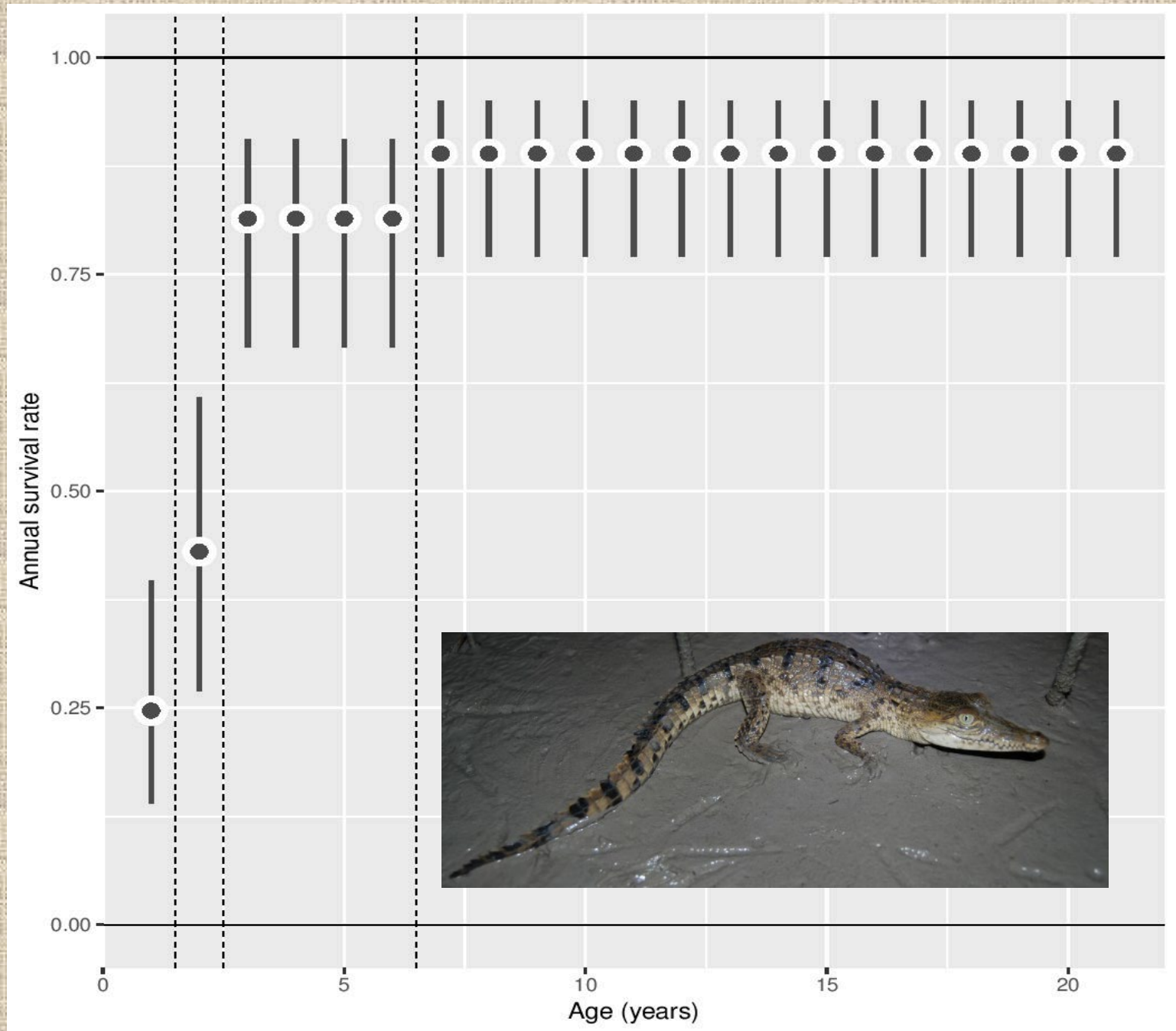
- Capture-Mark-Recapture analyses (CMR)
- 1978-2015: 9,040 crocs
- Long-term response



Survival

1yr survival rates:

- Croc Lake 69%
- Flamingo 53%
- NEFL 34%



Relative Density

- N-mixture model [detection probability (p) and abundance (λ)]
- 2004-2015: 1449 observations

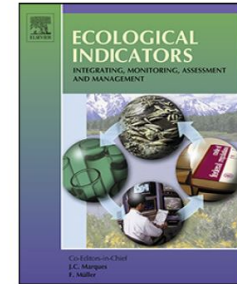
Ecological Indicators 102 (2019) 608–616



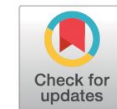
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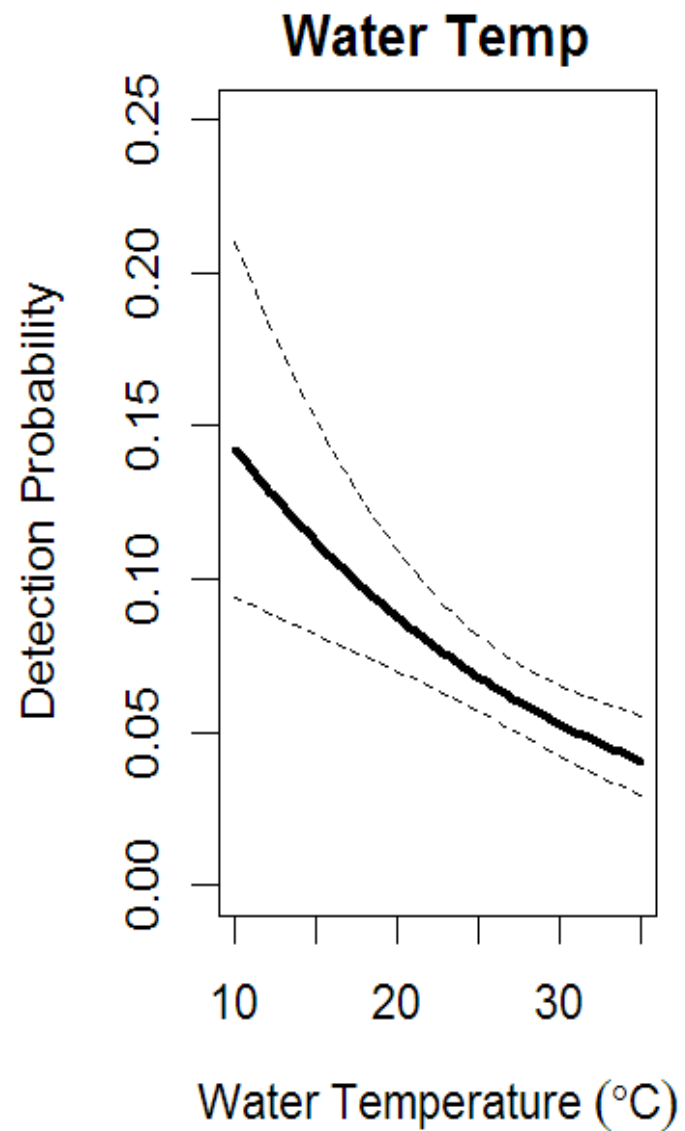
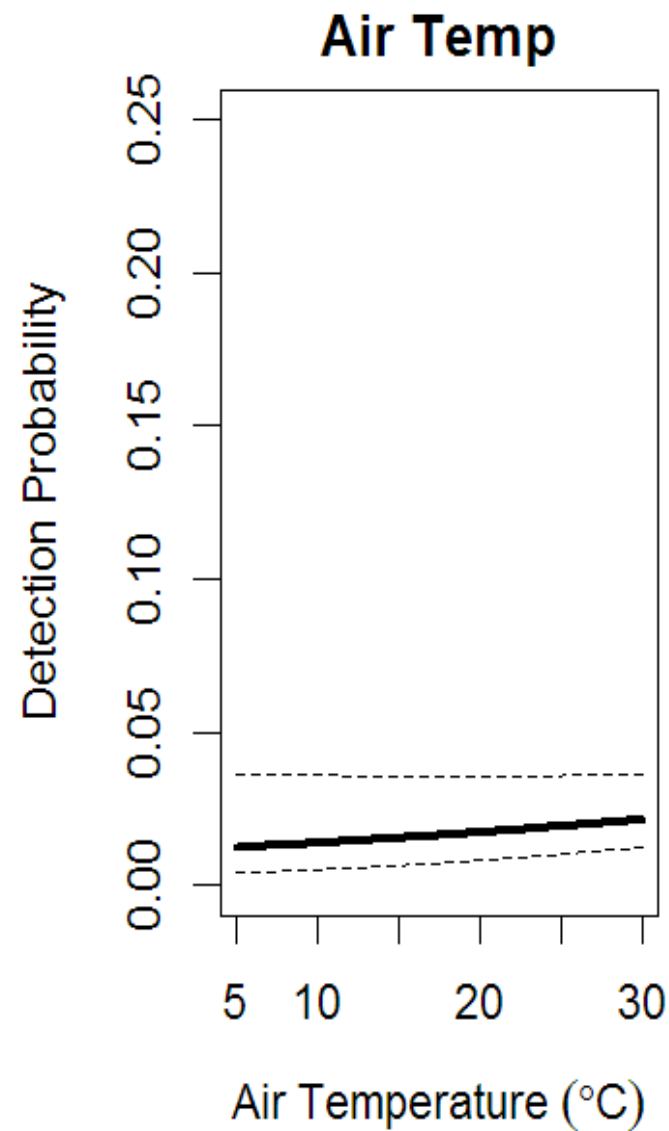


Influence of salinity on relative density of American crocodiles (*Crocodylus acutus*) in Everglades National Park: Implications for restoration of Everglades ecosystems



Frank J. Mazzotti^{a,*}, Brian J. Smith^b, Michiko A. Squires^a, Michael S. Cherkiss^c, Seth C. Farris^a, Caitlin Hackett^a, Kristen M. Hart^c, Venetia Briggs-Gonzalez^a, Laura A. Brandt^d

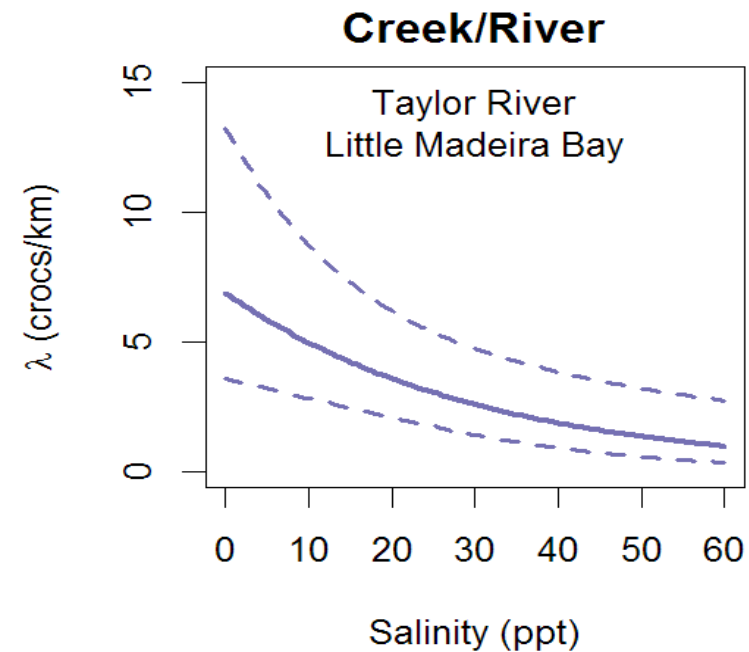
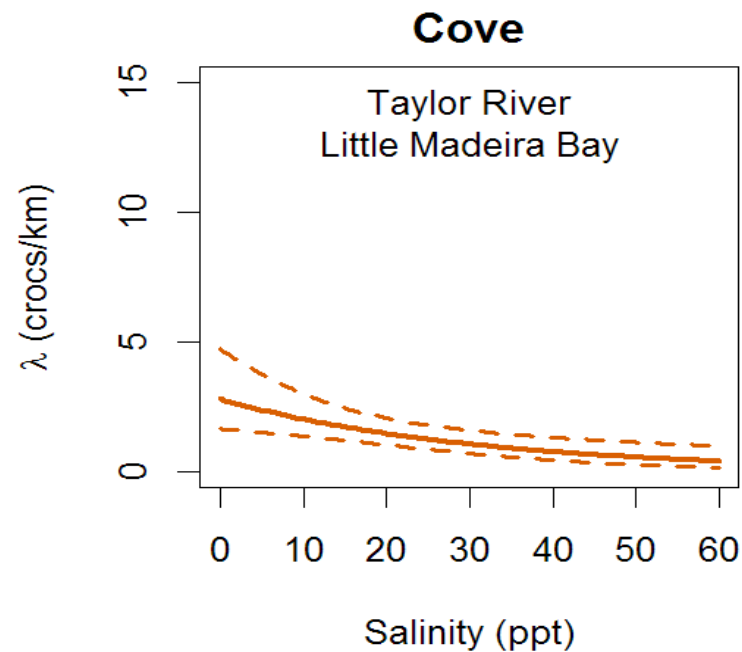
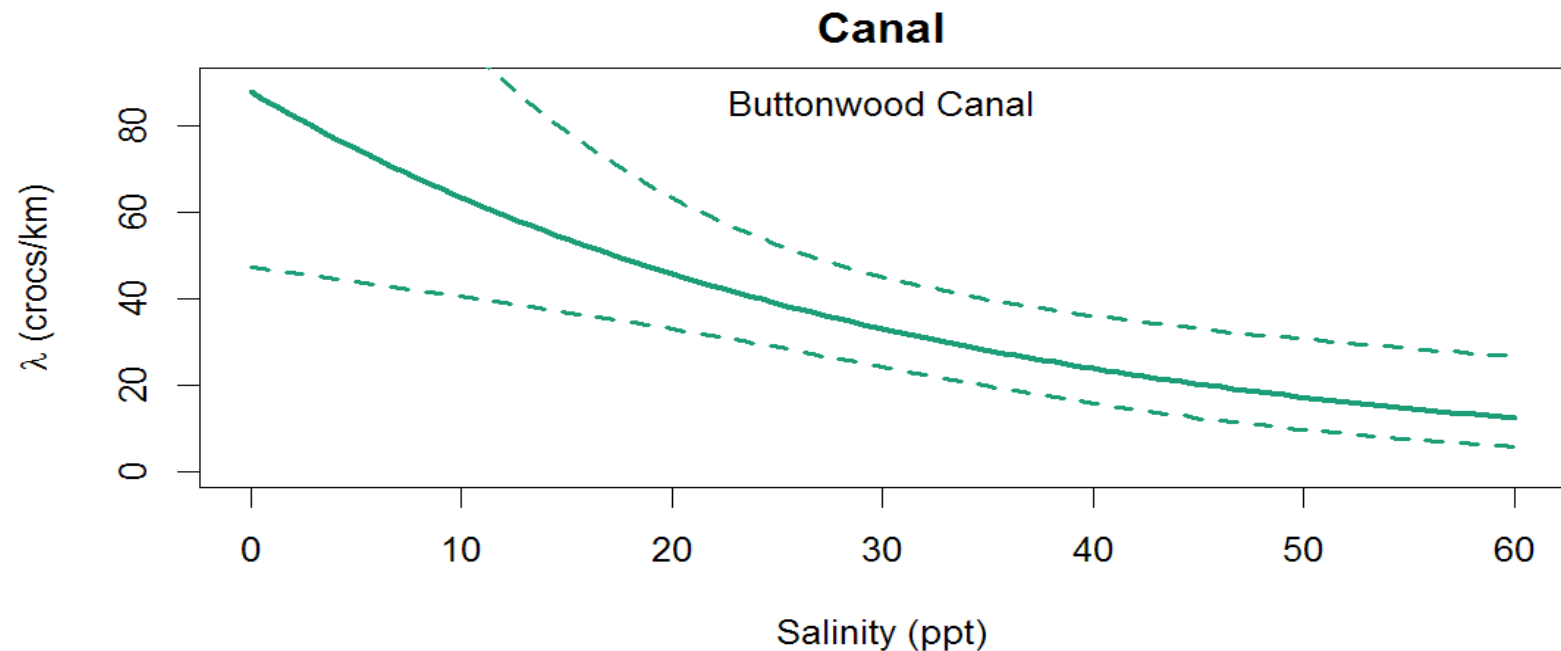
Relative Density



$p = 0.061$

Relative Density

$$\lambda = 2.9 \text{ croc/km}$$



Summary

- **Location, frequency and duration** of hypersaline conditions affect crocodiles.
- **Nesting** differs among **areas, increased with lower salinity.**
- **Body condition** differs among **areas, seasons, greater with lower salinity.**
- **Growth** differs among **areas, greater with lower salinity.**
- **Survival** differs among **areas, greater with lower salinity.**
- **Relative Density** differs among **areas, greater with lower salinity.**
- **Crocodiles do better at lower salinity for both physiological and trophic reasons.**

Predictions: *Increased crocodilian responses with C-111 Spreader Canal and increased freshwater flow.*

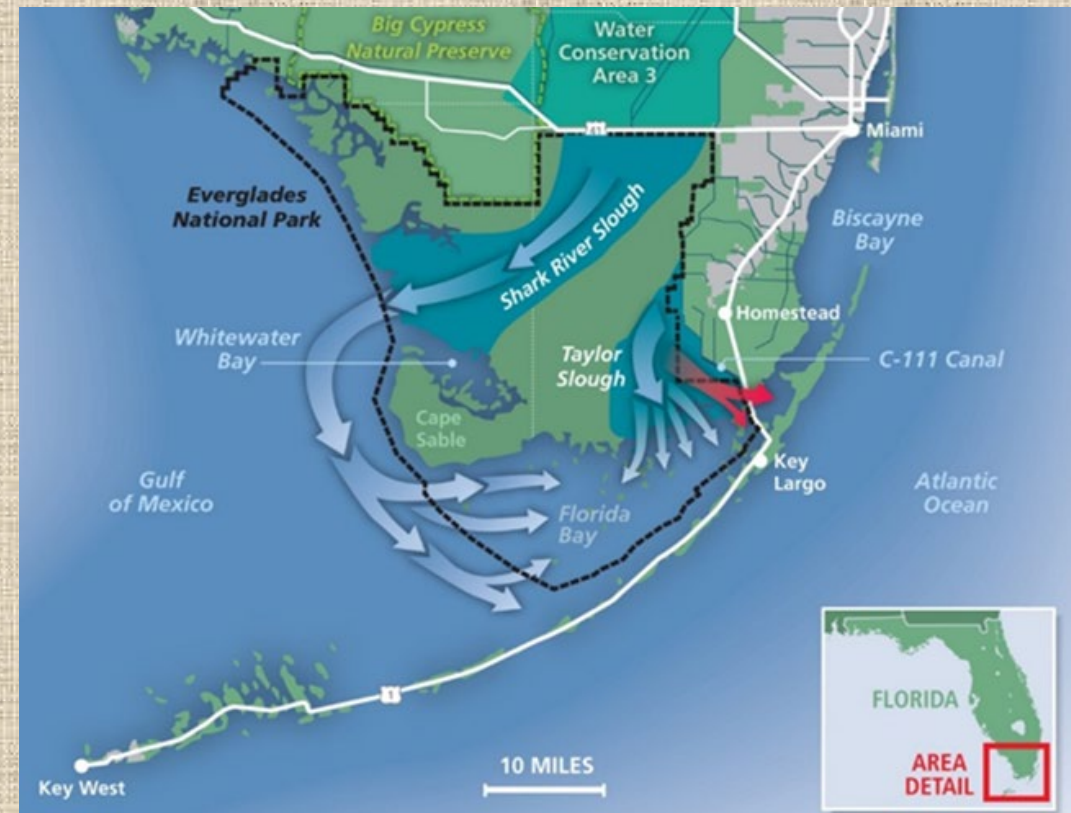


Implications for Restoration

- Confirm MAP hypothesis: **restored flow and lower salinities will result in improved conditions for crocodiles and alligators.**
- Provide support for ecosystem management recommendations for crocodilians
 - **restore Taylor Slough** as a main source of freshwater for NE Florida Bay
 - **restore early dry season flow** (October to January) from Taylor Slough to NE Florida Bay.

Success:

- Fluctuating mangrove back-country salinity that **rarely exceeds 20 ppt.**
- **Increase in crocodile and alligator performance Measures.**



Thank you

Supported by:

- RECOVER
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- USGS's Greater Everglades Priority Ecosystems Science (GEPES) Program
- National Park Service
- U.S. Army Corps of Engineers
- FL Power and Light Company
- Save Your Logo/Lacoste
- University of Florida



In Memory of Rafael Crespo Jr.