

# Modeling the Effect of Salinity and Sea Level Rise on Alligator Production

JEM

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## Background

- Salinity is an important factor within coastal ecosystems, but lack of available salinity models means many ecological models used to inform Everglades restoration do not include it.
- Sea Level Rise (SLR) is an important factor in planning for Everglades restoration but is difficult to model.
- The development of the Biscayne and Southern Everglades Coastal Transport (BISECT) model has allowed us to explore incorporating salinity and sea level rise into existing models.
- The Alligator Production Suitability Index (APSI) model has been in use since 2015 to assess the effects of restoration efforts on the American Alligator *Alligator mississippiensis*.

## Methods

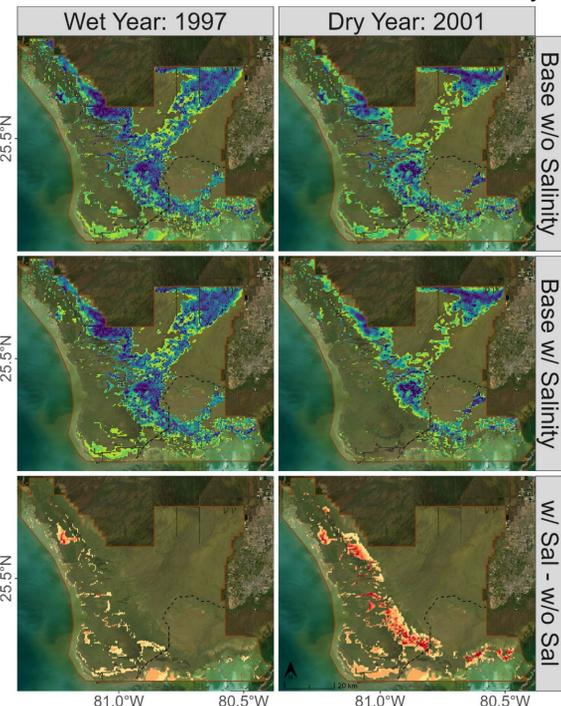
- We ran three separate sea level scenarios through the BISECT model in Everglades National Park (ENP).
  - Baseline: actual sea level in 1996
  - Medium SLR: Baseline + 53cm of SLR
  - High SLR: Baseline + 152cm of SLR
- We took the depths and salinity output from BISECT and used them as inputs in the APSI model.
- The APSI was run both with and without salinity inputs at all sea levels to isolate the effect of salinity on the model.
- Salinity intrusion is affected by the amount of freshwater flow, so we compared results for both a wet and dry year.

Wet and dry years are shown side by side to demonstrate the difference in suitability due to natural water level fluctuations. The first two rows of each panel are different model runs, and the third row shows the difference between model runs. Higher scores represent higher theoretical alligator production.

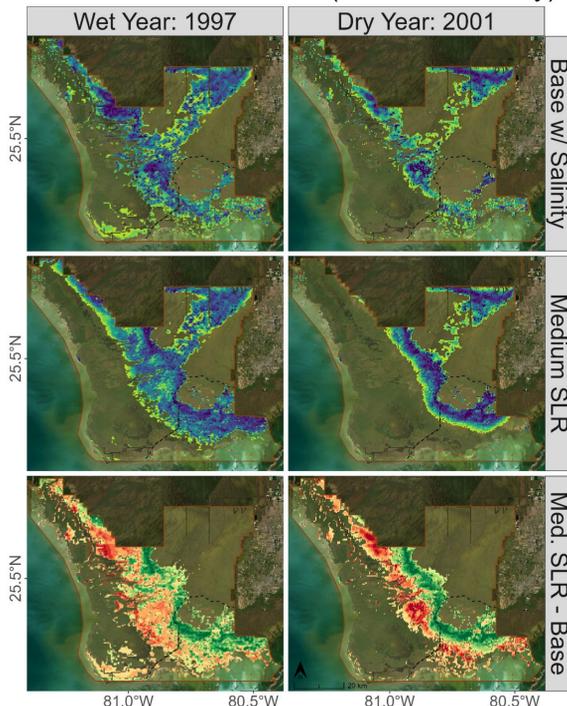
*Left:* Comparing the APSI output using the Baseline scenario with and without salinity.  
*Middle:* Comparing the APSI output using the Baseline and Medium SLR scenarios, both with salinity.  
*Right:* Comparing the APSI output using the Baseline and High SLR scenarios, both with salinity.

## Alligator Production Suitability Index (APSI)

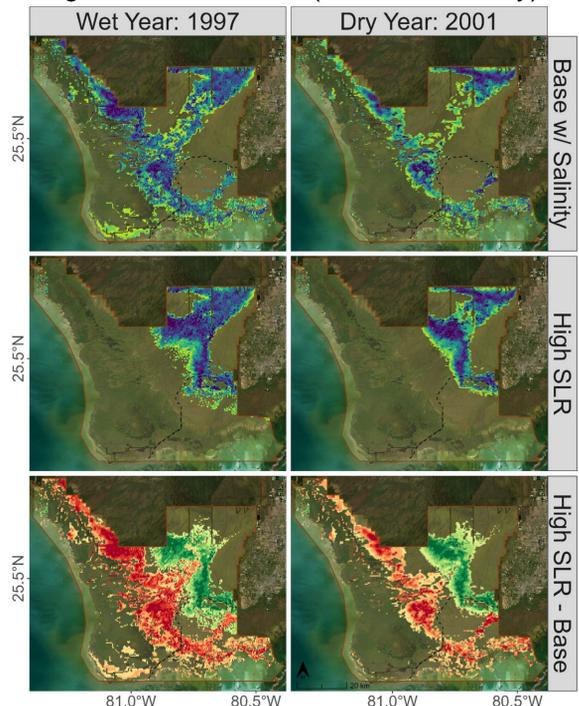
Baseline Scenario With and Without Salinity



Medium SLR vs Baseline (Both with Salinity)

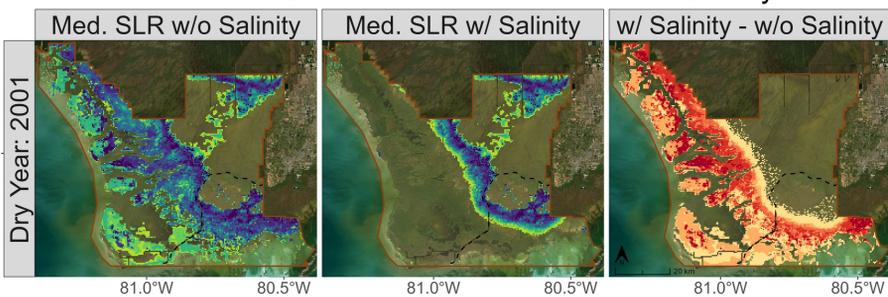


High SLR vs Baseline (Both with Salinity)

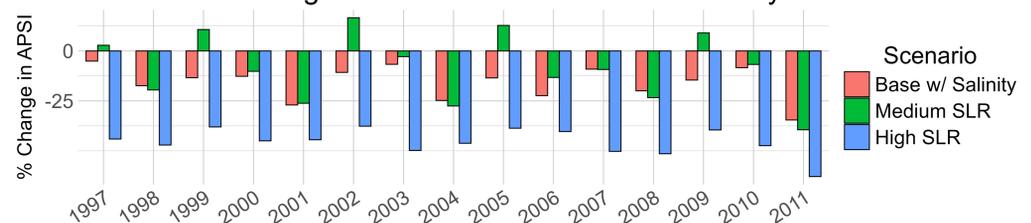


Basemap Source: Schwab-Willmann J (2024). *basemaps: Accessing Spatial Basemaps in R*. R package version 0.1.0; ESRI World Imagery

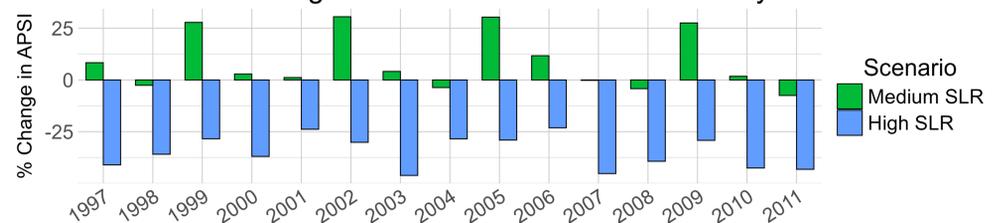
Medium SLR Scenario With and Without Salinity



Percent Change in APSI from Baseline w/o Salinity



Percent Change in APSI from Baseline w/ Salinity



## Results

- Using salinity as an input into the baseline model showed that salinity has a relatively small impact on alligator production suitability during wet years, but salinity intrusion during dry years is more pronounced.
- The medium SLR scenario improved the APSI score within Everglades National Park compared to the baseline scenario with salinity.
- The high SLR scenario worsened the APSI score within Everglades National Park across all years and compared to all scenarios.
- Not considering the effect of salinity would significantly overestimate the APSI in the medium SLR scenario.

## Conclusions

- Including SLR in models without accounting for the increase in salinity could lead to overestimation of the APSI in coastal regions.
- There is a need for the development of salinity and sea level rise models that can be included in modeled restoration scenarios, to better predict ecological outcomes of water management.