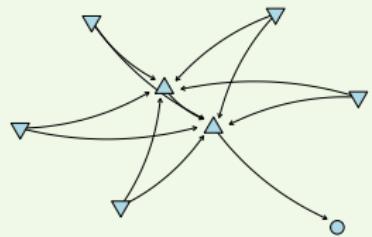
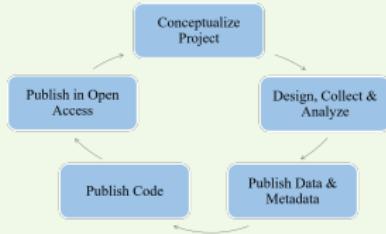


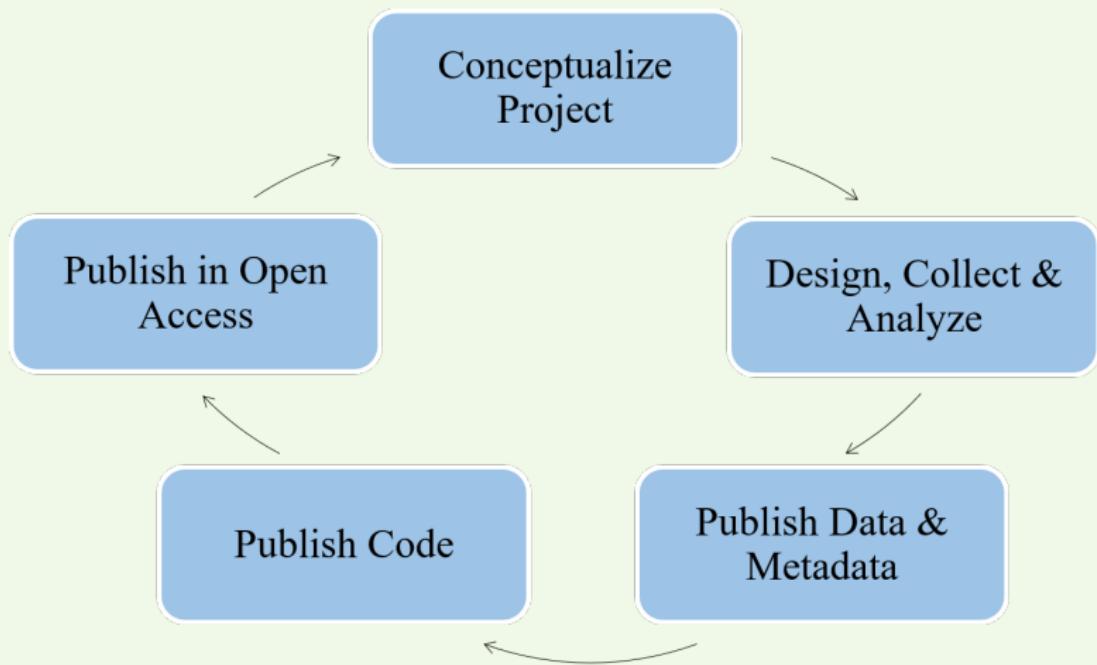
# Use of open science to inform restoration projects in estuaries: A Tampa Bay example

Marcus W. Beck<sup>1</sup>, Ed Sherwood, Kirsten Dorans, Jessica Renee Henkel, Kathryn Ireland, Patricia Varela

<sup>1</sup>Southern California Coastal Water Research Project, Costa Mesa, CA  
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April 23, 2018





Modified from Hampton et al. 2015. The Tao of open science for ecology. *Ecosphere* 6(7):1-13.



# Open science workflow

## *Open Science for Synthesis: Gulf Research Program*

July 10 - July 28, 2017

NCEAS, Santa Barbara, CA





# Today's talk

Our experience using the open science workflow to inform restoration projects in estuaries



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Our experience using the open science workflow to inform restoration projects in estuaries

Can we use disparate data to prioritize future restoration projects aimed at improving water quality?

- *Synthesize* data in space and time to evaluate cumulative effects of restoration projects
- *Develop* a decision support tool with empirical observations to evaluate likelihood of potential outcomes

# Tampa Bay - from gross to less gross



## Past:

- Mid-1970s N load  $8.2 \times 10^6$   $\text{yr}^{-1}$  [Greening and Janicki, 2006]
- Elevated chl-a concentrations
- Increased occurrence of HABs



# Tampa Bay - from gross to less gross



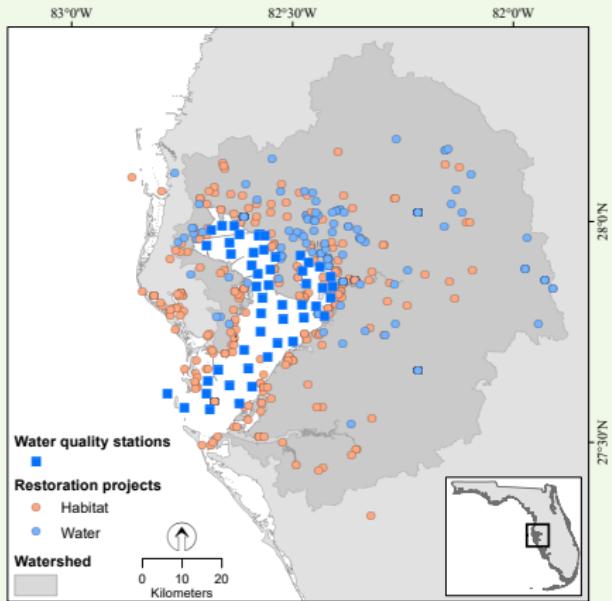
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## Present:

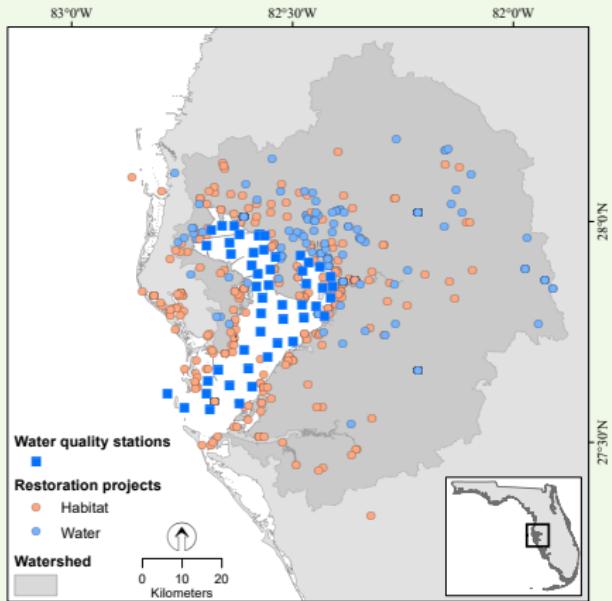
- 2016 seagrass at ~17k ha [Sherwood et al., 2017]
- Reductions in nutrient load, chlorophyll
- Increase in water clarity [Morrison et al., 2006, Beck et al., 2017]

# Tampa Bay - open data sources



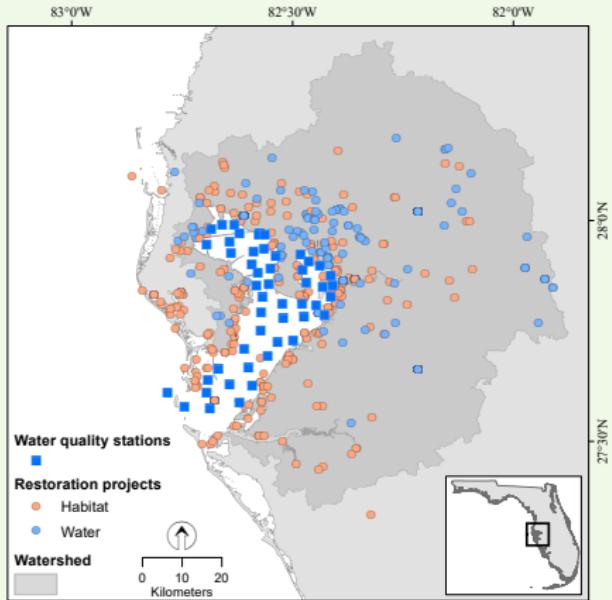
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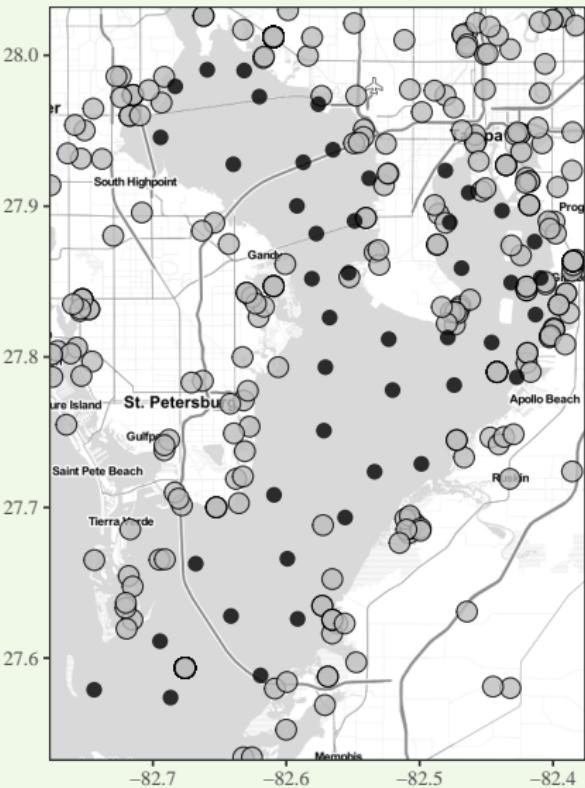
Despite considerable *investments* in restoration, *effectiveness evaluation* continues to elude practitioners at geographic scales

[Diefenderfer et al., 2016]

**Task 1:** Can we empirically link 500 restoration projects to chlorophyll changes at water quality stations over a forty year period?

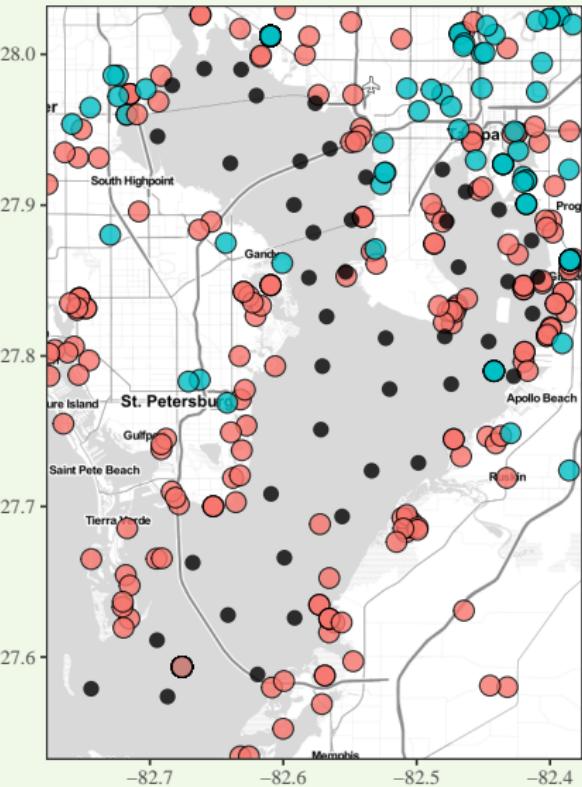


# Data munging with open source tools



Can we link 500 restoration projects to chlorophyll changes over a forty year period?

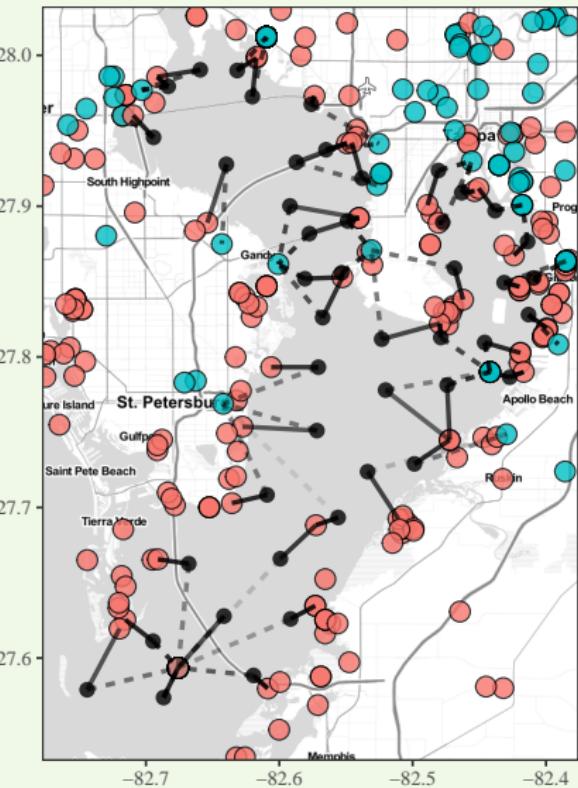
# Data munging with open source tools



Can we link 500 restoration projects to chlorophyll changes over a forty year period?

- Consider an effect of restoration *site type*?

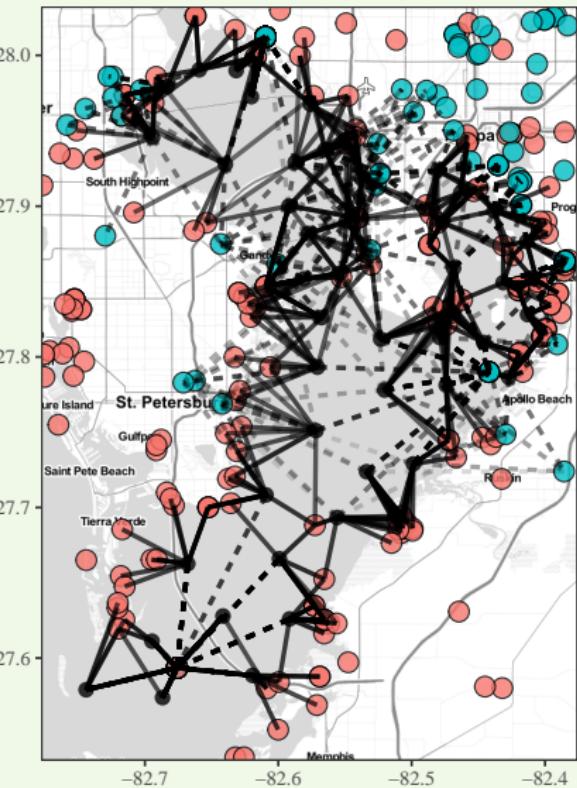
# Data munging with open source tools



Can we link 500 restoration projects to chlorophyll changes over a forty year period?

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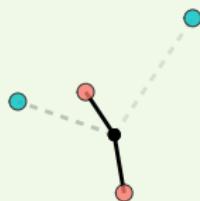
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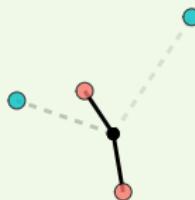
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- Consider an effect of restoration *site type*?
- Consider *distance* of sites from water quality stations?
- Consider *cumulative effects*?

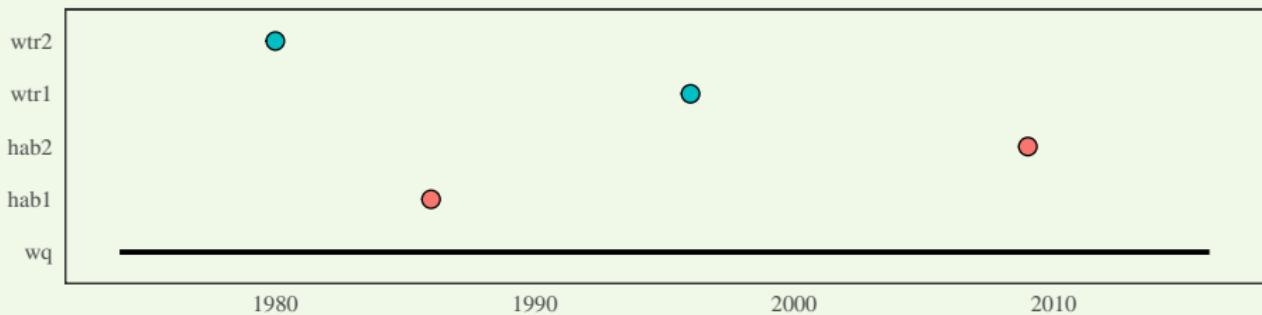
WQ and restoration sites: *spatial join*



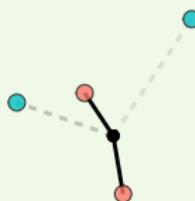
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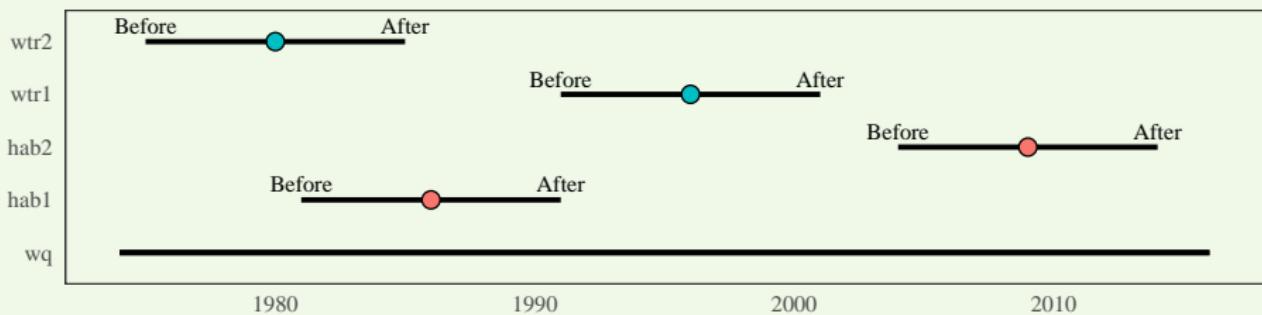
WQ and restoration sites: *temporal join*



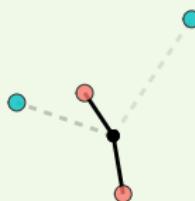
WQ and restoration sites: *spatial join*



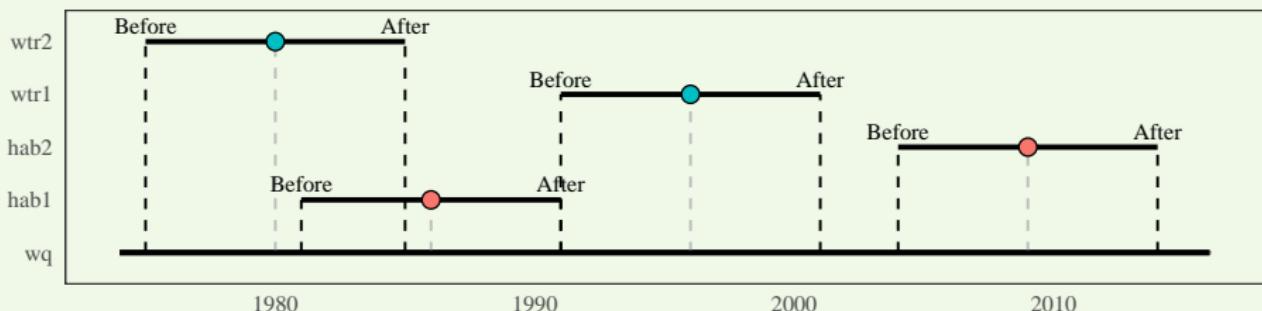
WQ and restoration sites: *temporal join, before/after*



WQ and restoration sites: *spatial join*

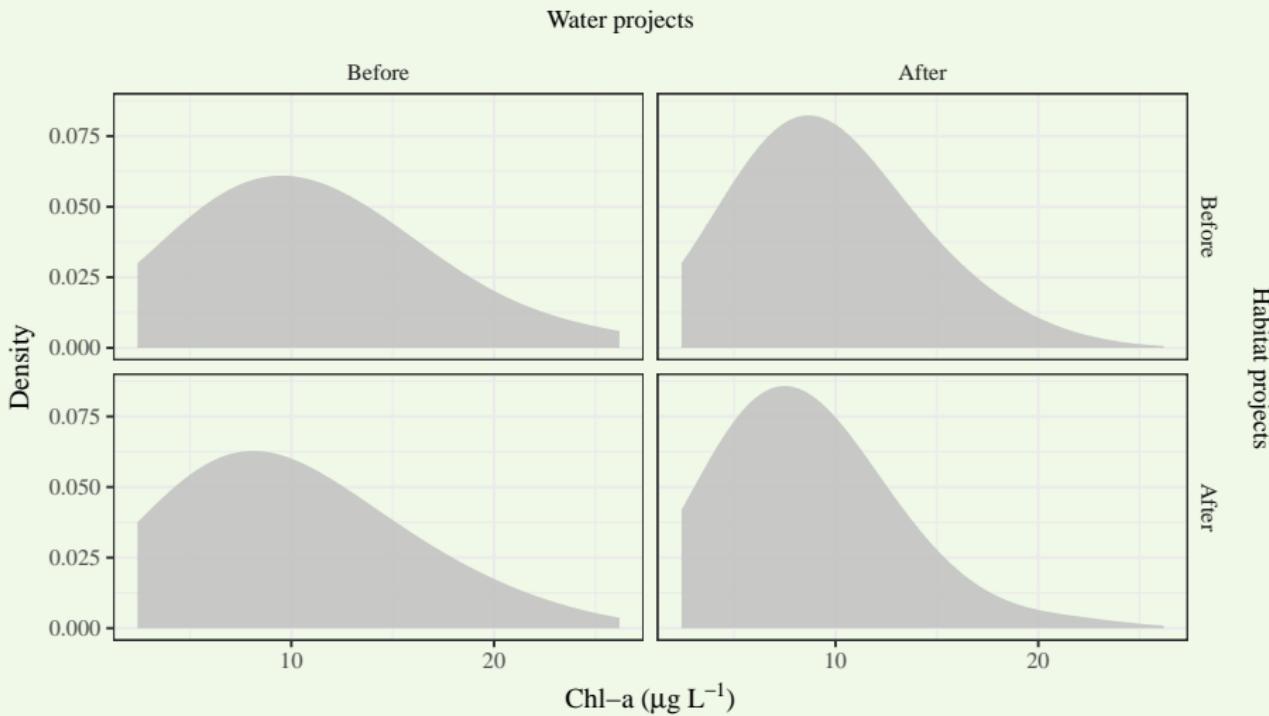


WQ and restoration sites: *temporal join, before/after, slice*



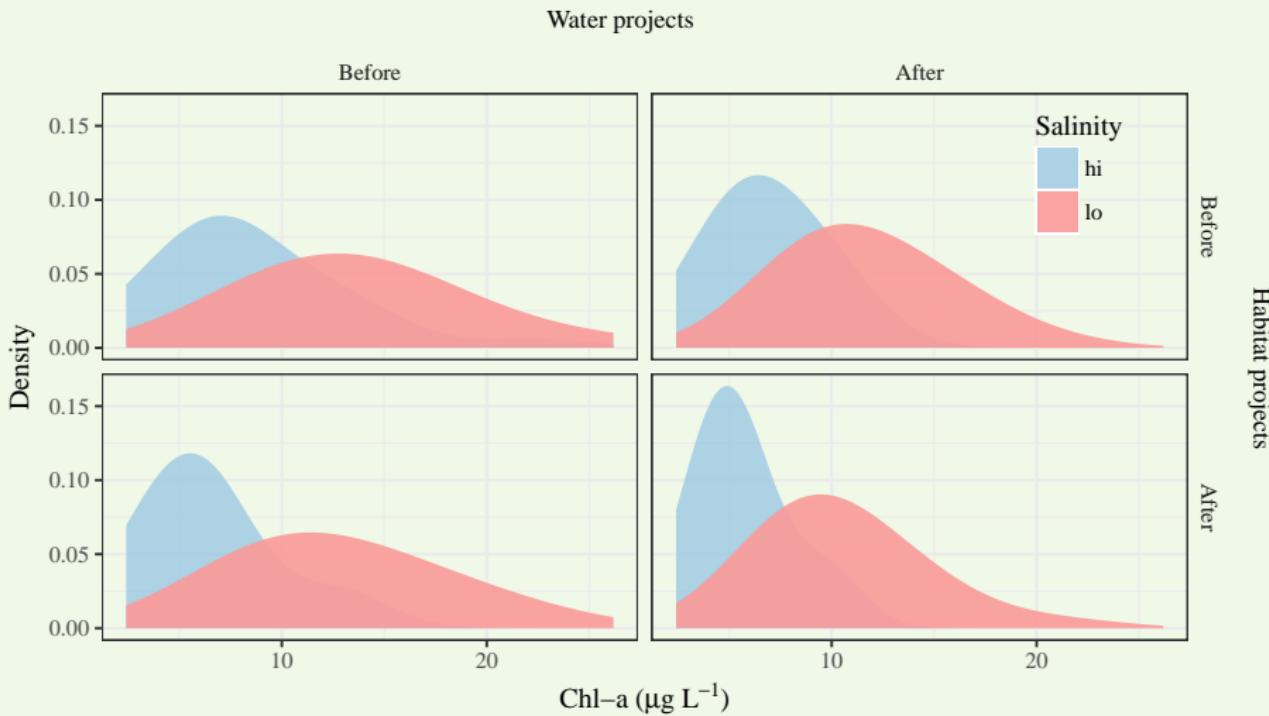
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For *many* water quality stations matched to *many* restoration sites...



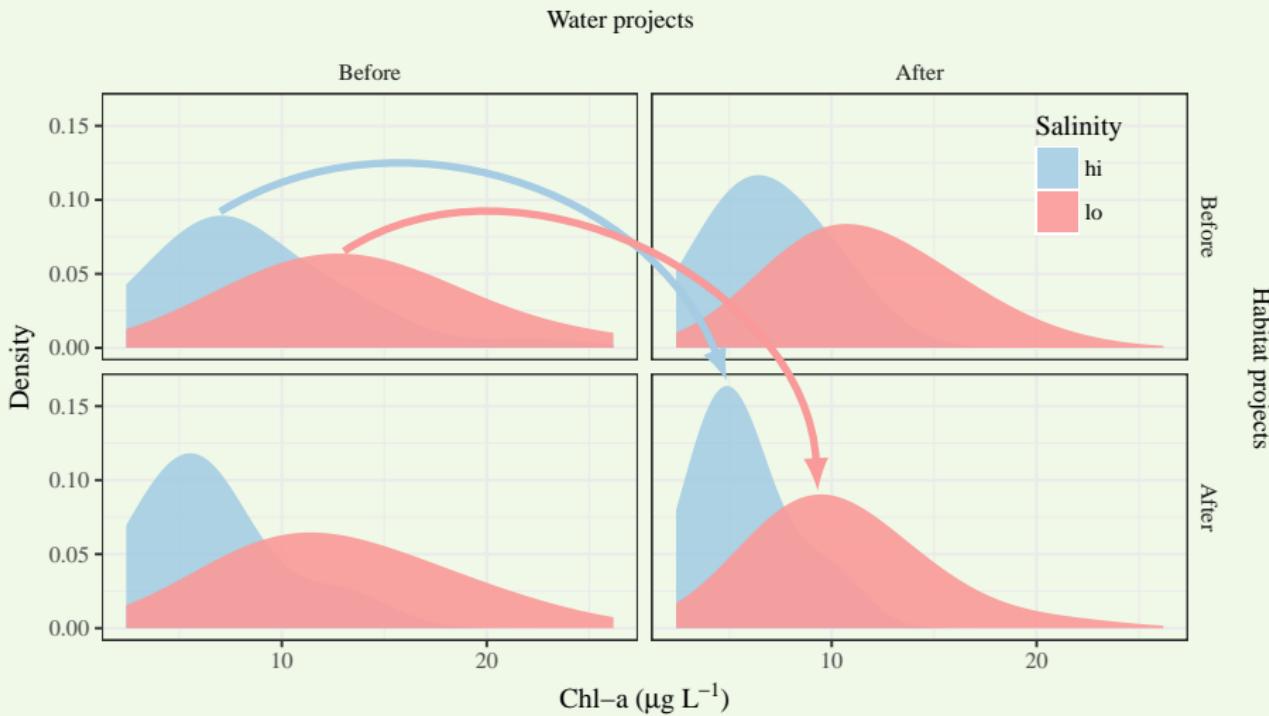
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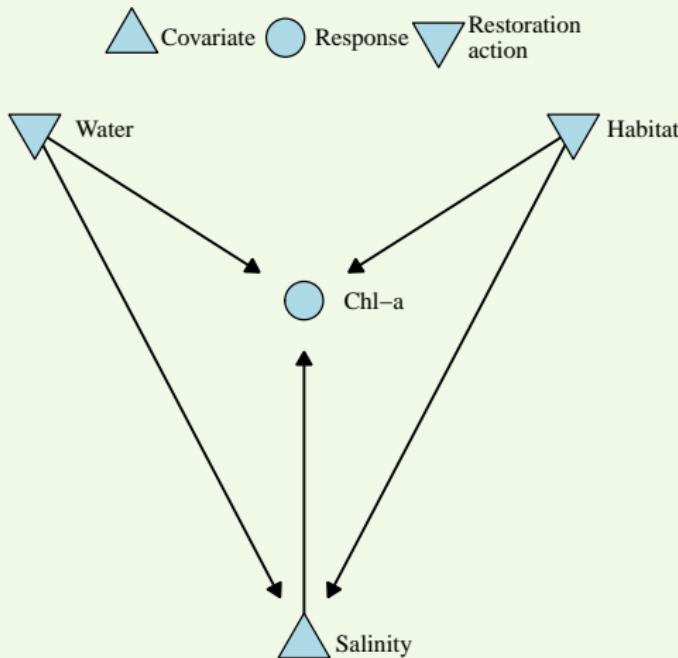
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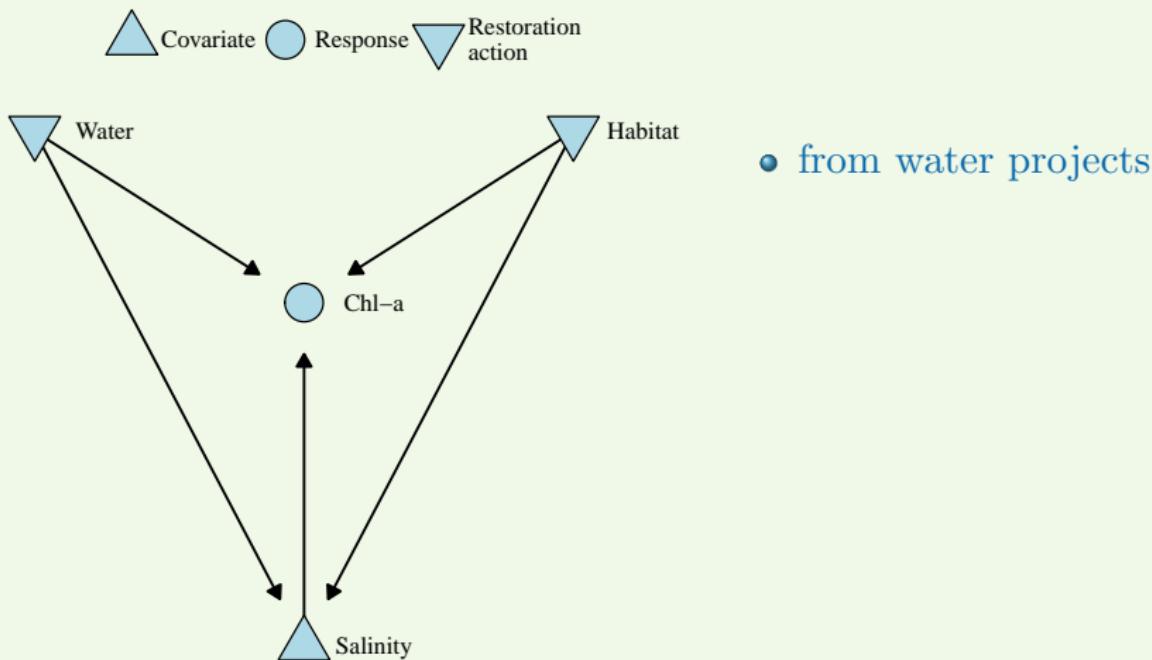
# Building a decision support tool

Using the *conditional probabilities* from the *empirical response*, what's the probability of low/high chlorophyll...



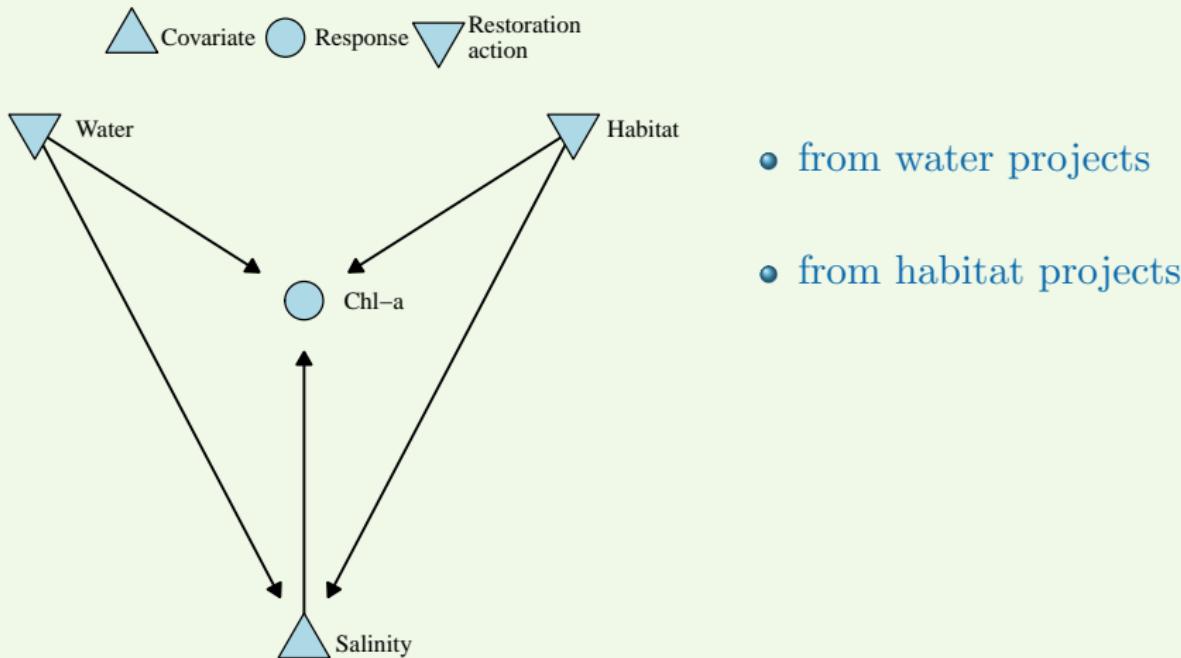
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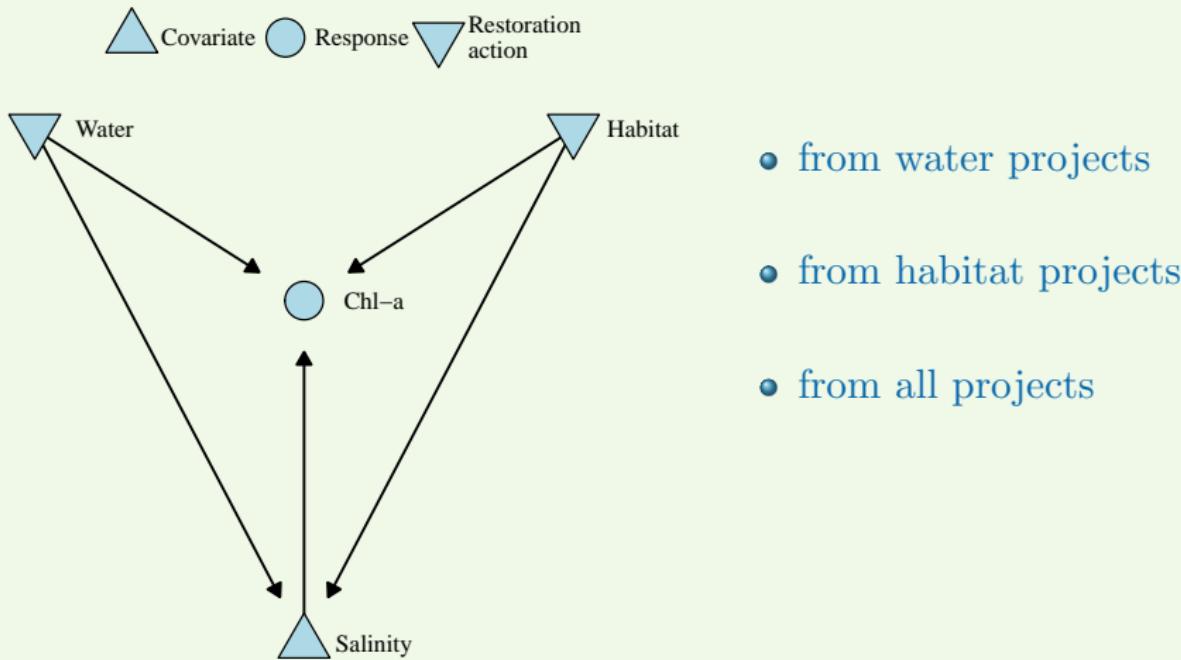
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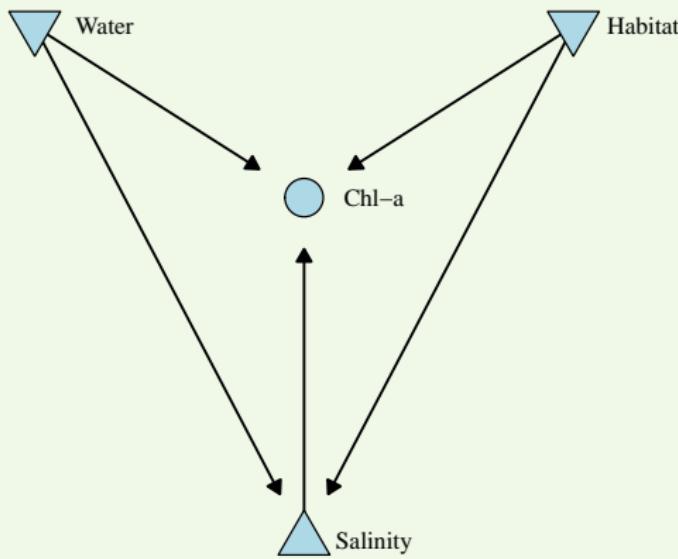
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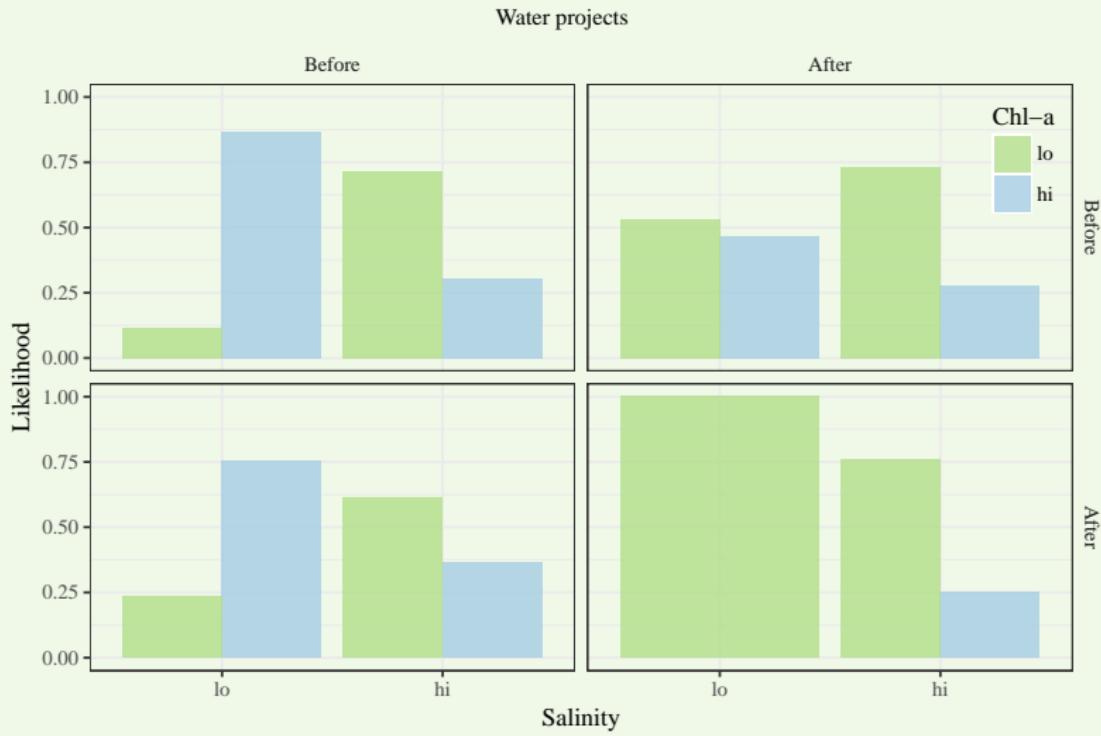
Using the *conditional probabilities* from the *empirical response*, what's the probability of low/high chlorophyll...

△ Covariate    ○ Response    ▼ Restoration action



- from water projects
- from habitat projects
- from all projects
- by salinity regime

All possible scenarios:



*Individual scenarios:* Probability of high chlorophyll

Water projects:

- Before: 53%
- After: 26%

Habitat projects:

- Before: 50%
- After: 50%

*Individual scenarios:* Probability of **high** chlorophyll

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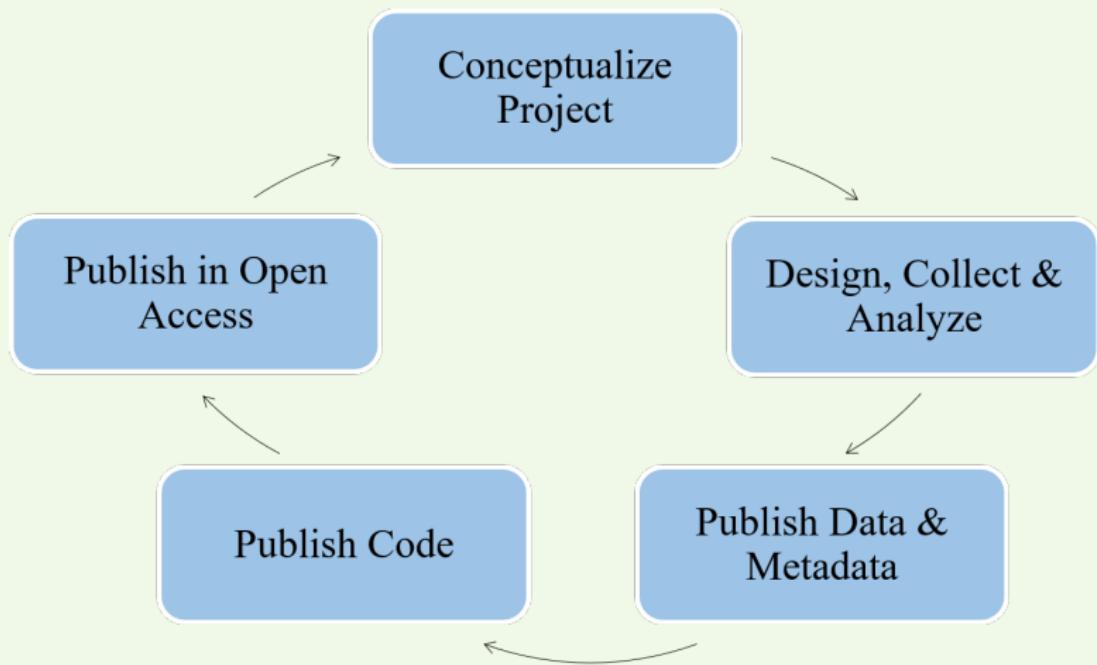
*Individual scenarios:* Probability of **low** chlorophyll

Water projects:

- Before: 46%
- After: 77%

Habitat projects:

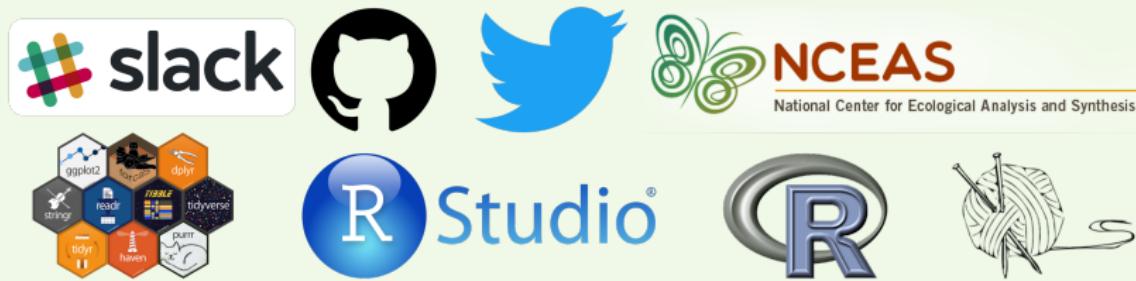
- Before: 49%
- After: 51%



Modified from [Hampton et al., 2015]

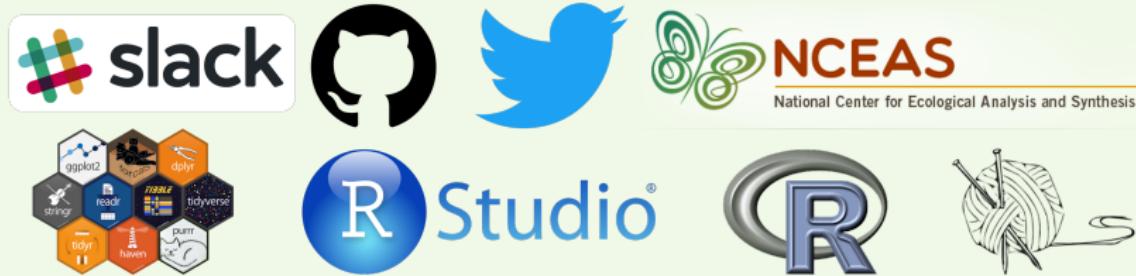
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- Early idea conception
  - Long distance collaboration
  - Transparent and reproducible analysis



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*... but the circle is not complete*

## *Acknowledgments:*

Research staff and employees at NCEAS: M. B. Jones, A. Budden, T. Neal, B. Mecum, C. Lortie, L. Wasser, J. Brun

The Gulf Research Program

Field staff and data managers at Hillsborough County Environmental Protection Commission

Abel Santana (SCCWRP) for cartography

## *Funding sources and contact:*



marcusb@sccwrp.org, 7147553217

GitHub (project):  
<https://github.com/fawda123/restorebayes>

GitHub (presentation):  
[https://github.com/fawda123/AWRA\\_2018](https://github.com/fawda123/AWRA_2018)

Twitter: @fawda123

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