Assessing the cumulative effects of restoration activities on improving water quality in Tampa Bay, Florida

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Presentation Outline


• Tampa Bay Estuary Program
• An Urban Estuary in Recovery
• A New Approach to Assess Progress
• Tampa Bay Results
• Broader Applicability
Tampa Bay Estuary Program

1 of 28 Estuaries of National Significance

Mission: Develop & foster partnerships to implement a science-based, management & restoration plan for the Tampa Bay estuary

Charting the Course: The Comprehensive Conservation & Management Plan for Tampa Bay 2017 Update (ccmp.tbep.org)
Partnership for a Healthy Bay

Tampa Bay 2019
An Urban Estuary in Recovery

- 1950 – 1980: Nearly ½ of seagrasses lost
- 1980 – 1990: Initial point source and nonpoint source regulations enacted
- 1991: Tampa Bay Estuary Program
- 1994 – 1996: Tampa Bay Nitrogen Management Consortium formed to more fully address loads to Bay
- 1992 – 2017: >470 projects implemented; 530 Tons of TN precluded; >$2.5 Billion invested
- 2014 – Now: Sustaining seagrass coverage above 1950s & Restoration Goal levels
Tampa Bay’s Seagrass Recovery

2017: CERF Coastal Stewardship Award
2018: 40,652 Acres of Seagrass
2020: Next Seagrass Survey

Other Improvement Indicators:
BIG PICTURE OF RECOVERY

Reduced Loads → Clearer Waters → More Seagrass
An Open Science Opportunity

July 10 – 28, 2017

• Build synthetic research capacity in the Gulf of Mexico community

• Expose practitioners to technologies & workflows that encourage collaboration & sharing

• Identify, analyze and report on a novel synthesis approach for natural resources & communities in the Gulf
Can we use the lessons learned / data from the Tampa Bay recovery to inform other restoration efforts, particularly those in the Gulf of Mexico occurring at various scales?

OSS Data Synthesis Team

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Kirsten Dorans, Assistant Professor of Epidemiology, Tulane University

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Tampa Bay: Open Data Sources

- **Water quality** monitoring data (tampabay.wateratlas.usf.edu):
  - 1974 to present
  - ~45 sites; 45+ years, monthly obs.

- **Restoration projects** data:
  - Tampa Bay Water Atlas (1971-2007; tampabay.wateratlas.usf.edu)
  - EPA NEP Mapper (2008-2017; gispub.epa.gov/NEPmap/)
  - TBEP Action Plan Database Portal (1992-2016) Infrastructure Improvements (apdb.tbeptech.org)

Restoration Projects Implemented

(a) Counts of restoration project types over time

(b) Locations of restoration project types over time

Mashing Up The Data: Spatially

Goal:
Link water quality observations to 1 to n restoration activities

Mashing Up Data: Temporally

Goal: Subset water quality observations 1-yr prior to x-years after restoration activities

Understanding Site Specific, Water Quality Improvements

**Example Station Match**

**Restoration Type**
- Green: Habitat Enhancement
- Light Green: Habitat Establishment
- Light Blue: Habitat Protection
- Blue: Nonpoint Source Control
- Light Blue: Point-Source Control

**Shiny TBEPTech.org/restoreTB/ind_eval.Rmd**

Scaling Up to the Entire Estuary

- **Point & nonpoint source controls** were more associated with overall chlorophyll-a improvements.

- **Habitat protection** linked to chlorophyll reductions regardless of assessment length and # of projects implemented.

- **Habitat protection & point source controls** observed water quality benefits in a shorter time and with fewer projects implemented.

Beck et al. 2019. shiny.tbeptech.org/restoreTB/ind_eval.Rmd
An Adaptable Decision Support Tool

Learn from historic changes in the estuary & provide future context for water quality improvement expectations with further management interventions

Flexible & simple approach that’s highly adaptable to novel contexts:
- Other estuaries with similar datasets;
- Spatial & temporal flexibility,
  Water quality parameters or management questions can vary;
- Open-Source and Reproducible:
  • http://github.com/tbep-tech/restoreTB
  • http://shiny.tbep-tech.org/restorebayes/ind_eval.Rmd
Improving the framework

Improved quantification of flow paths between restoration sites (black) and water quality stations (red)

Straight line vs. hydrologic
Improving the framework

Higher weighting by effort for different restoration projects


Photo by Donna Bollenbach
THANK YOU!

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Continuing the Paddle

Ensuring that Tampa Bay’s recovery is sustained into the future

- **Limitation:** Uncertainty in quantifying Bay wide effects of restoration projects that vary considerably in how they influence water quality (exploring additional weighting factors other than distance)

- **At worse:** An approach that can identify the closest restoration projects that have occurred near a water quality monitoring site and over what time periods changes in water quality observations could be expected as a result of those projects being implemented.

- **At best:** A decision support tool that provides managers with estimates of how water quality is expected to change given certain restoration activities, how much improvement can be expected given the number of projects, and within which time frames improvement could be observed.
Changes in water quality relative to each type of restoration project:

Key assumptions:

- Restoration projects will benefit water quality through a decrease in chlorophyll (magnitude not estimated)
- Chlorophyll changes will vary by project type
- Model is designed to describe cumulative effects at different spatial scales
Tampa Bay – Preliminary Analyses

Beck et al., 2019.