A REVIEW OF SEAGRASS LOSSES AND ALGAL BLOOMS IN BISCAYNE BAY

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Biscayne Bay Seagrass and Algal Bloom Monitoring Timeline

• About 40 year time span

• One seagrass die off event documented prior to 2005 and no algal blooms

• Since 2005 - Four major events
  • One phytoplankton bloom coinciding with a seagrass die off event
  • One macroalgal bloom causing a seagrass die off
  • One diatom bloom
  • One seagrass die off currently advancing
North Bay Seagrass loss event in late 1990’s

- Monitoring consists of one 30m transect (BH10) with three fixed quadrats.
North Bay Seagrass loss event in late 1990’s

- Density increased steadily 1986 – 1990
- Declined rapidly 1995-1997
- No causal event identified
- Seagrass monitoring in the basin has been limited – therefore the extent of the area lost is unknown
- Sustained recovery has not occurred in the transect area through 2016
2005-2007 Phytoplankton Bloom in the Southern Biscayne Bay Basins

- Series of events contributed to the phytoplankton bloom that lasted 2.5 years
  - Preceded by a two year drought and hypersalinity event with database Period of Record highs in 2004 and 2005
  - Aug 2005 Hurricane Katrina rainfall resulted in a large Total Phosphorus discharge & rapid salinity decreases
  - Oct 2005 Additional disturbances to the region with Hurricane Rita
  - US1 road construction practices likely contributed (Rudnick et al. 2007)
**2005-2007 Phytoplankton Bloom in the Southern Biscayne Bay Basins**

- Median concentrations of Total Phosphate (TP) in the central, southern Bay, as well as Card and Barnes Sounds is 0.005 mg/l (5 ppb)
- August 2005, Post Hurricane Katrina concentrations increased to as high as 0.1 mg/l (100 ppb)
2005-2007 Phytoplankton Bloom in the Southern Biscayne Bay Basins

- Effect of freshwater discharge on salinities of the Biscayne Bay system following passage of Hurricane Katrina.
- Note the extent and duration of the salinity change in the southernmost basins Manatee Bay & Barnes Sound.
  - Salinity in Manatee Bay and Barnes Sound was decreased from ~25 psu to 5 psu in less than 2 days.
2005-2007 Phytoplankton Bloom in the Southern Biscayne Bay Basins

**Low Dissolved Oxygen**

In addition to the significant and sudden changes in salinity, Dissolved Oxygen (DO), and possibly sulfide mobilization (as indicated by historically low Oxidation Reduction Potentials [ORP]) were documented during post-storm sampling conducted by DERM.

**Seagrass losses**

A general pattern was noted – the areas with moderate to highest density seagrass, measured the lowest DO & ORP and subsequently lost the most seagrasses.
2005-2007 Phytoplankton Bloom in the Southern Biscayne Bay Basins

- Current status of seagrass losses

<table>
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<th>Present</th>
<th>Lost Area</th>
<th>Percent Decrease</th>
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<tbody>
<tr>
<td>24.5 km² (2005)</td>
<td>12.6 km² (2014-2016)</td>
<td>11.9 km²</td>
<td>48.60%</td>
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- Seagrass community appeared to stabilize following the cessation of the bloom
- *Halodule* increased and in some areas was replaced by *Thalassia*
- Seagrass succession did not continue throughout and coverage has not returned to pre-bloom levels
- Currently both basins have 49% less seagrass than pre-bloom
Two species in the genus *Anodyomene*

- Majority of station had >75% cover – however, biomass was noted as variable
- Pattern of greatest biomass just offshore of the two main canals in the region: Snapper Creek and Coral Gables

2005-Present macroalgal Bloom in the North Central Inshore Region
2005-Present macroalgal Bloom in the North Central Inshore Region

Bloom has remained confined to the North Central Inshore Region.

Anadyomene tissue analysis showed:

- Based on %N, %P, and N:P ratios the blooming macro algae have no limitation of N above 1.8 %N (Duarte 1990)
- High values of $\delta^{15}N$ (> 5%) suggests anthropogenic sources of nitrogen supporting the bloom
- In 2016 20% of the samples from Coral Gables Waterway exceeded the standards for Fecal Coliform
Presently 39.1 km² have <5% seagrass cover as a result of this macroalgal bloom.

With the bloom also receding much of the area is left bare.

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<td>12.1 Km² (2014-2016)</td>
<td>39.1 Km²</td>
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In 2013 Diatom Bloom along inshore and the Southern Bay - Card Sound regions

SFWMD analysis shows early onset of rainy season, and periods of heavy rains have resulted in high flow from coastal control structures

Causes of this bloom are uncertain, however, higher flows from coastal structures would have increased nutrient loads
2013 Phytoplankton/Diatom Bloom

- Salinity (PSU) NOAA-AOML Cruise Sampling
- Discharges and salinity patterns relate to the bloom locations
2013 Phytoplankton/Diatom Bloom

- Sampling showed Chlorophyll concentrations up to 20x normal values
- Again - Causes of bloom are uncertain, however, higher flows from coastal structures would increase nutrient loads
2013-Present Developing Seagrass loss event in North Biscayne Bay

Julia Tuttle Basin
2013-Present Developing Seagrass loss event in North Biscayne Bay

Julia Tuttle Basin
2013-Present Developing Seagrass loss event in North Biscayne Bay

- The basin is (was) predominantly characterized by very high biomass *Syringodium*
2013-Present Developing Seagrass loss event in North Biscayne Bay

Julia Tuttle Basin Water Quality

Annual Average Nutrients Concentration (Nitrate/Nitrite, Ortho Phosphate and Total Phosphorus) at Station BB14 and Station LR01 (exit of C7 canal)

Annual Average Chlorophyll-A Concentration at Station BB14

Error bars indicates Standard Deviation
2013-Present Developing Seagrass loss event in North Biscayne Bay

Julia Tuttle Basin

- Estimated 45% loss of seagrass area

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2005 - Present  Summary of seagrass loss events

- An estimated total of 56km² of seagrass has been lost
- An 88km² area that has been effected and lost 64% of the seagrass.

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<td><strong>Total</strong></td>
<td>87.7 Km²</td>
<td>31.3 Km²</td>
<td>56.4 Km²</td>
<td>64.31%</td>
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Take home points

• In a monitoring program that dates back thirty years – there has been overall stability in the Bay, however the last ten have seen algal blooms and significant seagrass losses that were unprecedented in the prior twenty years.

• The two phytoplankton blooms were associated with storm/rain events with large discharges and associated nutrients which were preceded by periods of drought and elevated salinity.

  • Further work is needed to better understand this dynamic.

• Areas of high density/high biomass seagrass are can be repositories of nutrients and are at risk of loss events.

  • Identifying areas of high seagrass biomass in conjunction with C:N:P ratios and isotopic N may help guide protective measures.
Acknowledgments
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