Spatial and Temporal Trends of a Multi-year Macroalgal Bloom

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Overview

• DERM had been conducting annual surveys of stratified random stations since 1999 and fixed transects since 1985.

• Period of Record showed stable seagrass community throughout Biscayne Bay through 2007.

• Bloom became apparent in 2010 and reviews of the data indicate development in 2004-2005.

• Bloom is composed of two species in the genus *Anodyomene*.

• Bloom has remained confined to the North Central Inshore (NCI) region of the bay.
Monitoring Program

- SAV surveys are conducted annually by at 11 fixed stations and 101 sampling sites within Biscayne Bay using a stratified random design.

- Additional sampling has been conducted since 2010 in the NCI region with a total of 165 stations surveyed between 2010-2014

- SAV Metrics
  - SAV is sampled with a 0.25m² grid.
  - 4 grids per station
  - Visual percent cover is estimated using the Braun-Blanquet scale (BBCA) for both seagrass and macro algae.

**Braun-Blanquettte Cover-Abundance scale.**

0.1 = < 5% cover with a solitary
0.5 = <5% cover with few individuals/shoots
1 = <5% numerous individuals/shoots
2 = ≥5% to ≤25% cover
3 = >25% to ≤50% cover
4 = >50% to ≤75% cover
5 = >75% cover
Biscayne Bay – North Central Inshore Region

- Identified as a distinct region in a number of multi-dimensional water quality analyses.
  - Combination of physical and nutrient data.

- Receives freshwater input from Coral Gables Waterway / C-2 and Snapper Creek / C-3
  - Relatively low flow but high N.

- The region had historically received significant groundwater contribution.
NCI Seagrasses 1999-2007

- NCI Region had a varied but stable mix of *Thalassia*, *Halodule*, and *Syringodium*. 
NCI Seagrasses Fixed Stations

- Two fixed seagrass monitoring stations within in the bloom 29 & 34.
- Period of Record dating to 1985, showing seagrass at high shoot densities through 2005.
Bloom Composition

- Two species in the genus *Anadyomene*
- **Image 1: Anadyomene stellata**
  - Found throughout Central Southern Biscayne Bay <5% cover.
  - Present throughout the bloom area, with some areas of dominance in the north.
- **Image 2: Anadyomene sp**
  - DNA unable to confirm identification, appears morphologically closest to *Anadyomene linkiana* - previously described from single specimen collected from deep waters in the Bahamas.
  - Dominant throughout the bloom, regularly >75% cover and attaining high biomass.
  - Not previously recorded in Biscayne Bay or elsewhere in Florida.
Bloom Development

- **2002 – 2004:**
  Present throughout the bay, mostly low percent cover.
  - First indications of bloom in the northern part of NCI.

- **2005 – 2007:**
  Development becomes evident.

- **2008 – 2010:**
  Bloom is established in the NCI region
Bloom Peak 2010 - 2012

- Dedicated sampling beginning in 2010 using the full sampling grid in the NCI.
- Combined DERM & UM SWAPS data to produce a map of the bloom.
- Large areas of *Anadyomene* with coverage 75-100%.
- Total approximate bloom area is approximately 60km².
- Distinct Eastern fringe from 75-100% cover to absent between station 2000ft apart.
2012 Cubic volume evaluation:

- While the majority of station had >75% cover – biomass was noted as variable.
- Percent Cover x Area (0.25m²) x Height (cm).
- Pattern of greatest biomass just offshore of the two main canals in the region: Snapper Creek and Coral Gables.
Seagrass Impacts

- **1999-2004 Pre-bloom**: Seagrass high BBCA values (> 50% coverage), Green Algae low BBCA values (<5%)

- **2005-2009 Bloom Development**: Increase in Green Algae BBCA coverage in the 5% to 25% category and some increase in the highest categories (> 50% coverage).

- **2010-2014 Bloom**: Opposite abundance pattern than observed during pre-bloom (< 5% coverage for seagrasses, >50% coverage for Green Algae)
Seagrass Impacts

Shift in coverage from *Thalassia* dominant area to Green Algae dominance and subsequent decrease for both groups.
Seagrass Impacts

- During the pre-bloom (2000-2004) and bloom development (2005-2009) periods, the average Total Seagrass (TSG) coverage in the area was an estimated 51 km².

- Approximately 31 km² have been lost, a decline of 63% in TSG coverage.

<table>
<thead>
<tr>
<th>NCI Bloom Total Area (60 Km²)</th>
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<tr>
<td>Pre-Bloom</td>
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<tr>
<td>Average Total Seagrass Coverage Area (Km²)</td>
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<td>50.6</td>
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Seagrass Impacts

- Detailed Map of Total Seagrass, at >5% cover, for 2012 and 2014 surveys.

- As of 2012 area off of Matheson Hammock absent of grass.

- Between 2012-2014, the reduction in the TSG coverage area was 10.71 km².
Bloom Time Series

Station 3G

2010-2012

Station 6A

2014

Station 9C
Bloom Current Status

2014 Cubic volume evaluation:

- Snapper Creek: Decrease in the *Anadyomene* spp. percent cover and height.
- Coral Gables Waterway: Barren bottom areas throughout area.
- Overall reduction in the total bloom area in the southern extent.
Seagrass Recovery

- Losses of seagrasses are ongoing where *Anadyomene* spp. persists.

- Only stations with a reduction in 80% or more in *Anadyomene* spp. coverage experienced some seagreass recovery.
Summary

• Prior to the *Anadyomene* spp. bloom NCI had a stable diverse seagrass community, dominated by *Thalassia*.

• The *Anadyomene* spp. bloom developed rapidly during the 2004 – 2009, and peaked 2010-2012.

• The bloom, which covers ~60km², has remained confined to the North Central Inshore region.

• *Anadyomene* spp. had become the dominant SAV in the region.

• Approximately 30 km² of seagrass coverage has been lost, which is decline of 63%.

• The bloom has dissipated from a peak in 2012, however seagrass recovery has been minimal to date.
Future Considerations

• *Anadyomene* sp., where else is it?

• What will the SAV community be like going forward?
  – Will seagrass recover?
  – Will the bloom persist?

• The DERM Biscayne Bay SAV monitoring program is presently without a funding partner and is unable to continue.