Carbon Cycling in Tidal Marshes and Oyster Aquaculture

Source A[redacted]lysis Using [redacted]OM Slope

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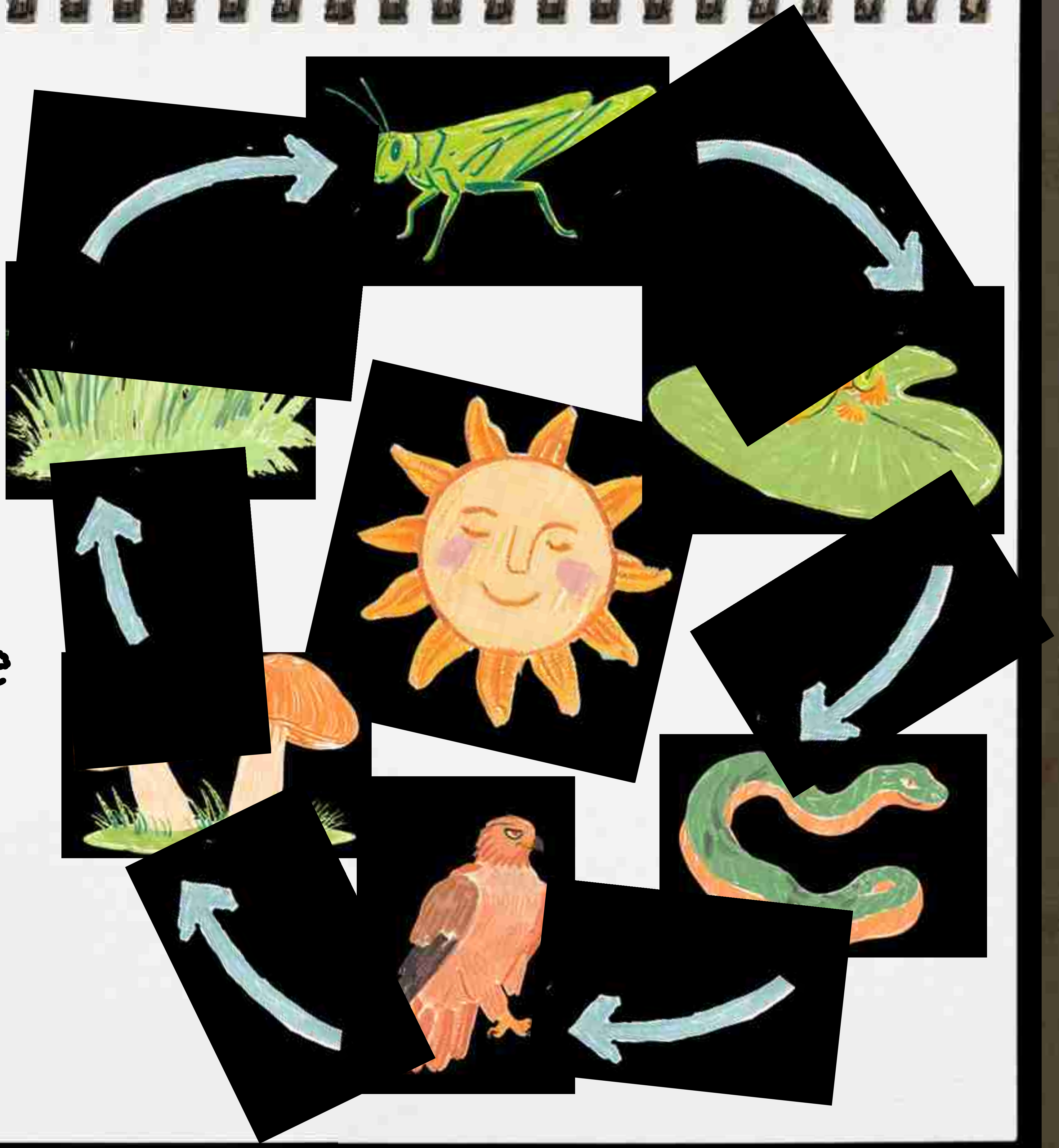
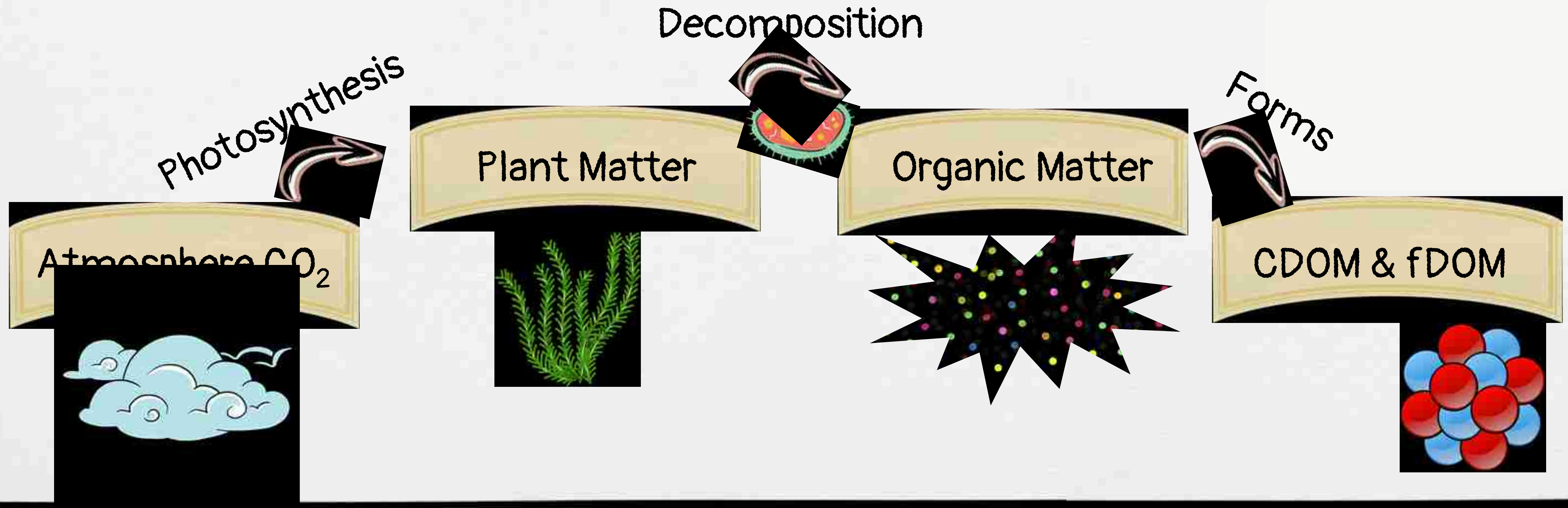
Morgan State University - PEARL



Background: Organic Matter

How does carbon enter our waterways?

How does carbon cycle through the biosphere and hydrosphere?



Sources of Organic Matter

Marsh-Estuarine Interface

- Place of change where these materials are exchanged
- This could also be true for the interface between oyster aquaculture and estuaries

Marsh
watershed, soils, marsh plants

Estuary
plankton/algae, fish, ocean

Composition of Dissolved Organic Matter

DOM is a complex mixture

1. Many different sources
    a. Riverine inputs, plankton, plants, algae, soils, GW pores

1. Range of molecular weights
    a. Can organisms use/consume it? Is it worth it? Is it useful?

Composition of Dissolved Organic Matter

DOM is a complex mixture

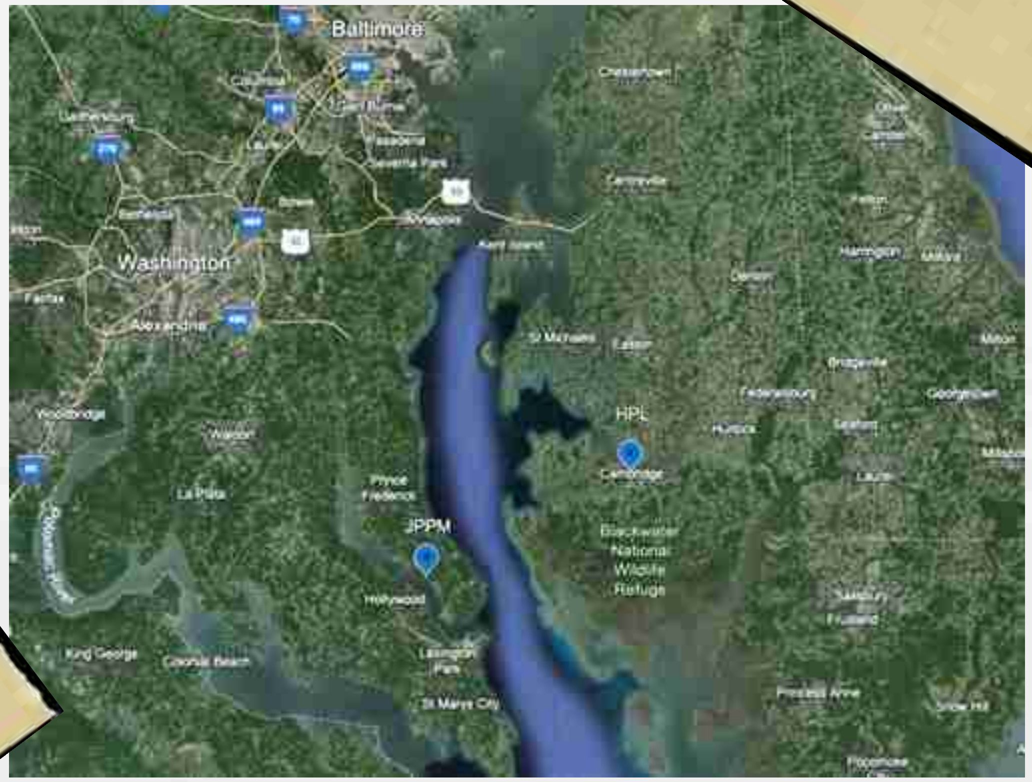
1. To help identify this complex mixture, we use CDOM
   a. Absorption and fluorescence of CDOM used to estimate potential sources, average molecular weight, and bio and photochemical reactivity
      i. Will it break down in sunlight?

1. Fluorescence (fDOM) helps identify humic-like materials (terrestrial) and protein-like (aquatic) materials

Goals

01 How do CDOM SR and fDOM SF ratio vary between Tidal Marshes and Oyster Aquaculture systems?

02 How does this impact future climate change studies?



Field & Lab Methodology

1. Place ISCOs to run for 25 hour period at TM and OA sites
2. Use vacuum filtration to filter known quantity of sample through GF/F Filters
3. Collect filtrate and filter again through 0.2 µm syringe filters for fDOM and CDOM analysis
4. Store filtrate in fridge
5. Repeat for all samples
    a. 1-11, A&B, ES&JP
        i. More sample reps

TM : Tidal Marsh

OA : Oyster Aquaculture

ES : Eastern Shore

JP : Jefferson Patterson Park

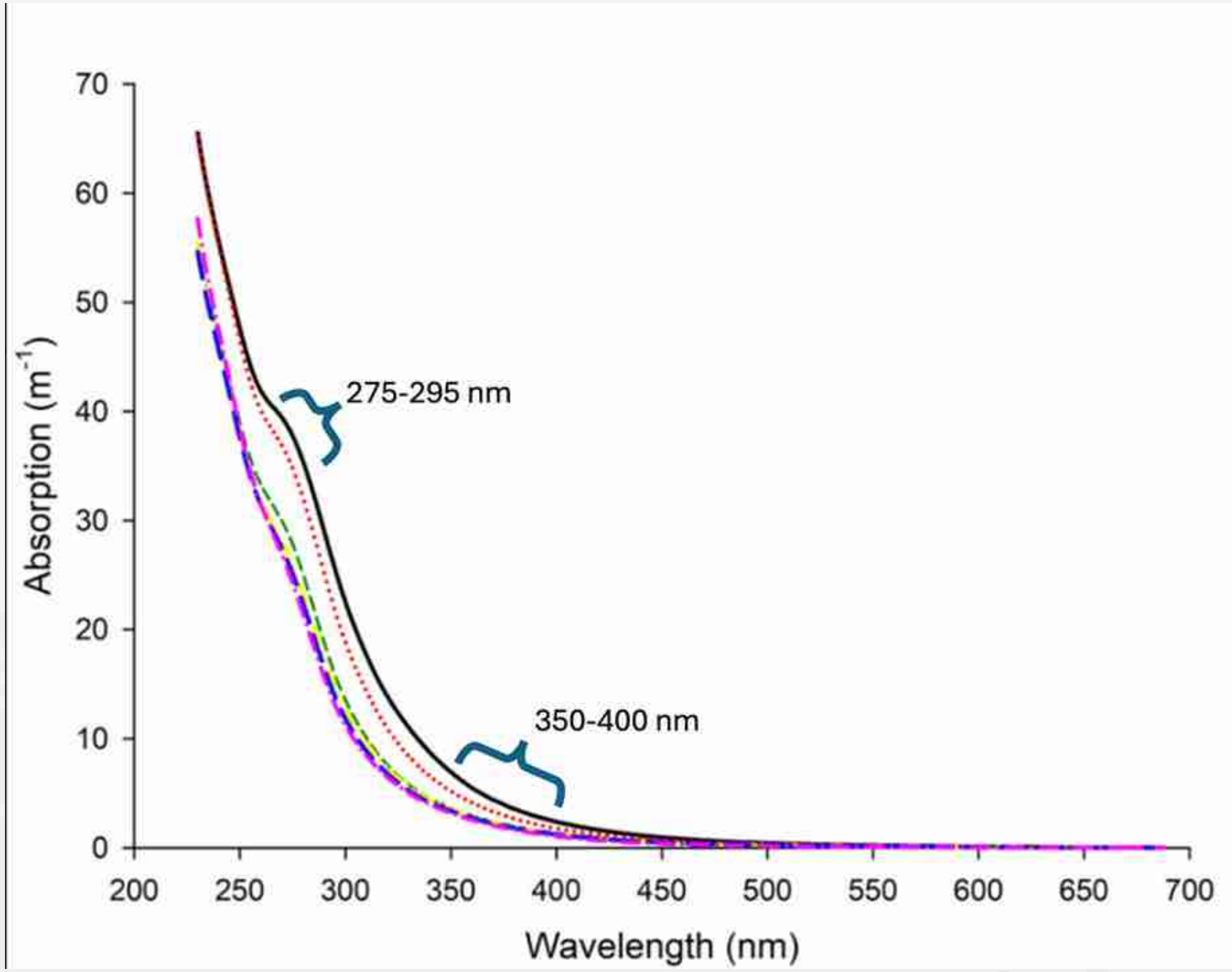
EX: OAJP is Oyster Aquaculture at Jefferson Patterson Park

CDOM Methodology

1. Let refrigerated samples sit for one hour
2. Boot up UV-1900i "Leela" and run DI water for standardization
3. Run samples through UV-1900i Spectrophotometer
4. Absorbance measured from 240 - 750 nm
5. Run data through MATLAB

CDOM Absorbance Scan

Amount of light the sample absorbs



Wavelength of light hitting the sample

CDOM & Slope Ratio

Slope Ratio

- High slope ratio: More low molecular weight molecules (marine/ocean)
- Low slope ratio: More high molecular weight molecules (terrestrial)

Importance

- Learning source and type of organic matter = learning about what's available for organisms
- OM regulates water quality/health of coastal ecosystems
- Climate change impacts on TM and OA

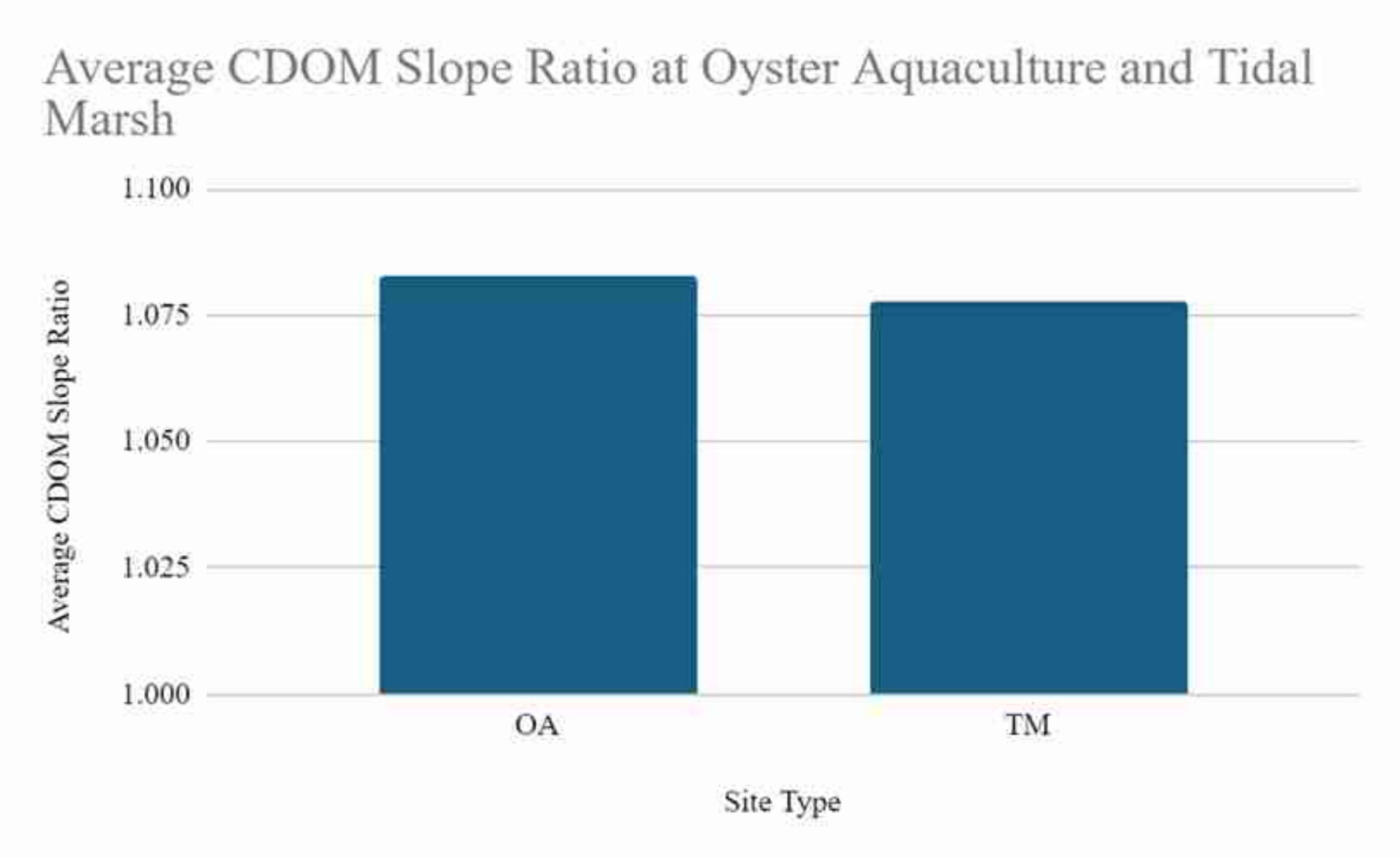
Definition

Slope Ratio:

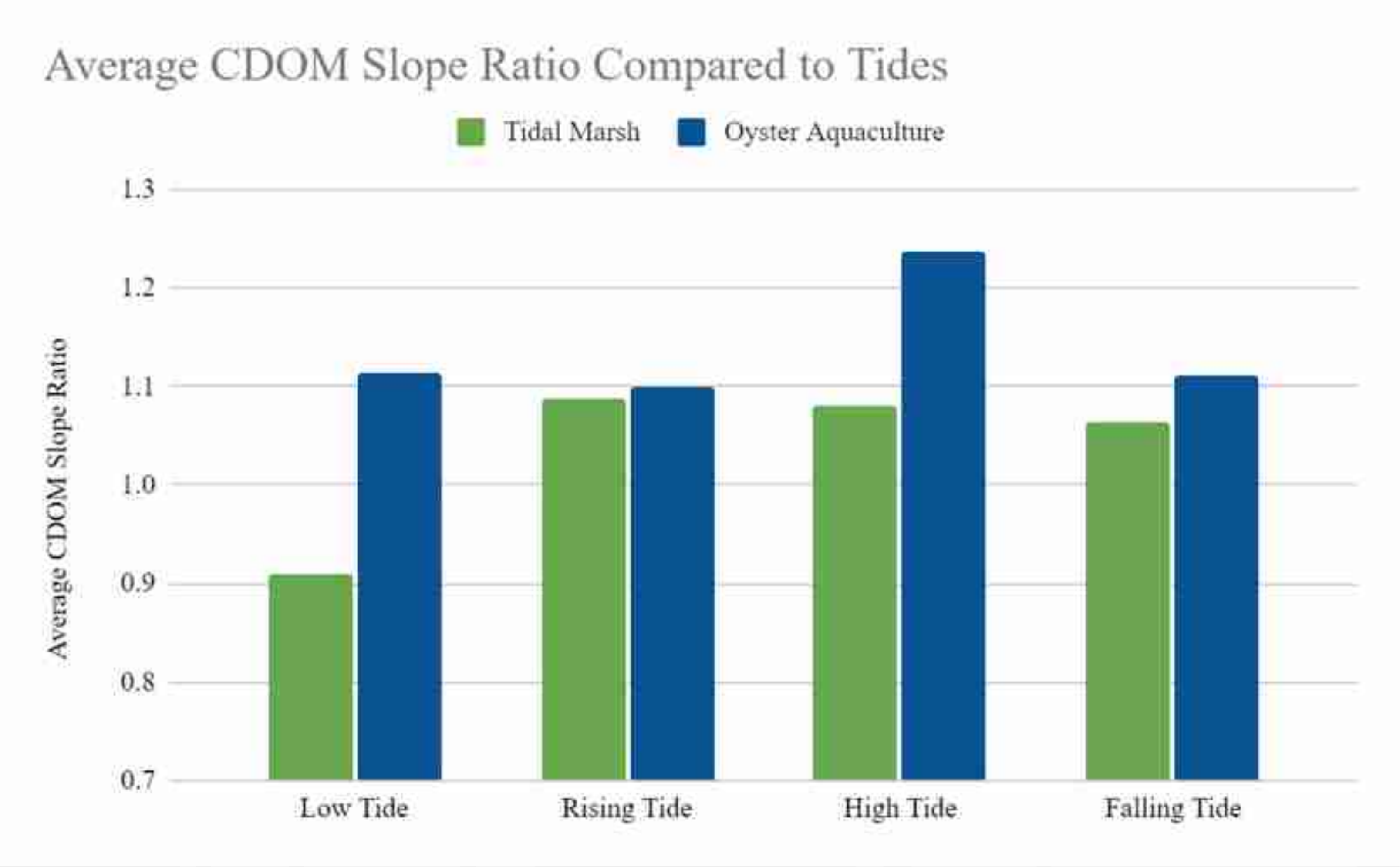
A comparison of the slopes of two portions of CDOM absorbance scan. (S275-295 and S350-400)

Greatest variability!

CDOM Slope Ratio Results



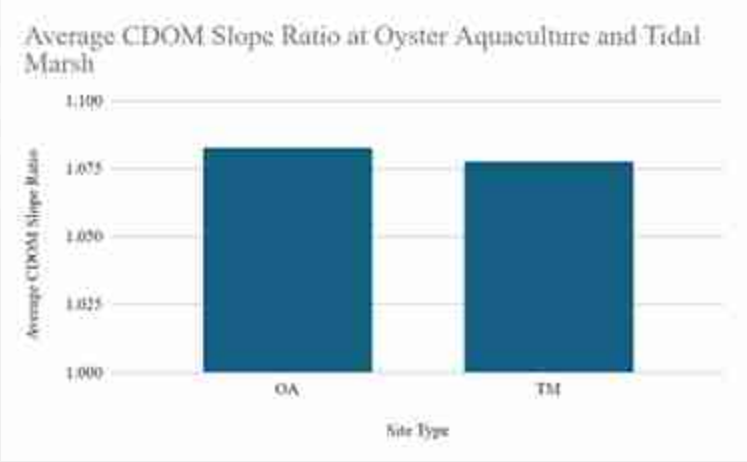
Tidal Marshes had a lower slope ratio than Oyster Aquaculture Systems
p=0.2078 (not significant)



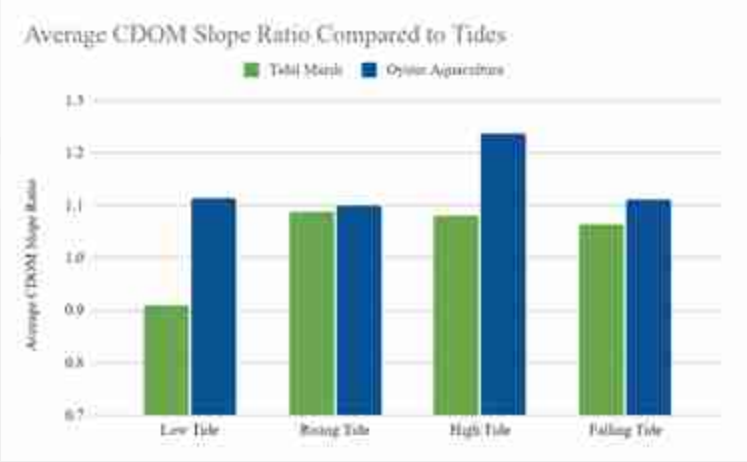
Low tides had lower slope ratios than most other tidal stages
p=0.1247 (not significant)

CDOM Slope Ratio Discussion

1. **Tidal Marshes had a lower slope ratio (SR)**
   a. Lower SR = more terrestrial sources, and higher molecular weights
      i. Harder to breakdown and use



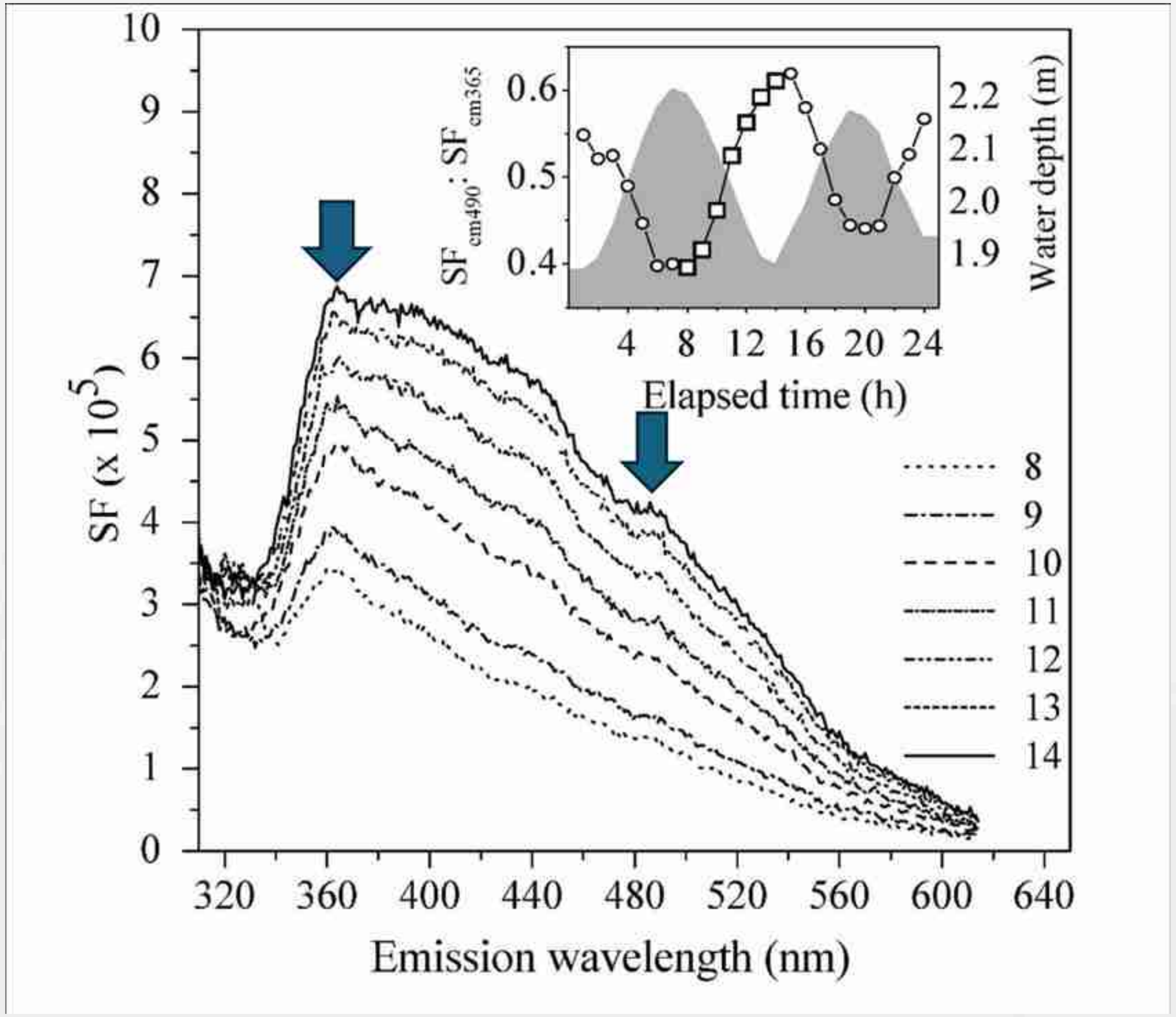
2. **Low tides had a lower slope ratio**
   a. Less marine/ocean water coming in, more riverine input



fDOM Methodology

1. Let refrigerated samples sit for one hour
2. Boot up RF-6000 "Kiki" and run DI water for standardization
3. Run samples through SF programs in RF-6000
    a. SF: Synchronous Fluorescence
4. Run data through MATLAB

fDOM Synchronous Fluorescence (SF)



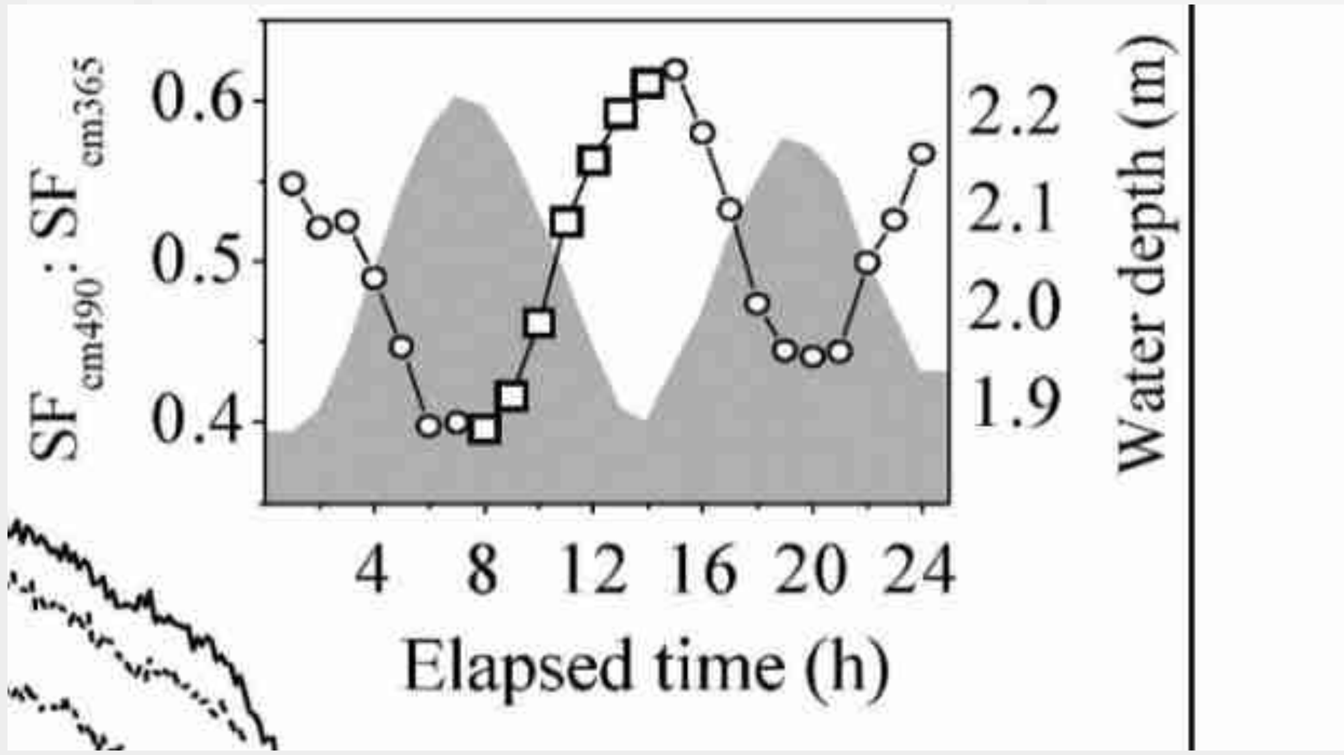
Synchronous fluorescence intensity

Wavelength of light hitting the sample

fDOM & SF Ratio

fDOM SF Ratio

- High SF Ratio- higher molecular weight, terrestria
- Low SF Ratio - lower molecular weight, marine
- Higher SF Ratio at low tide (more terrestrial!)



Tzortziou et al. 2008

Definition

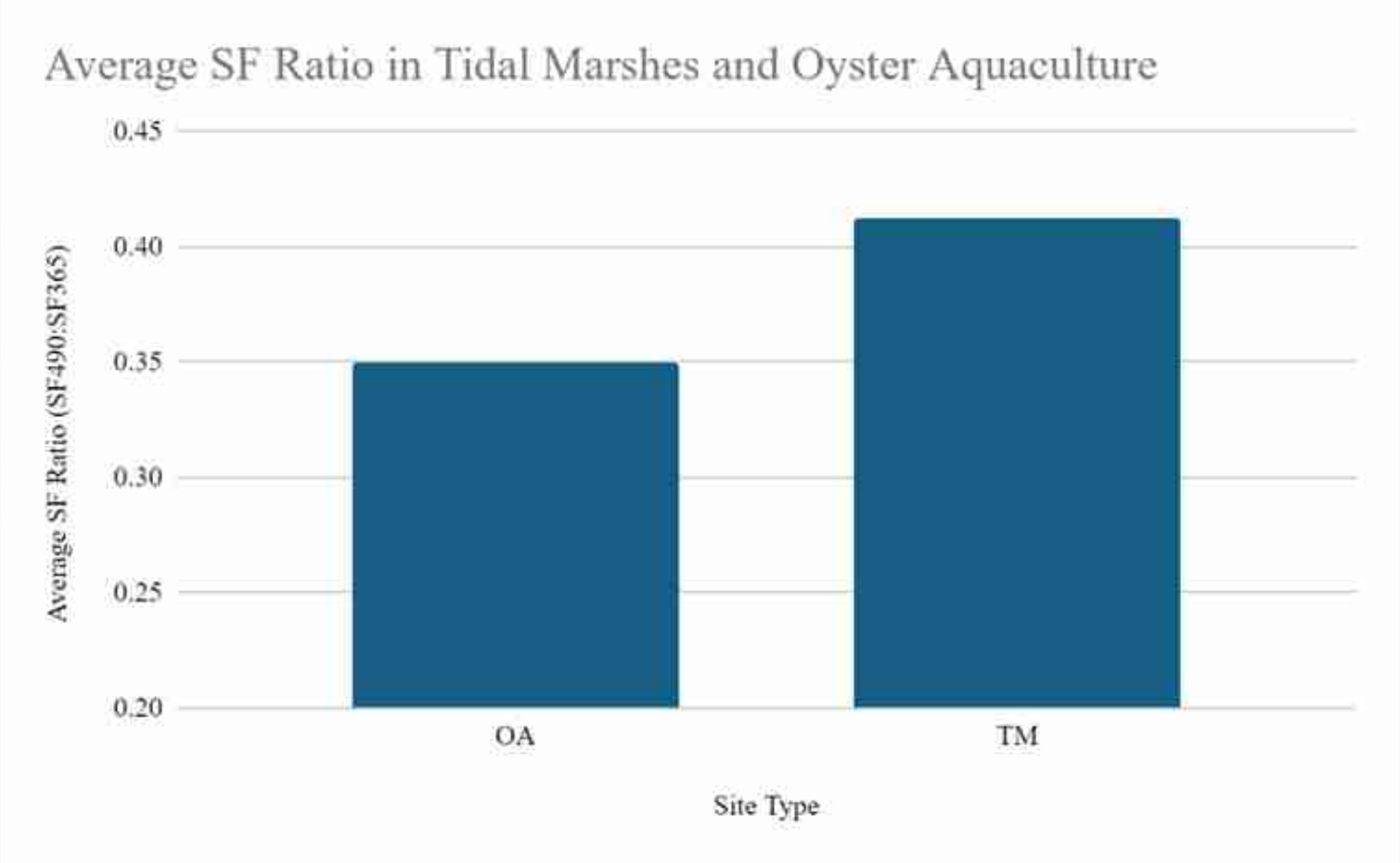
Fluorescent Dissolved Organic Matter:

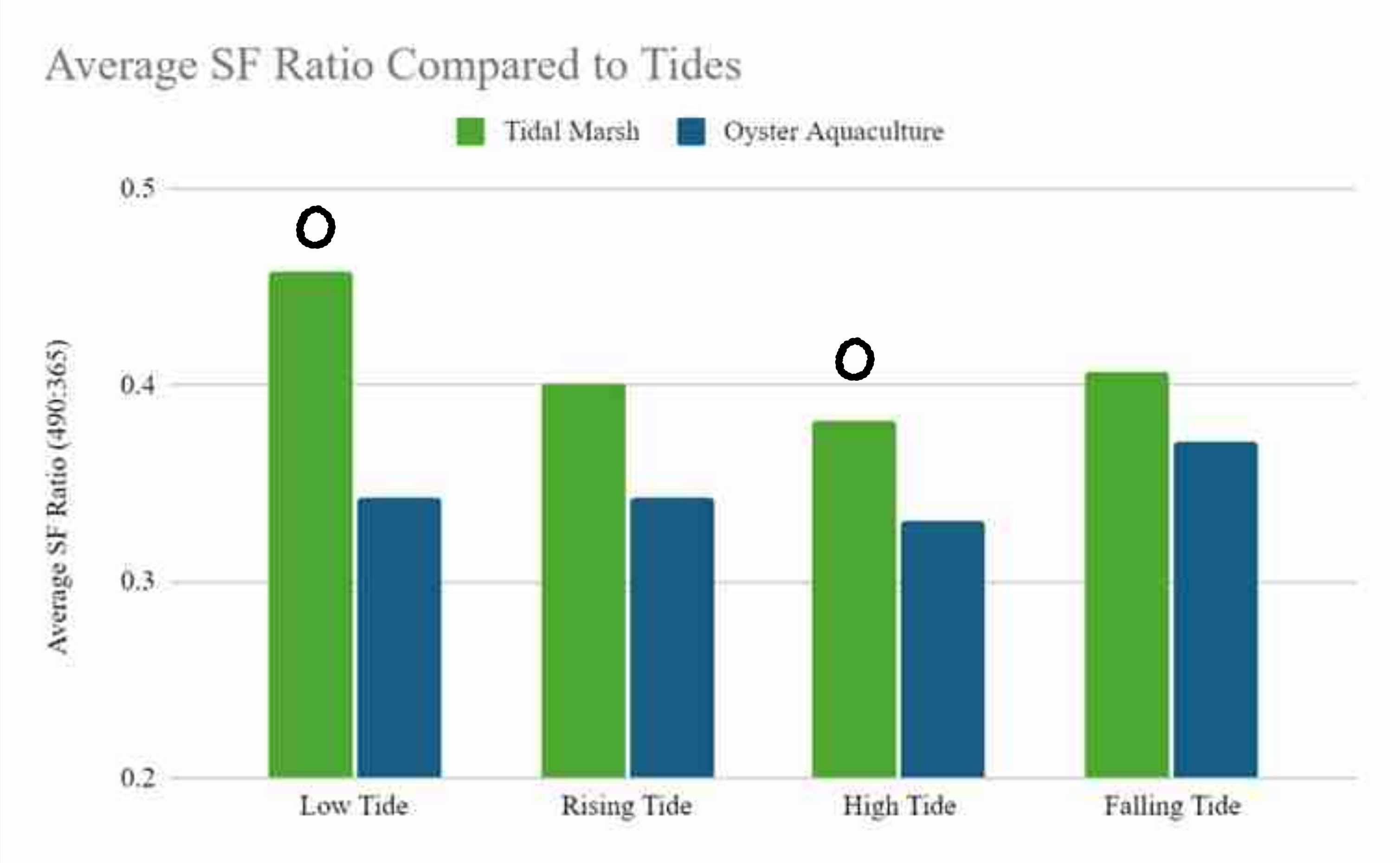
Fraction of CDOM that fluoresces.

Absorbs light over a broad range of visible and UV wavelength.

Ratio - SF490 : SF365

fDOM SF Results



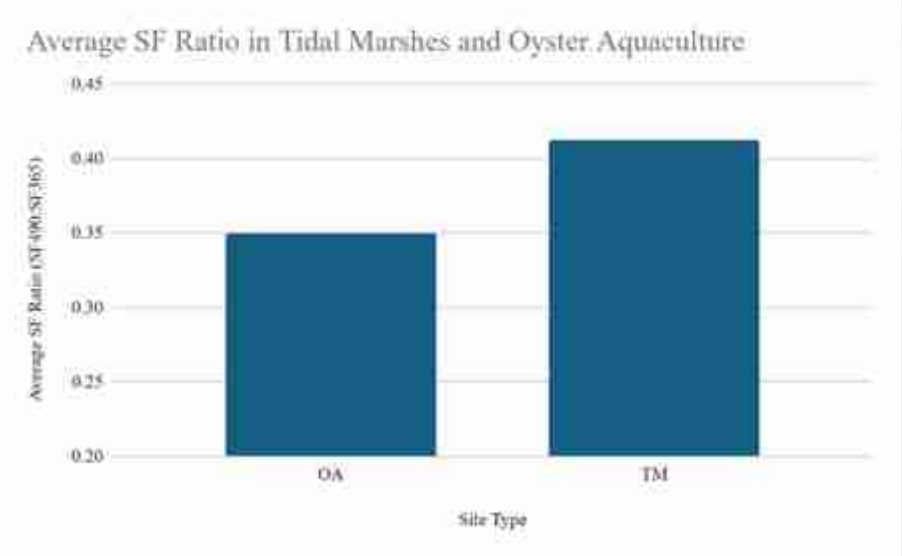


Tidal Marshes had a higher SF ratio than Oyster Aquaculture Systems
p< 0.001 (significant)

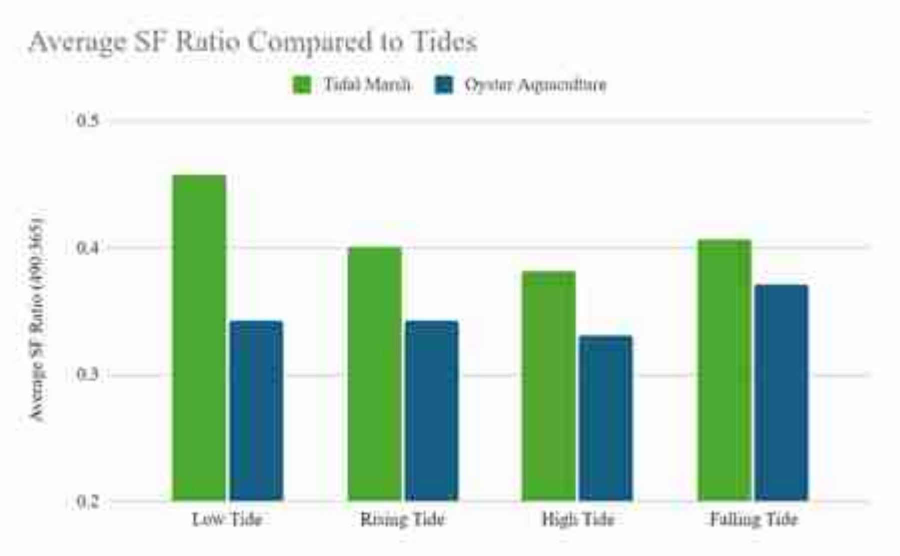
Tidal Marshes had more variation than Oyster Aquaculture
p=0.019 (significant)

fDOM SF Discussion

1. **Tidal Marshes had a higher SF ratio**
   a. Higher SF = more terrestrial sources, and higher molecular weights
      i. Harder to breakdown and use



2. **TM and OA variation difference**
   a. Tidal stage influences TM more dramatically than OA
   b. High tides = lower SF = more marine/ocean



Goals (Revisited)

01 How do CDOM SR and fDOM SF Ratio vary between Tidal Marshes and Oyster Aquaculture systems?

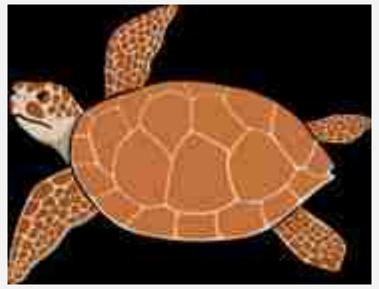
02 How does this impact future climate change studies?

01 More terrestrial organic matter was found in tidal marshes and during low tides. Tidal stages played larger role in Tidal Marshes.

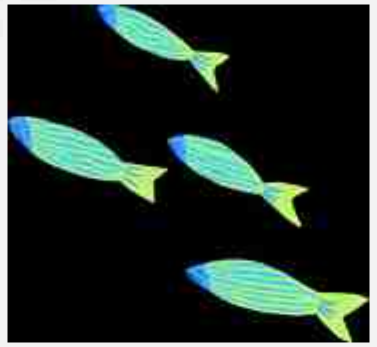
CDOM SR and fDOM SF Ratio in agreement.

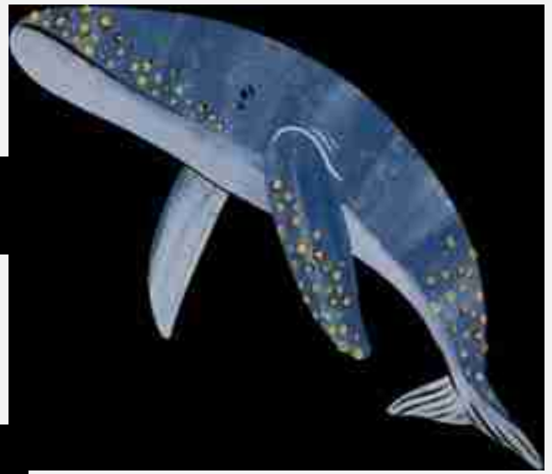
02 OA minimizes impact of tides on OM→ less variation.

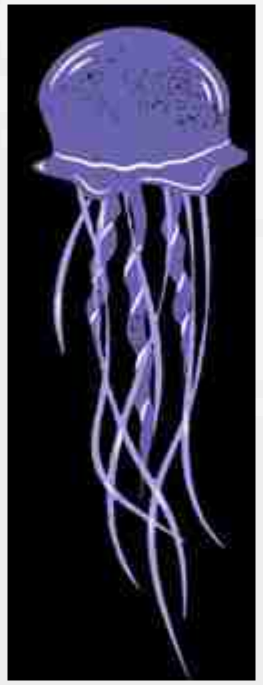
Possible oysters are transforming terrestrial OM into marine OM. Less terrestrial→easier to use→used for respiration or energy instead→less sequestration→more CO_2 in atm



Next Steps





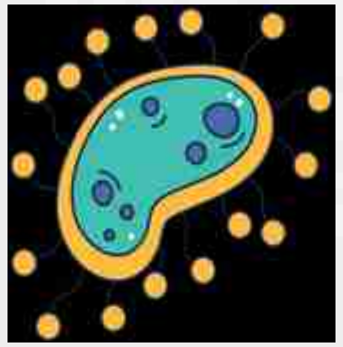


fDOM Excitation Emission Matrix

Different Seasons

Weather Patterns

Potomac River Site



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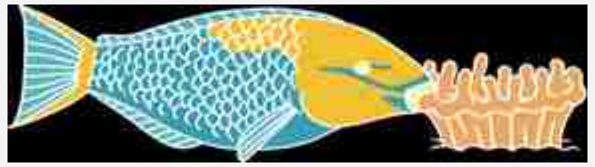





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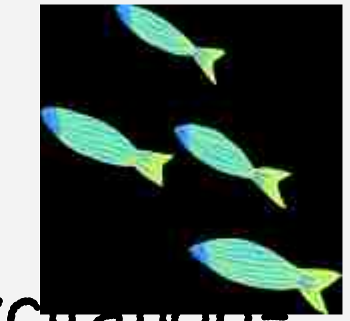

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