

# The Effects of Prescribed Burns of *Phragmites australis* on Salt Marsh Ecosystem Services

Andrew Wozniak, Mollie Yacano

Image: Wayne Lehman



DELAWARE  
CENTER FOR THE  
INLAND BAYS

preserve • protect • restore



A. Rogerson



Oh, that's  
cool! I like salt  
marshes and  
black carbon.



Me too. Let's write  
a proposal!



National Estuarine  
Research Reserve System  
Science Collaborative

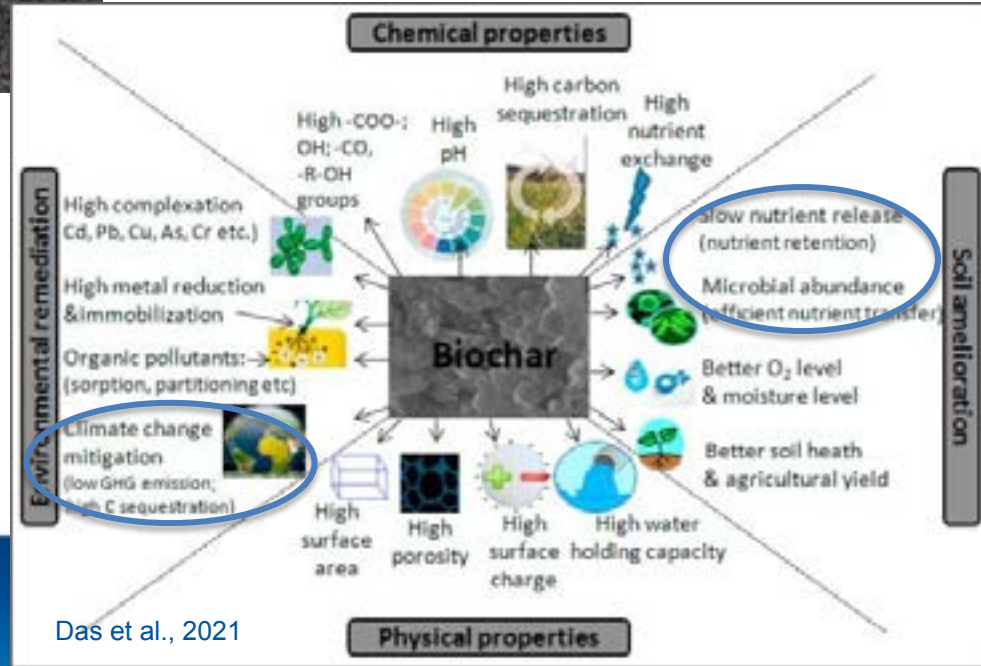


Do prescribed burns of *Phragmites* for tidal marsh restoration bring C, N, and P biogeochemical ecosystem services?

## Black Carbon/Biochar



- Biomass fires make biochar.
- Biochar has physicochemical properties that offer biogeochemical ecosystem services.
  - e.g., C, N, P, pollutant immobilization



Das et al., 2021

# “Collaborative” Research

## Question:

Where do prescribed burns and biochar fit within a climate adaptive restoration framework for Delaware (and beyond)?

<Subject of this talk>



# Study Goals

- Summarize the state of the science on prescribed burns in salt marshes
- Assess the impacts of *Phragmites* removal via herbicide-burn treatments on marsh ecosystem services
- Help managers decide if this treatment aligns with their priorities

## Impacts of Prescribed Burns on Tidal Marsh Ecosystem Services

Authors:

<sup>1</sup>Andrew S. Wozniak, <sup>2</sup>Mollie R. Yacano, <sup>3</sup>Pamela C. Edris, <sup>4</sup>Christopher L. Kelly, <sup>5</sup>Emma E. Leaseburg



# Prescribed Burns – Why?, How?, Challenges



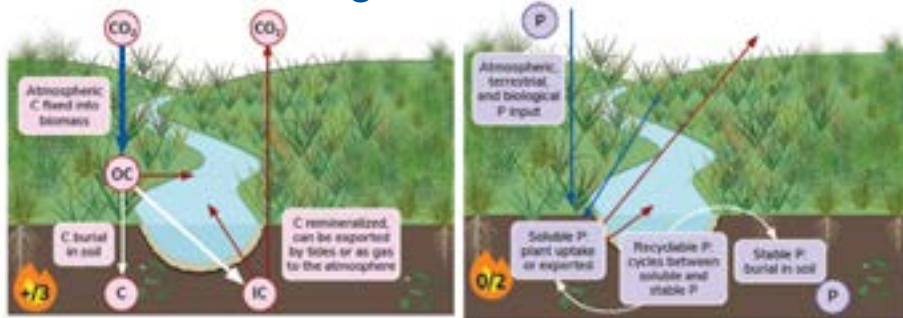
## Why? How?

- Historically – marsh access for resources
  - Now – remove potential wildfire fuel, “rejuvenate” the marsh by removing wrack, restore native vegetation
  - Pair with herbicide applications
  - Repeat as needed
- 
- Burn windows are short (< 40 days between October to April)
    - Air Quality concerns in summer, Hunting/trapping seasons
  - Personnel - requires 10-14 trained staff
  - Weather conditions (winds, drought), Tides
  - Funding is low and often unpredictable

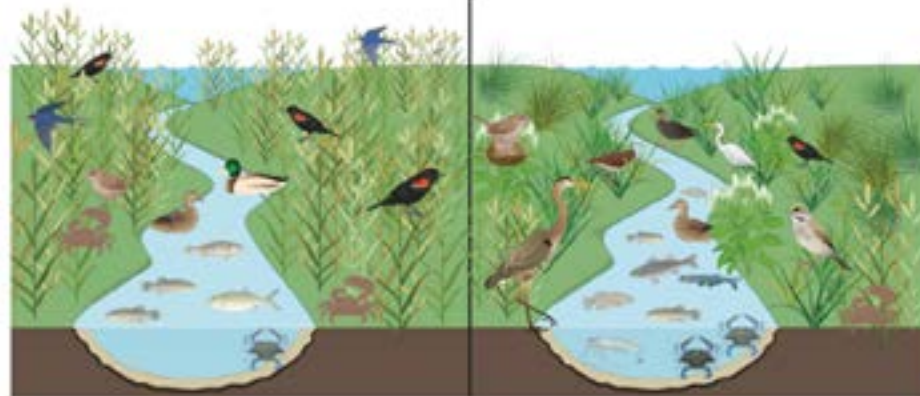


# Tidal Marsh Ecosystem Services

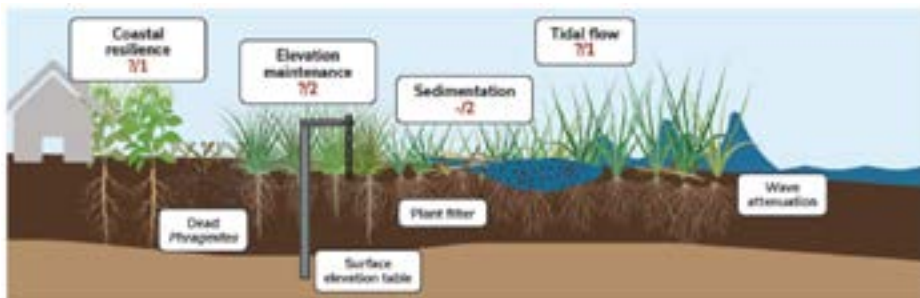
## Biogeochemical



## Biological



## Physical



## Recreational



\*Economic, cultural and other services are acknowledged but not assessed here.

# Ecosystem Service Rating Scheme

Assessment of Impact  
on an Ecosystem  
Service →

Table 1. Ecosystem Service Assessment Impact Scores

| Score | Description     | Reasoning                                                                                                                                                                  |
|-------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -     | Negative Impact | Available data demonstrate net negative impacts on the service of interest.                                                                                                |
| +     | Positive Impact | Available data demonstrate net positive impacts on the service of interest.                                                                                                |
| 0     | No Impact       | Available data demonstrate no net impacts on the service of interest.                                                                                                      |
| ?     | Unknown Impact  | There are no data currently available that sufficiently assess burning impact on the service of interest OR available data demonstrate both positive and negative impacts. |

Confidence in that  
Assessment →

Table 2. Ecosystem Service Assessment Confidence Levels

| Score | Description         | Reasoning                                                                                                                                               |
|-------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Low Confidence      | Little to no data is available on the service of interest. Little to no regional or prescribed burn-specific data available.                            |
| 2     | Moderate Confidence | Sufficient data is available on the service of interest. Regional and prescribed burn specific data on the service of interest may be available as well |
| 3     | High Confidence     | Sufficient data are available. Regional and prescribed burn related data on the service of interest are available as well.                              |



# Challenges

- Very few studies directly assess how burn restorations impact the full suite of ecosystem services
- Assessments of burn restoration success are also scant.
  - Success defined as *P. australis* replaced by native over long timescale

# Assumptions

- Burn to native restorations are 100% successful
- Where data are missing, impacts on ecosystem service assessed as replacing *Phragmites* with native *Spartina*
- All burns assumed to be paired with herbicide application



# Biogeochemical Services

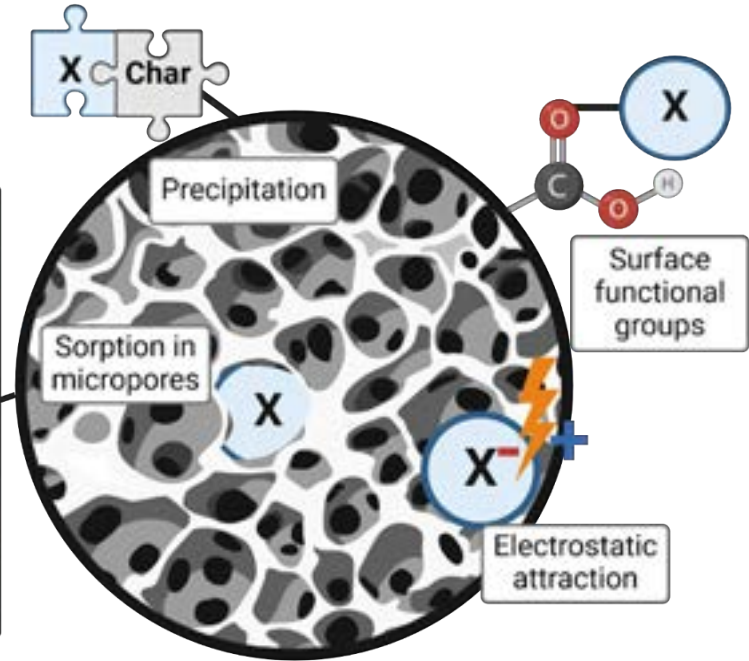
| Service                     | Impact/<br>Confidence |
|-----------------------------|-----------------------|
| Carbon Storage              | +/3                   |
| Nitrogen Removal            | -/2                   |
| Phosphorus<br>Storage       | 0/2                   |
| Pollutant Removal           | +/1                   |
| Greenhouse Gas<br>Reduction | -/1                   |

- Burns increase biomass production and carbon storage
- No strong evidence for other positive biogeochemical impact from herbicide-burn restorations



# Biogeochemical Services

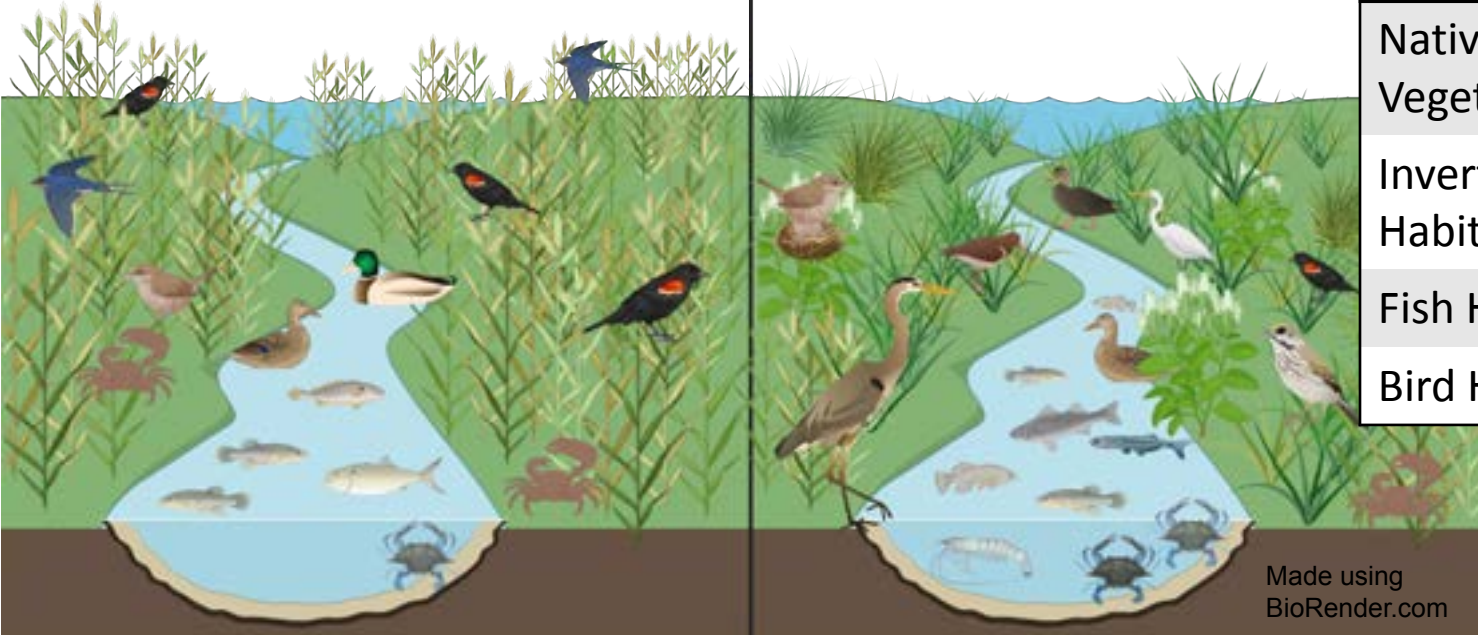
| Service                  | Impact/<br>Confidence |
|--------------------------|-----------------------|
| Carbon Storage           | +/3                   |
| Nitrogen Removal         | -/2                   |
| Phosphorus Storage       | 0/2                   |
| Pollutant Removal        | +/1                   |
| Greenhouse Gas Reduction | -/1                   |



Made using BioRender.com



# Biological Services



| Service              | Impact/<br>Confidence |
|----------------------|-----------------------|
| Native Vegetation    | +/-2                  |
| Invertebrate Habitat | +/-2                  |
| Fish Habitat         | +/-2                  |
| Bird Habitat         | +/-2                  |

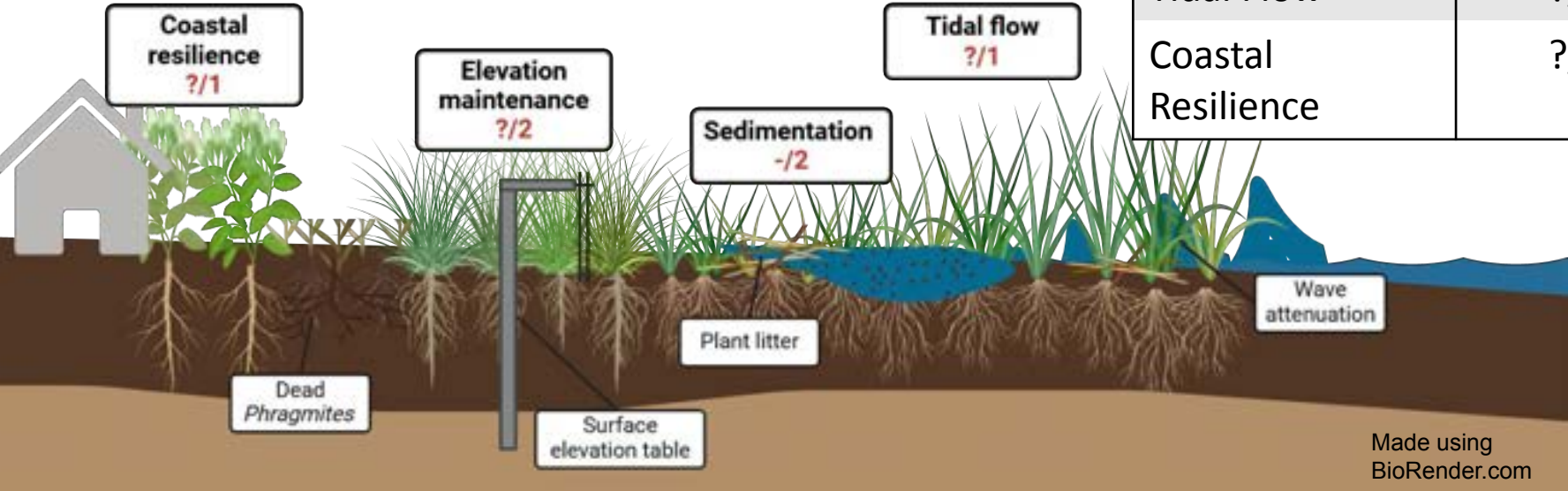
- While data are scarce, there is evidence burn restorations can remove *Phragmites*
- Effects on animals can be species specific; generalists do well with *Phragmites*, specialists do better with *Spartina*



# Physical Services

- Little to no burn-specific studies
- Literature reports are variable
- *Phragmites* improves sedimentation
- Assessments of herbicide impacts are needed

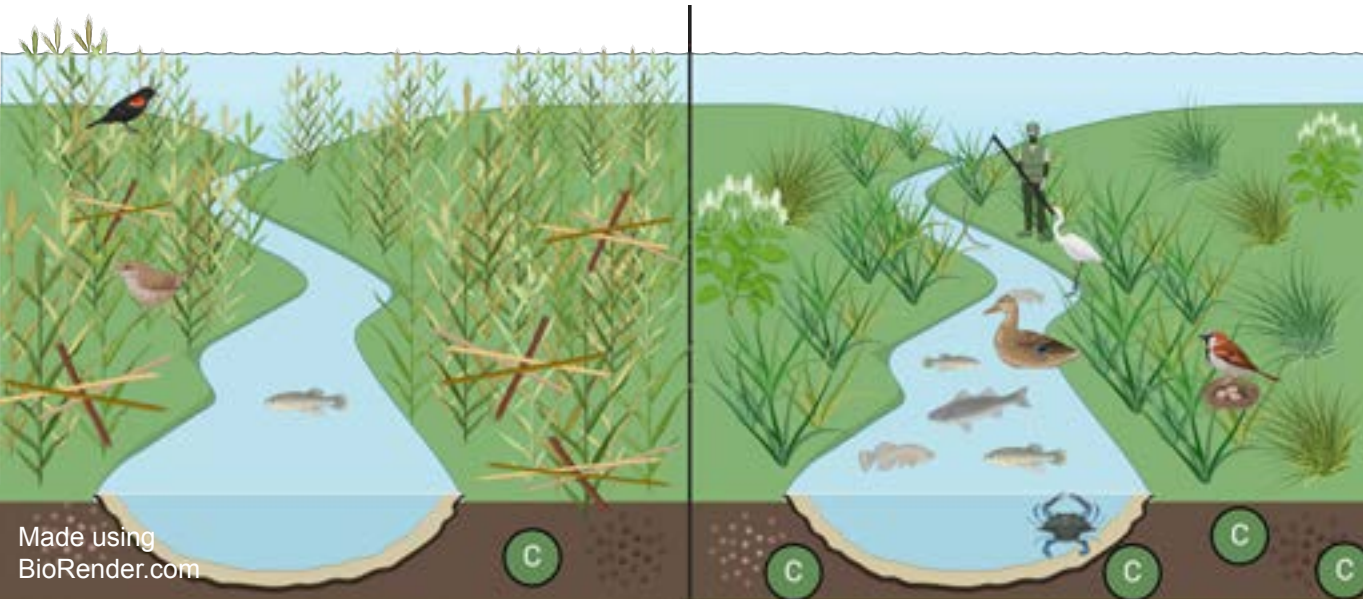
| Service                  | Impact/<br>Confidence |
|--------------------------|-----------------------|
| Sedimentation            | -/2                   |
| Elevation<br>Maintenance | ?/2                   |
| Tidal Flow               | ?/1                   |
| Coastal<br>Resilience    | ?/1                   |



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# Recreational & Cultural Services

- No burn-specific studies
- Impacts are largely tied to biological and physical services



| Service              | Impact/<br>Confidence |
|----------------------|-----------------------|
| Ecotourism           | +/1                   |
| Outreach & Education | ?/1                   |
| Hunting & Fishing    | +/1                   |
| Connection to Land   | ?/1                   |
| Spiritual            | ?/1                   |



# Recommendations

- Managers are urged to use our review/assessments in the context of their own management goals and ecosystem service priorities
- Long-term monitoring efforts (5-10 years) are needed
- Herbicide-burn specific studies are needed; assessment of herbicide effects and effectiveness would add confidence to assessments
- Large-scale effort to assemble and critically evaluate existing monitoring data would be valuable for informing success/failure of restoration goals
- Studies of public, stakeholders' perceptions of marsh ecosystem goals and willingness to pay for restoration interventions





# Conclusions

- Existing literature reports assessing prescribed burn restoration impacts on ecosystem services are few
- Ecosystem service impacts are variable within and among ecosystem service categories
- Prescribed burns continue to be conducted though they are logistically difficult
- An end of project Workshop in September 2024 identified several barriers, solutions, and opportunities to improve *Phragmites* management
- See next week's NSC Webinar, 10/30 @ 3PM for more.



3:00 - 4:00 pm ET, Thursday, October 30, 2025

[Register via Zoom](#)



## Biochar in Marsh Restoration Advisory Committee

|                    |                    |
|--------------------|--------------------|
| Alison Rogerson    | Anthony Gonzon     |
| Hannah Small       | Bart Wilson        |
| Taylor Beck        | Jamie Joachimowski |
| Christina Whiteman | Craig Rhoades      |
| Kaity Ripple       | Josh Moody         |
| Kyle Hoyd          | Erin Wilson        |
| Marianne Walch     | Sam Topper         |

# Acknowledgments



Dr. Kari St. Laurent



## U. Delaware

Kyle Krezdorn  
Jacob Ukropec  
Dr. Alina Ebling  
Jackalyn Wyrobek  
Tia Ouyang  
Felix Agblemany



## DNREC/DNERR

Lynne Pusey  
Jenn Holmes

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# Thank you!



Project webpage at NERRS

Acknowledgements:

Funding: NOAA NERRS Science Collaborative (#NA19NOS4190058)

Proposal: Kari St. Laurent

Field & lab assistance: A. Ebling, K. Krezdorn, J. Ukropec, T. Beck





# National Estuarine Research Reserve System Science Collaborative



WEST COAST

Padilla Bay, Washington

South Slough, Oregon

San Francisco Bay, California

Elkhorn Slough, California

Tijuana River, California

Kachemak Bay, Alaska

He'eia, Hawai'i

Jobos Bay, Puerto Rico

CARIBBEAN

Mission-Aransas, Texas

GULF OF MEXICO

GREAT LAKES

Lake Superior, Wisconsin

Old Woman  
Creek, Ohio

Weeks Bay,  
Alabama

Grand Bay, Mississippi

NORTHEAST

Wells, Maine

Great Bay, New Hampshire

Waquoit Bay, Massachusetts

Narragansett Bay, Rhode Island

Hudson River, New York

MID ATLANTIC

Jacques Cousteau, New Jersey

Delaware

Chesapeake Bay, Maryland

Chesapeake Bay, Virginia

SOUTHEAST

North Carolina

North Inlet-Winyah Bay, South Carolina

ACE Basin, South Carolina

Sapelo Island, Georgia

Guana Tolomato, Florida

Apalachicola, Florida

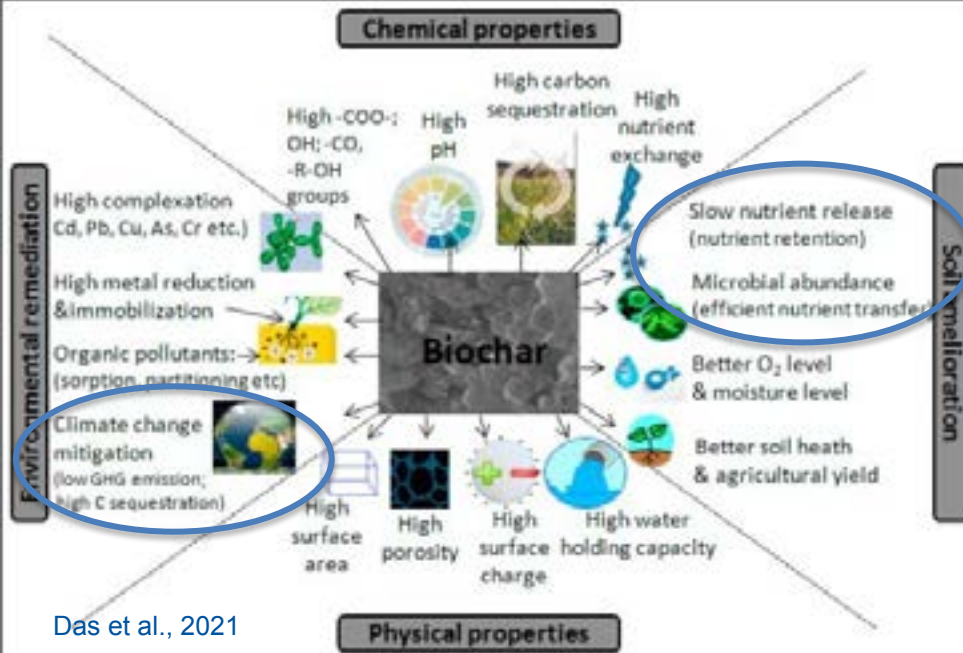
Rookery Bay, Florida



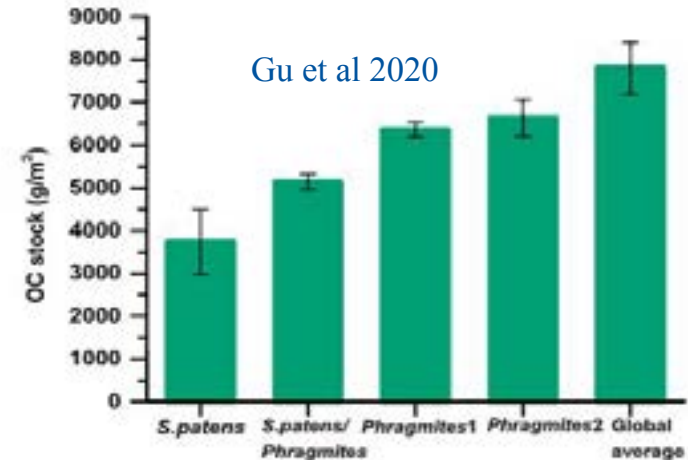


## Technical Research Question:

Do prescribed burns of *Phragmites* for tidal marsh restoration bring C, N, and P biogeochemical ecosystem services?



Das et al., 2021



# Prescribed Burns – Challenges/Considerations



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