

# **Seaside Hard Clam Culture & Submerged Aquatic Vegetation: Research to Inform Policy**

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# Introduction

- Historically, the Virginia coastal bays along the seaside of the Eastern Shore supported extensive beds of eelgrass, *Zostera marina*.
- Served as nursery grounds for juvenile fishes, crabs, and bay scallops.
- Declined dramatically in the late 1920s due to disease due to disease and few other factors and went locally extinct in the early 1930s.

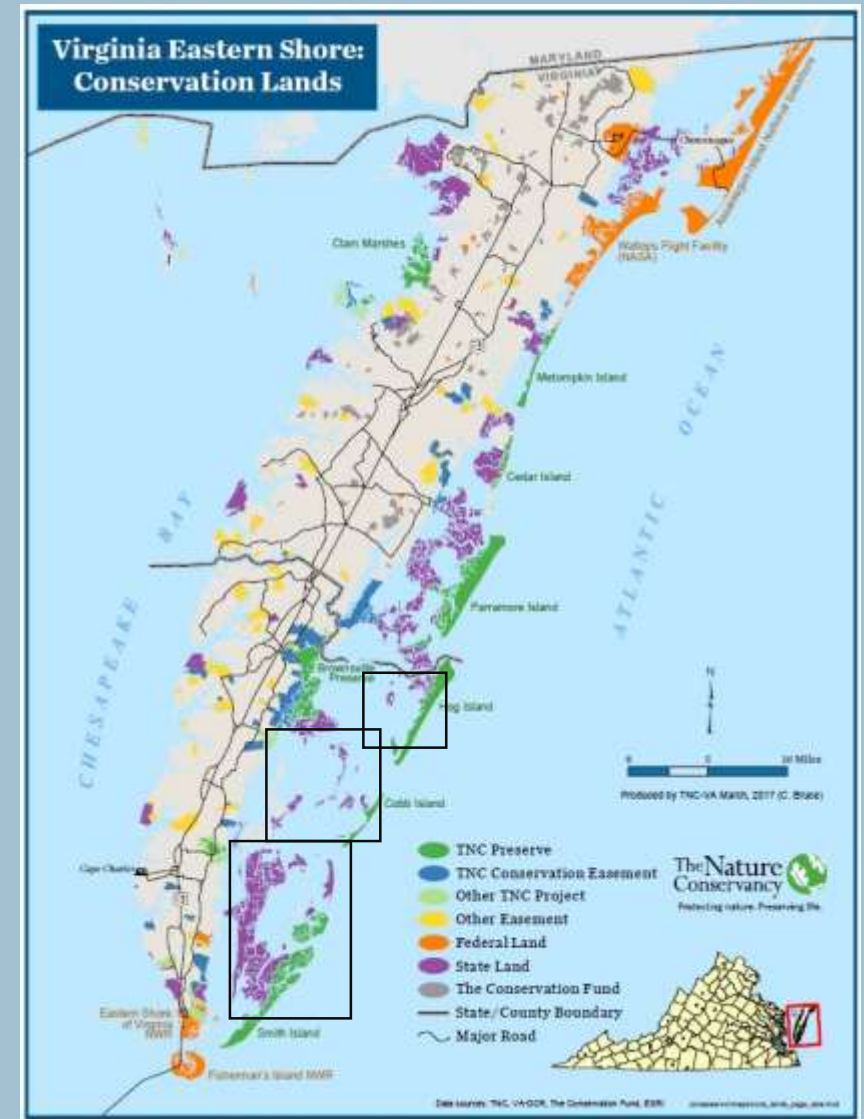


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# Eelgrass Restoration

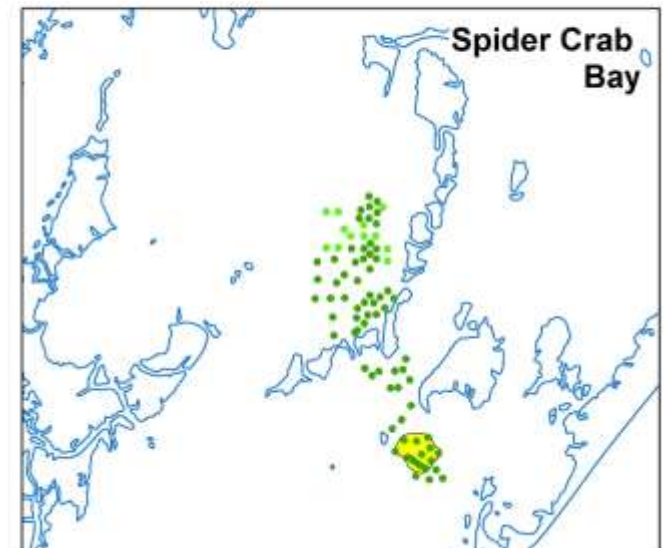
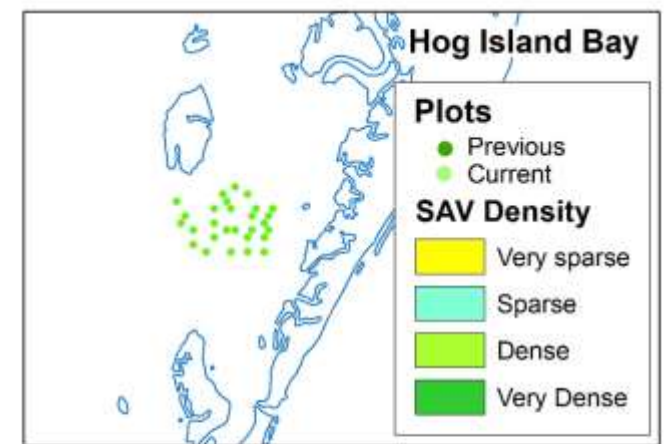
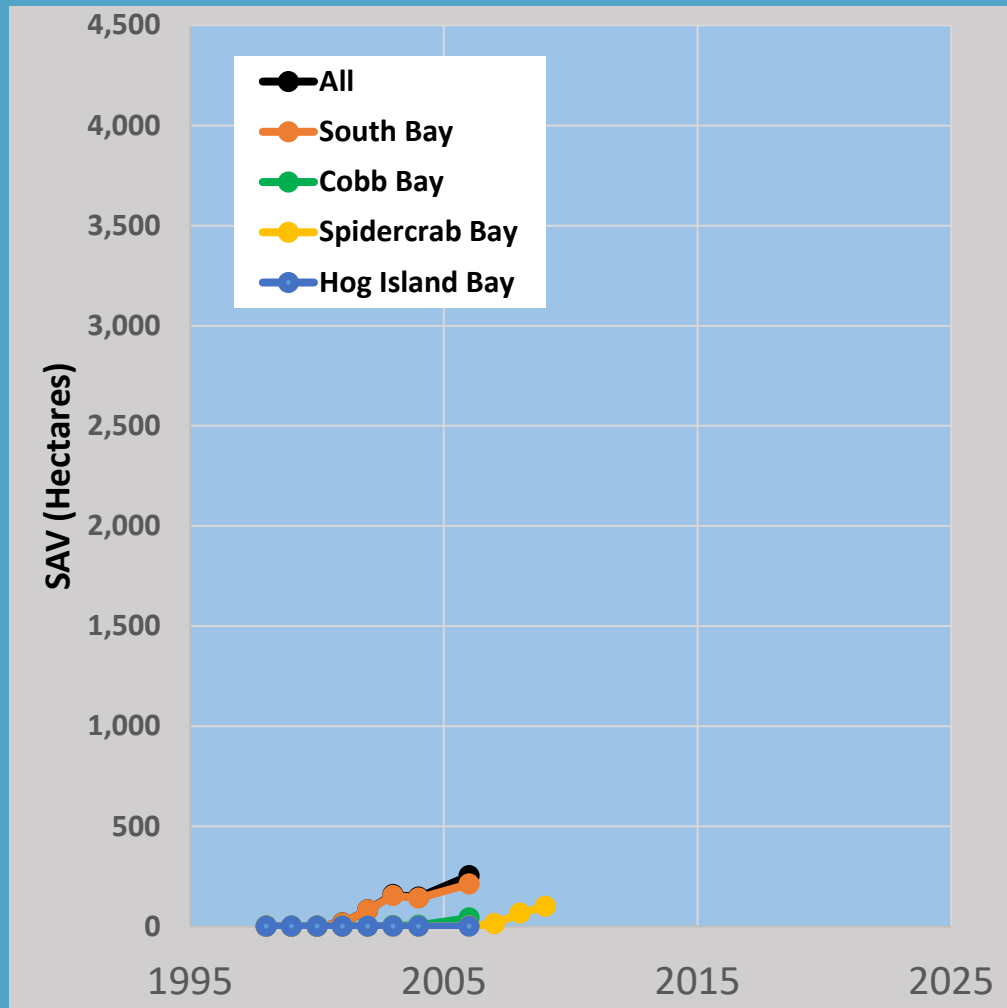
- Initiated restoration efforts in near Wreck Island in 1999.
- Collected *Z. marina* from beds in Chesapeake Bay with the help of TNC volunteers
- Broadcast into shallow-water a site in South Bay approved by VMRC.
- Later added sites in Hog Island Bay and Spider Crab Bay.



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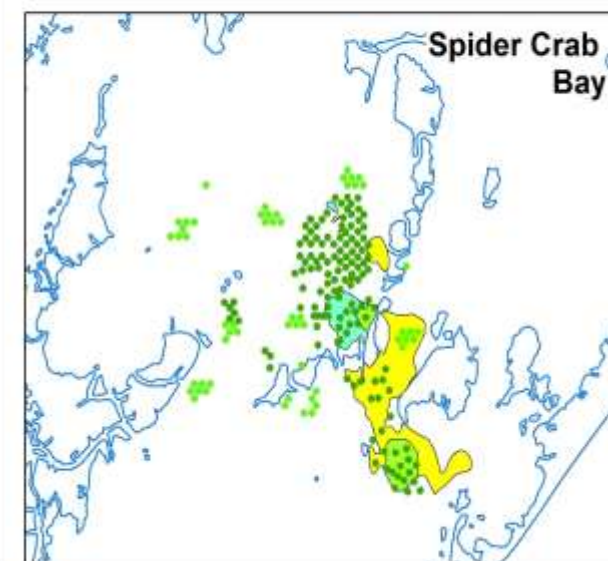
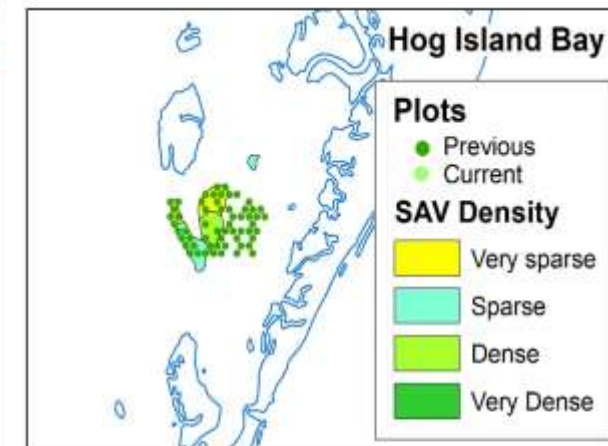
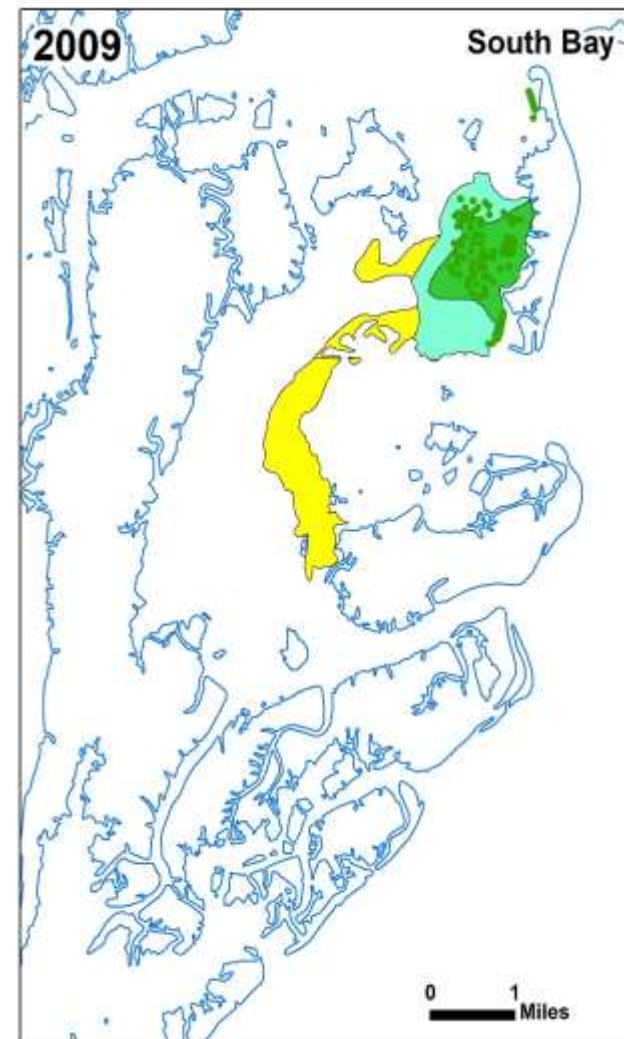
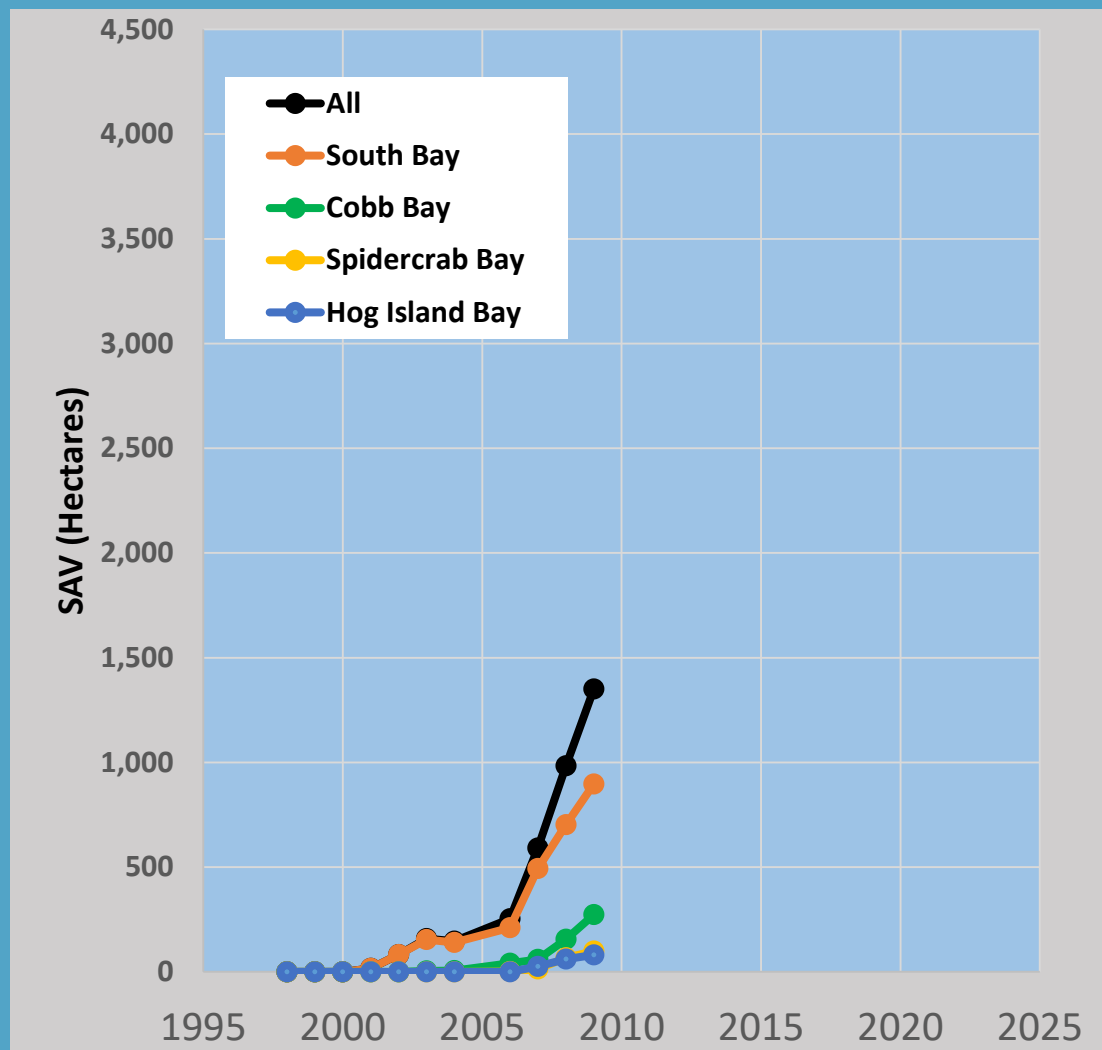






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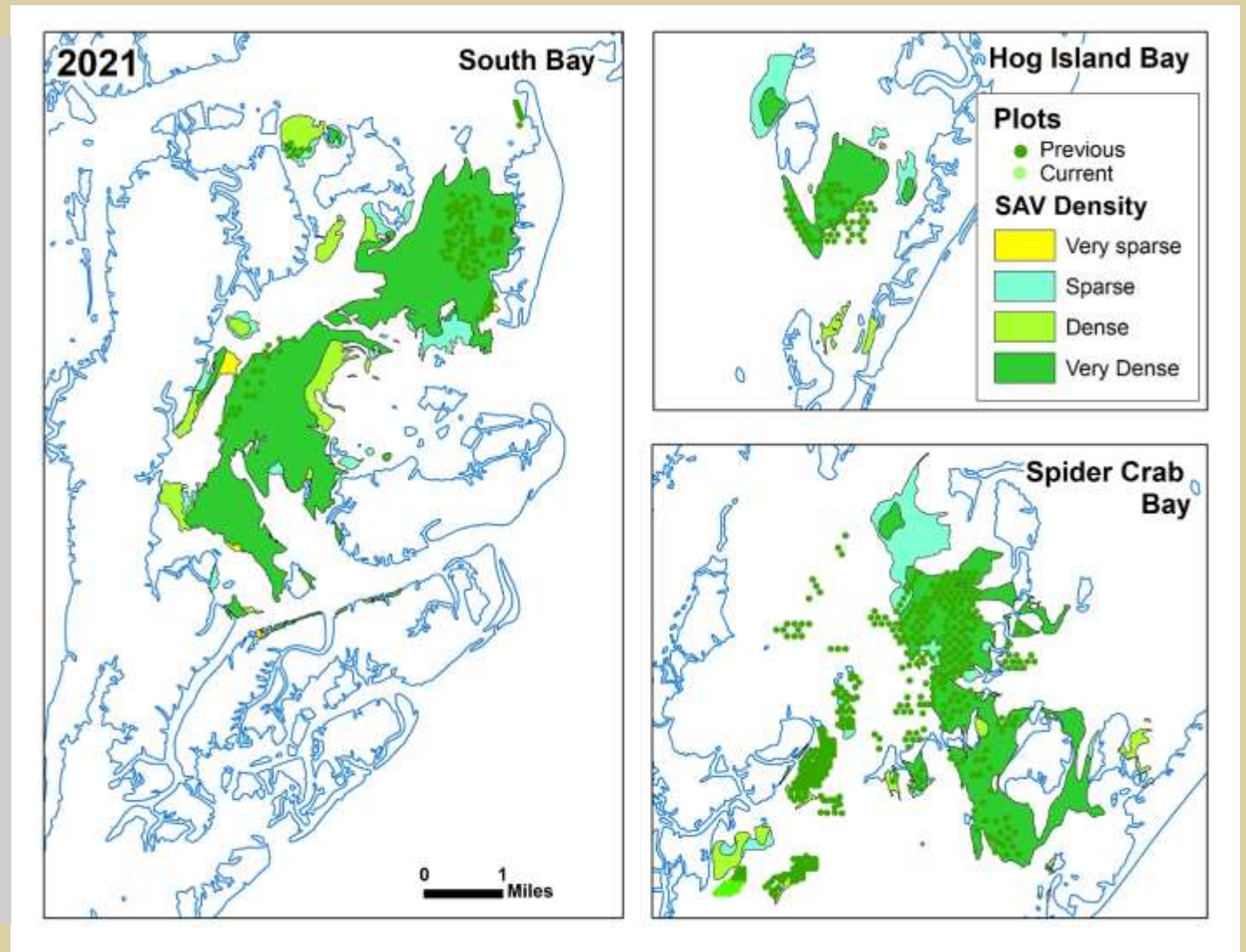
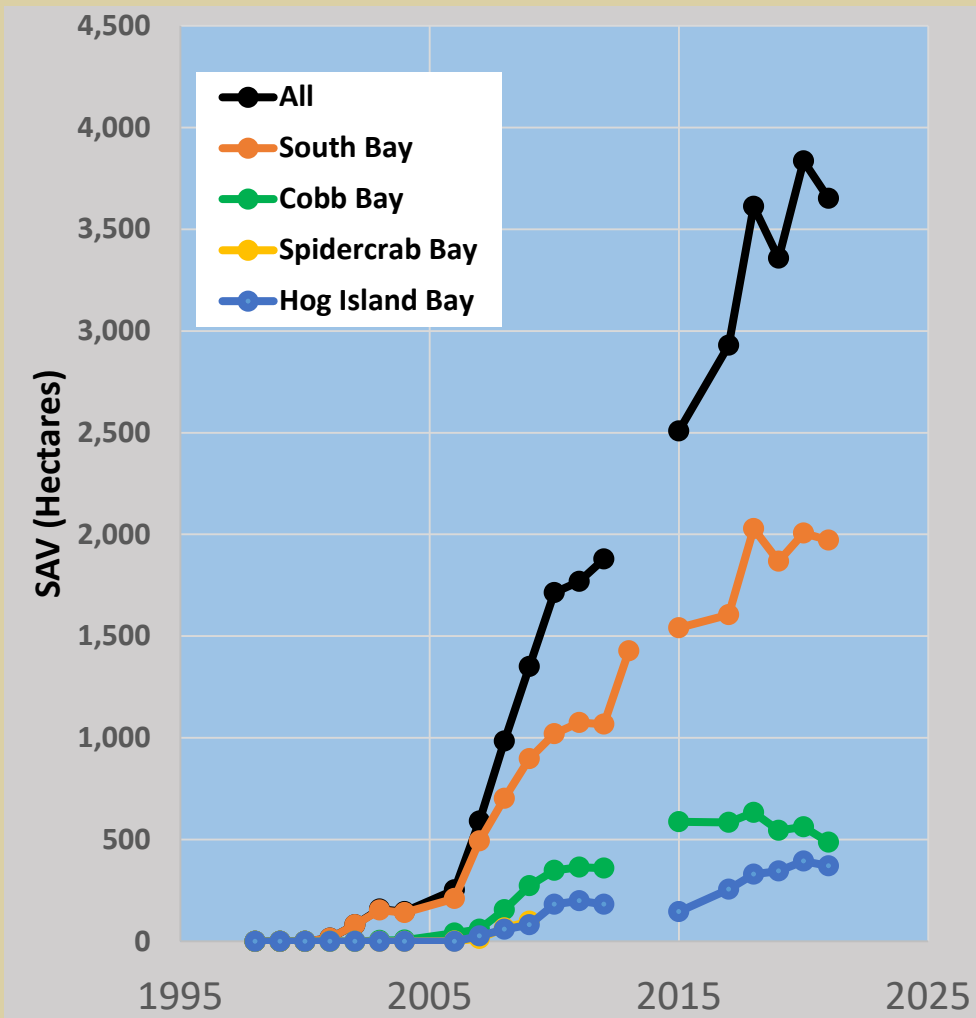




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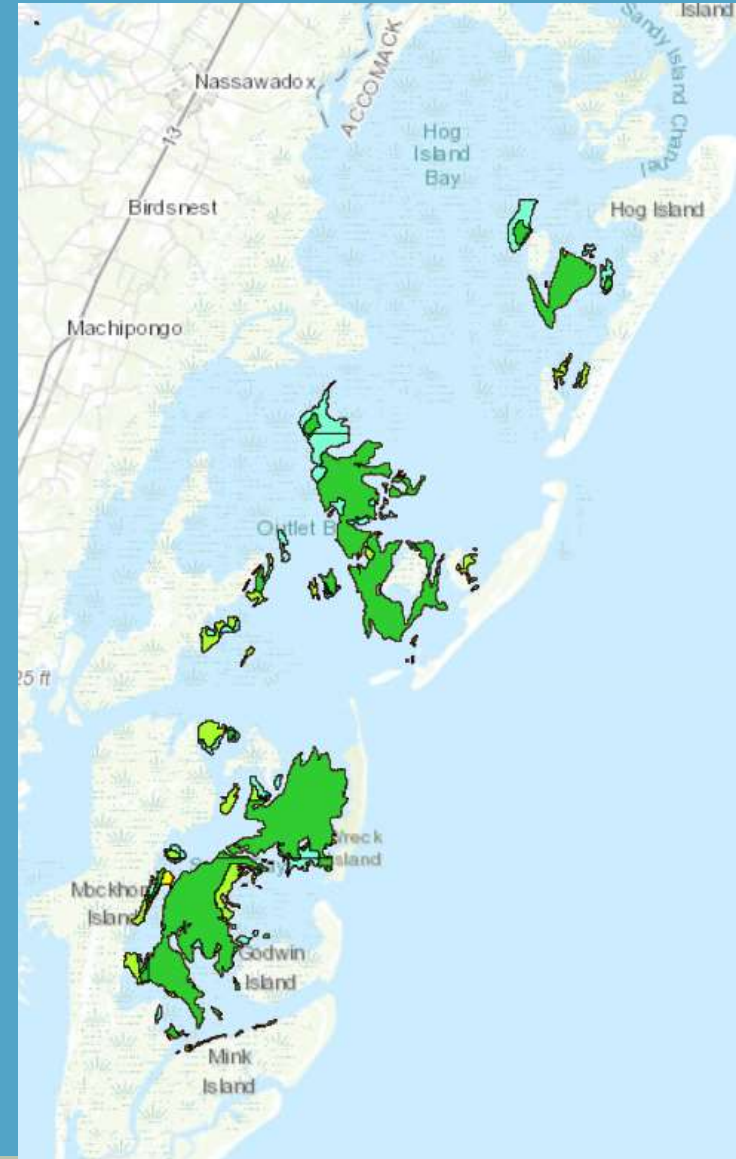
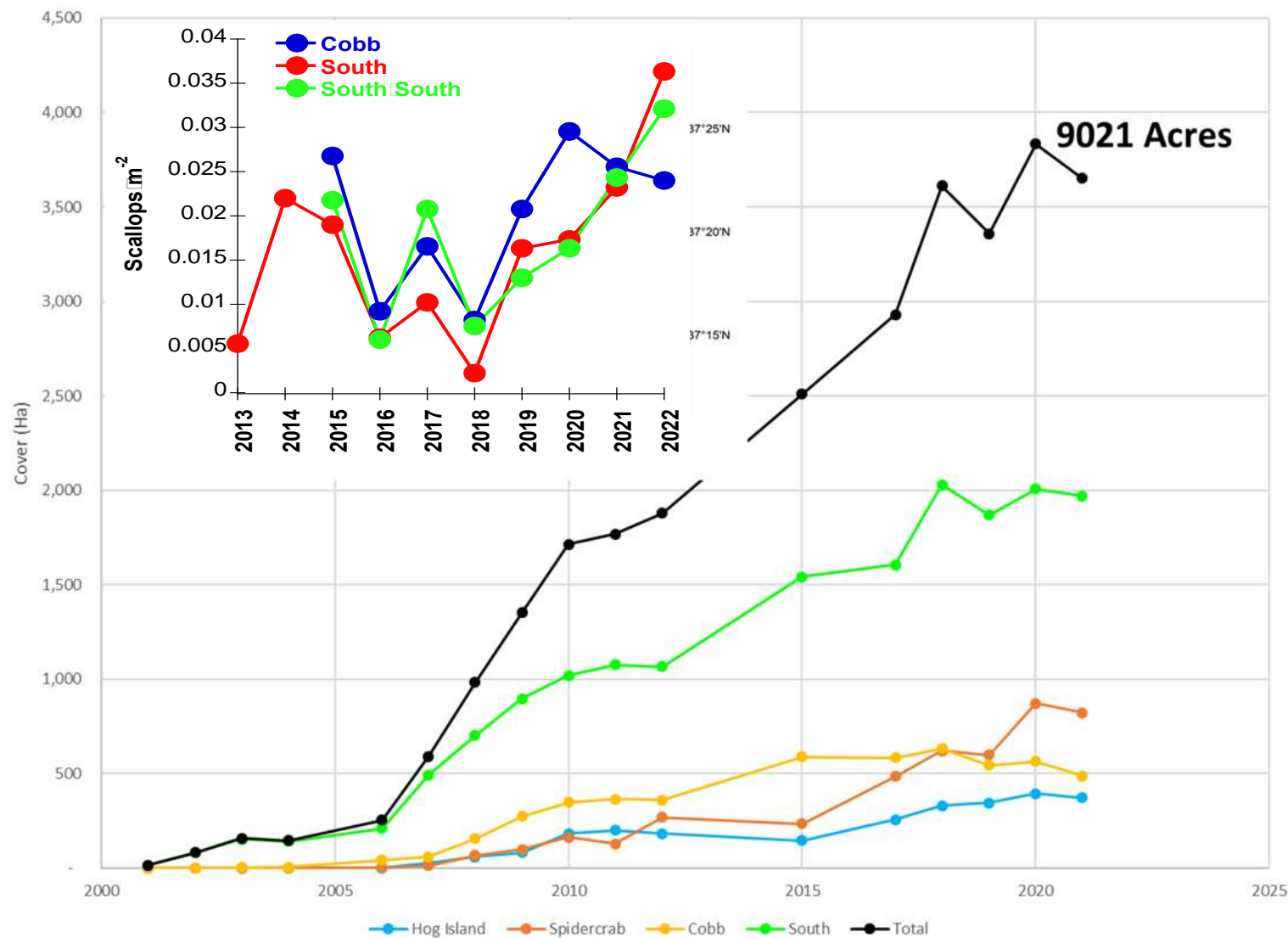






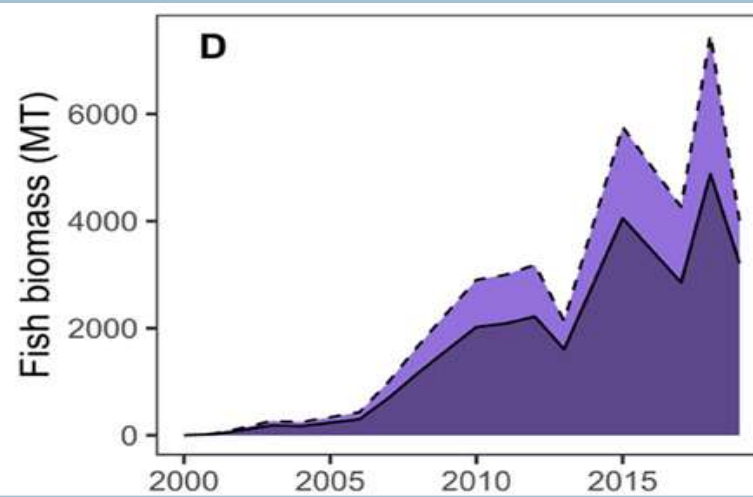
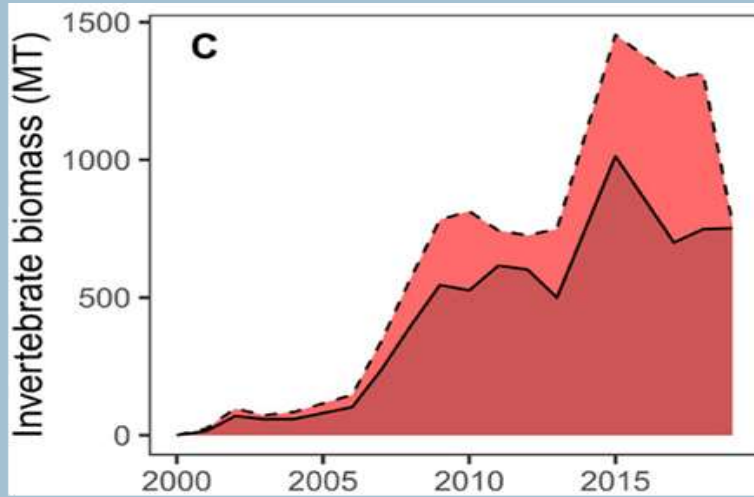
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Huge increases in the abundance of invertebrates and fish living in the bays as well as waterfowl such as Brant.

*Orth et al. 2020*



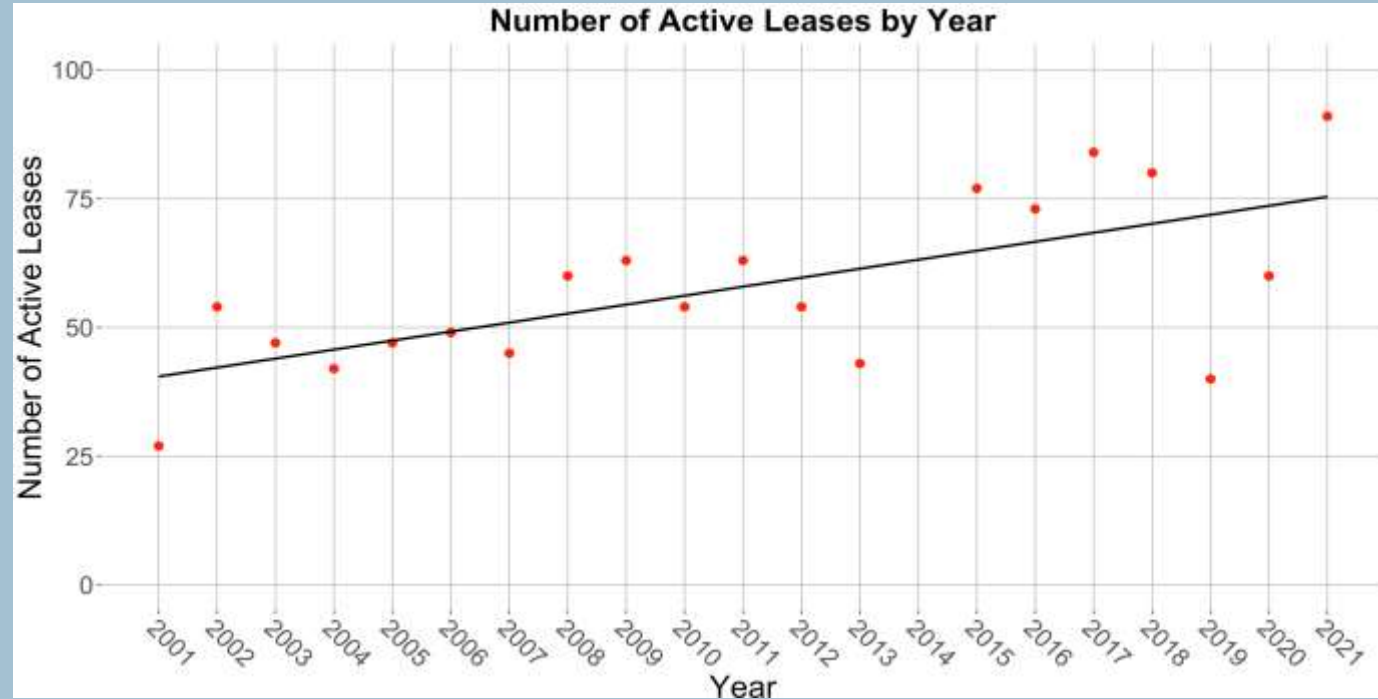
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# Growth in Clam Aquaculture

- Industry has expressed concern that if grass spreads onto their leases, it will restrict their use.
- Current guidelines allow them keep existing nest in place but not to operate in new areas with grass.
- Previous habitat suitability models Luckenbach & Ross 2011 and Oreska et al., 2021) did not predict large overlap with existing clam leases.



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# Goals



**Spatial Data**



**Field Data**



**Objective:** Monitor and study the interaction between seagrass and clam aquaculture in the Virginia Coastal Bays

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# Spatial Methods



**Spatial Data**



**Field Data**



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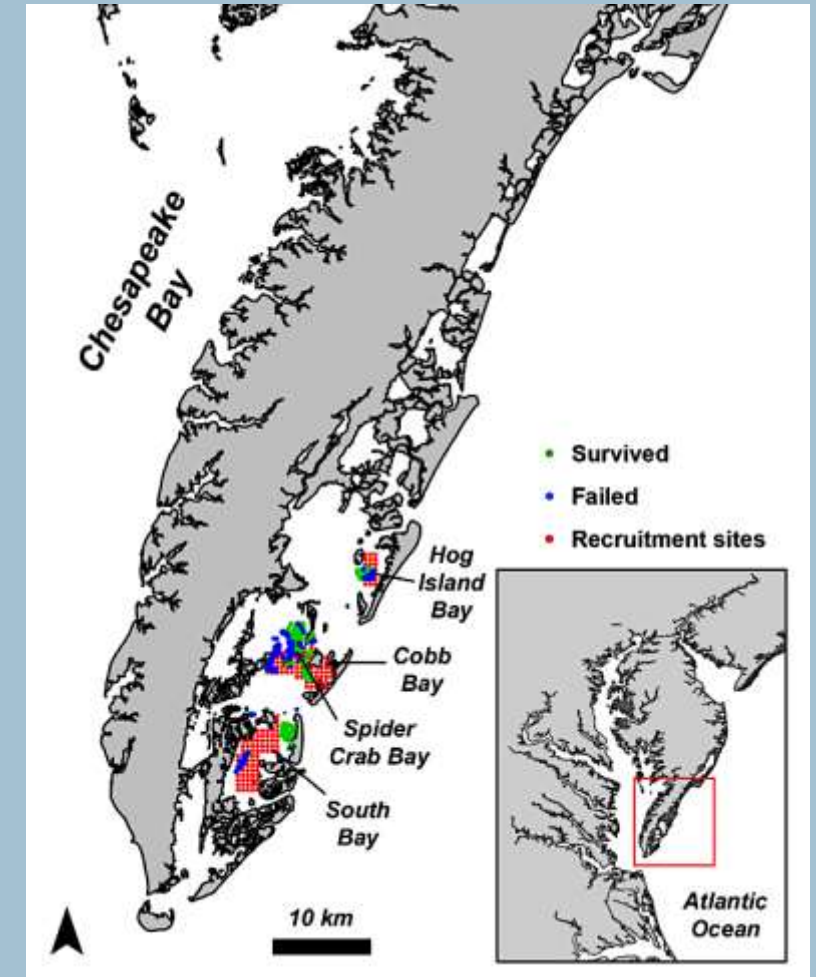
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# Questions

- Where are seagrass and clam aquaculture operations distributed now and how have these distributions changed over time?
- What environmental characteristics make an area suitable for seagrass vs clam aquaculture?
- Where are these two bottom uses going to spread in the future?



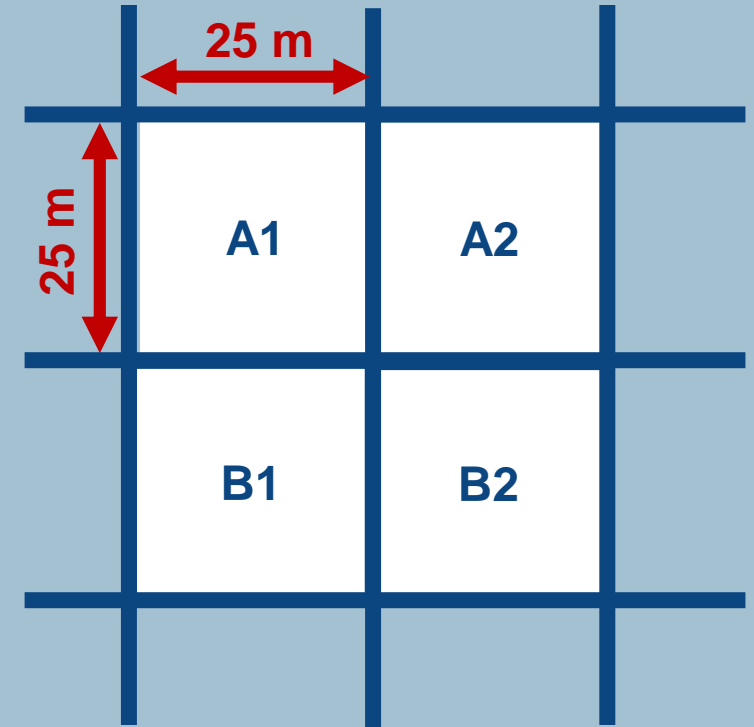
Oreska et al. 2020

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# Data

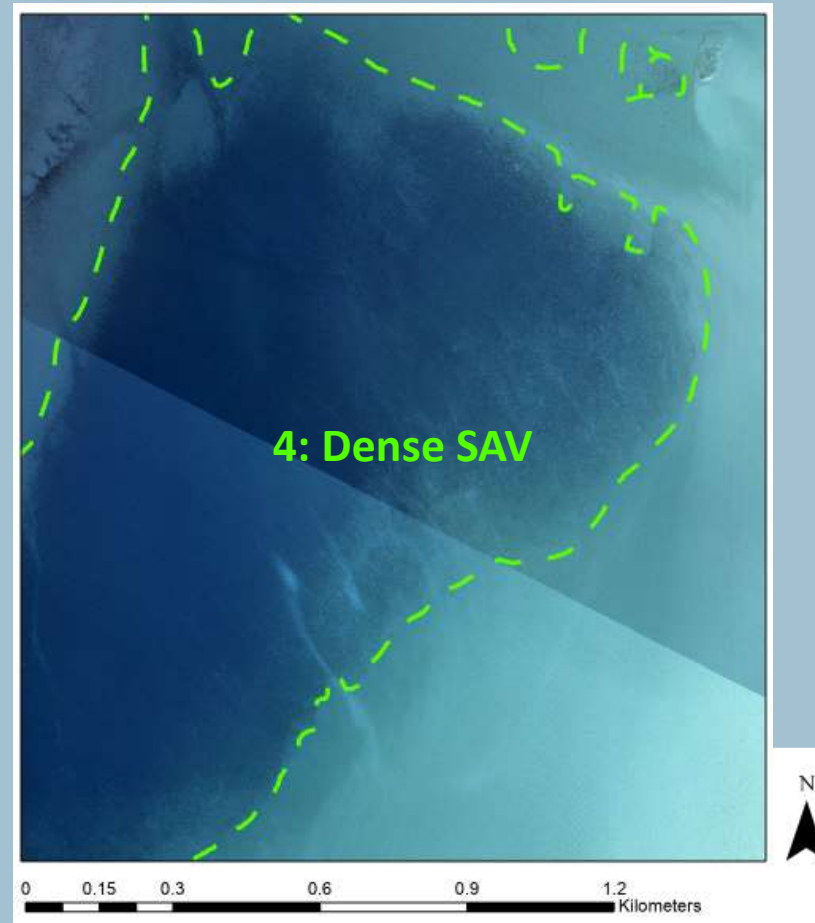
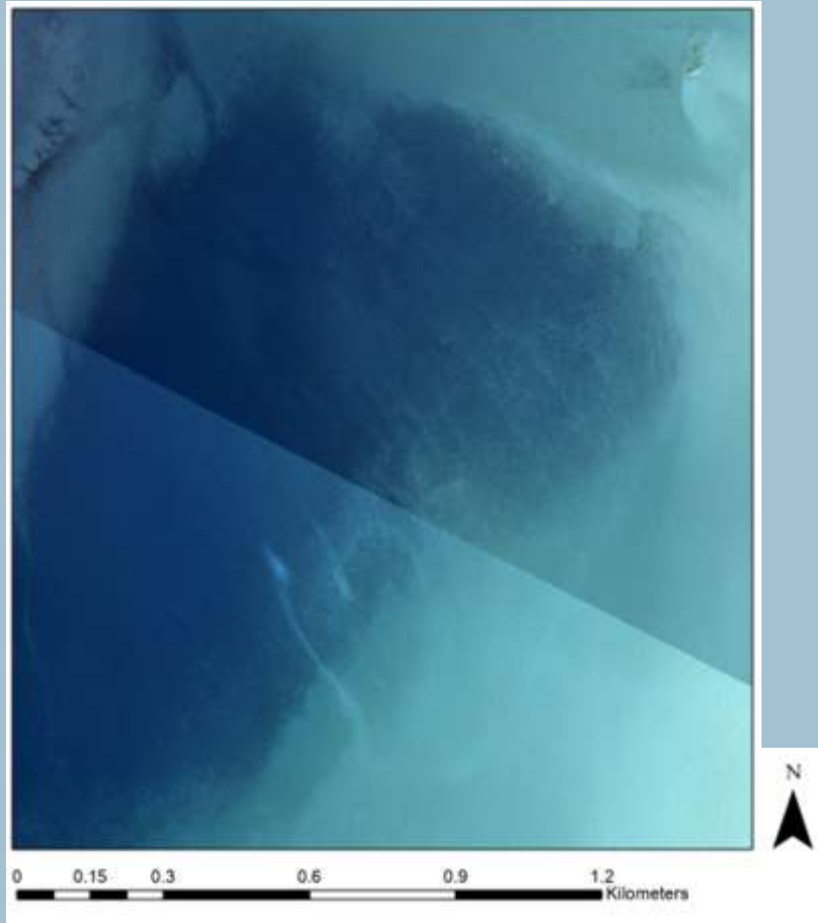
- Twenty-year time series of aerial imagery (2001 – 2021)
- Raster of environmental data across region
  - Depth
  - Sand Fraction (Grain Size)
  - Sea Surface Temperature
  - RMS Velocity (Mean Current Speed/Direction)
  - Fetch (Length of Unobstructed Wind)



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# Mapping SAV: Defining Beds



## Seagrass Density Scale

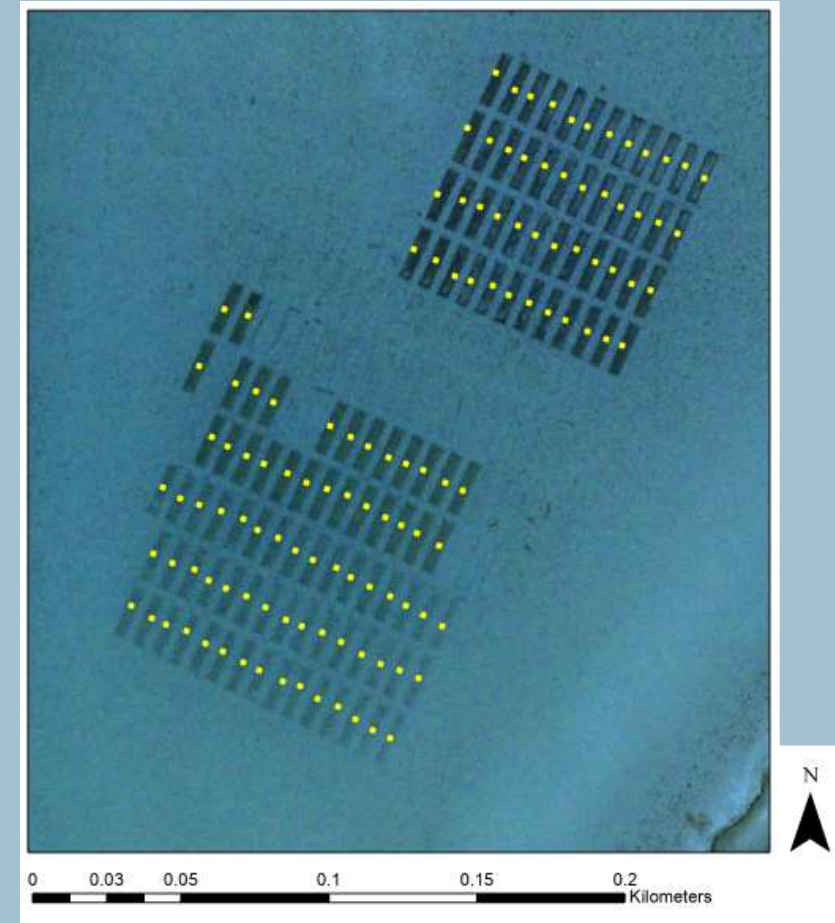
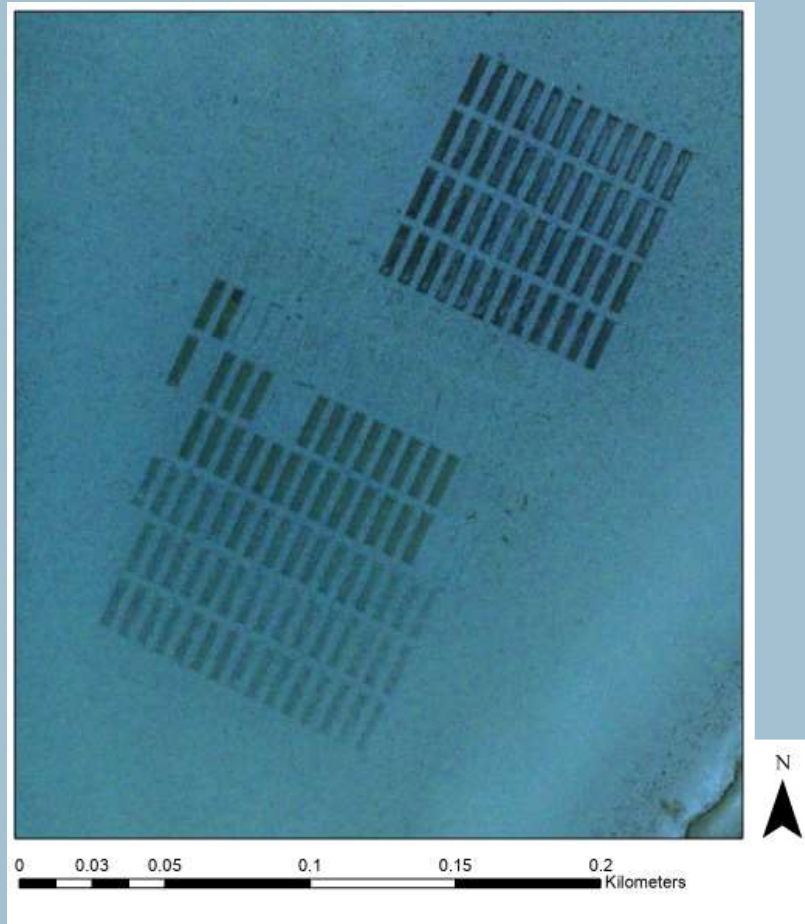
- 1: Very Sparse
- 2: Sparse
- 3: Moderate
- 4: Dense

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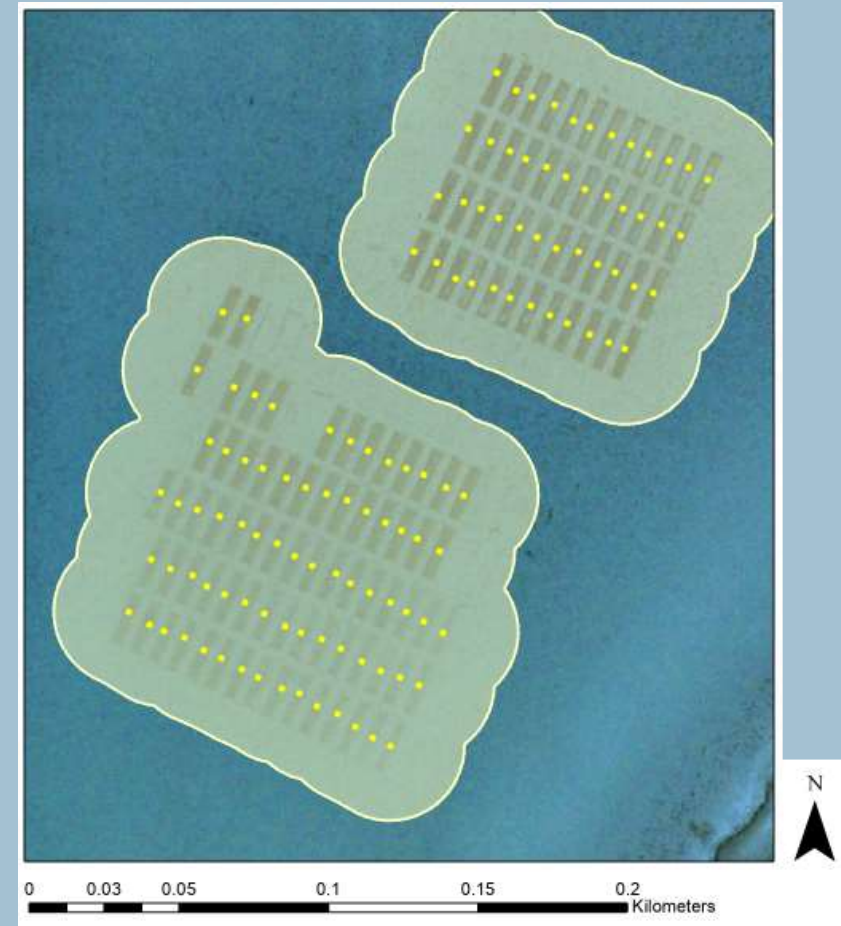
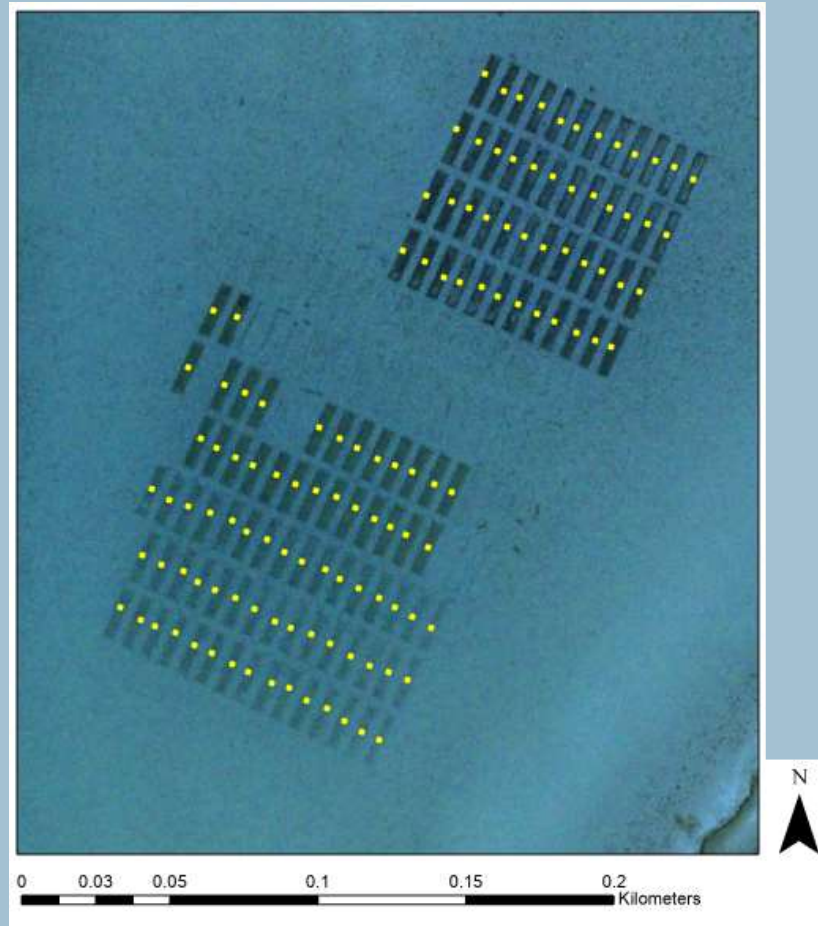
# Mapping SAV: Identifying Nets



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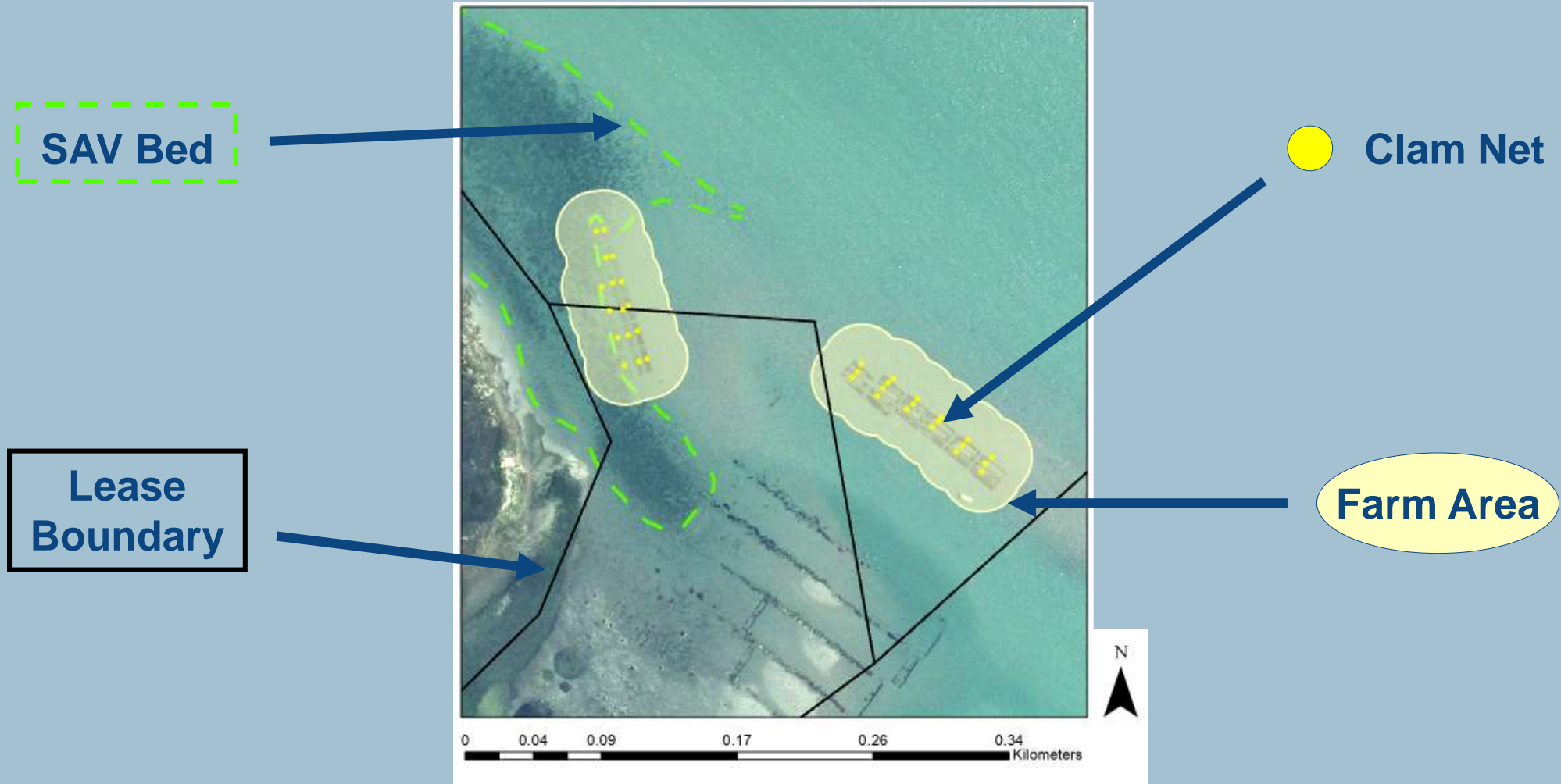
# Mapping SAV: Defining Farm Area



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# Putting It All Together



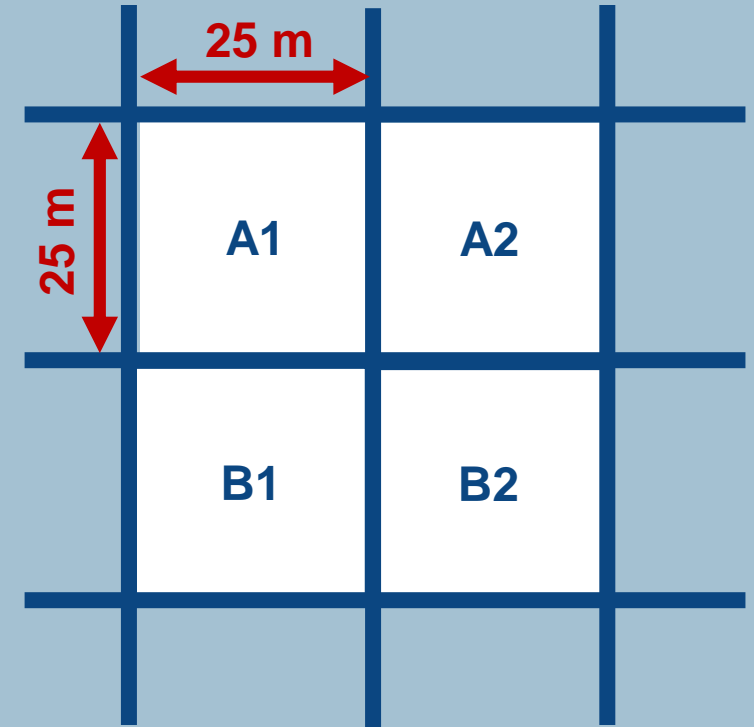
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# Data

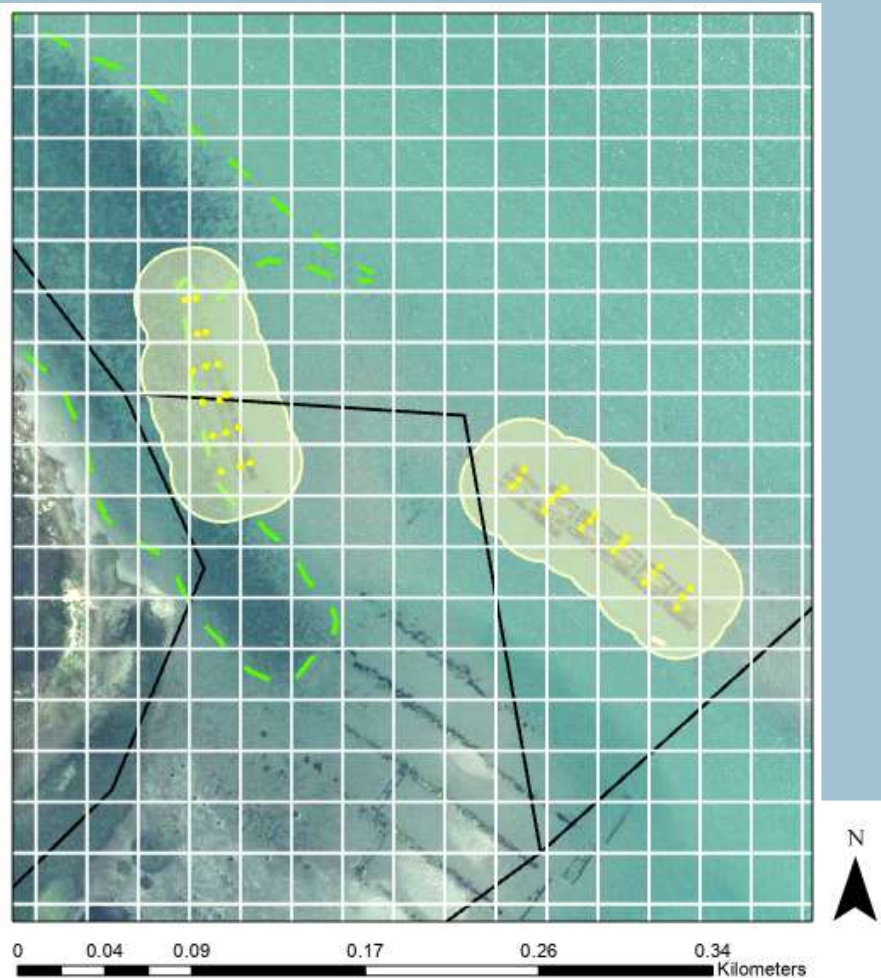
- Twenty-year time series of aerial imagery (2001 – 2021)
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# Putting It All Together

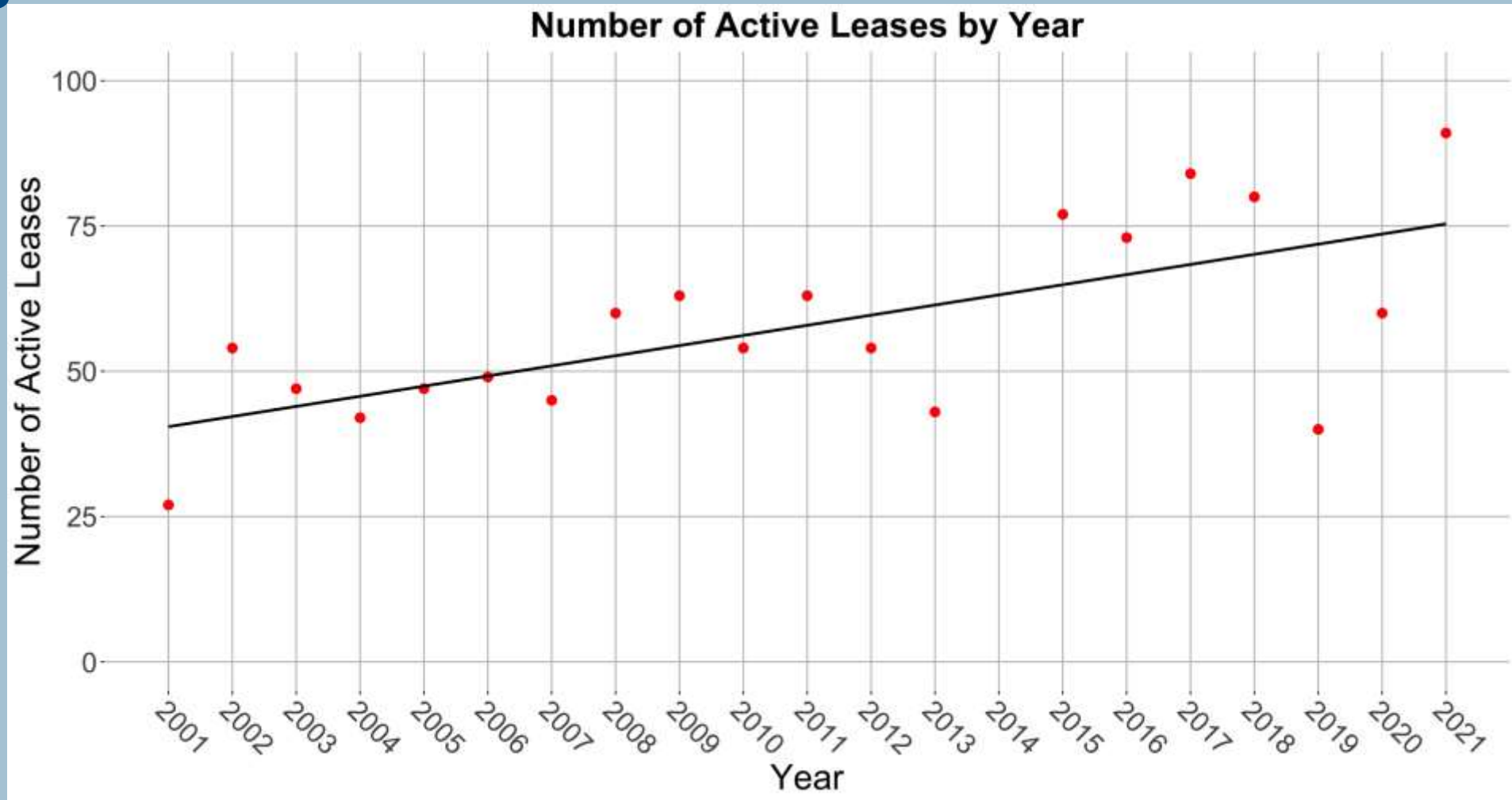


	Cell A	Cell B	Cell C	Cell D
Depth	-0.594	-0.601	-0.337	-0.919
Sand Fraction	0.913	0.982	0.205	0.550
Sea Surface Temperature	0.161	0.335	0.128	0.268
RMS Velocity	0.642	0.128	0.052	0.295
Fetch	8901.3	1297.7	2203.0	4068.6
Clam Nets Present?	Yes	Yes	No	No
Seagrass Present?	No	Yes	Yes	No

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# Trends

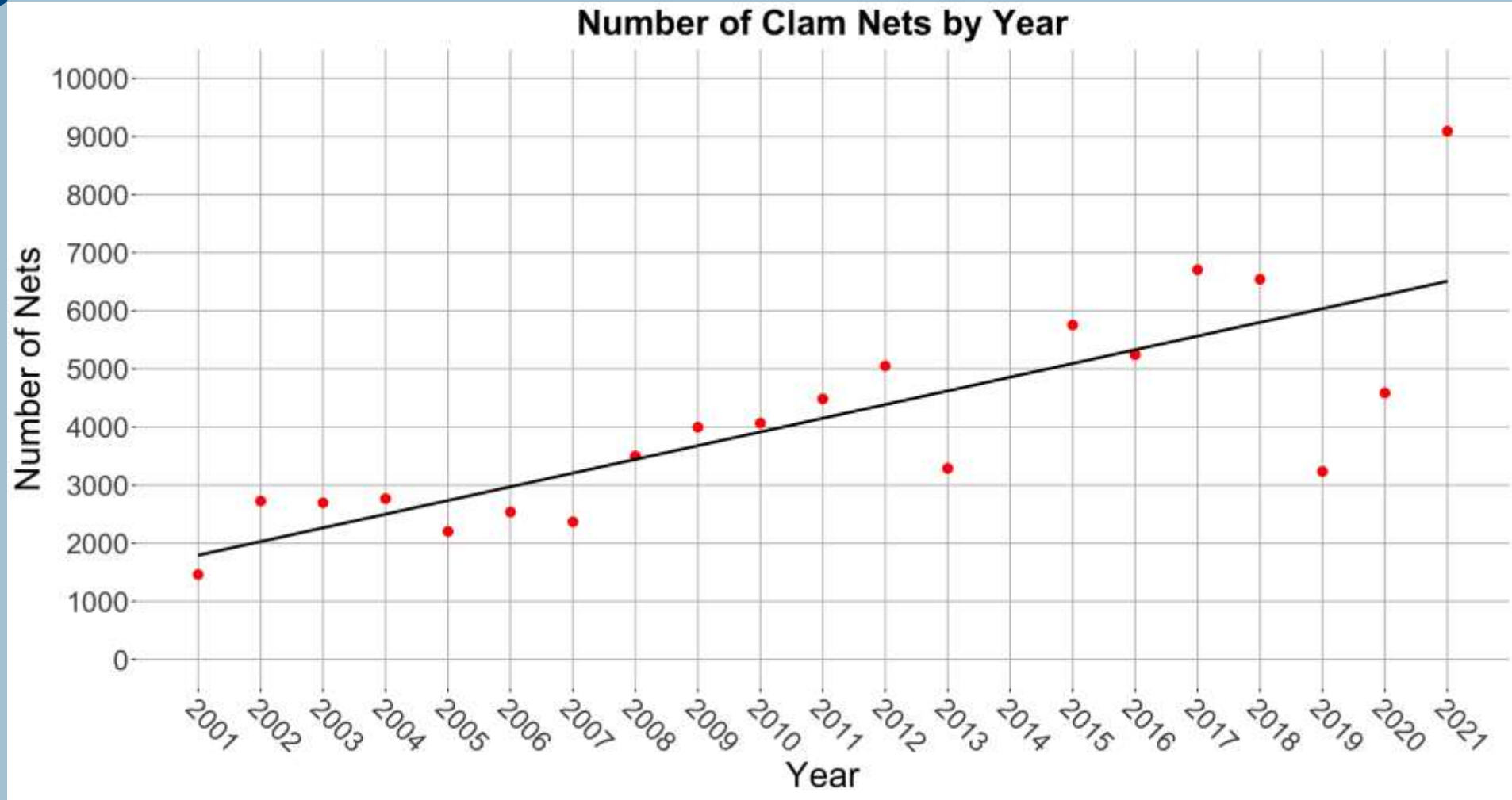


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# Trends



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# Trends



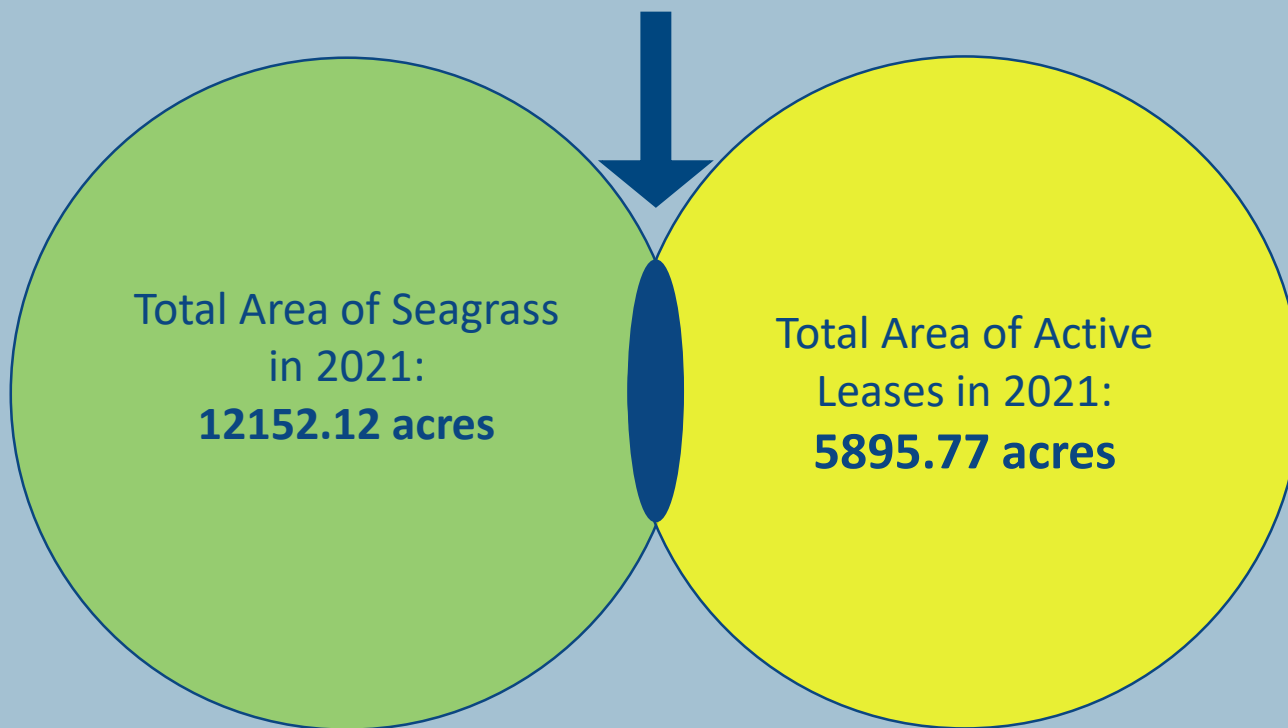
	2001	2021
Number of Active Leases	27	91
Area of Active Leases (acres)	1357.9	5895.8
Number of Nets	1461	9090
Area of Seagrass (acres) (Excluding Chincoteague Bay)	39.2	9040.4
Area of Seagrass (acres) (All Coastal Bays)	7910.6	12152.1
Number of Nets within 100m of Seagrass	0	1114

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# 2021 Trends

Total Area of  
Seagrass in Active  
Leases in 2021:  
**520.46 acres**



- ~4% total seagrass area in active leases
- <9% active lease area has seagrass
- <0.5% total seagrass area within 100m of a clam net
- <9% total farm area has seagrass

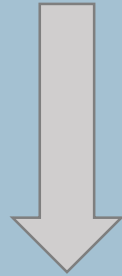
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# Field Methods



**Spatial Data**



**Field Data**



**Objective:** Monitor and study the interaction between seagrass and clam aquaculture in the Virginia Coastal Bays

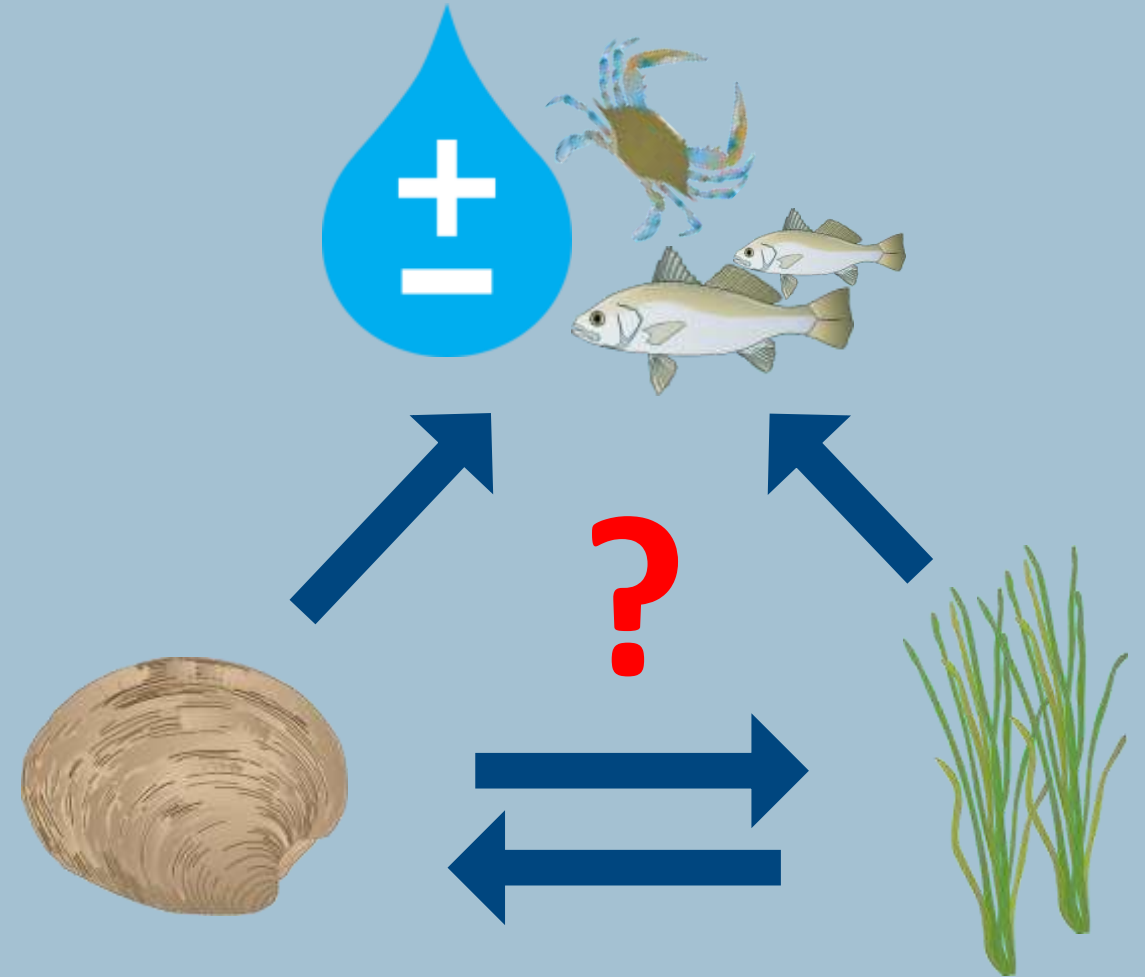
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# Questions

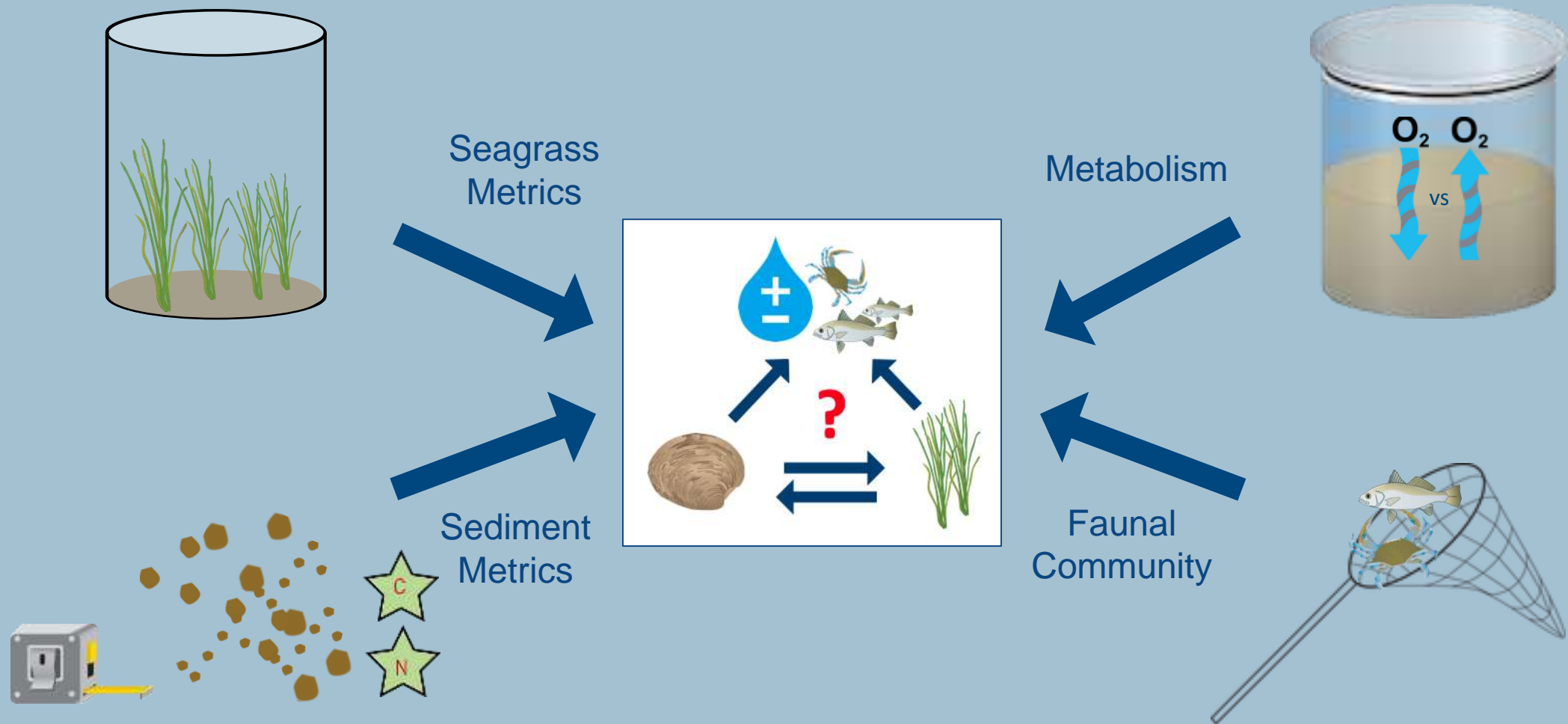
- How does clam aquaculture effect seagrass?
- How does seagrass effect clam aquaculture?
- How do clam aquaculture and seagrass effect the surrounding ecosystem?



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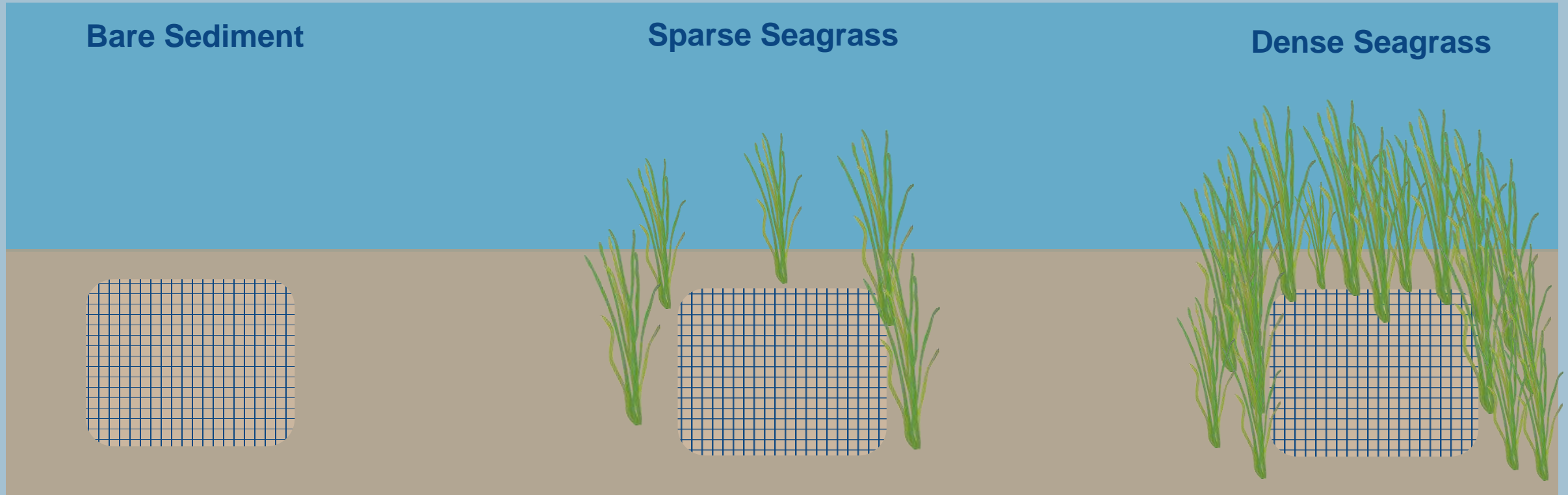
# Observational Data



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# Experimental Data



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# Methods Summary

- We are using both spatial and field data to explore the interaction between seagrass and clam aquaculture
- We want to understand the effects of:
  - Clam Aquaculture → Seagrass
  - Seagrass → Clam Aquaculture
  - Seagrass & Clam Aquaculture → Environment
  - Environment → Seagrass & Clam Aquaculture
- These data allow us to track trends over space and time
- We use these data to recommend management strategies to the VMRC

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# Proposed Pilot

- We recently proposed a 5 yr. pilot management strategy to VMRC
- Permit the 11 active farms in the southern Bays that have SAV on their leased to move clams anywhere on their lease.
- If they plant over grass must space nets a minimum of 8 ft. apart.
- Must grant access to VIMS to monitor condition of SAV in the vicinity of their farms.

## Monitoring Design

1. Detailed analysis of each site base on aerial imagery  
Number of nets, overlap with grass, survivorship of grass around nets
2. On farm sampling  
Sediment sampling for grain size and nutrients content before planting and after harvesting  
Assessment of grass health in a subset of plots across leases following net removal in years 4 and 5.
3. Grower provided information  
Anticipated timing of planting on grass  
Method used to set nets over grass  
If they are willing, yield of clam grown over grass vs not over grass
4. Continue VIMS annual mapping of the entire coast bay system will also include:  
Identifying and mapping all nets  
Identifying farm footprints  
Tracking of changes in coverage of grass, farms, and their overlap

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# Acknowledgements

- Alyson C. Hall
- Matthew Smith
- VIMS SAV Monitoring & Restoration Program
- VIMS Coastal & Estuarine Ecology Lab
- Virginia Coast Reserved LTER
- Patricia Wiberg
- Michael Pace
- Graphics Credit: Integration and Application Network (intumesced/media-library)

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