Submerged Aquatic Vegetation in the Chesapeake: Sentinel of a Changing Bay

Chesapeake Bay Program's SAV Workgroup

presented to Climate Resiliency Workgroup

January 27th, 2020

Bay-wide SAV Restoration Goal

Vital Habitats Goal

Restore, enhance and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed.

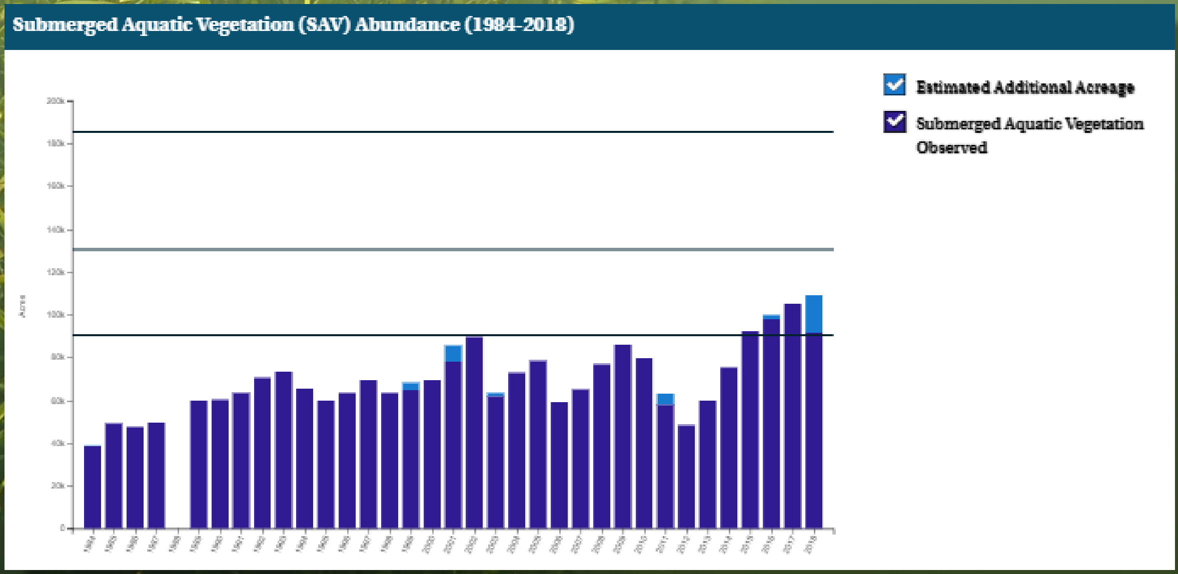
Submerged Aquatic Vegetation (SAV) Outcome

Sustain and increase the habitat benefits of SAV (underwater grasses) in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV Bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.

2017: 90,000 acres

2025: 130,000 acres

Ultimate Goal: 185,000 acres of SAV Bay-wide



Bay-wide SAV Restoration Goal

For SAV acreage attainment, the Bay is divided into 92 jurisdictional segments that each have their own SAV restoration target.

Why is SAV important?

SAV meadows form Ecologically and Economically Important Habitat

Photo: Jay Fleming

SAV beds absorb and filter nutrients and sediments from the water column, and reduce resuspension of sediments, promoting increased water clarity

SAV beds provide food for a variety of Bay critters

SAV beds attenuate wave energy and reduce shoreline erosion

SAV releases oxygen into the water column

SAV sequesters carbon

Chesapeake Bay SAV - 17 Species of grasses are commonly found in the Bay and its tributaries. The six most common are:

Wild Celery (*Vallisneria americana*)

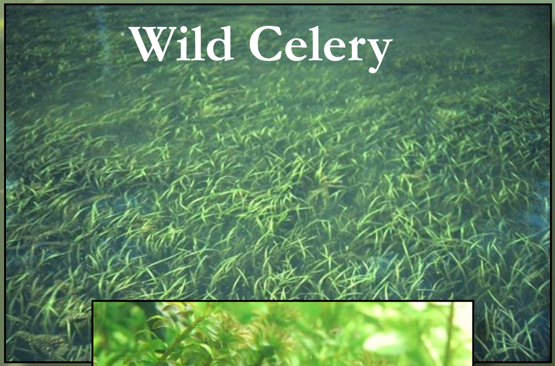
Hydrilla (*Hydrilla verticillata*)

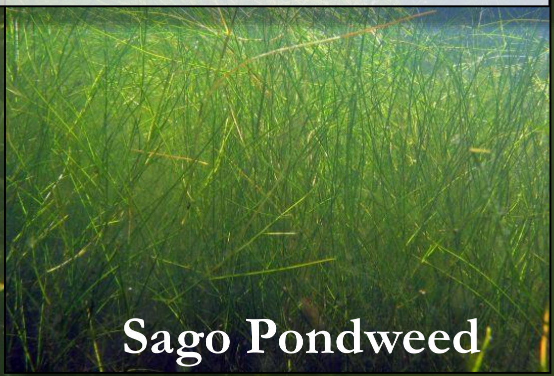
Redhead Grass (*Potamogeton perfoliatus*)

Sago Pondweed (*Stuckenia pectinata*)

Widgeon Grass (*Ruppia maritima*) (the most widespread)

Eelgrass (*Zostera marina*) (the only "true" seagrass species, can tolerate salinities as low as 10 ppt, but is dominant in the lower reaches of the bay where salinity is higher, *heat intolerant*)





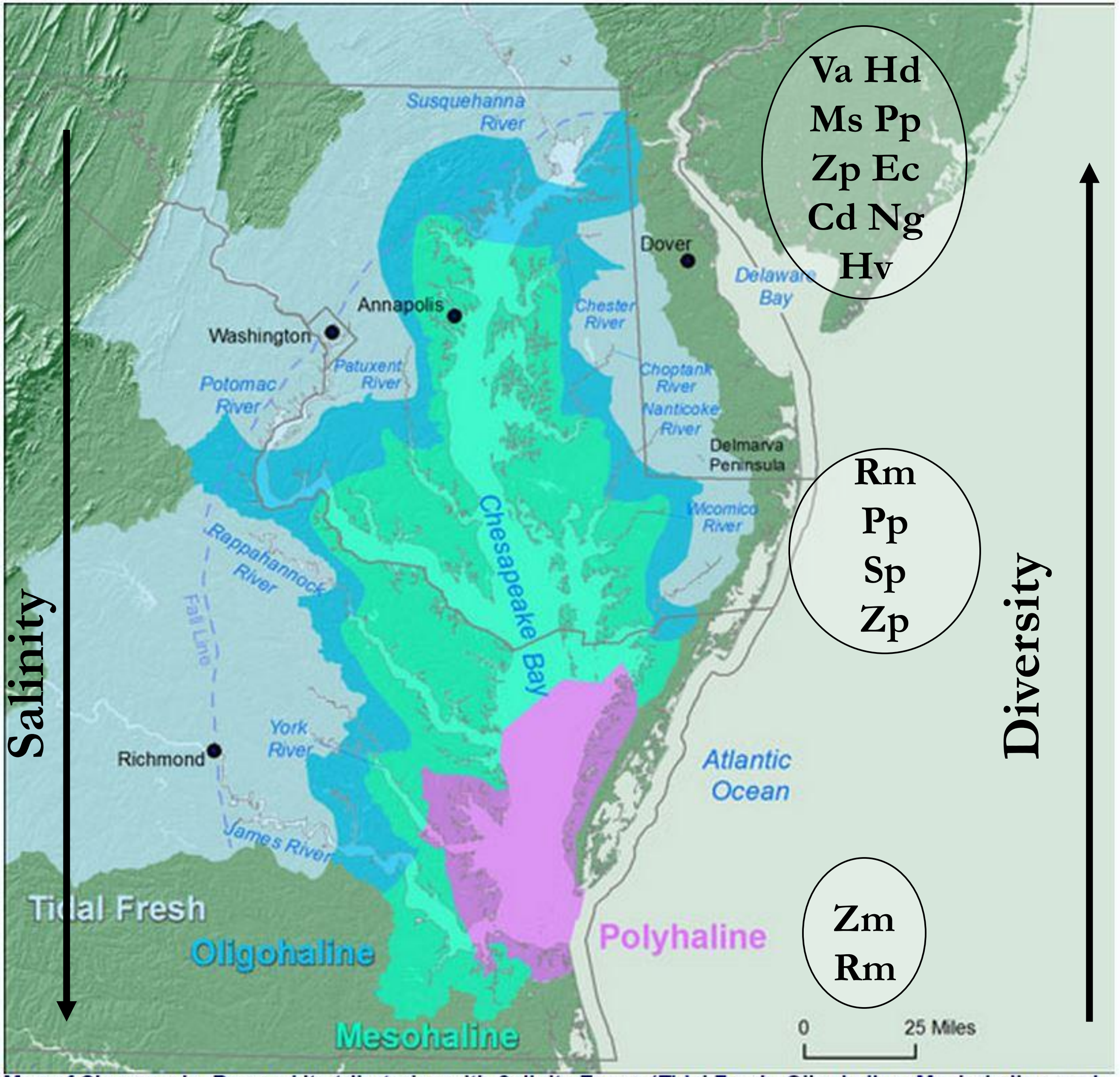
Other species of SAV commonly observed in the Bay:

1. *Potamogeton crispus* (Curly pondweed)
2. *Potamogeton pusillus* (Slender pondweed)
3. *Zannichellia palustris* (Horned pondweed)
4. *Elodea canadensis* (Canadian waterweed)
5. *Ceratophyllum demersum* (Coontail)
6. *Heteranthera dubia* (Water stargrass)
7. *Najas guadalupensis* (Southern naiad)
8. *Najas minor (Brittle naiad)*
9. *Najas gracillima (Slender waternymph)*
10. *Myriophyllum spicatum (Eurasian watermilfoil)*

Chesapeake Bay Salinity Zones and SAV distribution

<u>Tidal Fresh</u>
0-0.5 ppt
<u>Oligohaline</u>
0.5-5 ppt
<u>Mesohaline</u>
5-18 ppt
<u>Polyhaline</u>
18-30 ppt

(The open ocean is 30+ ppt, on average about 35 ppt)



Map of Chesapeake Bay and its tributaries with Salinity Zones (Tidal Fresh, Oligohaline, Meshohaline, and Polyhaline)

Chesapeake Bay SAV Monitoring Program and Three-Tiered Approach

Tier 1: Bay-wide SAV aerial survey

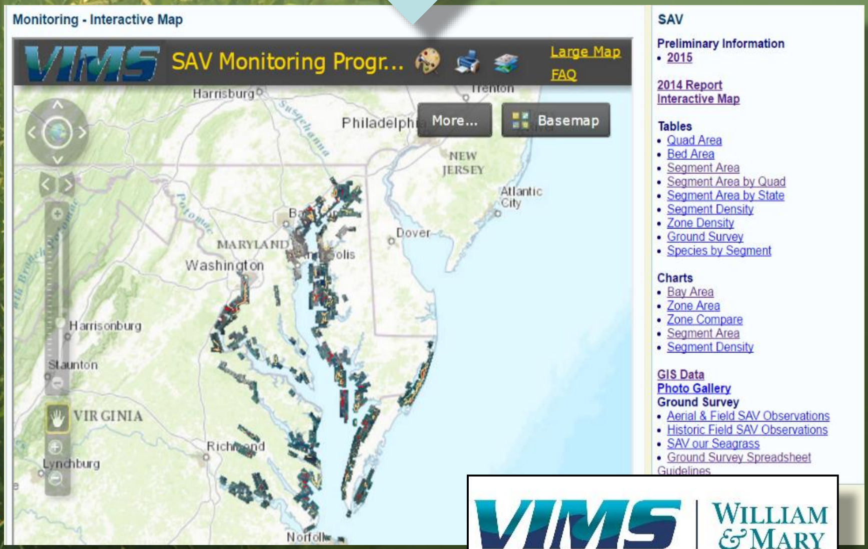
-Conducted annually May-Oct

-180+ flight lines collecting imagery

-Ongoing since 1984

-Funded by Federal/State partnership

- Quantifies SAV habitat distribution and density throughout the Bay and its tributaries



VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

http://web.vims.edu/bio/sav/

Tier 2: Chesapeake Bay SAV Watchers and other ground survey efforts

-Conducted April – October, throughout the Bay

- Started in 2019

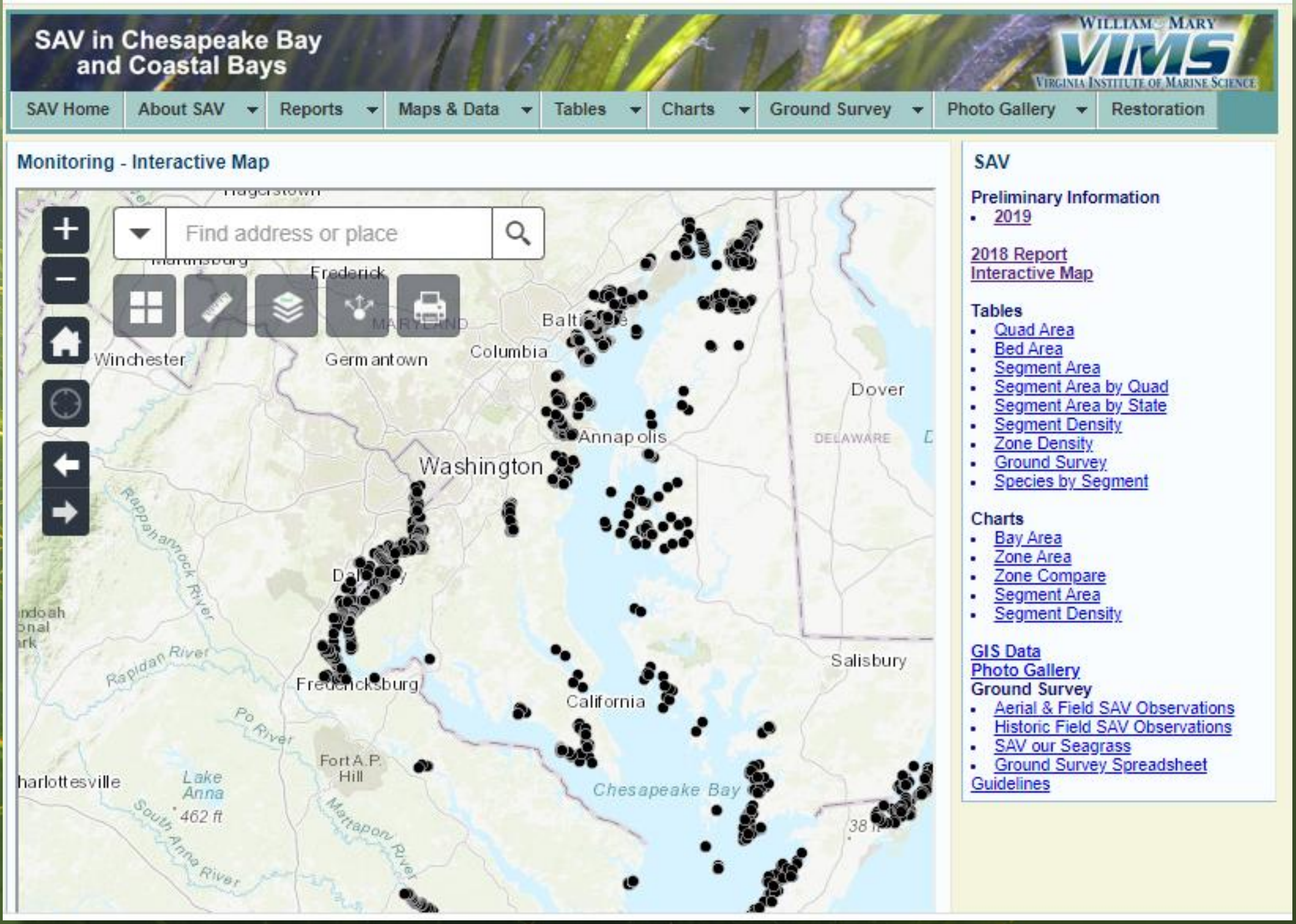
- Conducted by volunteers and Citizen Scientists

-Presence, species composition, detailed density, water quality and physical parameters, shoreline condition, additional observations

-Allows for broad-scale condition assessments; identifies and quantifies driver/response relationships

www.chesapeakebaysavwatchers.com

Tier 2: also includes other ground survey efforts….



Tier 3: Chesapeake Bay SAV Sentinel Site Program (in development)

-Will be conducted at peak biomass, possibly monthly during growing season

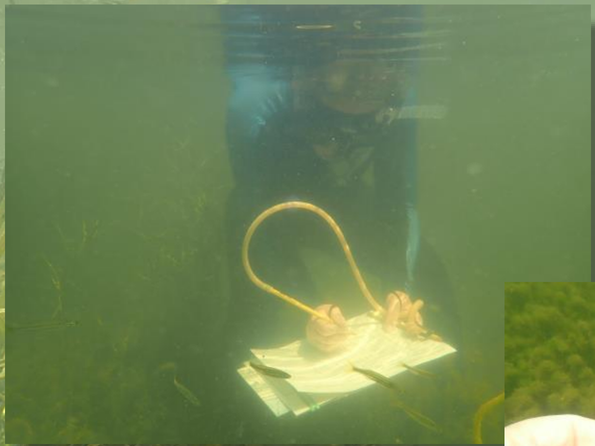
- Starting in 2020

- 20 sites, 5 in each salinity regime

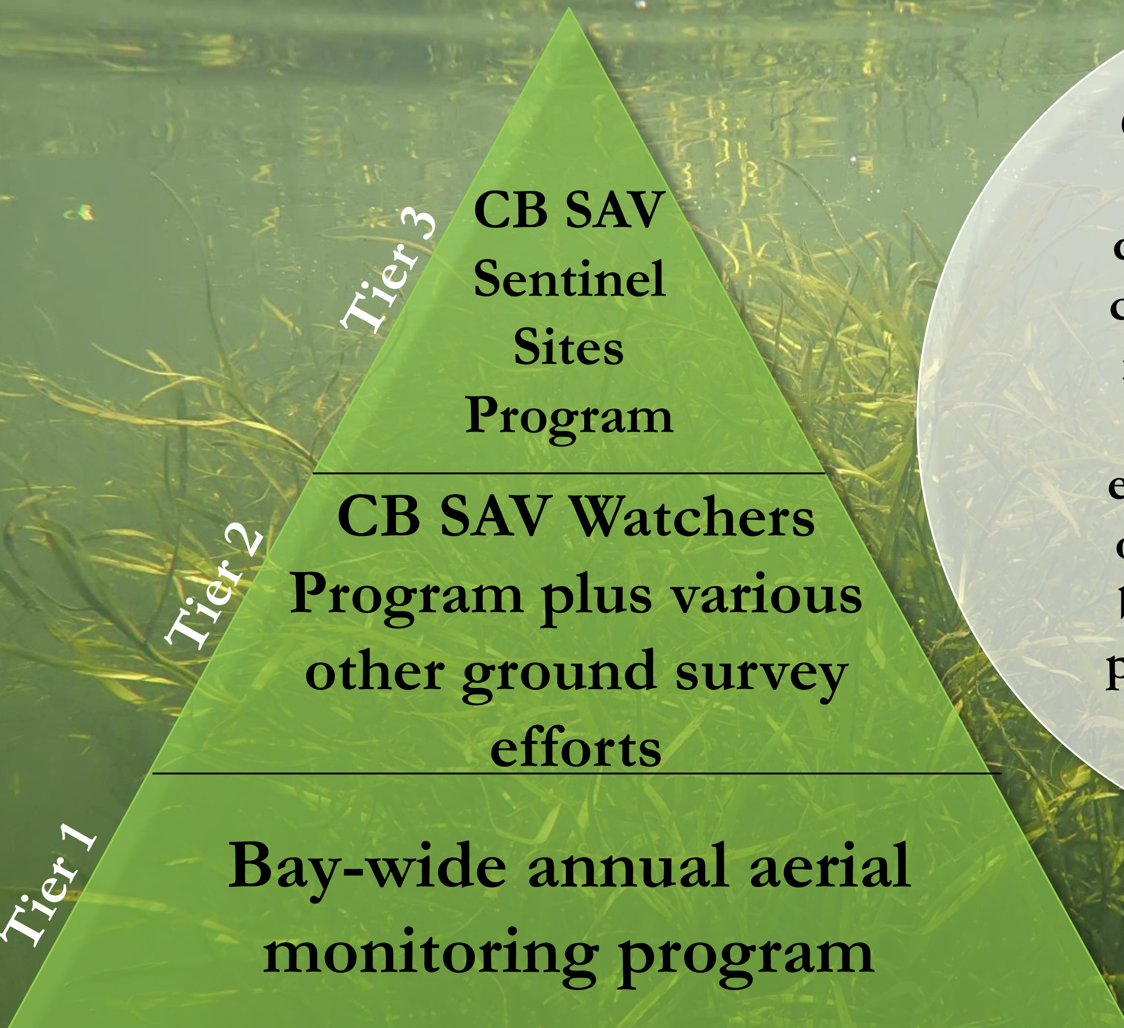
- Conducted by CB researchers and trained watershed organizations

-In-depth data/parameters collected: SAV species, density, canopy height, epiphyte loading, shoot count, indications of disease, water quality and physical parameters, chemical parameters, etc.

-Identifies causal relationships by intensively monitoring drivers of change, ecosystem responses, and ecological processes



Putting the tiers together



Changes in SAV habitat extent or condition detected at Tiers 1 and 2 can direct process-based investigations at Tier 3, and statistical and explanatory models built on Tier 2 and 3 data can be used to interpret and predict resource patterns and conditions at the larger scales.

Neckles et al. 2012. Integrating scales of seagrass monitoring to meet conservation needs. Estuaries and Coasts 35:23-26.

Concerns regarding climate change

1. **Increasing water temperatures and the loss of eelgrass in the southern Bay.**

   a. Eelgrass is a cold-water species nears its southern boundary in the Chesapeake.

   b. Eelgrass may be replaced by Widgeongrass, but the seasonal shift may lead to a lack of habitat for important fisheries in early spring and late fall.

   c. Economic consequences to fisheries.

   d. 2019 was a particularly bad year for eelgrass.

From Lefcheck et al. 2017. Multiple stressors threaten the imperiled coastal foundation species eelgrass (*Zostera marina*) in Chesapeake Bay, USA: [The authors] show that eelgrass area has declined 29% in total since 1991, with wide-ranging and severe ecological and economic consequences. [The authors] go on to identify an interaction between decreasing water clarity and warming temperatures as the primary drivers of this trend. Declining clarity has gradually reduced eelgrass cover the past two decades, primarily in deeper beds where light is already limiting. In shallow beds, however, reduced visibility exacerbates the physiological stress of acute warming, leading to recent instances of decline approaching 80%. While degraded water quality has long been known to influence underwater grasses worldwide, [the authors] demonstrate a clear and rapidly emerging interaction with climate change. [The authors] highlight the urgent need to integrate a broader perspective into local water quality management, in the Chesapeake Bay and in the many other coastal systems facing similar stressors.

Global Change Biology (2017), doi: 10.1111/gcb.13623

Concerns regarding climate change

2. Changes in freshwater flow into the Bay – both chronic and acute.

1. Droughts are generally good for SAV because they reduce sediment and nutrient loadings that reduce water clarity.

2. Increased freshwater flow (from expected increased in precipitation) can alter community composition and range through changes in salinity and water clarity.
    * Can also lead to HABs

3. Increased frequency and severity of storms. Storms cause acute damage to SAV through increased flow, causing scour or burial. They also lead to abrupt and (sometimes lasting) changes in water clarity.

4. Loss of diversity and consequently resilience. In extreme or fluctuating conditions, generally only a couple of the hardiest species survive.

Studies such as Gurbisz et al. (2016) suggest that denser SAV beds with a more diverse range of species offer greater resilience because they are more easily able to regenerate and recover from a catastrophic event (e.g., a flood or storm), better able to adapt to changing conditions (e.g., warming; shifting in response to sea level rise), and able to harbor a more diverse array of other life forms. **Mechanisms of storm-related loss and resilience in a large submersed plant bed. Gurbisz, C., W.M. Kemp, L.P. Sanford, and R.J. Orth. 2016. Estuaries and Coasts 39:951–966. doi:10.1007/s12237-016-0074-4.**

Concerns regarding climate change

3. **Sea Level Rise.** SLR will change the profile of the shallow water habitat currently available for SAV production and expansion.

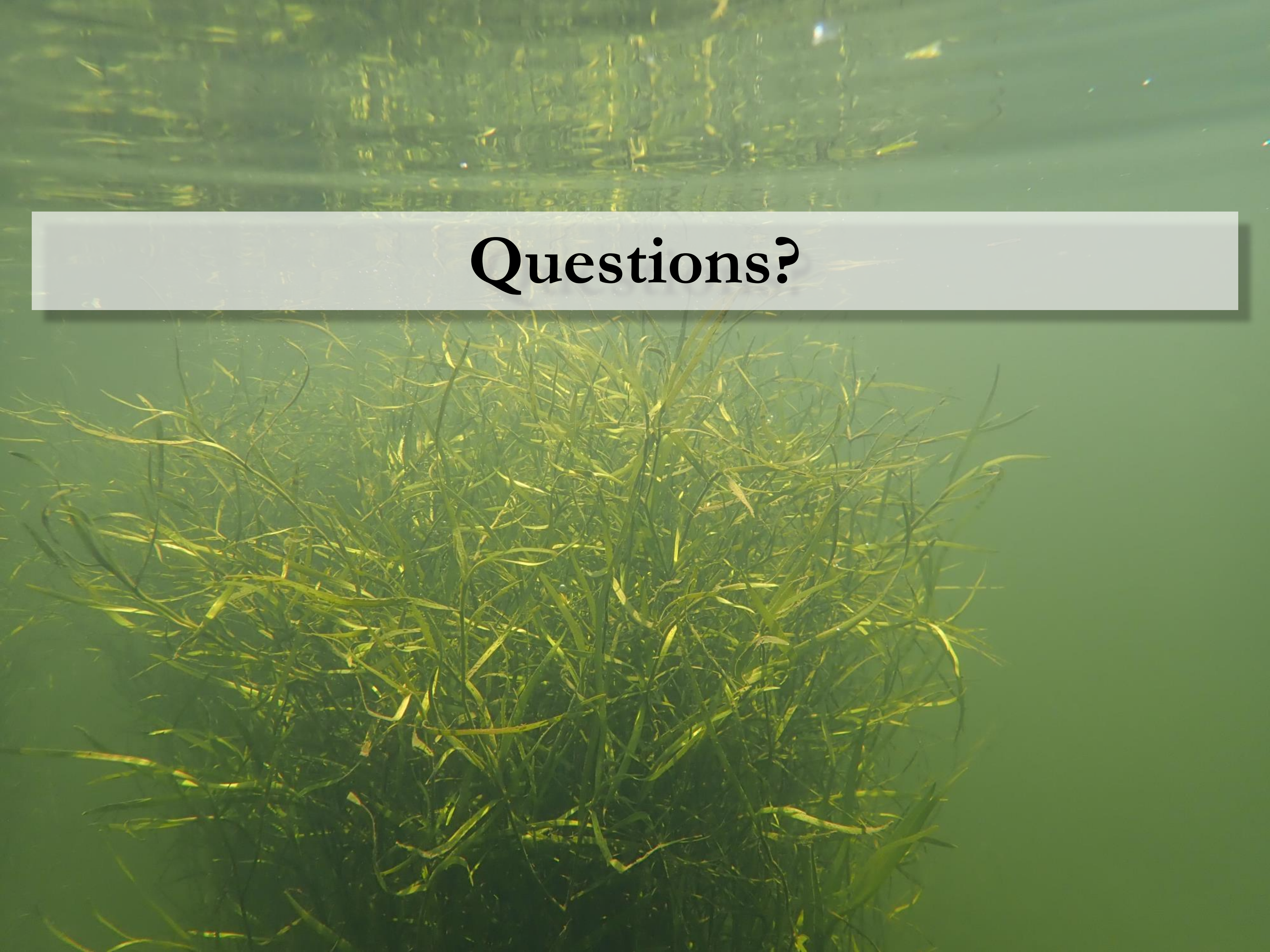
4. **Shoreline armoring associated with SLR** as well as nearshore development). Not only is shoreline armoring detrimental to SAV because of the immediate physical impacts, but SAV needs to be able to migrate inland with SLR.

5. **Pathogens and invasive plants and animals** that shift north with the tropicalization of the bay. What threat will they play?

6. **Ocean/coastal acidification…it** might help. Increased CO2 = increased photosynthesis and productivity.

Climate Change Indicators

1. Water temperatures (chronic and acute changes)
2. Changes in freshwater flow (chronic and acute changes)
3. Sea Level Rise
4. Shoreline armoring associated with SLR as well as nearshore development
5. Pathogens and invasive plants and animals
6. Ocean/coastal acidification


Questions?