South Bethany Water Quality and its Submerged Aquatic Vegetation

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Kayla Clauson, DNREC

January 2024- Workgroup Formation

Starting ahead, not behind.

We are a dedicated work group of professionals from state, federal, academia, and non-profit organizations that come together to spearhead SAV efforts in the First State.

Co-chairs

Brittany Haywood

Sea Grant DELAWARE

Kayla Clauson

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

Steering Committe

Jecy Klinkam

Partnership for the DELAWARE ESTUARY

Taylor Hoffman

DELAWARE CENTER FOR THE INLAND BAYS
preserve • protect • restore

What is Submerged Aquatic Vegetation?

Submerged aquatic vegetation (SAV) are **rooted vascular plants** that spend their **entire lifecycle underwater**, relying on water for structural support, to absorb dissolved nutrients and gases directly, and can be found in **freshwater, brackish, and marine environments**

Plant Types

Terrestrial - Growing above the mean high water line.

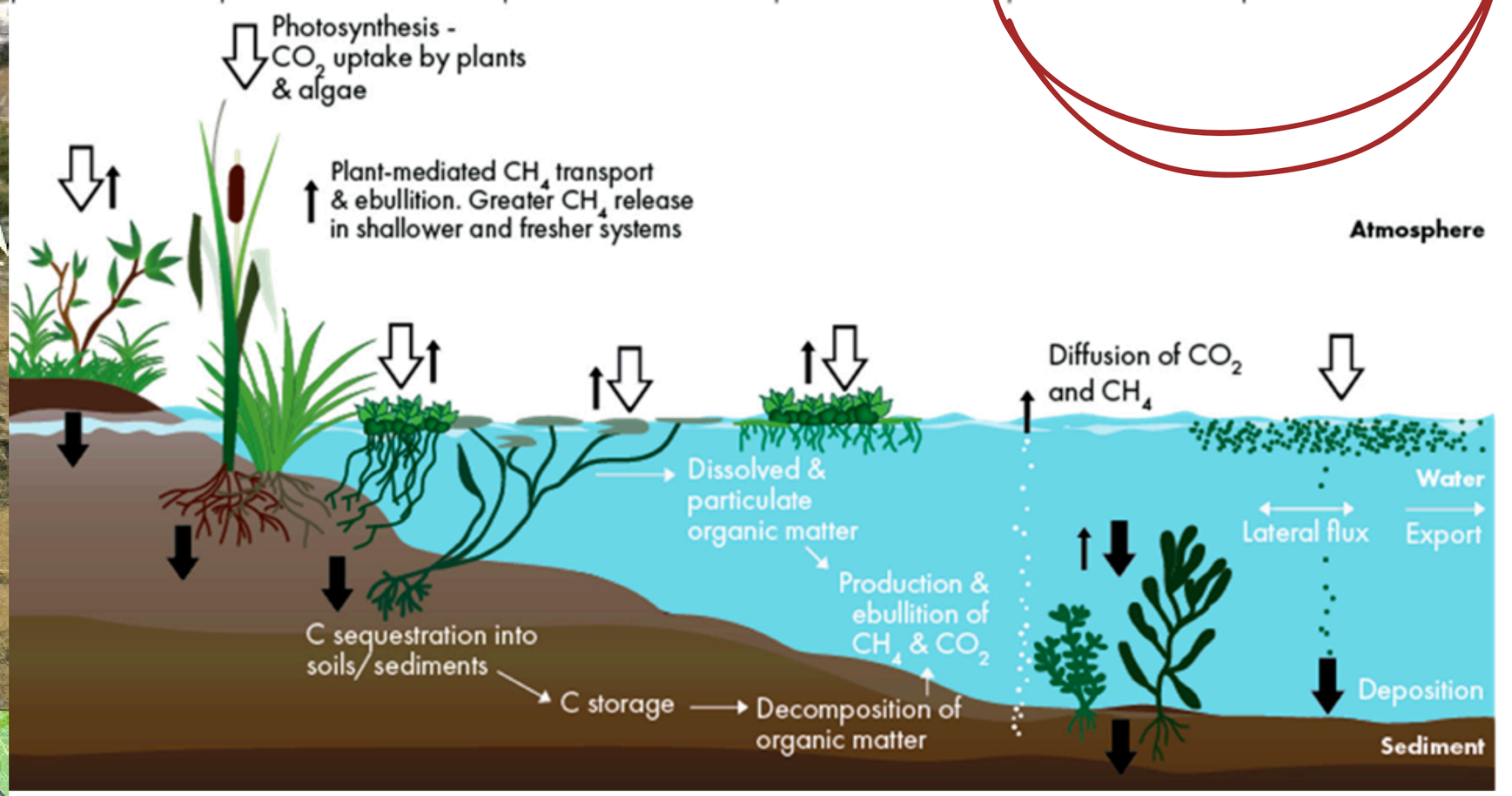
Emergent - Growing in shallow water with leaves or stems above the water's surface.

Floating - Growing unattached or rooted with floating leaves.

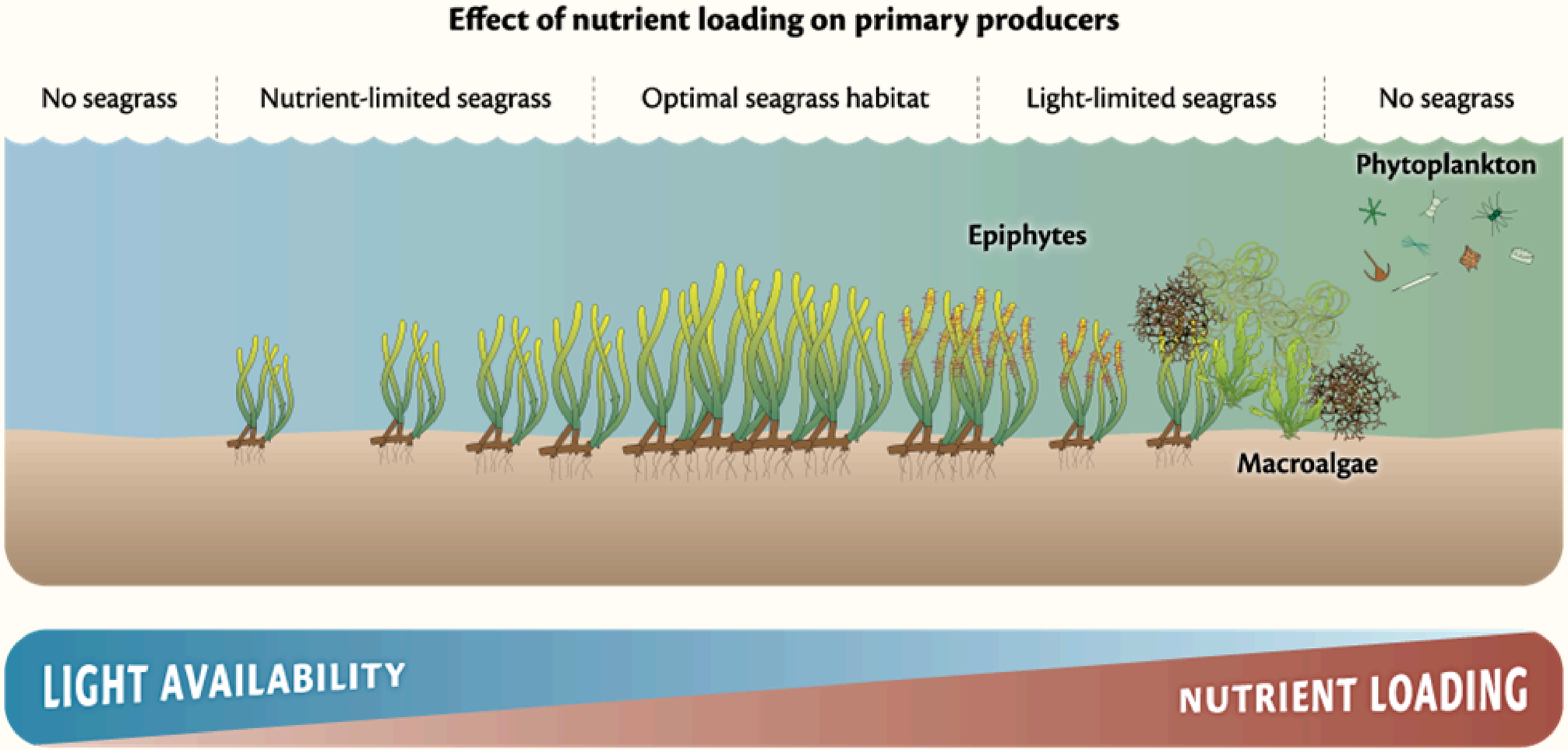
Unvegetated - No rooted vegetation.

Submerged - Growing entirely below and up to the water's surface.

Phytoplankton Cellular. No distinguishable stem or leaf.



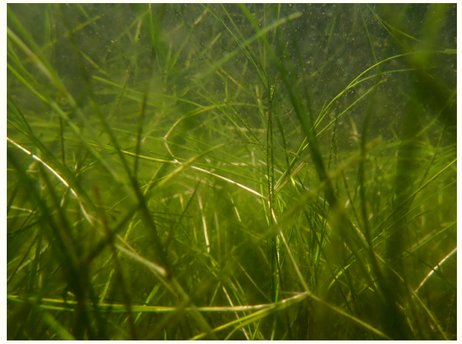
SAV vs Macroalgae

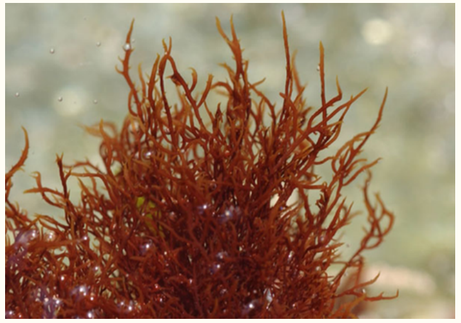


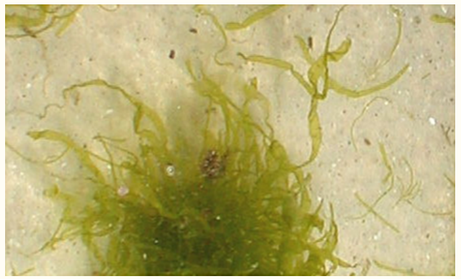
Conceptual diagram illustrating the optimal balance of nutrient load and light availability in a water source for seagrass and other primary producers, such as macroalgae and phytoplankton.

Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: *Dennison, W.C., J.E. Thomas, C.J. Cain, T.J.B. Carruthers, M.R. Hall, R.V. Jesian, C.E. Wazniak, and D.E. Wilson. 2009. Shifting Sands: Environmental and cultural change in Maryland's Coastal Bays. IAN Press, University of Maryland Center for Enviromental Science*

SAV vs Macroalgae







Why are they important?

SAV are..

Cleaning Crews

Filtering out dirt and nutrients to keep the water sparkling clean.

Neighborhoods

Providing the perfect places to hide, eat, and hang out for fish, crabs and other wildlife.

Carbon Banks

Locking away carbon dioxide in leaves and roots to help fight rising seas.

Air Factories

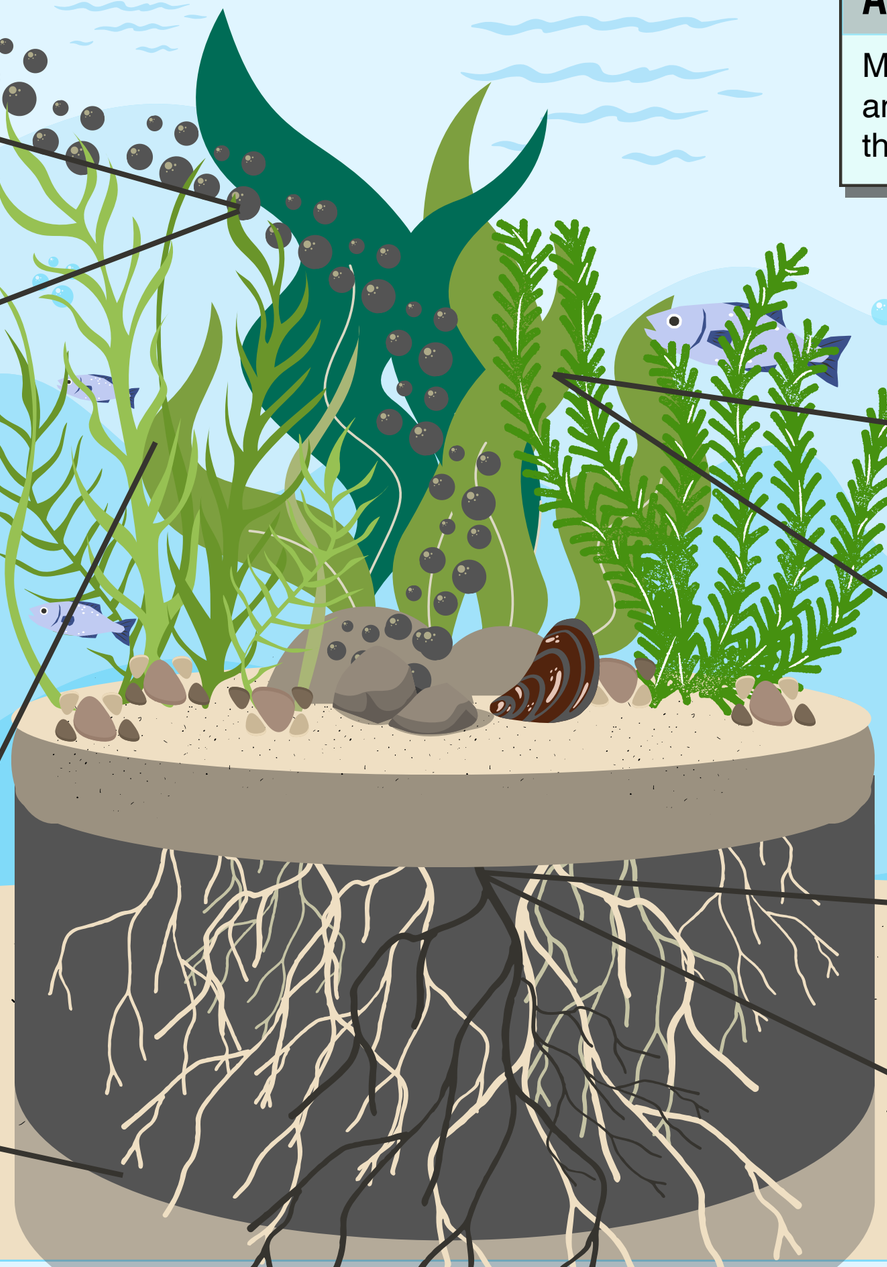
Making oxygen that helps animals breathe and keeps the water full of life.

Line Backers

Slowing down wave action and defending our shorelines.

Nature's Anchors

Holding the soil in place with their roots to stop it from washing away.



Brittany Haywood, Delaware Sea Grant, 2024

SAV growing conditions

Widgeon Grass (Ruppia maritima)

Salinity	0-70 ppt
Temperature	-15 – 30°C
Dissolved Oxygen	No Anoxia
Turbidity	clearer water with <22% light through water (PLW)
Wave Action	Low: between 10-100 cm/s
Sediment Type	Sandy to soft, muddy sediment

- SAV grows only where water conditions allow it: light, temperature and salinity must align.
- The canals support growth of *Ruppia maritima*, one of the 3 known baygrasses growing in the Inland Bays

What we've been up to in your canals

2023

- Began long-term efforts to monitor *R. maritima*

2024

- Bi-weekly monitoring of bed area
- CIB deploys one water quality monitoring station

2025

- Developed and piloted long-term monitoring protocol for *R. maritima*
- Developed *R. maritima* reproduction reference guide
- Deployed continuous water quality monitoring equipment at 5 sites
- Weekly water quality tests at project sites

Reproductive material was collected each year listed, and once in 2019

South Bethany work

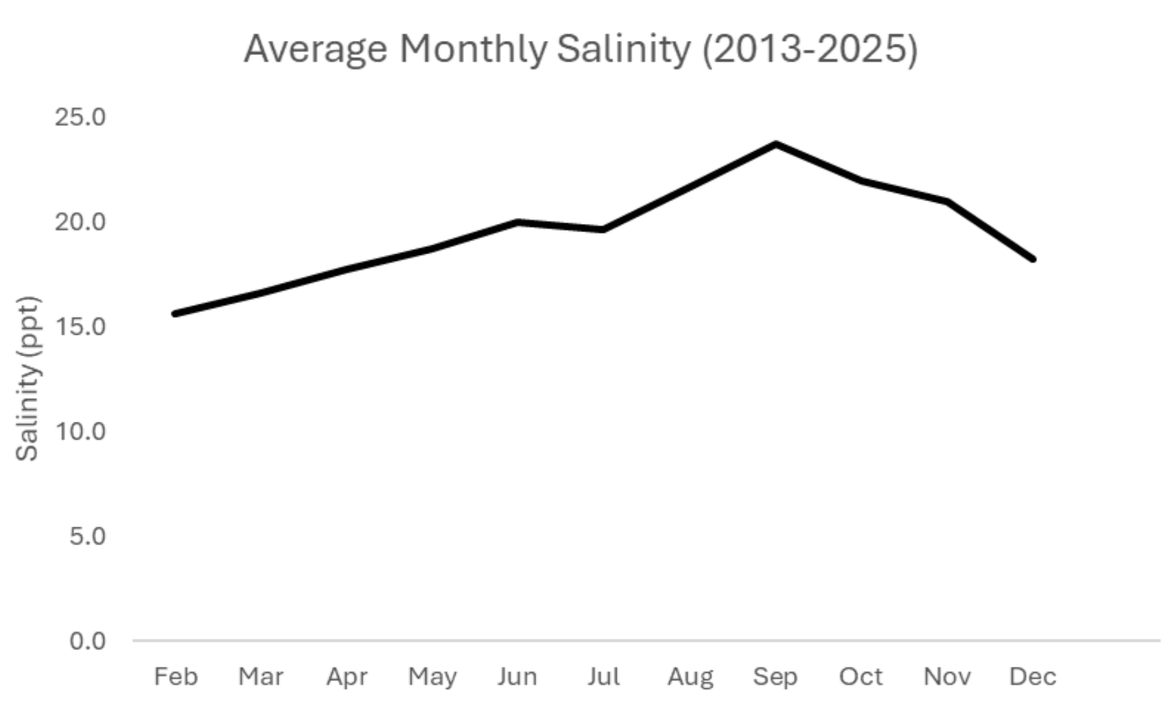
Understanding Current Water Quality Conditions

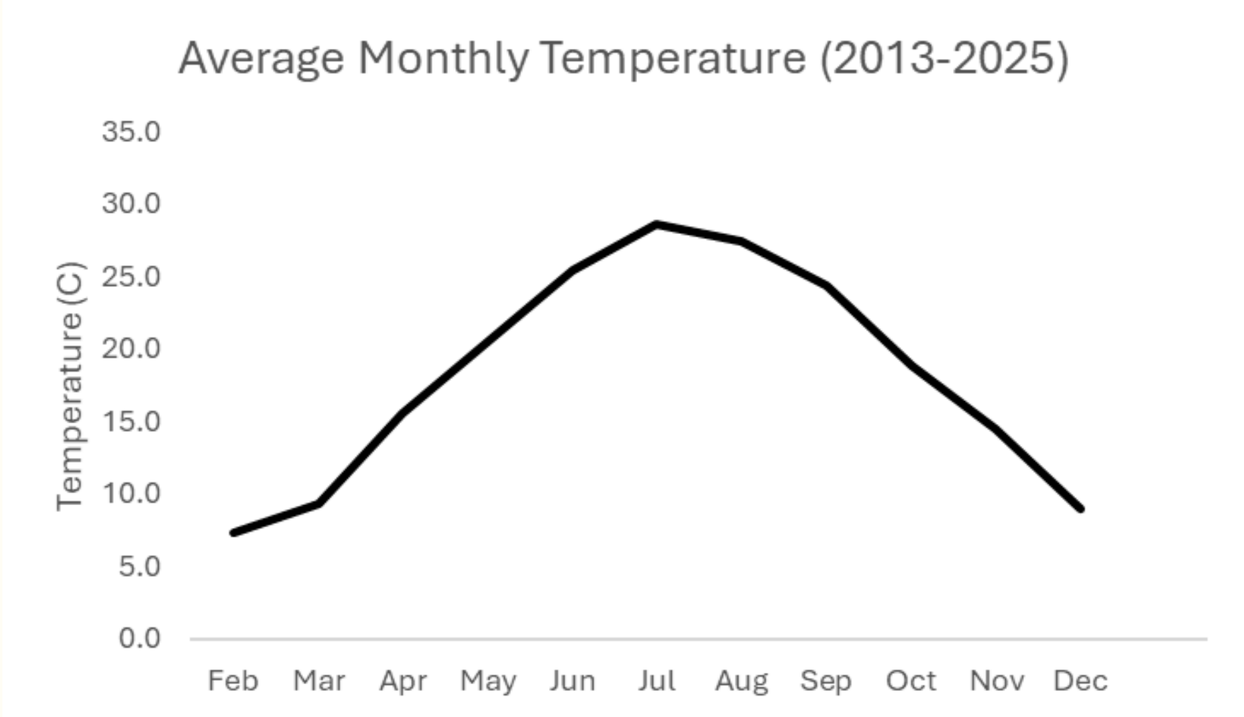
- Percent Light through Water (PLW)
- Temperature
- Salinity

Thank you to all the property owners who allowed us access!

Canal Water Quality

Baseline seasonal structure of the canal system. What does a "normal" year look like in the canals?





Take aways:

-Salinity remains comparatively stable across months, with modest seasonal variability (Min=15.6, Max=23.7, Range=8.1).

-A consistent annual temperature cycle, with warming beginning in March–April (spring) and peak temperatures in July–August (summer).

Canal Water Quality During SAV Growing Season

Averaged Secchi depth and derived light co-efficient (Kd) during growing season.

**Values represent system-wide averages across canals and mask site-specific variability.*

Clear days= can see bottom
Moderate Days= can see halfway
Murky days= can't see at least half way

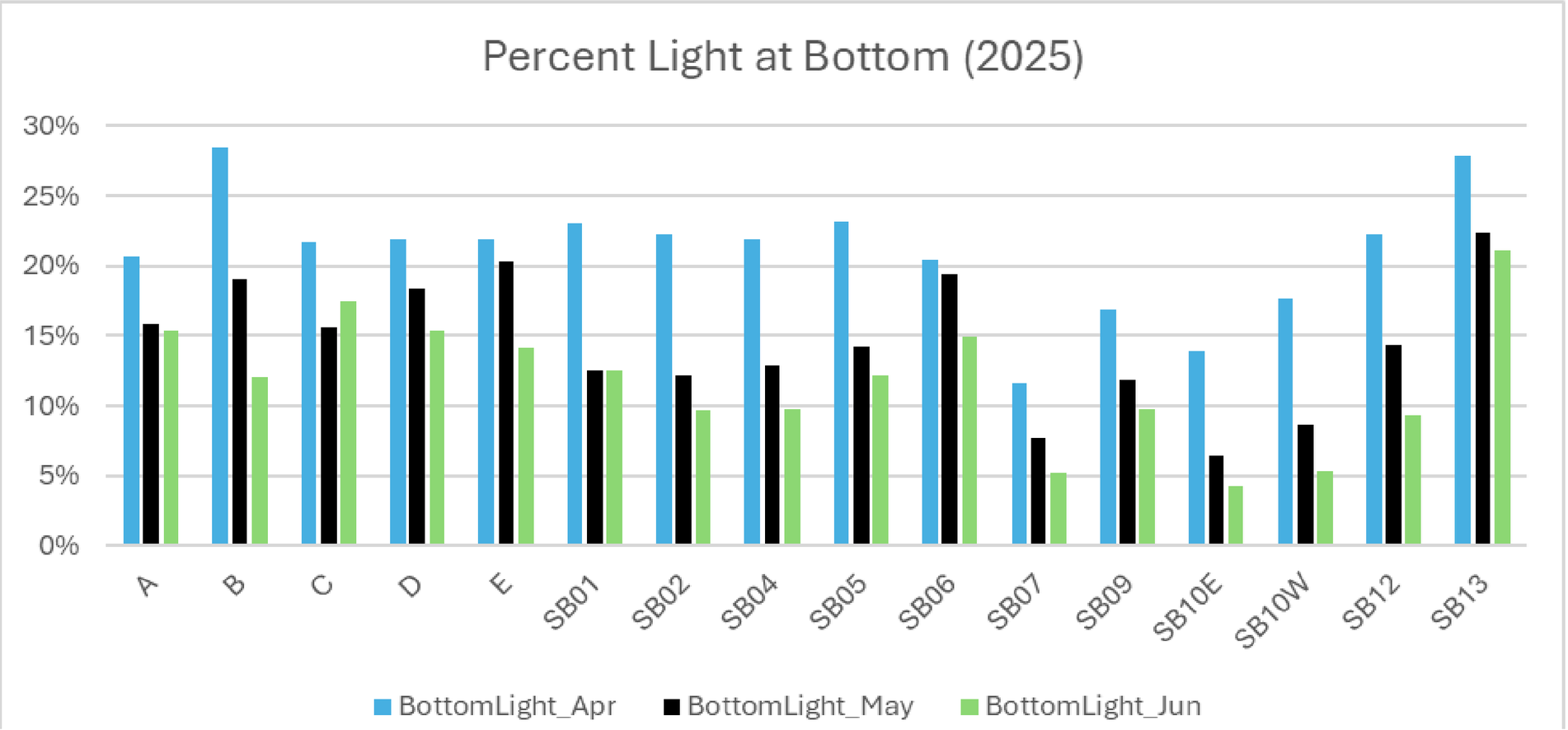
Condition	Rule
Clear (deep Secchi + low Kd)	Secchi ≥ 0.85 AND Kd ≤ 2.0
Moderate	everything else
Murky (shallow Secchi + high Kd)	Secchi ≤ 0.65 OR Kd ≥ 2.6

Year	Apr Clarity	May Clarity	Jun Clarity
2013	Murky	Moderate	Moderate
2014	Clear	Moderate	Moderate
2015	Moderate	Moderate	Murky
2016	Moderate	Moderate	Moderate
2017	Moderate	Clear	Moderate
2018	Clear	Murky	Moderate
2019	Murky	Clear	Moderate
2020	Moderate	Moderate	Moderate
2021	Moderate	Moderate	Murky
2022	Moderate	Moderate	Moderate
2023	Clear	Clear	Clear
2024	Clear	Clear	Moderate
2025	Clear	Moderate	Murky

Canal Water Quality During SAV Growing Season

Calculated available light at depth from Secchi across all canals

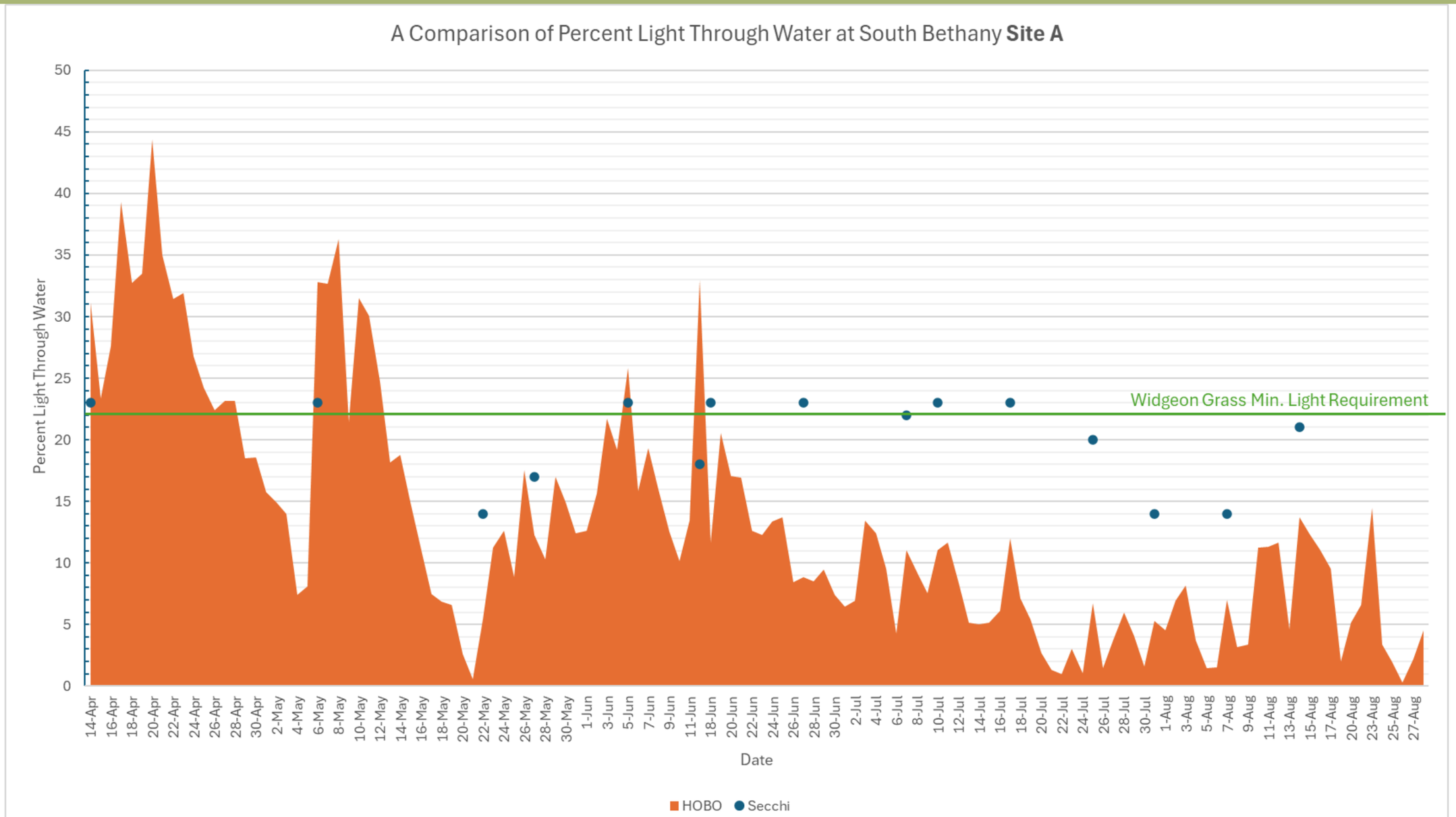
Example of how Secchi depth can be derived into light data. Only 2025 was done due to the availability of Secchi at our project sites.



Row Labels	Average of Hobo Kd PLW	Average of PLW
⊞<4/14/2025		
⊞Apr	29	23
⊞May	15	18
⊞Jun	15	22
⊞Jul	6	20
⊞Aug	11	17

1. Light conditions sufficient for Ruppia establishment (PLW >20%) were spatially limited and temporally constrained to early spring (April).
2. Majority of project sites had light available longer than other canals.

Continuous Monitoring vs Secchi



South Bethany work

Establishing Long Term Monitoring

- **3** times a year
- Percent cover of plant
- When flowering peaks

Seed Collection

It takes 100,000 viable seeds to plant 1 acre of Widgeon grass.

DNREC Seed Processing Facility

Processing

The Turbulator

2023: 80,000 seeds
2024: 2,200,000 seeds
2025: 10,000 seeds

Widgeon Grass Plantings

Assawoman Wildlife Area
- Summer & Fall 2024

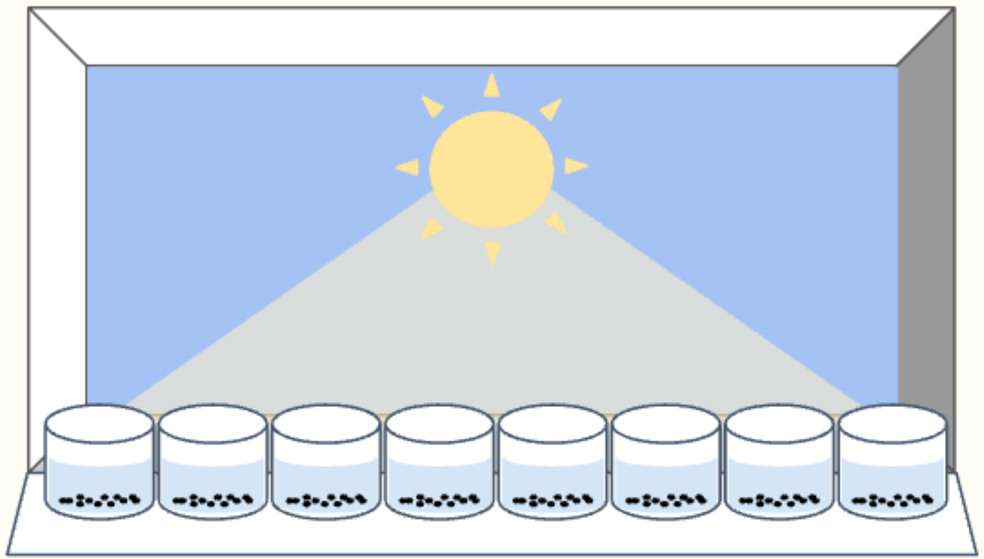
~7 Acres Planted

Pasture Point - Spring 2025

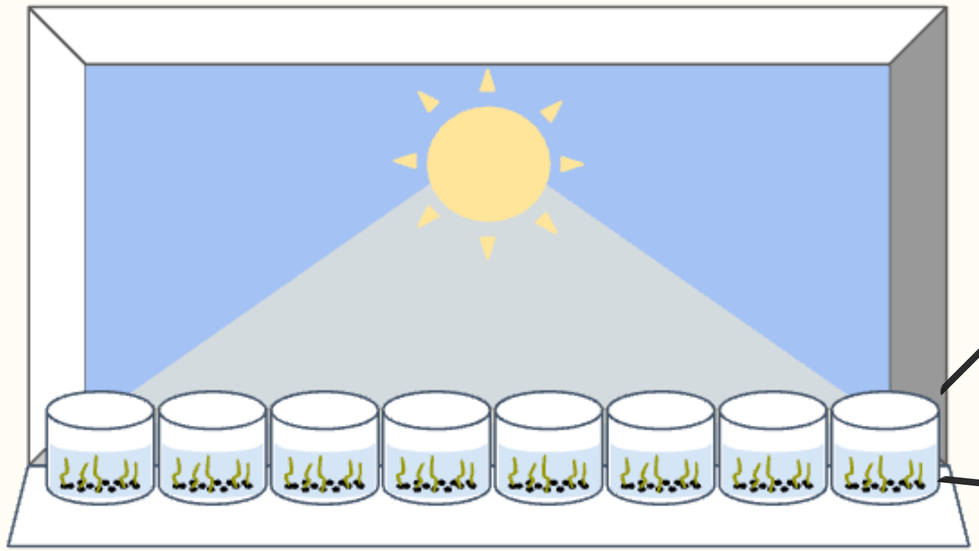
Germination Trials

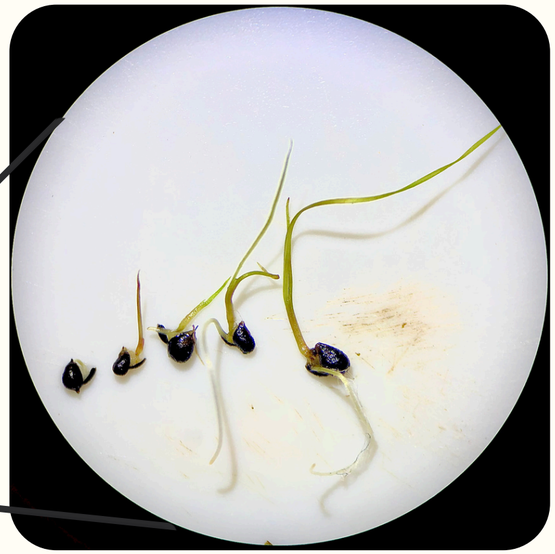
Tested growth conditions in various salinity treatments

Week 1



Week 4



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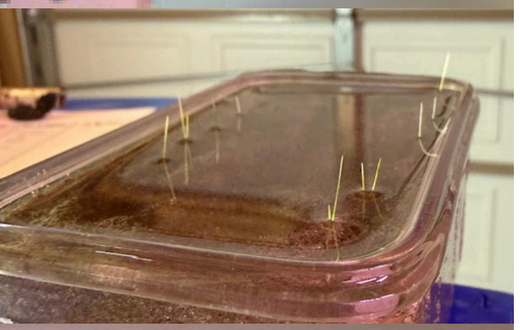
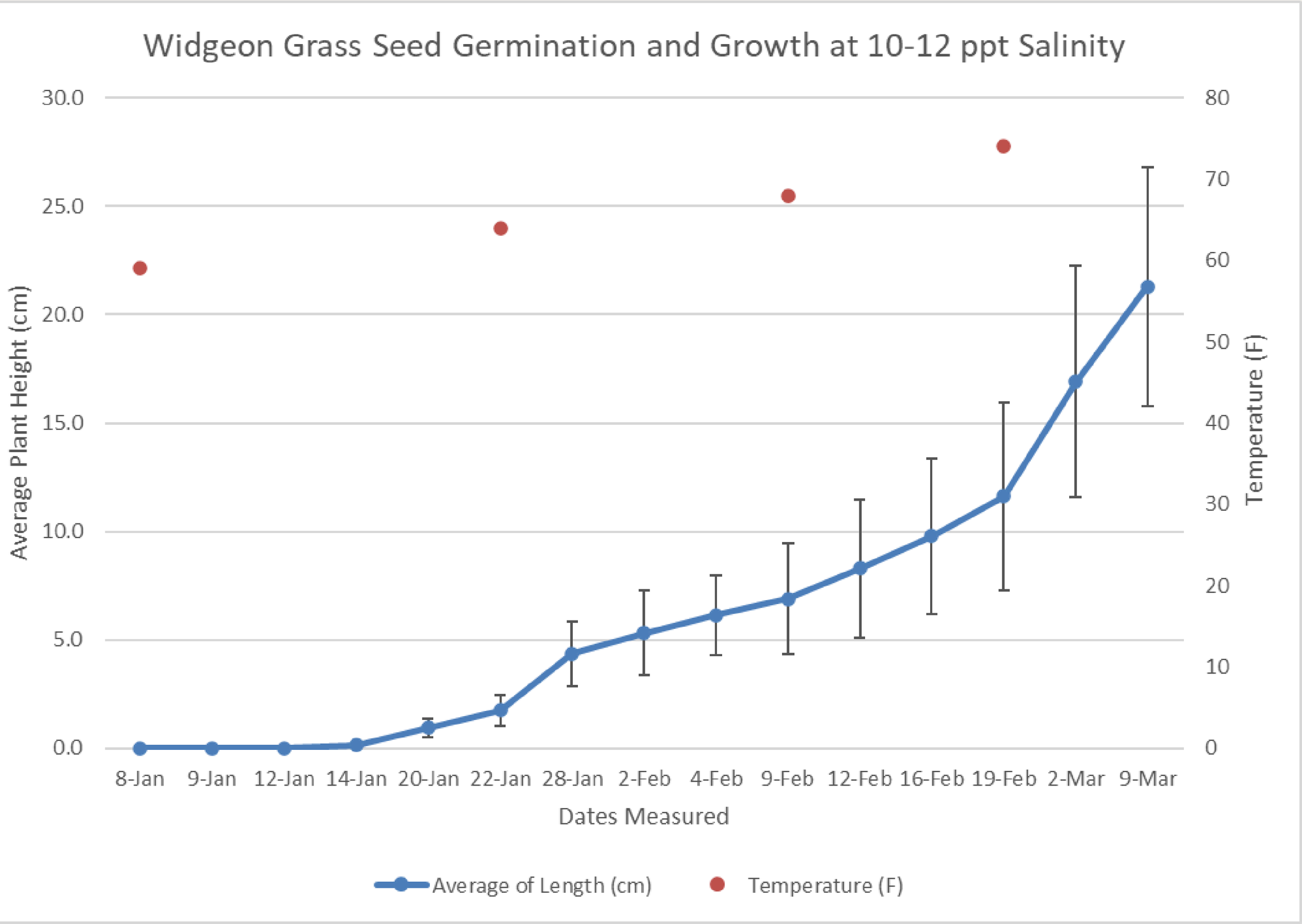



Widgeon Grass Seed Germination and Growth at 10-12 ppt Salinity
Average Plant Height (cm)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Temperature (F)
80
70
60
50
40
30
20
10
0
8-Jan
9-Jan
12-Jan
14-Jan
20-Jan
22-Jan
28-Jan
2-Feb
4-Feb
9-Feb
12-Feb
16-Feb
19-Feb
2-Mar
9-Mar
Dates Measured
Average of Length (cm)
Temperature (F)

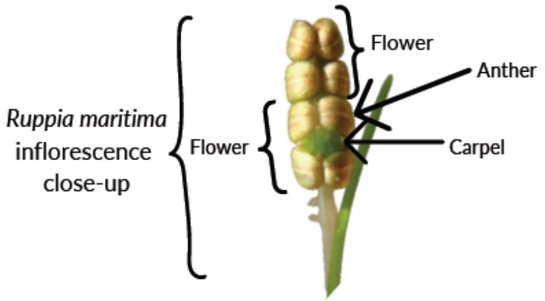
Moving Forward

Data Collection:

1. Bathymetry survey
    a. Process 2025 and collect 2026
2. Loggers and water quality
    a. Deploy loggers in select locations
3. Weekly checks
    a. Monitor reproductive growth
4. Collection and seed processing
    a. Typically end of May-early June
5. Aquatic life
    a. Conduct seining to study fish and invertebrate communities

Ruppia maritima Growth Development

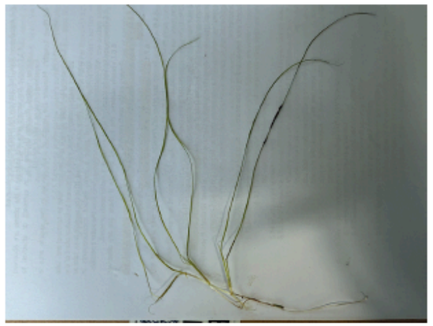
Ruppia inflorescence features two oppositely arranged flowers, each typically containing four anthers and four carpels at the end of an elongated peduncle (Taylor et al. 2020).



Inflorescence at end of peduncle

Inflorescence is 2-4 cm in length (WFO, 2025)

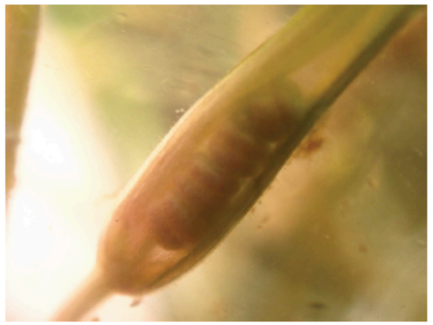
While development is continuous, the stages outlined below (1–10) represent key milestones from early inflorescence formation to mature seed, serving as a reference for monitoring.



Stage 1

Early plant growth.

Plants are visible with no inflorescence noted.



Stage 2

Early inflorescence.

Small, green, completely enclosed in sheath.

DelawareSAV.org

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THANK YOU!

Get Involved

- *Become an SAV Seeker*
- *Join our workgroup*
- *Contribute to iNaturalist*

Delaware Center for Inland Bays:
Taylor Hoffman
thoffman@inlandbays.org

Water Quality Sources

Sources:

1. Delaware Water Quality Portal (1998- current)
    a. University of Delaware Citizen Monitoring Program
        i. South Bethany Water Quality Monitoring Committee
2. DeSSAV *by DNREC & DE Sea Grant* (2025-current)
    a. Center for Inland Bays monitored one location in 2024