Widgeongrass seeding methods from a manipulative field experiment

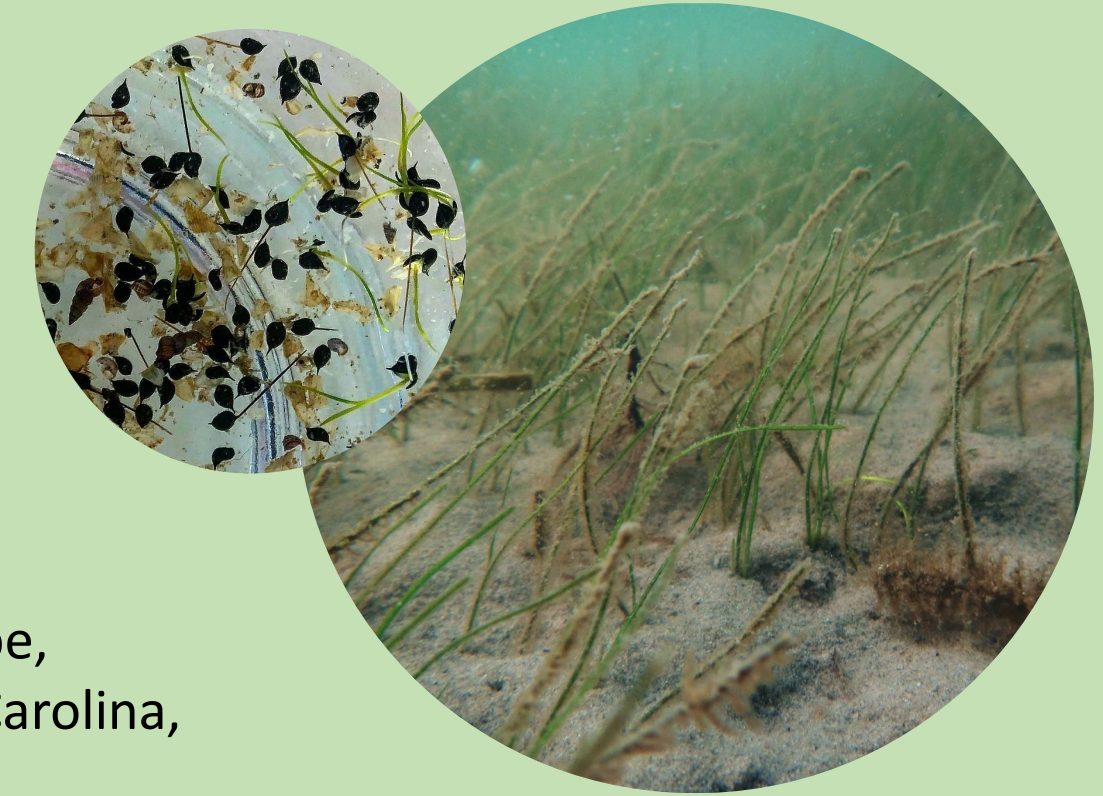
‘Incorporating generalist seagrasses enhances habitat restoration in a changing environment’

Presented by Enie Hensel

March 22, 2023 | SAV working group of the Chesapeake Bay

Widgeongrass *Ruppia maritima*

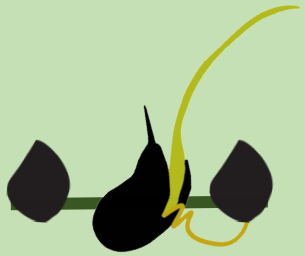
- Distributed worldwide
- Seed producing
  - Advantageous for global seagrass conservation
- Opportunistic
  - Fast growing
  - Shallow roots
  - ephemeral
- Generalist
  - Wide ranging salinity & temperature
- Tolerant to warming waters
- Restoration/applied ecological research in Europe, Australia, N. Gulf of Mexico, Florida Bay, North Carolina, Chesapeake Bay

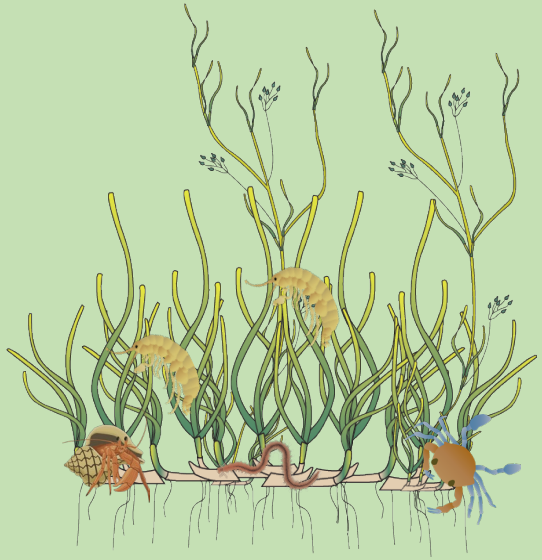


Outline

ruppia methods are modified from S. Ailstock's research and our lab's approach with *Zostera*

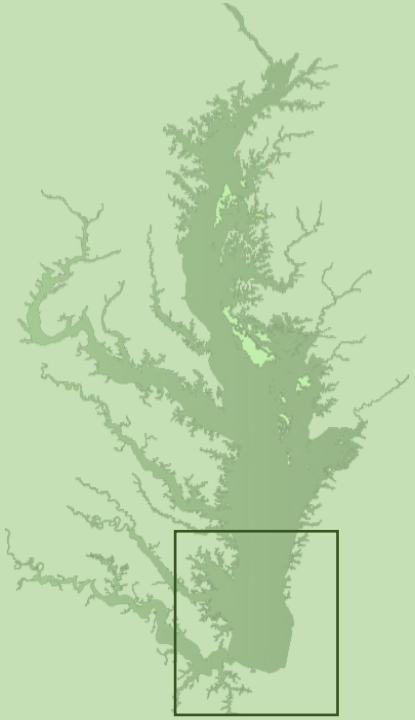
- Collection
- Processing
- Storage
- dispersal
- outcomes so far
  - germination in nature
  - sustained growth in nature





VIMS

Coastal Estuarine Ecology Lab & SAV Monitoring Program



Broad Bay
Lynnhaven River System
Experimental Location

VIMS | William & Mary
Virginia Institute of Marine Science

seed collection occurs in May & June

- Seeds are hand picked and still attached to plant material
- Seed + plant materials are kept submerged and sorted into large, outdoor, aerated tanks
- As plant material decays, it is sieved out while seeds drop
  - Different from S. Ailstock methods
  - Key to quickly remove *Ruppia* seeds from plant material

Seed are processed first through fluming

- Heavy *Zostera* seeds = best seeds
- Viability of *zostera* is tested from weight, or fall velocity, and seed firmness
- *Ruppia* – unknown if these simple test are reliable
- Aly Hall is working on a suite of viability tests
  - Fall velocity
  - Seed shape
  - Germination rate
  - Live tissue staining

Seeds are stored in aerated, chilled tank until planting time

- Stored in chilled tanks in bins (20-22C)
  - Keep seed ‘pile’ shallow, ~ 2.5-3”
- *Ruppia* seeds can store in dark fridge at 4C for 3-10years
- Planting time is in October

Seed broadcasting - planting

- Seeds per 1m^2 varies
  - 25 – 100 seeds per 1m^2
- *Ruppia* has been planted in the field a few times from our lab, all having establishment success thus far
  - Experiment – three locations
  - Restoration – primary focus are available lease areas in Lynnhaven River System

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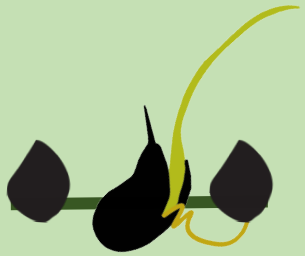
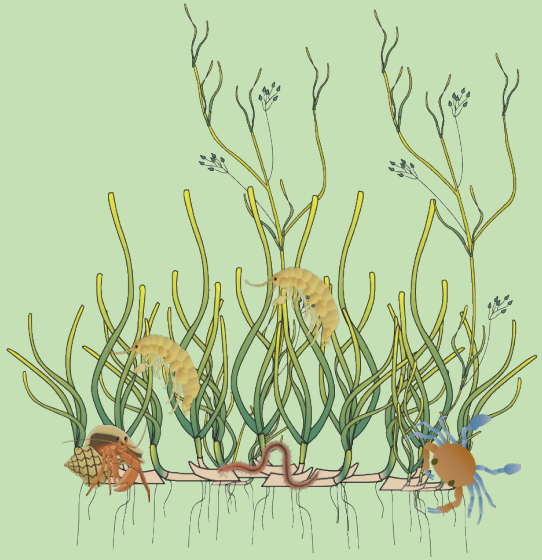
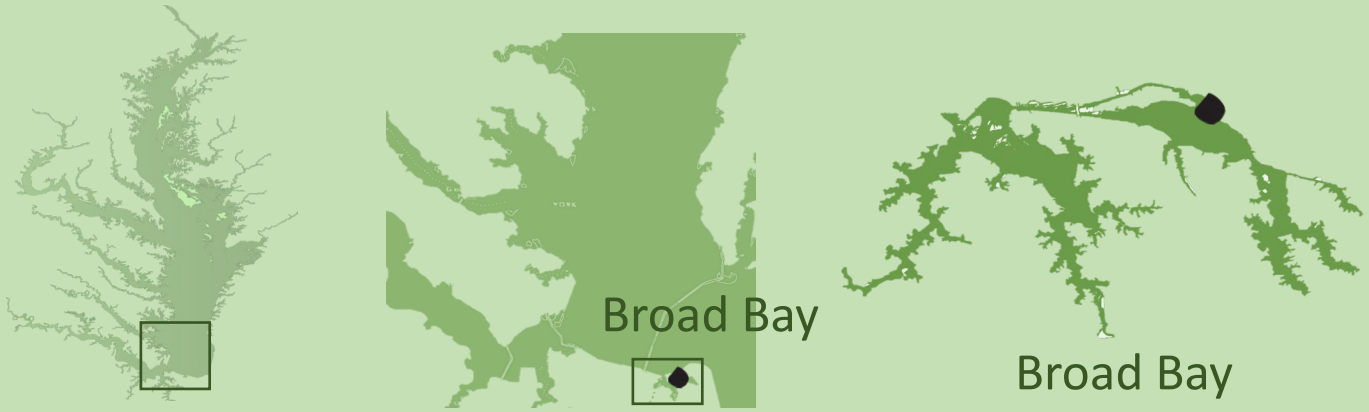


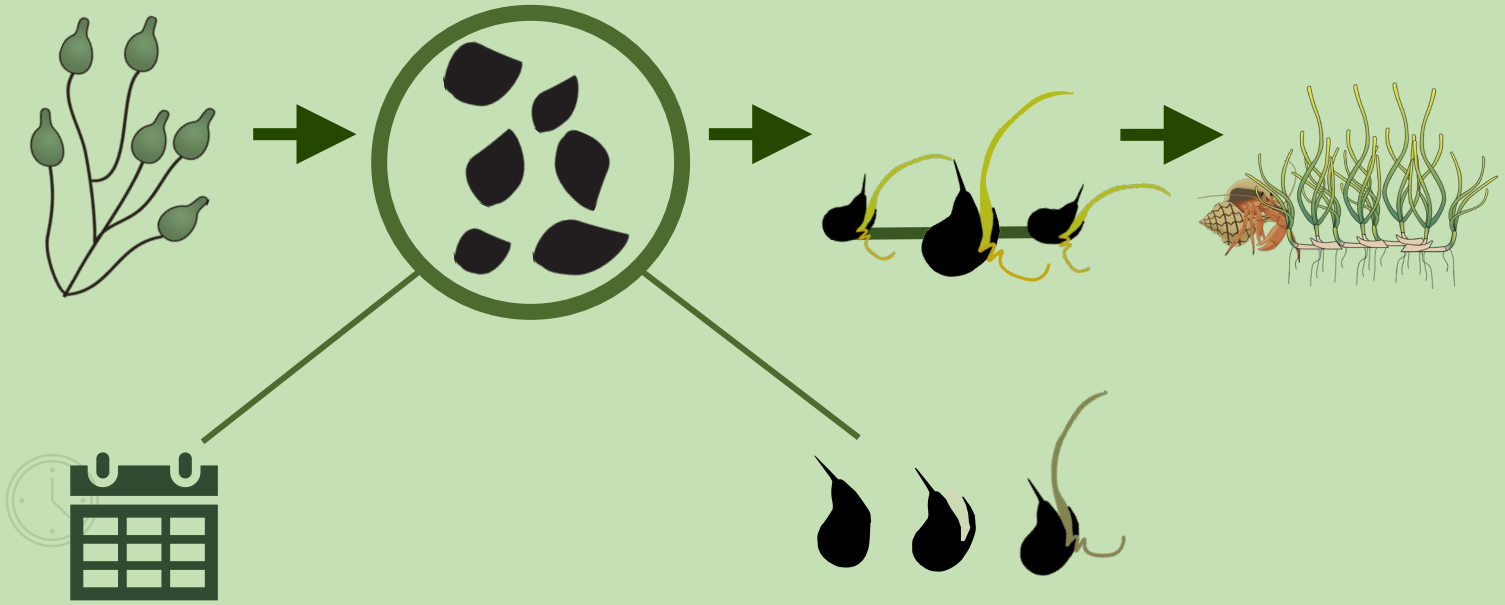


Review outcomes from a restoration field experiment with *Zostera marina & Ruppia maritima*

- Tested for best Ruppia maritima planting practices
- Compared how species alter bed structure and function
- Does experimental findings scale-up to restoration scales?
- Does planting both species enhance restoration success Does experimental findings scale-up to restoration scales?



How does *Ruppia maritima* broadcast seed dispersal method alter bed establishment and composition?



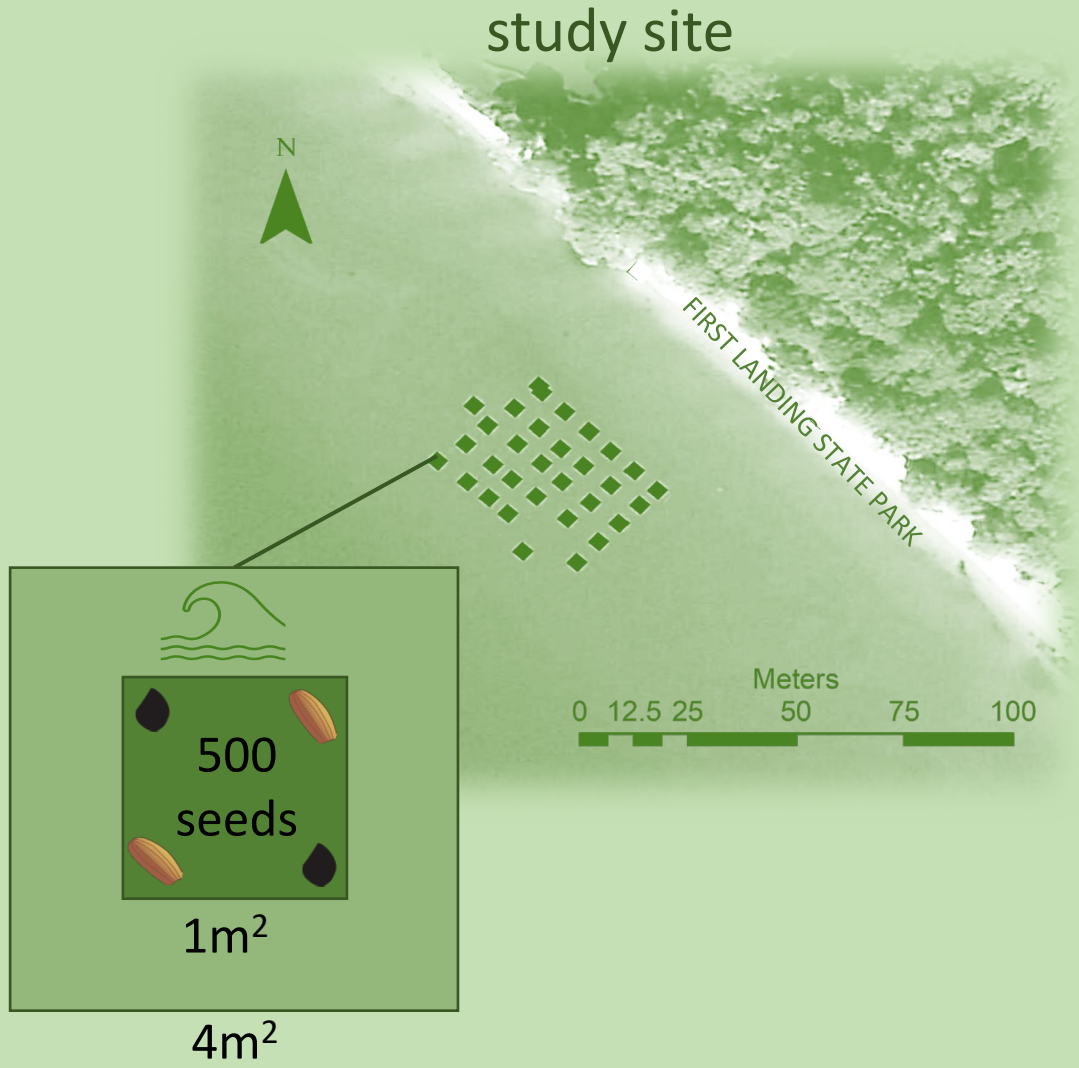
fall or spring

pre-seed treatment + development

experimental design

TREATMENTS

- ***Zostera maritima*** – seeded in fall
- ***Ruppia maritima*** – seeded in fall
- ***Ruppia maritima*** – seeded in spring
- ***Ruppia maritima*** – seeded in spring, seeds had 48-hour freshwater shock
- ***Ruppia maritima*** – seeded in spring, seeds had freshwater shock until germination
- **bare sediment control**



Ruppia maritima broadcast in the fall with no pre-treatment established bigger and denser plots

seeded in fall

no pre-treatment

no pre-treatment

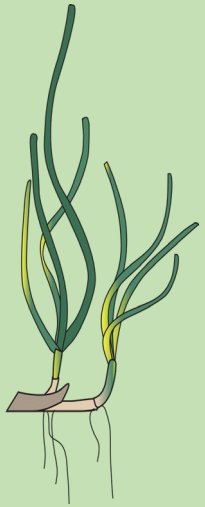
seeded in spring

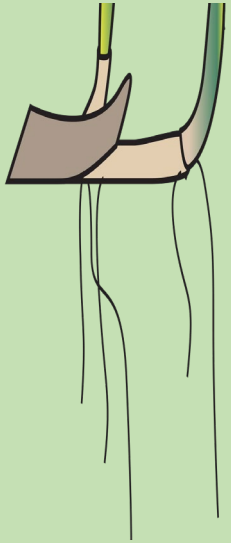
48-hr FW shock

FW till germination

R. maritima & Z. marina established in both sites

R. maritima may be vulnerable in Broad Bay

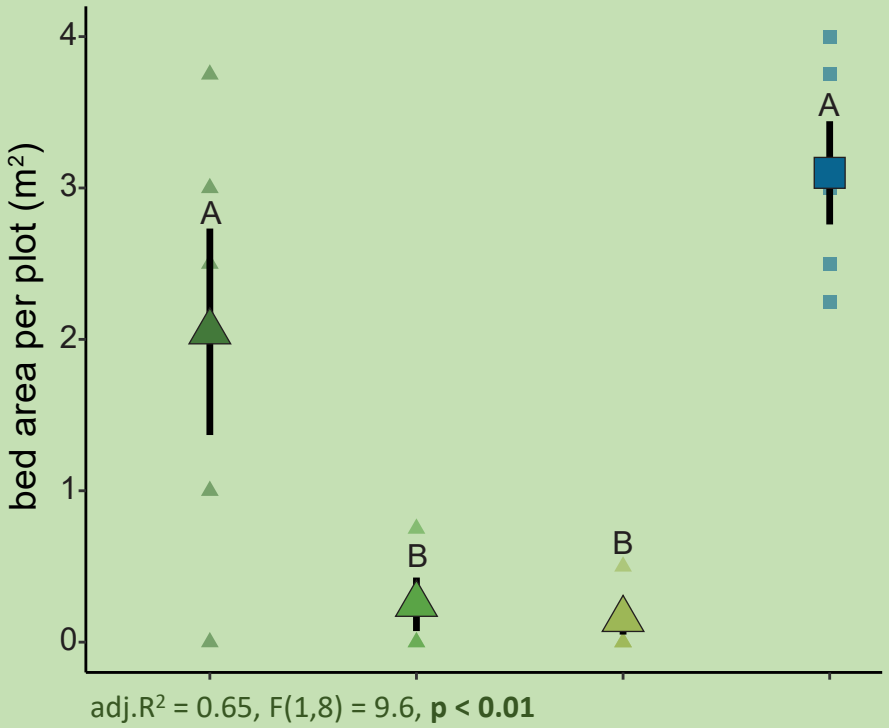




	Zostera	Ruppia fall	Ruppia spring	Ruppia spring + fw shock	Ruppia spring + gemination
Spring - April					
Lynnhaven	5	3	0	0	0
Goodwin	5	5	0	0	0
Summer - June					
Lynnhaven	5	4	3	4	3
Lynnhaven	5	4	2	2	0
Goodwin	5	5	5	5	5
Summer Final – July					
Lynnhaven	5	3	3	1	2
Goodwin	5	5	4	4	4
%plots w/ plants					
Lynnhaven	**100%**	**75%**	**100%**	**25%**	**67%**
Goodwin	**100%**	**100%**	**80%**	**80%**	**80%**

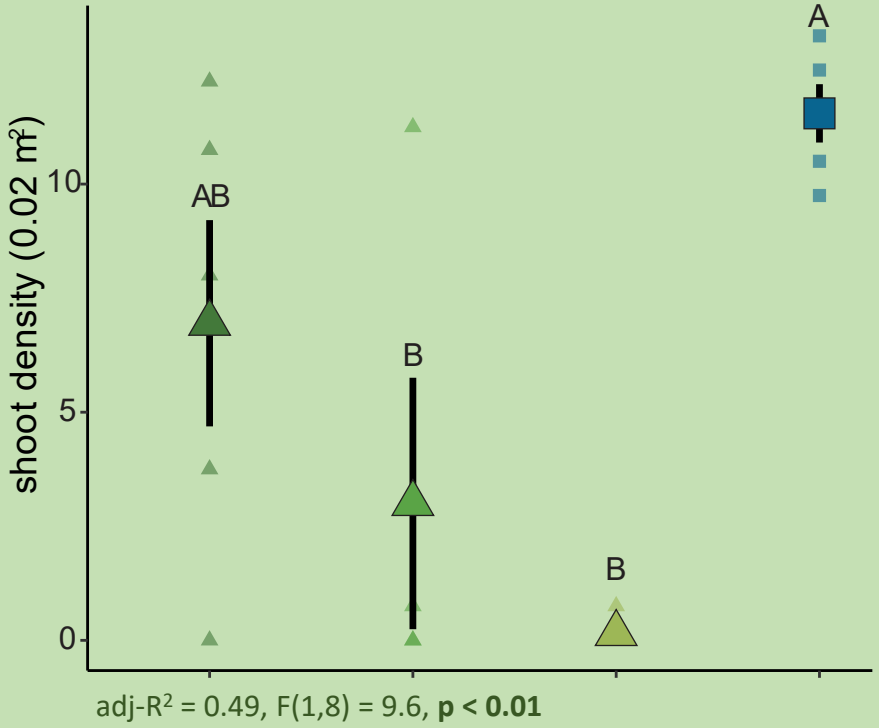
Zostera and *Ruppia* established similar bed area and shoot density

areal cover of 2-3 m²



adj.R^2 = 0.65, $F(1,8)$ = 9.6, **$p < 0.01$**

shoot density of 15-18 shoots



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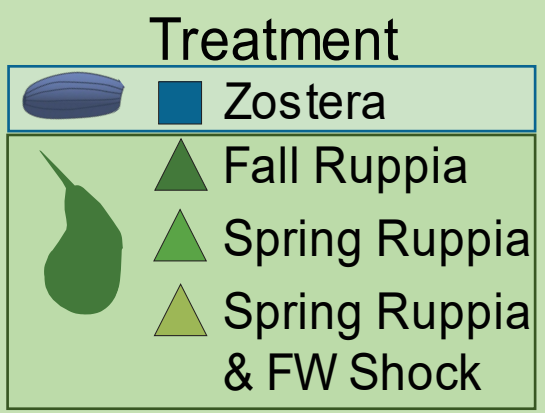
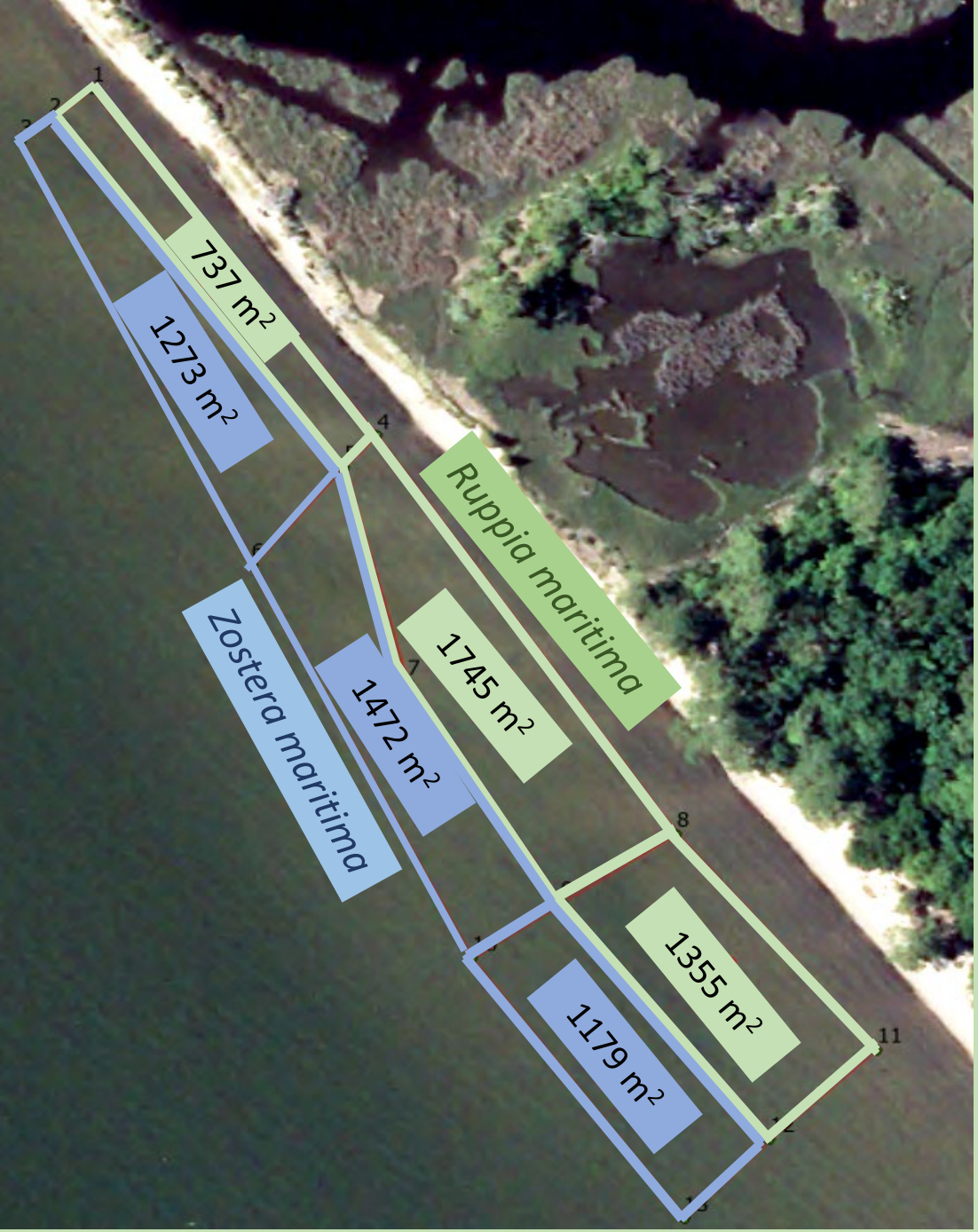


SHORT RESULTS TO UPDATE CHESAPEAKE BAY SAV WORKING GROUP October 2022, *manuscript in prep.*



Planted ~ 2 acres of seagrass

Ruppia : 50-100 cm depth at low tide, minimal depth increase at high tide aka nearshore

Zostera : 100-150 cm depth at low tide

Seedlings broadcasted & why

- *Ruppia maritima* 90 seeds per meter-sq
  - Determined by 9.2% and 0.76% germination rate estimates from spring 2021 experimental data as well as seeds available for broad-casting at SAV-CEEL lab.
- *Zostera marina* 50 seeds per meter-sq

planting area increased by 170 % using both grass species

LYNNHAVEN

***Zostera marina* 16.98 % ± 4.57 SD**

50 seeds dispersed per meter-sq

Ruppia maritima* 2.13% ± 0.6 SD

** Still too early to estimate based on 2021 R. maritima shoot emergence timing. Being re-assessed June 2022*

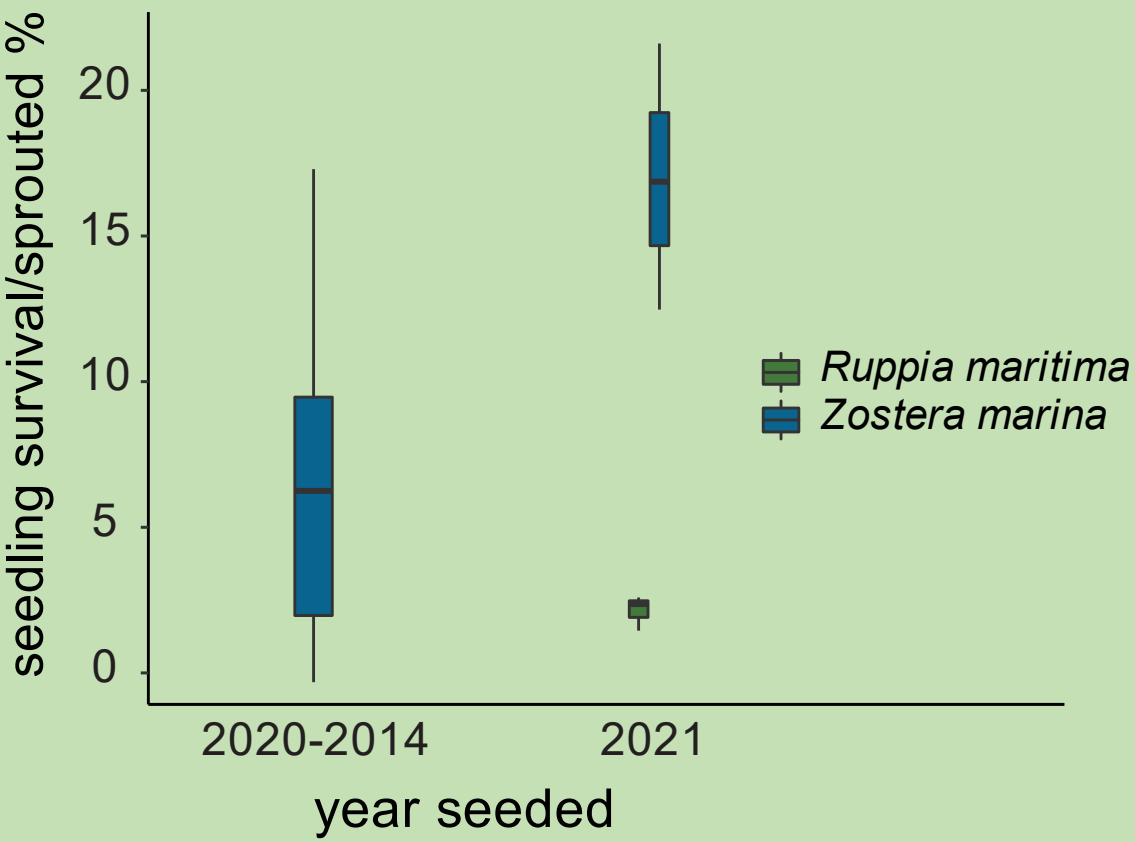
90 seeds dispersed per meter-sq

PAST RESTORATIONS 2014-2020

***Zostera marina* 5.71 % ± 4.54 SD**

min 25 seeds dispersed per meter-sq, range between various efforts is 25 -100 seeds dispersed per meter-sq

early spring seedling rates scale-up!



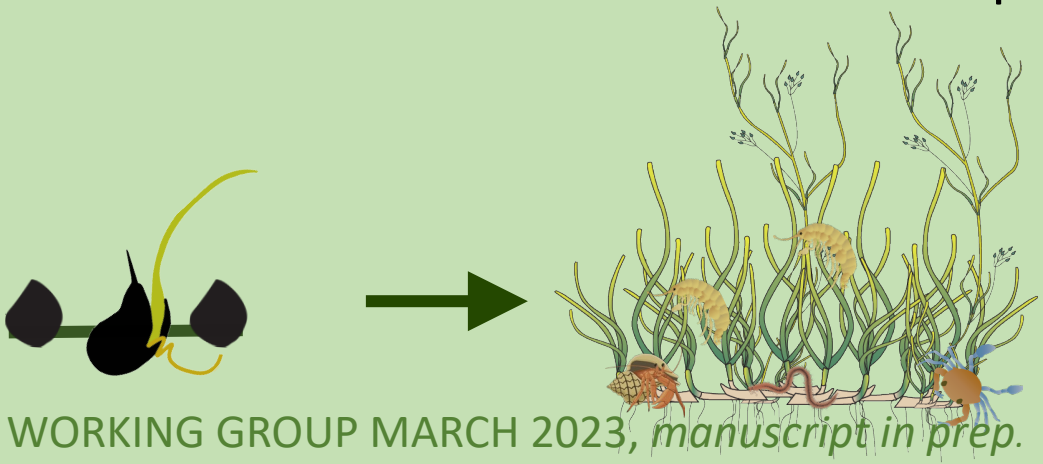
Experimental 1m^2 plots had

- 2-3m^2 areal growth for both species
- Shoot densities 750 – 900

upcoming monitoring

Ruppia is a proactive restoration choice

- Collection in June --- watch for flowers & seeds
- Processing --- immediately transfer to tanks and help remove plant material
- Storage --- 20-22C lightly packed in aerated saltwater
- dispersal --- broadcast seeding is promising, seed density min 80 seeds per m^2 recommended due to patchy growth pattern
- outcomes so far
  - Ruppia maritima can not only provide short term restoration success, also provide longer-term restoration success to lost or other species through its engineering



Acknowledgements

coauthors:
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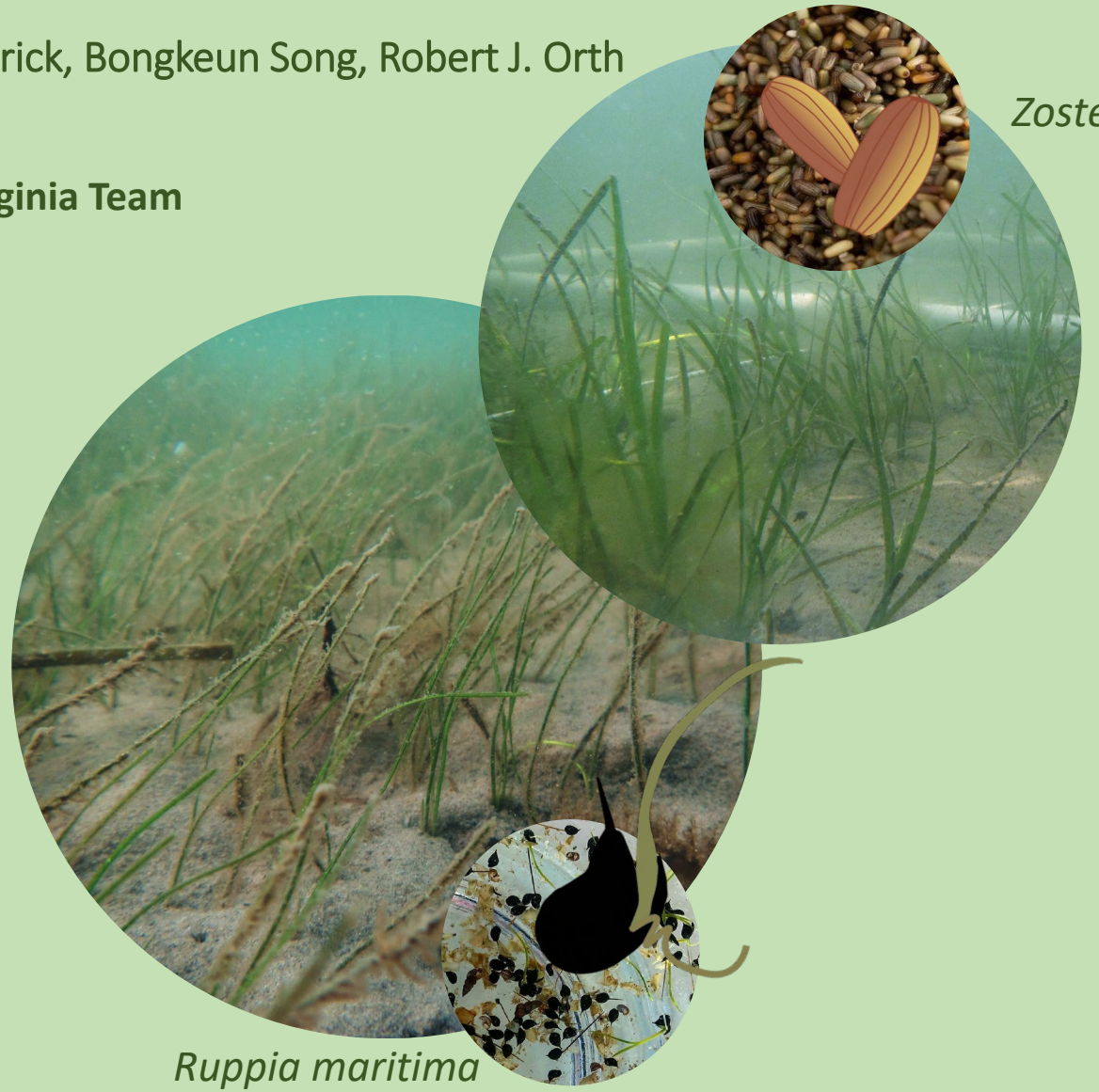

Zostera marina

Ruppia maritima

US Army Corps of Engineers®

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