MOSQUITO CONTROL MANGROVE IMPOUNDMENT AS A POTENTIAL SEAGRASS NURSERY HABITAT

J. Cho[1] & Jonathan Linder[2]

[1]Bethune-Cookman University

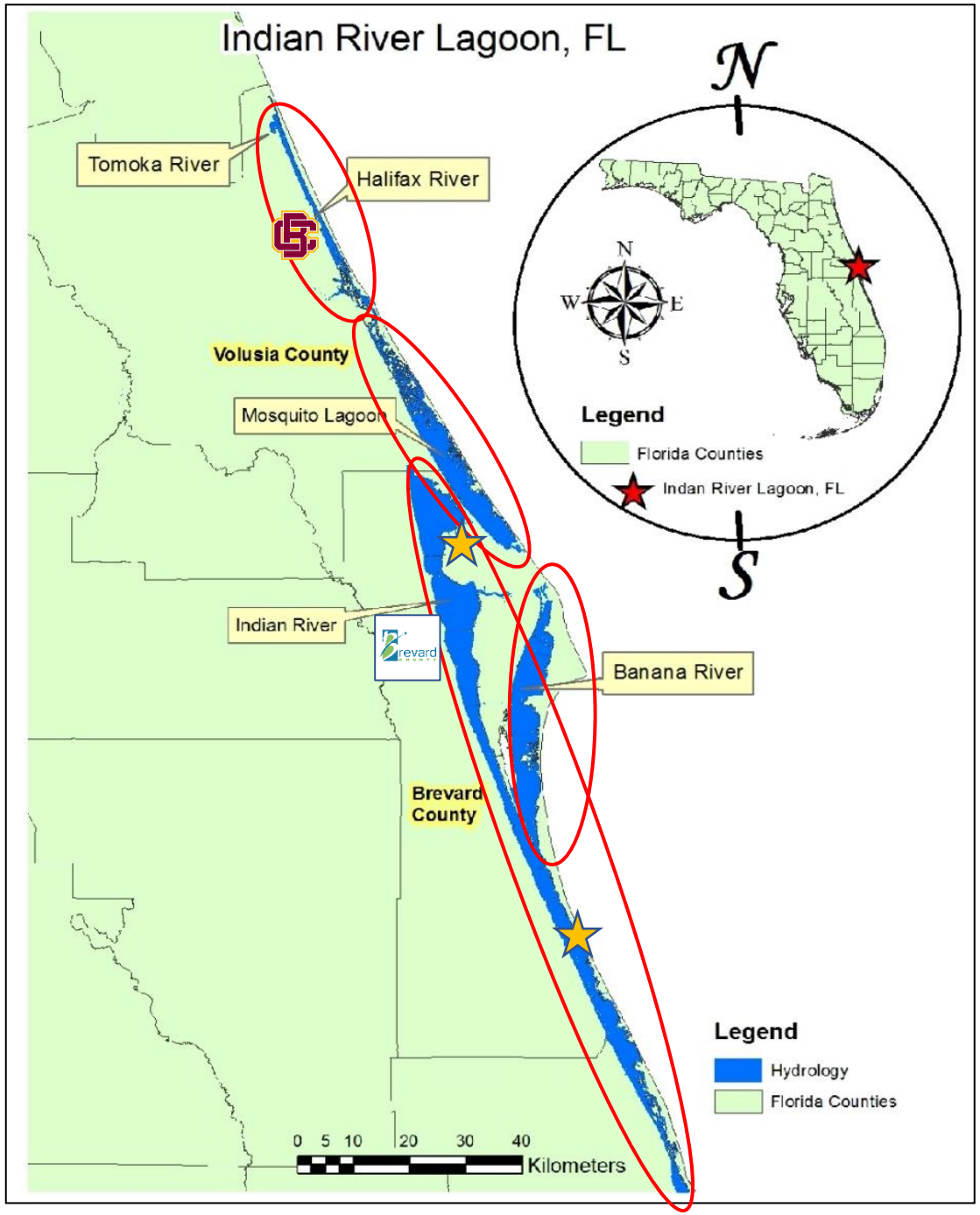
[2]Brevard County Mosquito Control

Prepared for and presented to 2024 CHIMMP

January 17, 2024 (Wednesday)

The Indian River Lagoon System

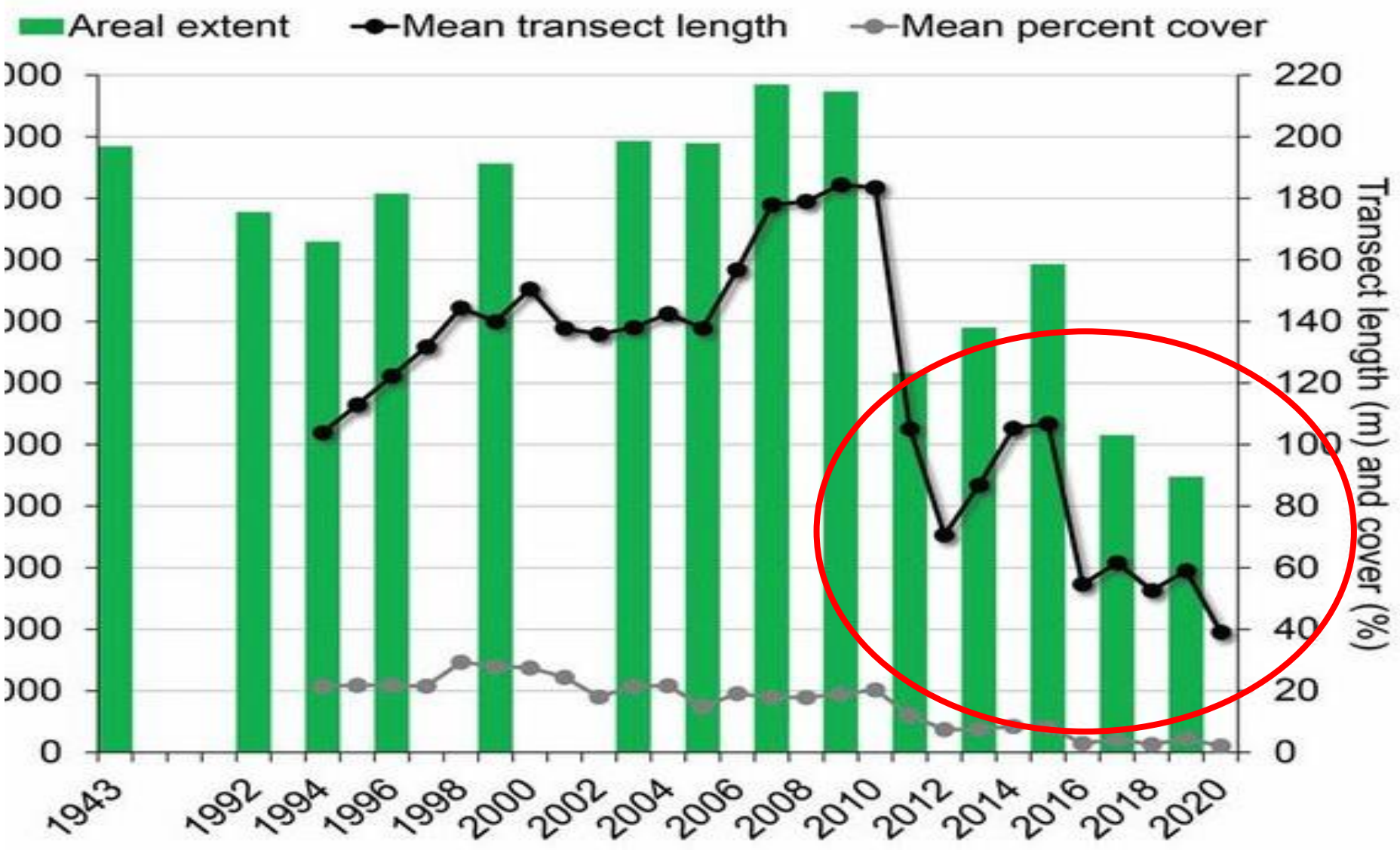
- An estuarine system with interconnected sub-lagoons (156 miles long)
  - Mosquito Lagoon
  - Indian River
  - Banana River
- Halifax River
  - A 23 mile (37 km) long estuarine lagoon
- Project locations
  - North Siphon, Indian River Lagoon Preserve State Park
  - Merritt Island




Chlorophyll-a
photo credit: R. Fatzinger


//phys.org/news/2017-05-wildlife-rich-lagoon-florida-threatened-boom.html


N
0 2.5 5 10 Miles
scene edge
2016.02.16
Landsat 8
Path 16, Row: 40
4,3,2 (true color) composite

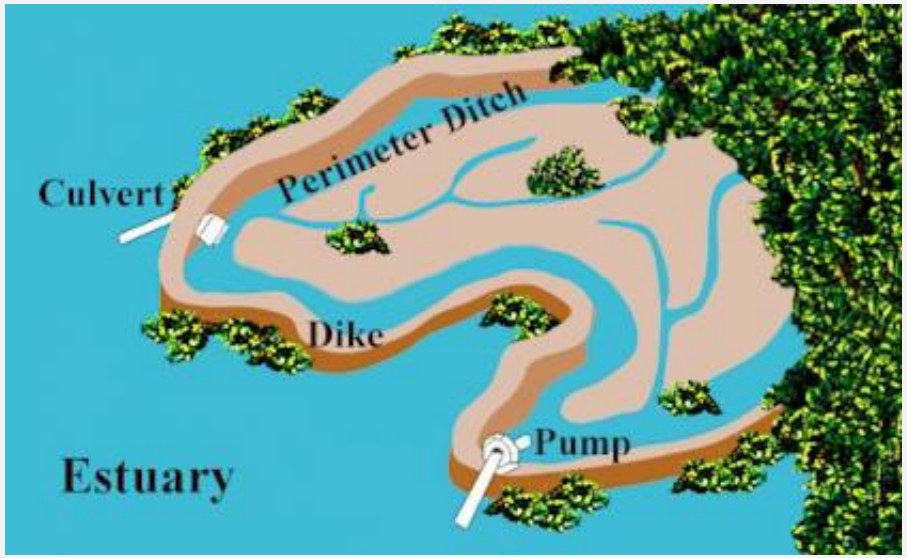


IRL Seagrass Survey Data; Source: St. Johns River Water Management District

IRL Seagrass Restoration using Mosquito Control Impoundment

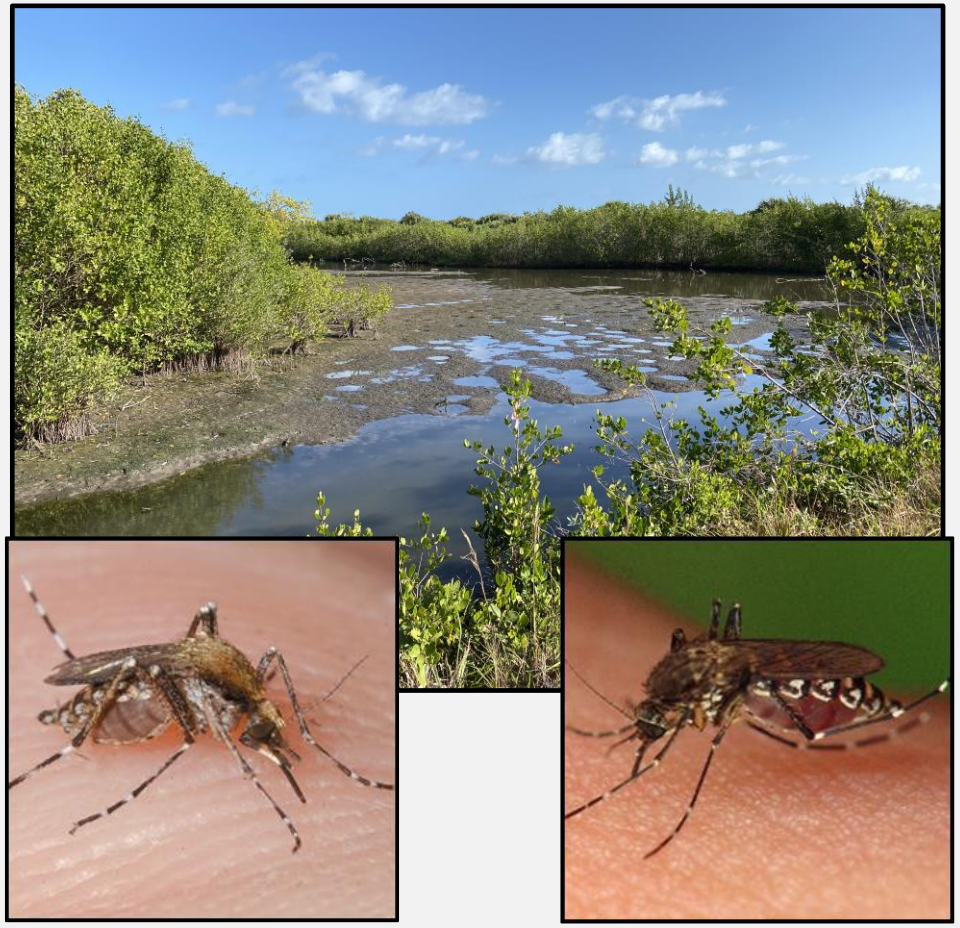
Google.com photo

WHAT ARE MOSQUITO CONTROL IMPOUNDMENTS?



WHY CREATE IMPOUNDMENTS?

Salt Marsh Floodwater Mosquitoes!

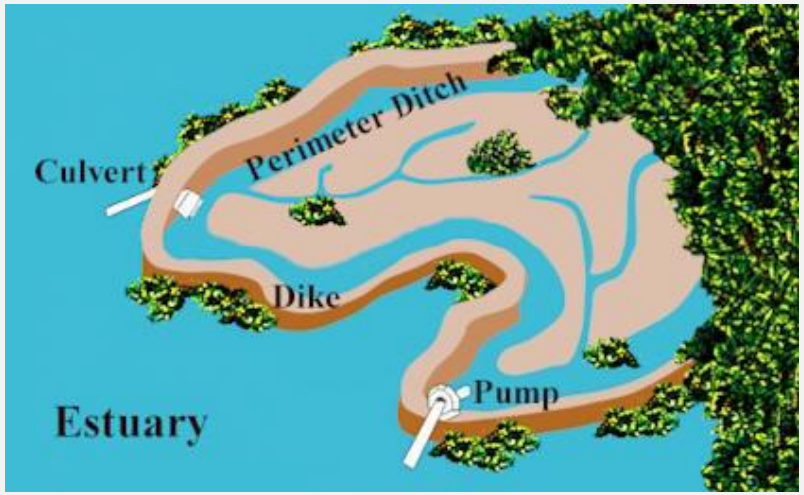


Aedes sollicitans

Aedes taeniorhynchus

- Oviposit on exposed mud
- Lay up to 45,000 eggs per foot = 2 billion eggs per acre
- Larvae hatch when mud is inundated with water
- Adults can emerge within one week
- Adults are aggressive nuisance species with long flight range
- *Ae. sollicitans* is associated with Eastern Equine Encephalitis

IMPOUNDMENT MANAGEMENT: LARGE-SCALE SOURCE REDUCTION



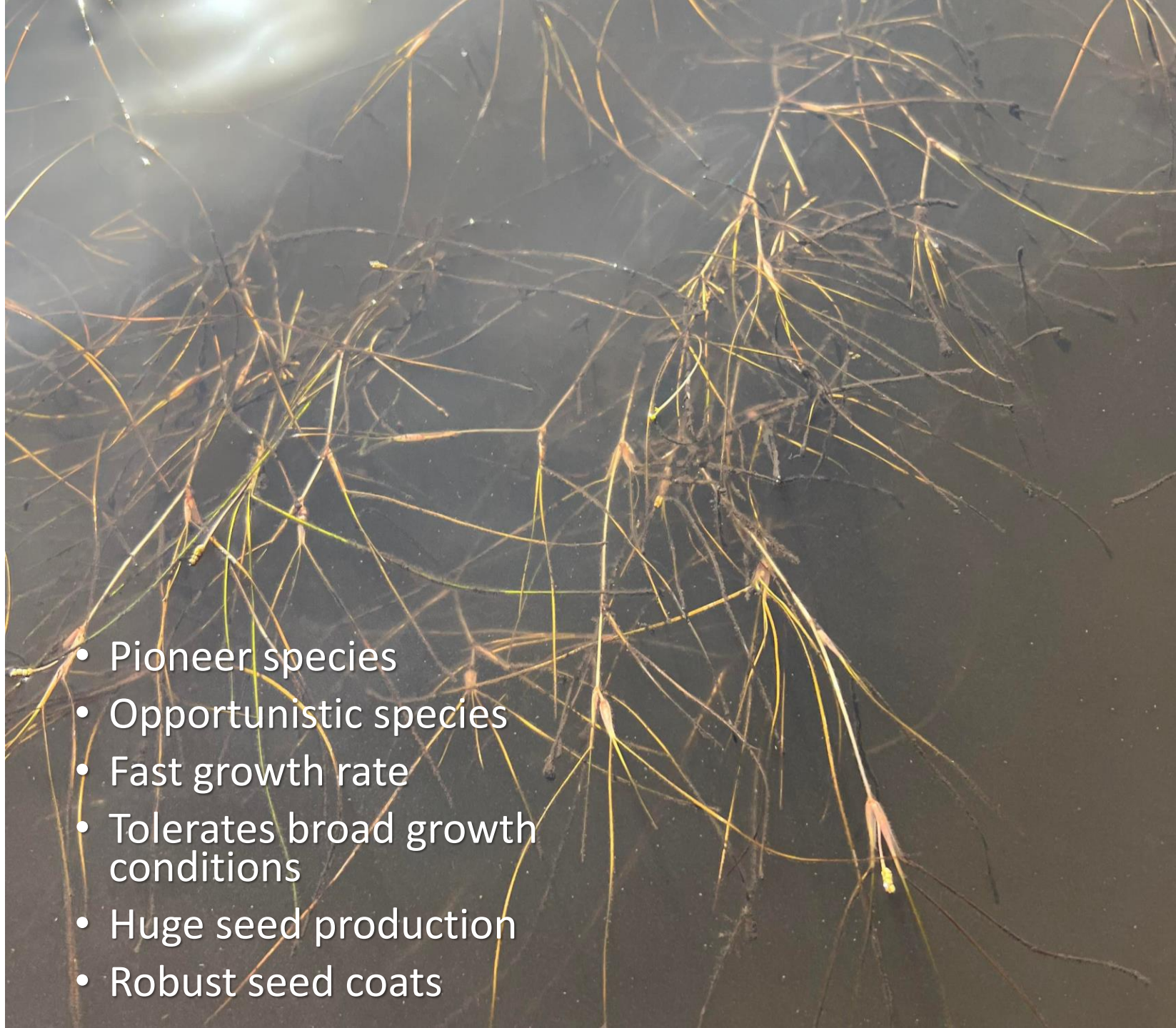
- Earthen dikes built to surround shallow wetland breeding areas
- Built in the 1950's and 1960's
- Greatly reduce salt marsh mosquito populations by keeping mud submerged
- Water level management enhanced by culverts and pumps
- Rotational Impoundment Management (RIM) program in managed areas

Why Impoundments May Excel As Seagrass Nurseries

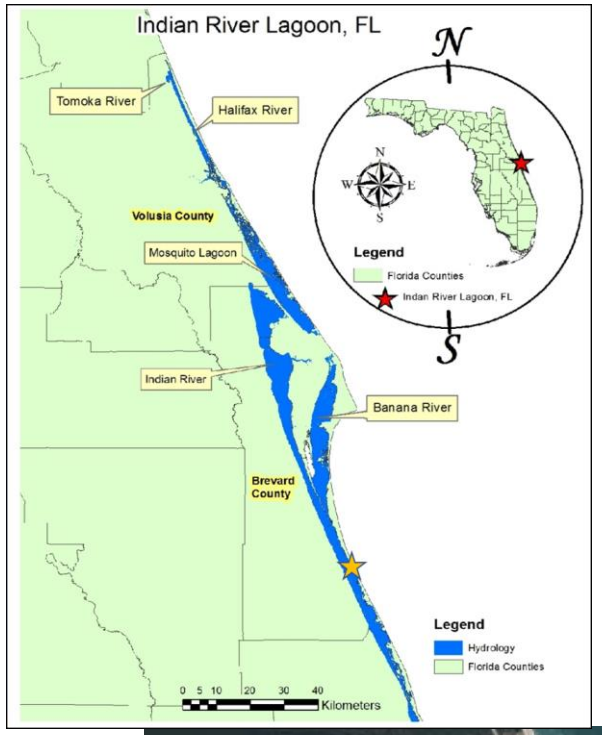
- Can be hydrologically separated from the IRL
- Limited access by large grazers
- Predictable seasonal water level changes
- Water elevation and flow can be adjusted using culverts and pump
- Culverts could be partially opened to allow seeds to spread into lagoon

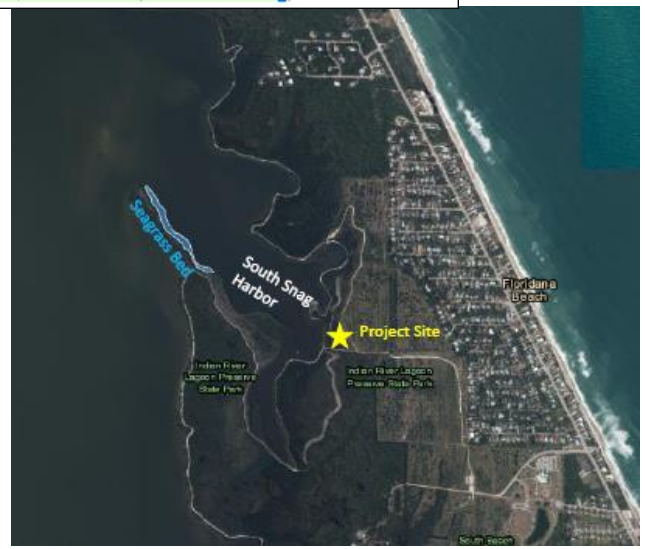
Ruppia maritima L.
Wigeongrass

- Tolerates salinities ranging from <5 to >40 ppt
- Fast growth and abundant production of seeds
- Long-distance dispersal of propagules through gut-passages of waterfowl and fish

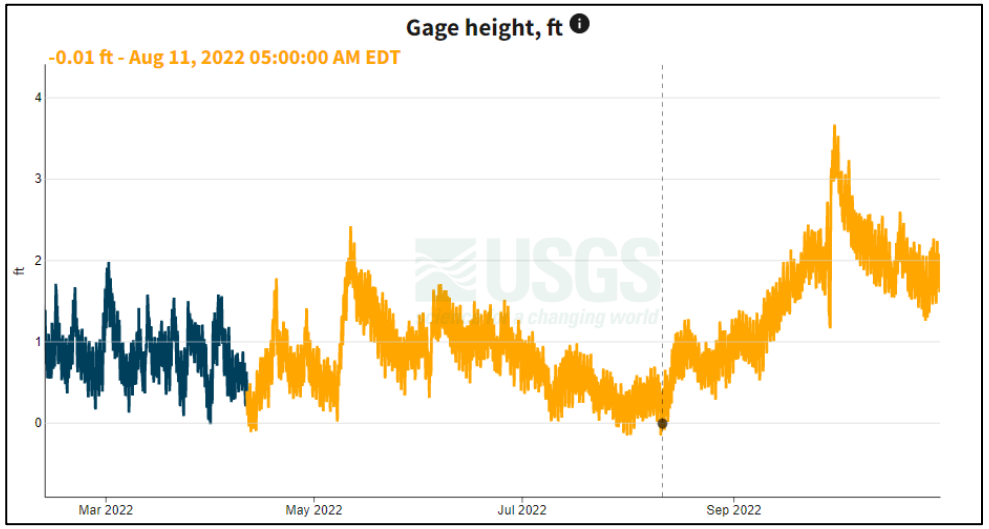


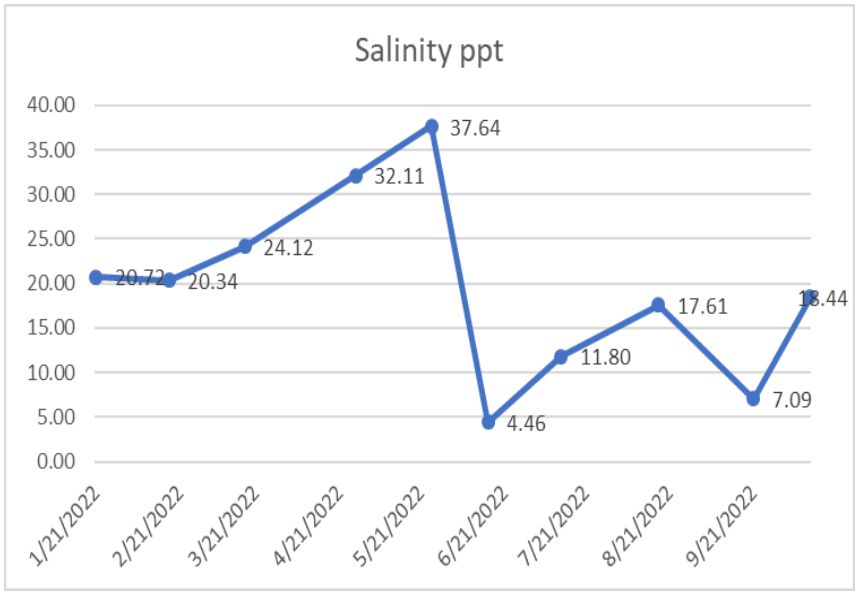
Impoundment *Ruppia* Plantings, 2022



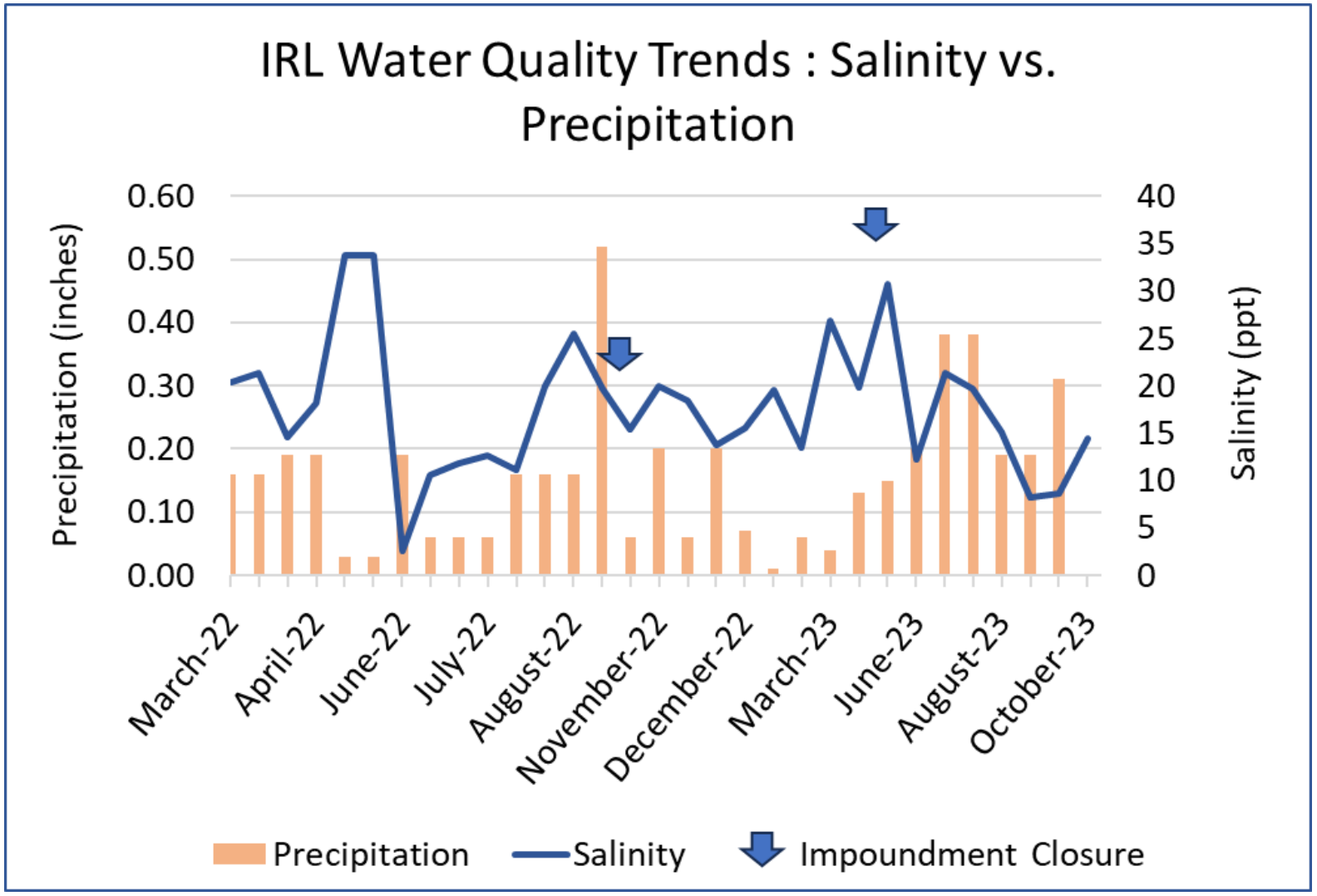


From Extremely Low Water to Hurricane Ian in 2022

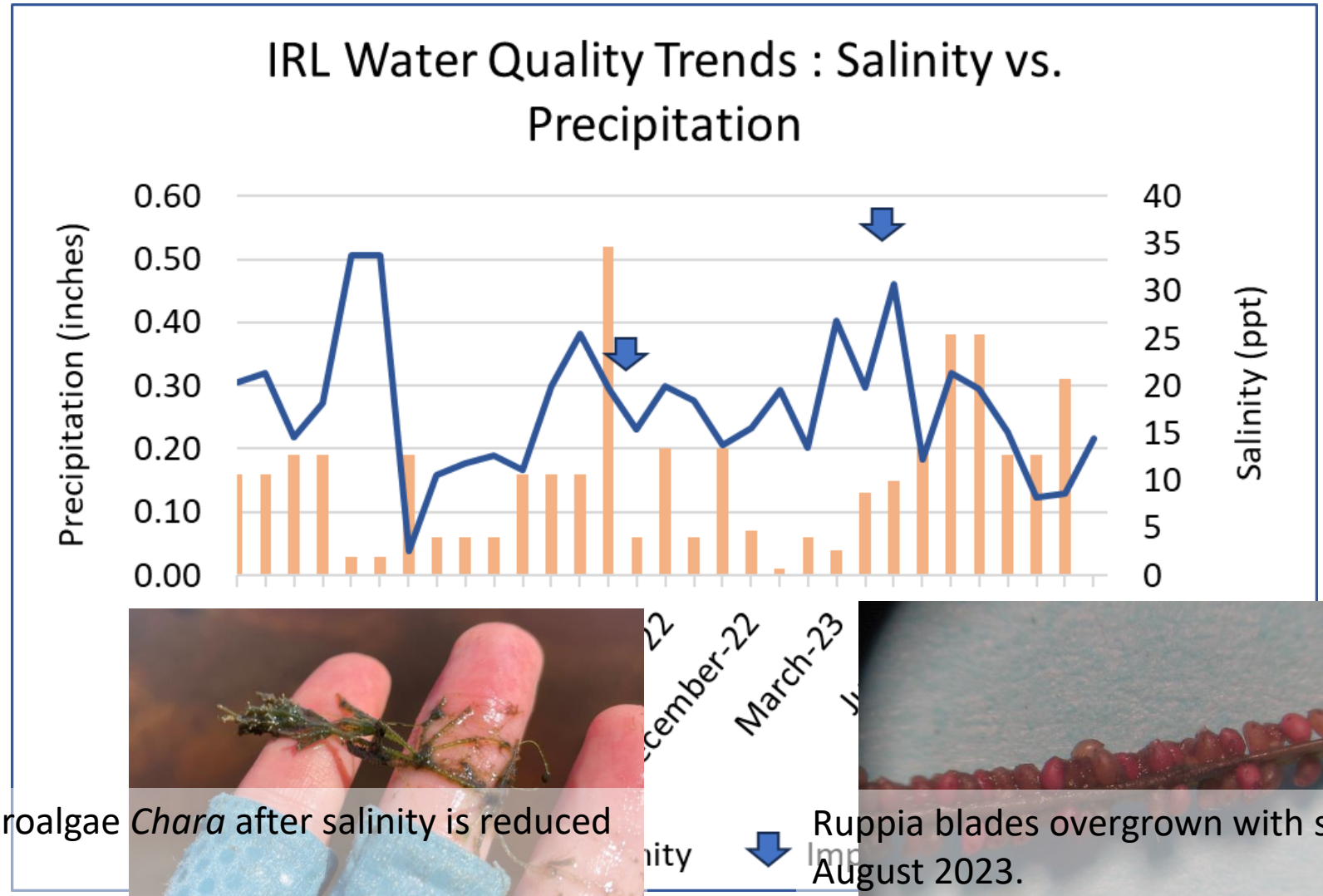




Tide, Precipitation, and Impoundment Closure: Drivers of Impoundment Water Level and WQ



Tide, Precipitation, and Impoundment Closure: Drivers of Impoundment Water Level and WQ



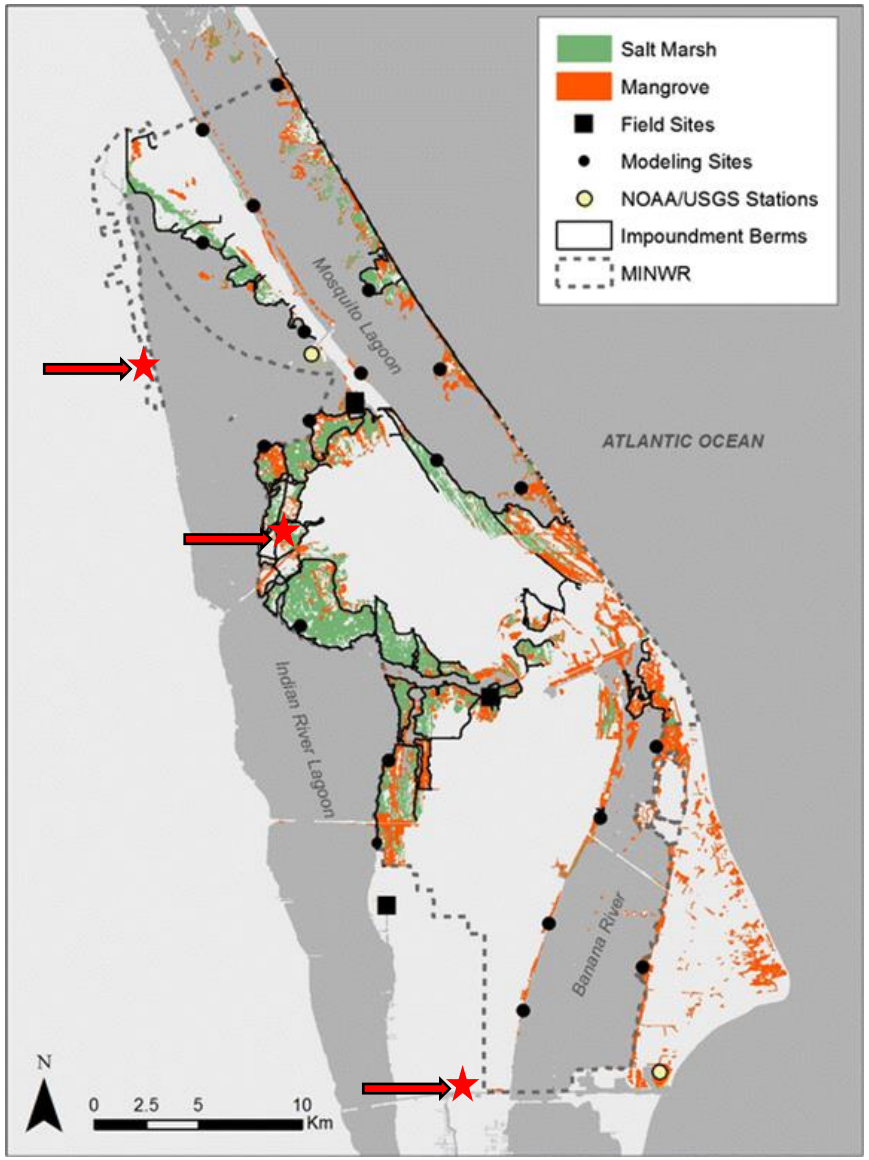
Growth of macroalgae *Chara* after salinity is reduced In July 2022.

Ruppia blades overgrown with snail (whelk?) eggs August 2023.

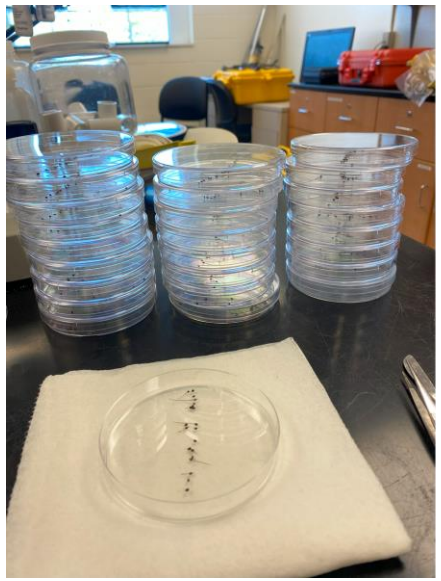
Biofilms/algae scum (photos by Dr. Anna Ponce at B-CU)

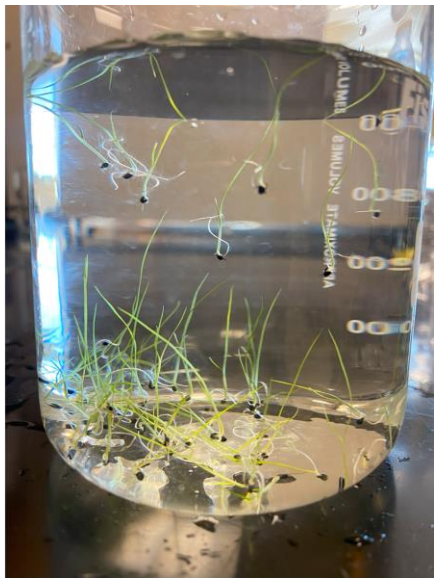
Biofilms/algae scum (photos by Dr. Anna Ponce at B-CU)

Ruppia Beds in Other Impoundments



Seed Harvest, Seed Bank, Viability, and Germination





To test the viability of the *Ruppia* seeds after stratification in either cold, dry, or control conditions, the *Ruppia* seeds were inserted into a 5% tetrazolium Red dye solution. For viable seeds, the seed embryo would become red at least 24 hours after being stored in the solution.

Collection Site	Source (N)	Mean & St.Dev # Seeds	Seed Viability
Merritt Island Impoundment	Reproductive shoots (5)	**(1523 ± 562)/L**	**66.0 ± 11.9** %
	Sediment (3)	**(433.3 ± 192.3)/L**	**56.0 ± 11.4** %
North Siphon Impoundment	Sediment (5)	**(8.4 ± 1.3)/L**	No data
Lagoon (Mosquito Lagoon)	Reproductive shoots		***85.0 ± 5.3** % (no-stratification)
			60.5 ± 11.9 % (cold-stratified)
			53.5 ± 15.5 % (dry-stratified)

Control (no stratification)

Fresh tap water at 19-21.5 °C

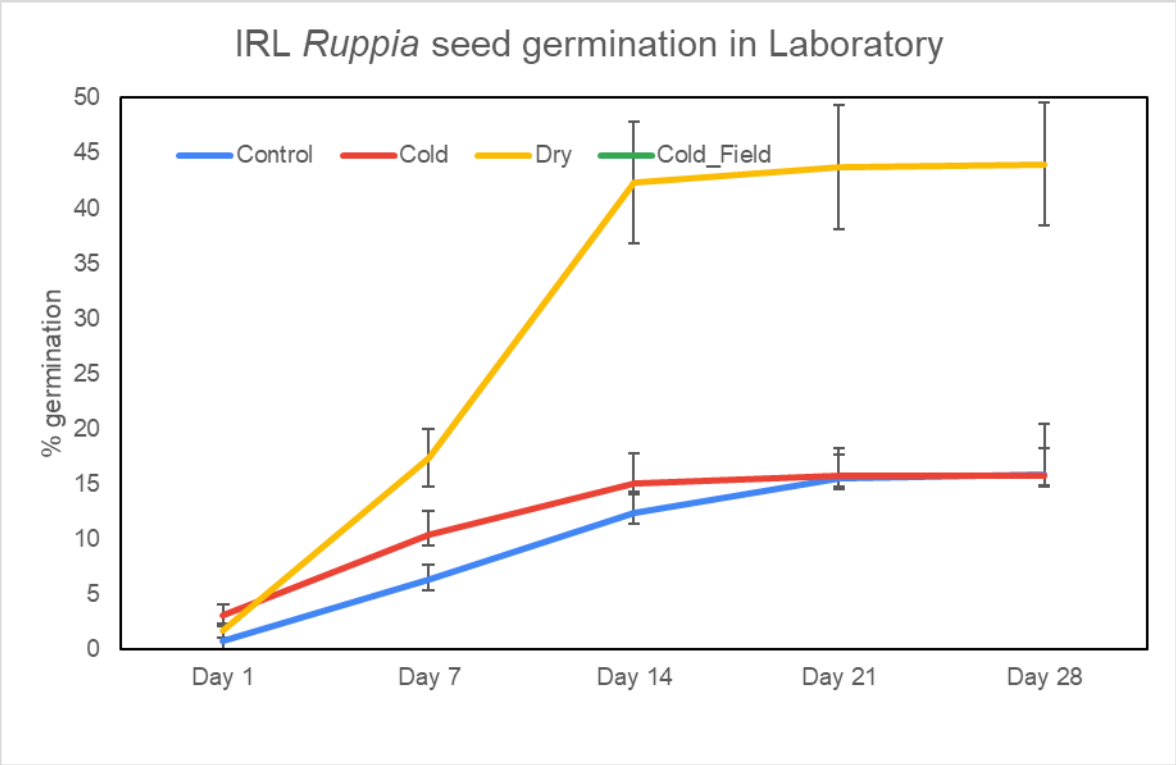
Dry Stratification

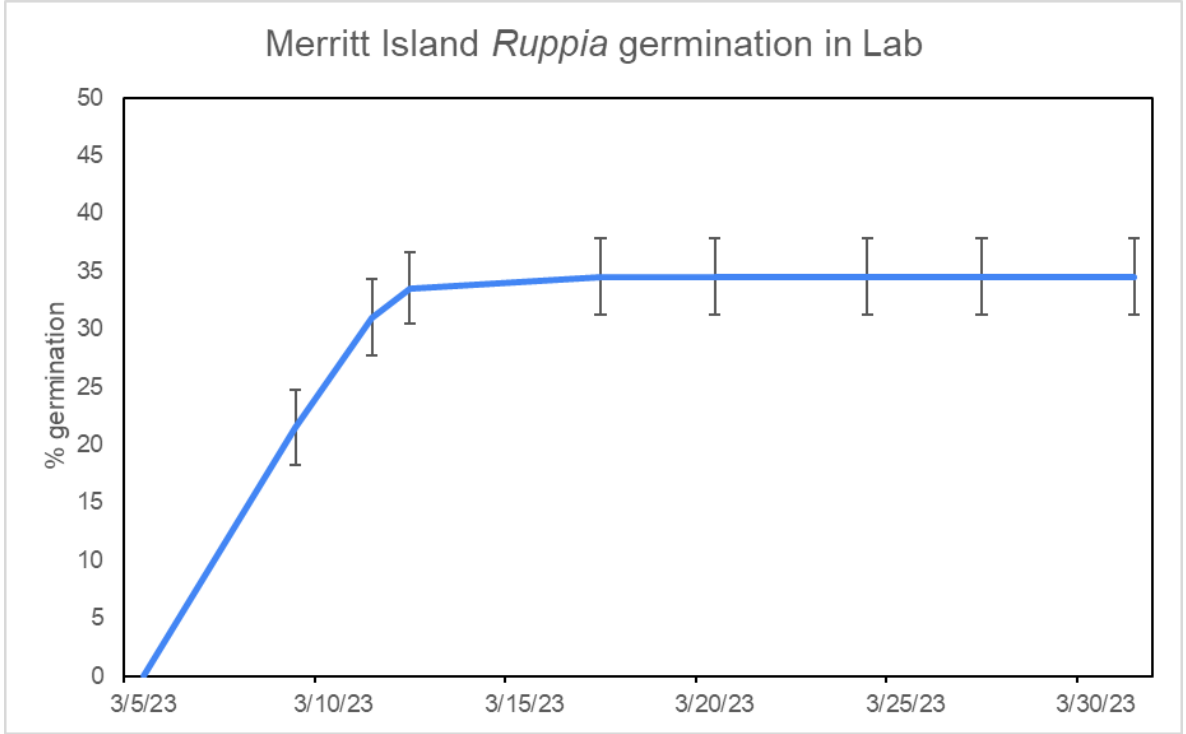
Room temperature air at 22-24°C

Cold Stratification

Fresh tap water at 1.5-3°C

Ruppia seed germination





Ruppia and duck populations

- Bortolus et al. 1998.
  - Waterfowl distribution was strongly associated with the presence of *R. maritima* an Argentina lagoon.

- Figuerola et al. 2002.
  - Ingestion by waterfowl enhanced the rate of germination and, for several duck species, it also had a positive effect on germinability.

- Figuerola and Green 2004. Effects of seed ingestion and herbivory by waterfowl on seedling establishment: a field experiment with wigeongrass *Ruppia maritima* in Doñana,

Lessons Learned and Future Direction

- Impoundment *Ruppia* restoration projects must coordinate with natural water level fluctuation and management plans.
- If local seed bank viability assessed and plant phenology understood, transplanting would not be needed for restoration.
- Reproductive shoots with mature seeds, woven into mats, would be better transplants than seedlings or vegetative shoots.
- Grazers (invertebrate, fish, waterfowl) and the overall trophic structure of impoundment ecosystem are important for long-term resilience and maintenance of *Ruppia* populations.

Acknowledgments

- This presentation was made possible by the National Oceanic and Atmospheric Administration (NOAA), Office of Education, Educational Partnership Program with Minority-Serving Institutions award #NA21SEC4810004 (NOAA Center for Coastal and Marine Ecosystems – II), the Indian River Lagoon National Estuary Program, and Florida Wildlife and Fisheries Conservation Commission.
- The contents of this poster are solely the responsibility of the award recipient and do not necessarily represent the official views of the funding agencies. Any opinions, findings, conclusions, or recommendations expressed in this presentation are those of the authors and do not necessarily reflect the view of the funding agencies.