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Vegetation Changes Along a Gradient of Salinity in the Ortega River of Northeast Florida

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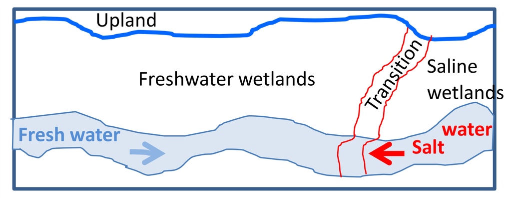
Background

Sea level rise or diminished river flow

Increased salinity in the lower reaches of coastal rivers

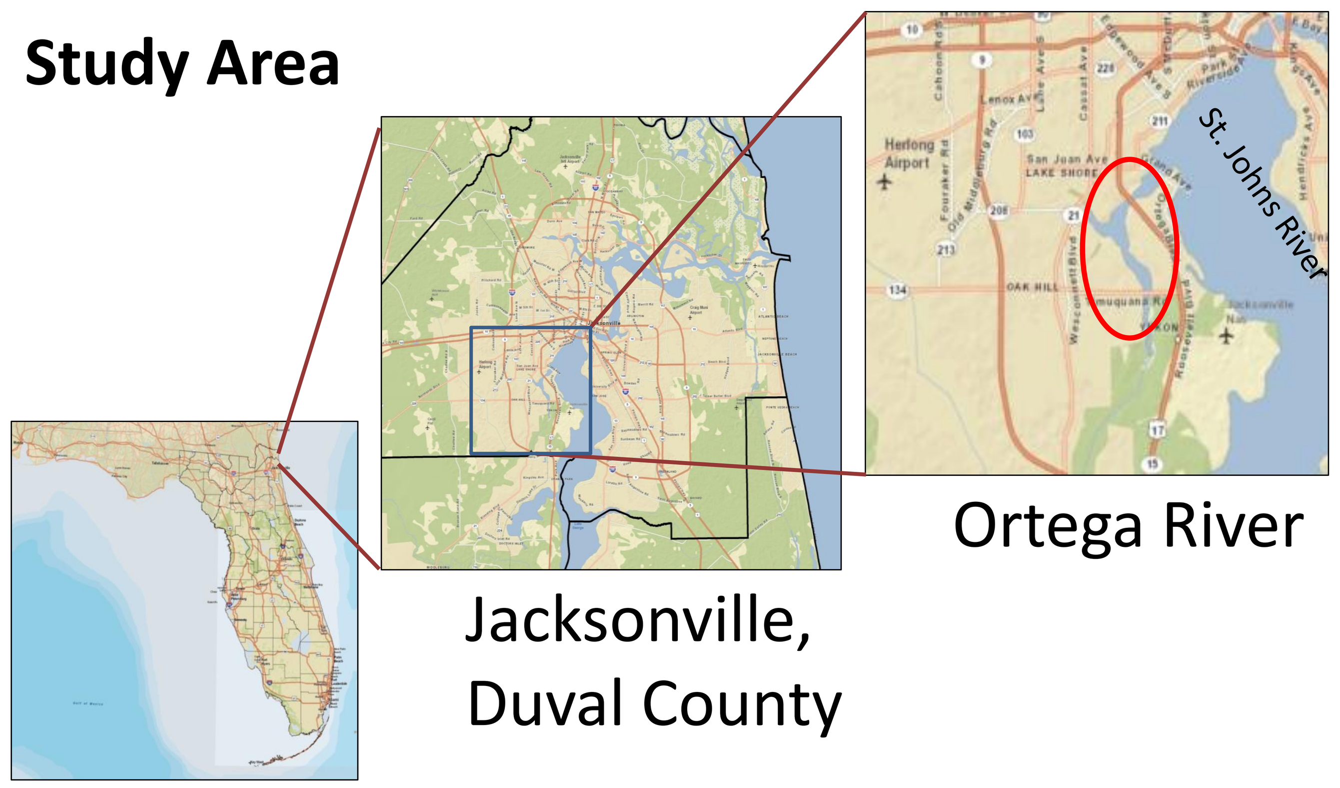
Increased soil salinities in tidally flooded wetlands

Changes in wetland community types, structure, diversity and composition



We studied this process in the **Ortega River**, a tributary of the **St. Johns River** in Northeast Florida and created a simple model to describe the changes along a gradient of river salinities, soil salinities and plant communities We then used the model to predict the potential movement of community boundaries with rising salinity levels.

Study Area



Ortega River

Jacksonville, Duval County

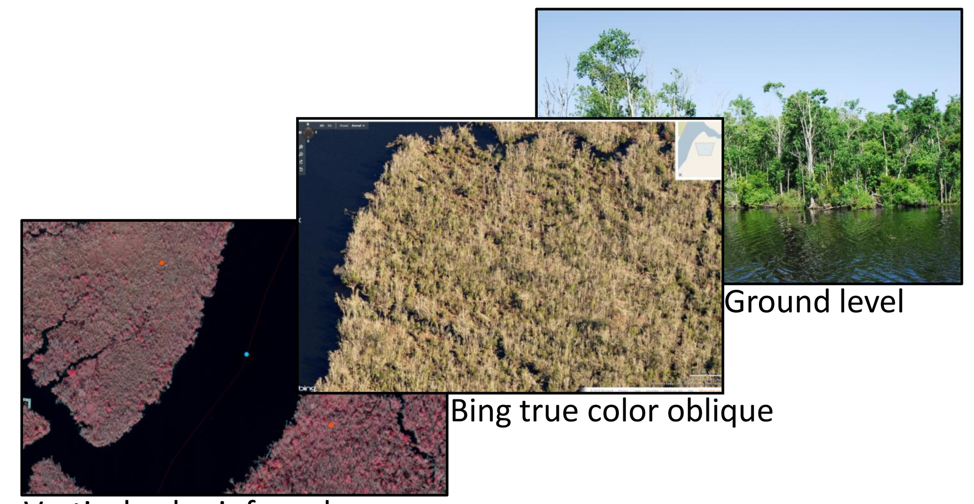
Florida

Objectives

- Relate changes in soil salinity to changes in surface water salinity along an estuarine gradient.
- Document changes in community type, structure, species diversity, and species composition change in response to salinity levels.
- Identify salinities at which specific changes occur.
- Identify and measure other environmental changes impacting vegetation.
- Predict future wetlands status under conditions of increasing salinity.

Methods

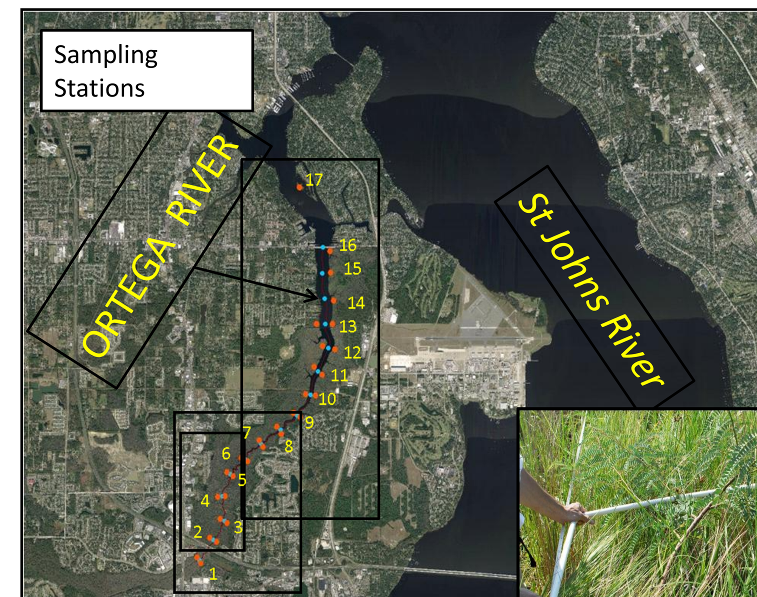
1. Document structural changes in vegetation and develop sampling design with aerial imagery and field reconnaisance.



Ground level

Bing true color oblique

Vertical color infrared

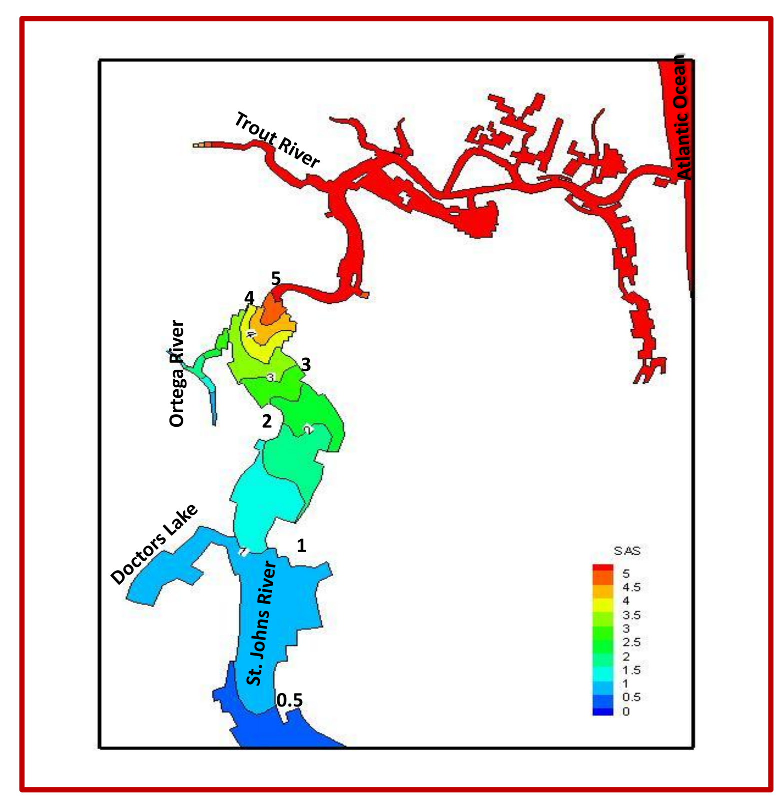


2. Sample vegetation in systematically placed, nested plots, 25m from waters edge at stations placed at ½ km intervals parallel to midline of river channel.

3. Measure salinity in bore holes, with a soil probe, and in the lab (saturated paste method).

4. Model surface water salinities

Estimates were made using a hydrodynamic model to simulate salinity at the mouth of the Ortega River in conjunction with a simple steady-state pseudo-empirical model having a functional form of a solution to the advection-diffusion equation for salt transport (Suscy, 2012).



10-Year average Surface water Salinities in the Lower St. Johns River

5. Relate boundaries between vegetation types, graphically and by interpolation, to changes to in soil salinity, and select break points.

6. Relate soil salinity through linear regression to surface water salinity.

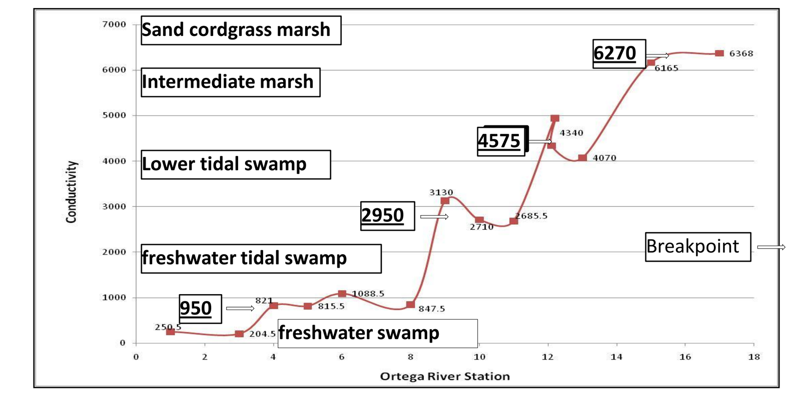
7. Predict movement of soil salinity breakpoints and plant communities from modeled movement of Ortega River isohalines.

Results

- Five vegetation community types were identified along the soil salinity gradient of the Ortega River.
- Breakpoints marking the soil salinity at mid-points of transition to a more saline type were determined (a).

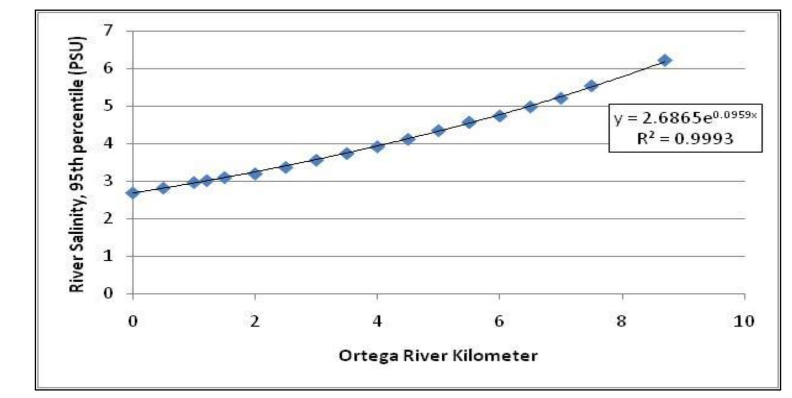
Community	Stations	Soil Salinity Breakpoint (PSU)
Freshwater swamp	1 , 3, 4, 5	0.47
Tidal freshwater swamp	6, 8, 9	1.53
Lower tidal swamp	10, 11, 12.2, 13	2.55
Intermediate marsh	12.1, 15	3.41
Sand cordgrass marsh	17	NA

(a)



- The 95 percentile of Ortega River base line salinity was related to River kilometer (b)

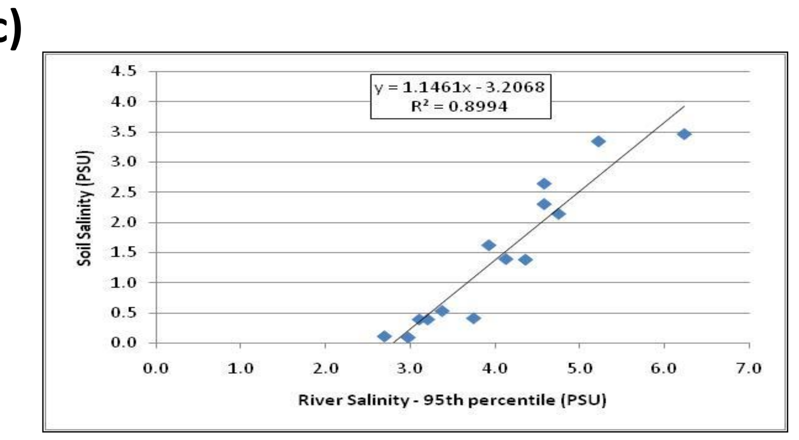
(b)



- The 95 percentile of Ortega River base line salinity was related to soil salinity (c).

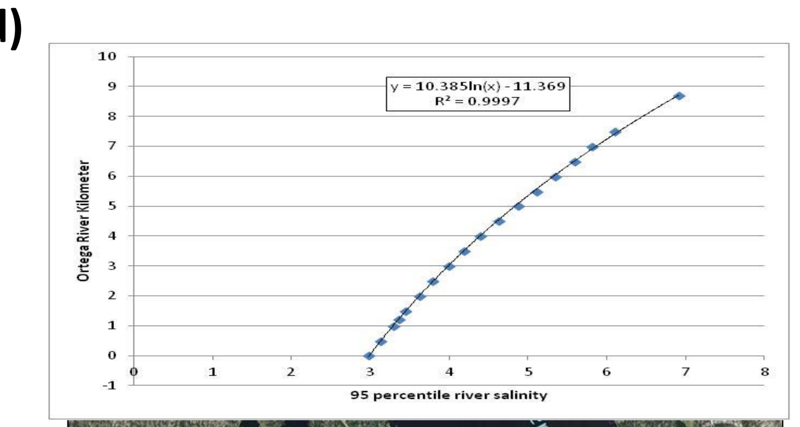
Community	Soil Salinity Breakpoint (PSU)	River Salinity 95%	Baseline River km.
Freshwater swamp	0.47	3.21	1.85
Tidal freshwater swamp	1.53	4.13	4.49
Lower tidal swamp	2.55	4.93	6.32
Intermediate marsh	3.41	5.77	7.97
Sand cordgrass marsh		NA	

(c)

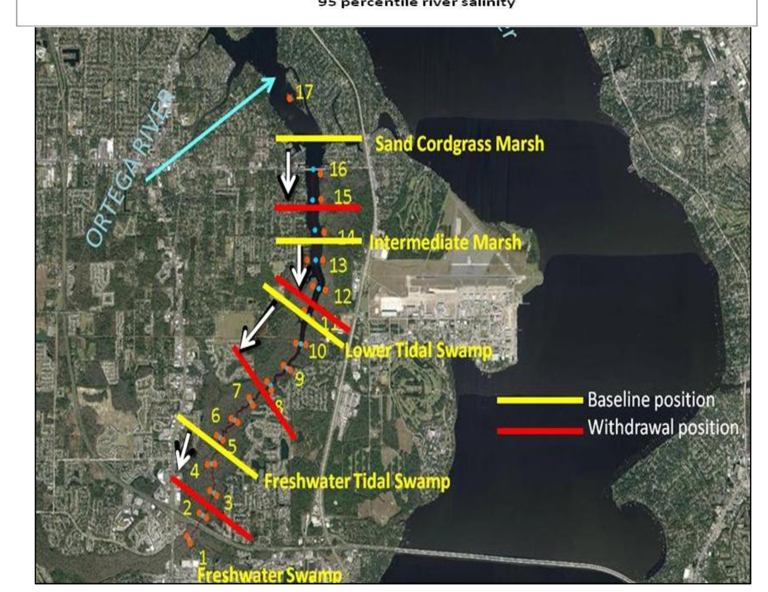


- To predict movement of community boundaries under a modeled water withdrawal scenario we solved for river kilometer from 95 percentile of river salinity (d).

(d)



Community	Soil Salinity Breakpoint (PSU)	River Salinity	Baseline River km.	Water Withdrawal Scenario, River Km.	Distance moved
Freshwater swamp	0.47	3.21	1.85	0.74	1.11
Tidal freshwater swamp	1.53	4.13	4.49	3.37	1.12
Lower tidal swamp	2.55	4.93	6.32	5.19	1.13
Intermediate marsh	3.41	5.77	7.97	6.84	1.13
Sand cordgrass marsh					



1. Freshwater swamp

2. Tidal Freshwater swamp

3. Lower tidal hardwood swamp

4. Intermediate Marsh

salinity

5. Sand cordgrass marsh

Plant assemblages

1. Freshwater swamp: species diverse, closed canopy, peat soils, pronounced microrelief
2. Tidal freshwater swamp –some tides, Loss of sensitive species, closed canopy, muck soils, pronounced microrelief
3. Lower tidal swamp – frequent tides, stunted trees, many grasses and herbs, open canopy, reduced relief
4. Intermediate marsh, frequent tides, few trees, many grasses and herbs, high light, flat ground
5. Sand cordgrass marsh – frequent tides, no trees, high dominance by one species, high light, flat ground

Break points for salinity

Fresh

uS	PSU
950	0.47
2950	1.53
4570	2.44
6270	3.41

Saline