Impacts to Submerged Aquatic Vegetation Associated with Hydrologic Changes in the St. Johns River Estuary, Florida

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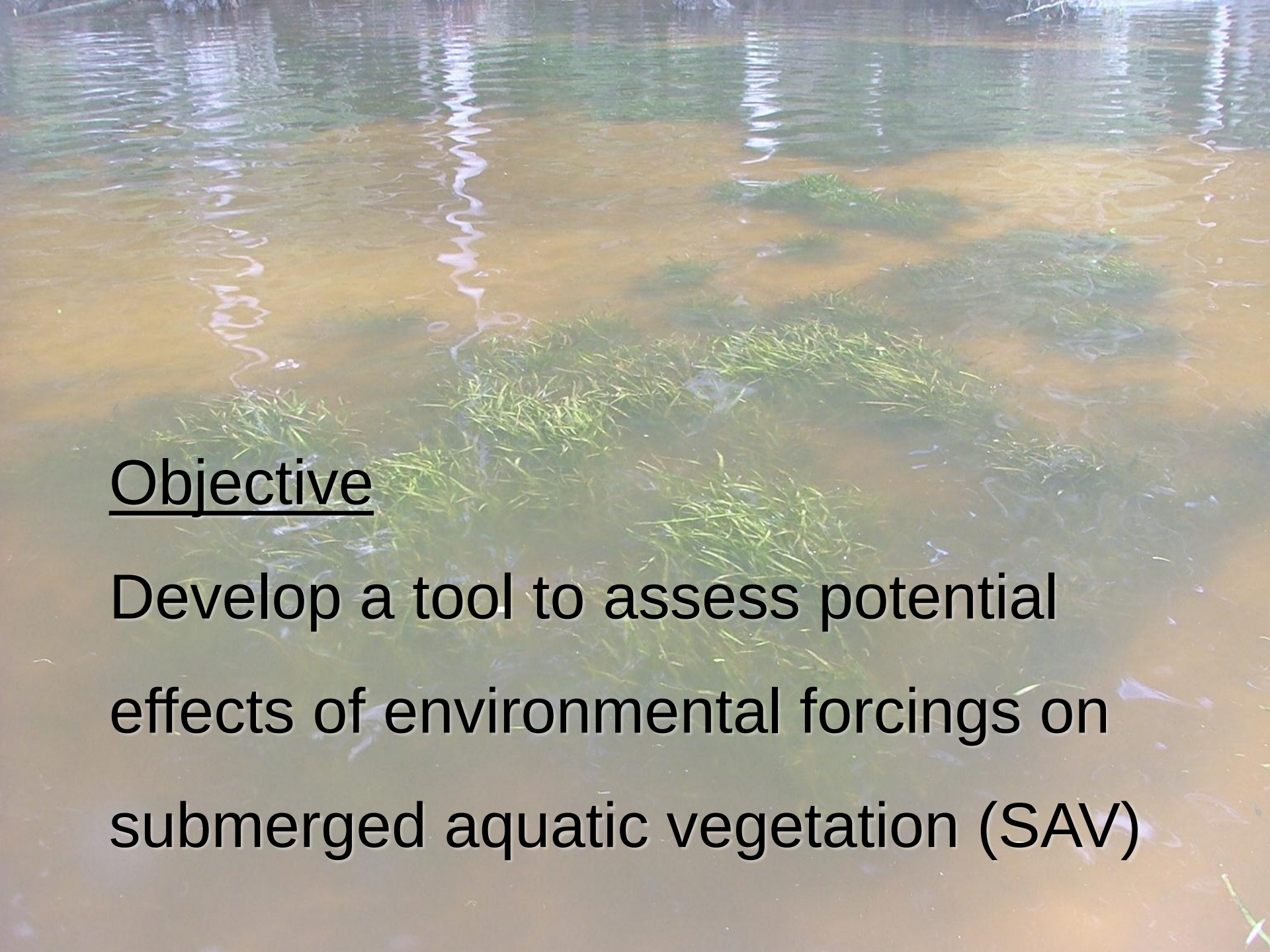
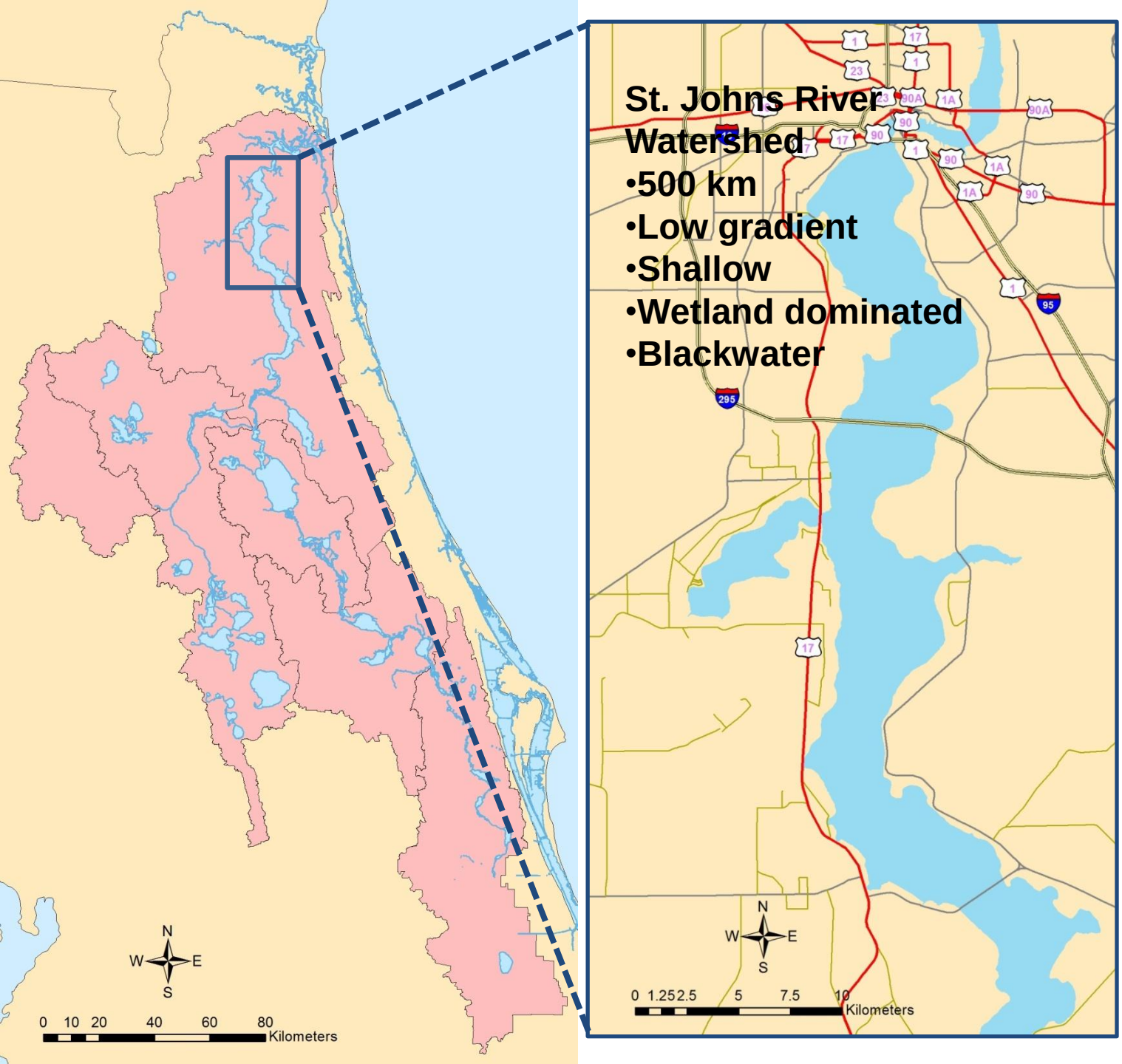


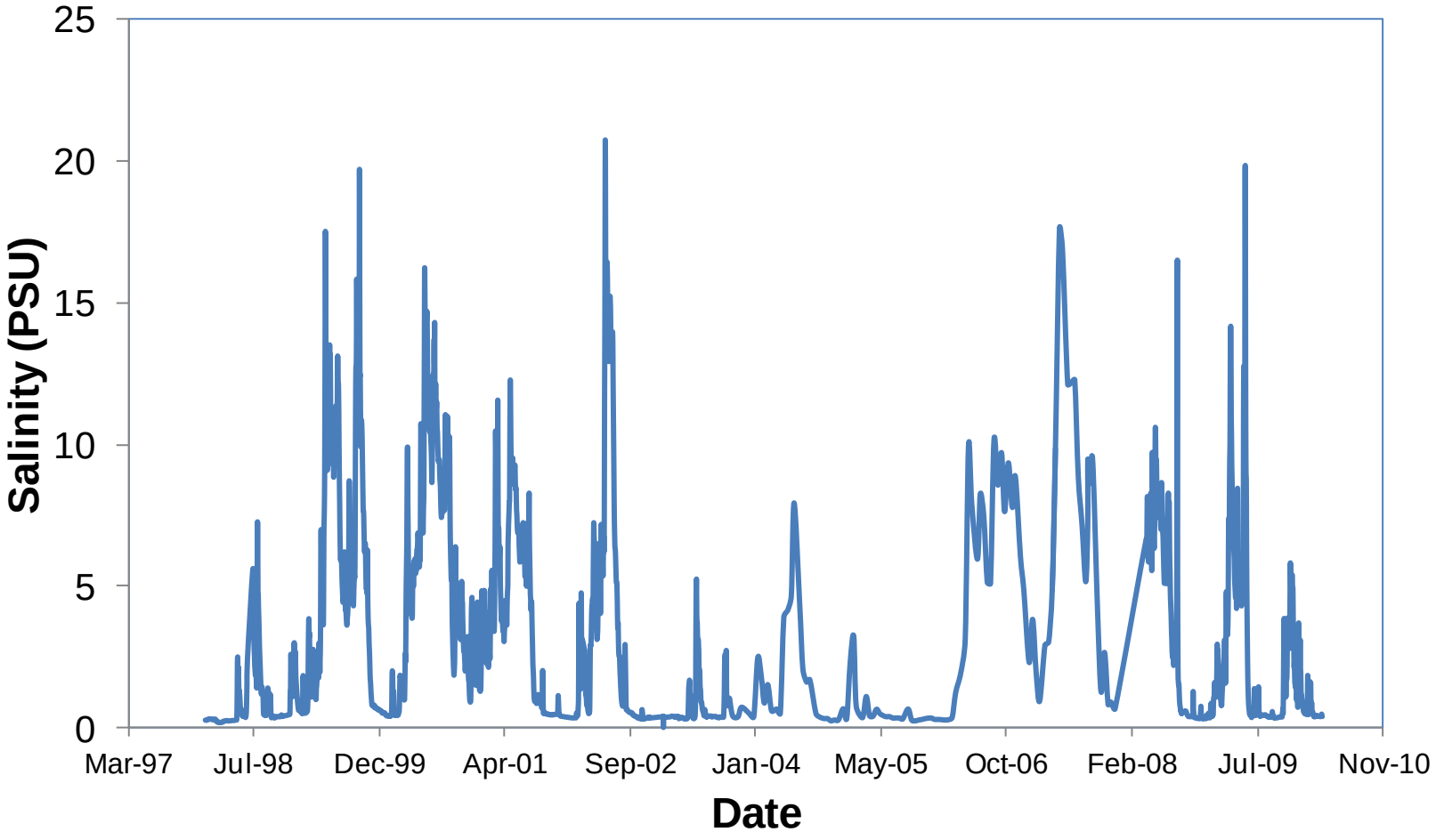
Objective

Develop a tool to assess potential effects of environmental forcings on submerged aquatic vegetation (SAV)



Lower Basin of the St. Johns River

St. Johns River Salinity at 58 km

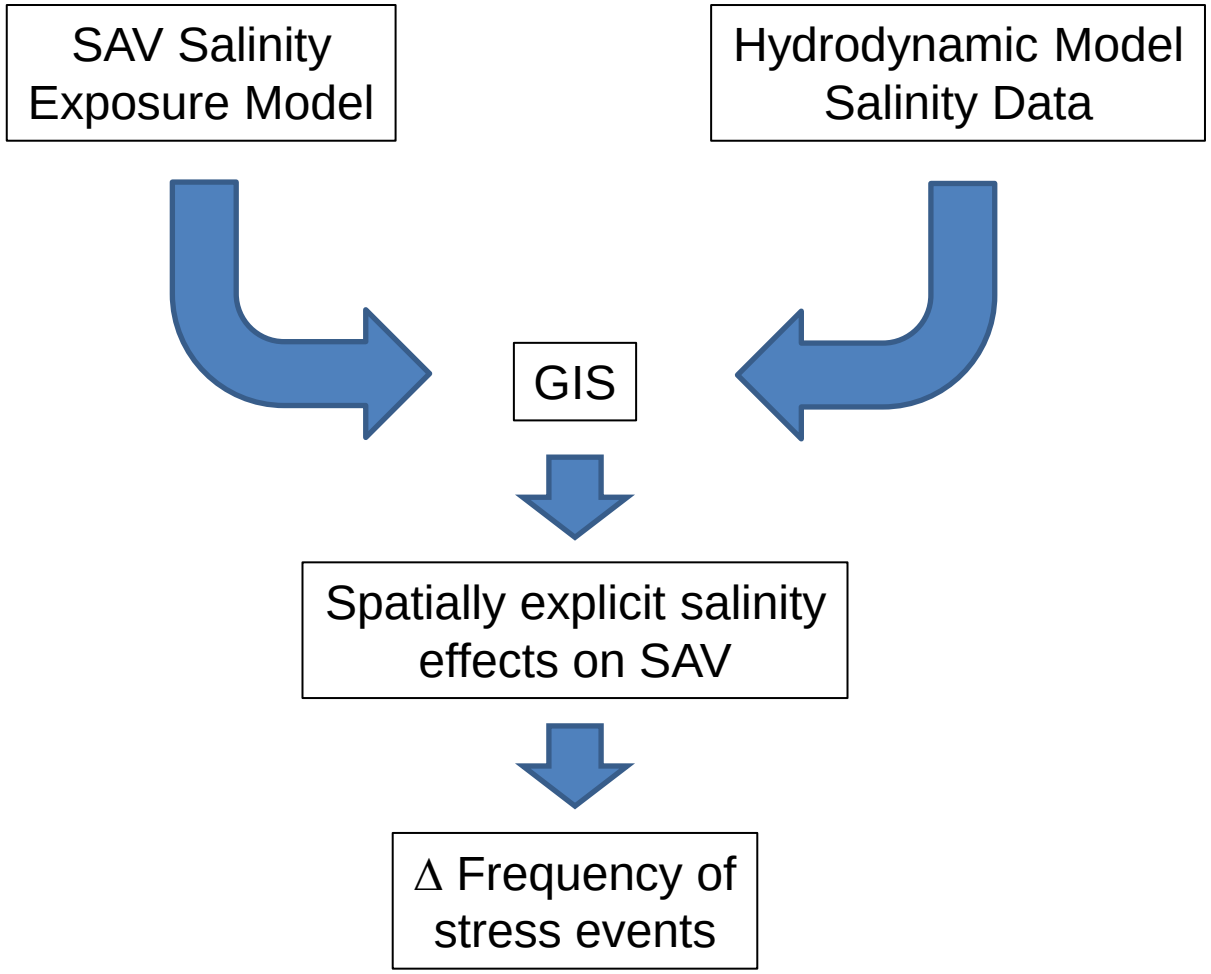


- *Dynamic flow regime (tide, drought/flood)*
- *Reverse flow events*

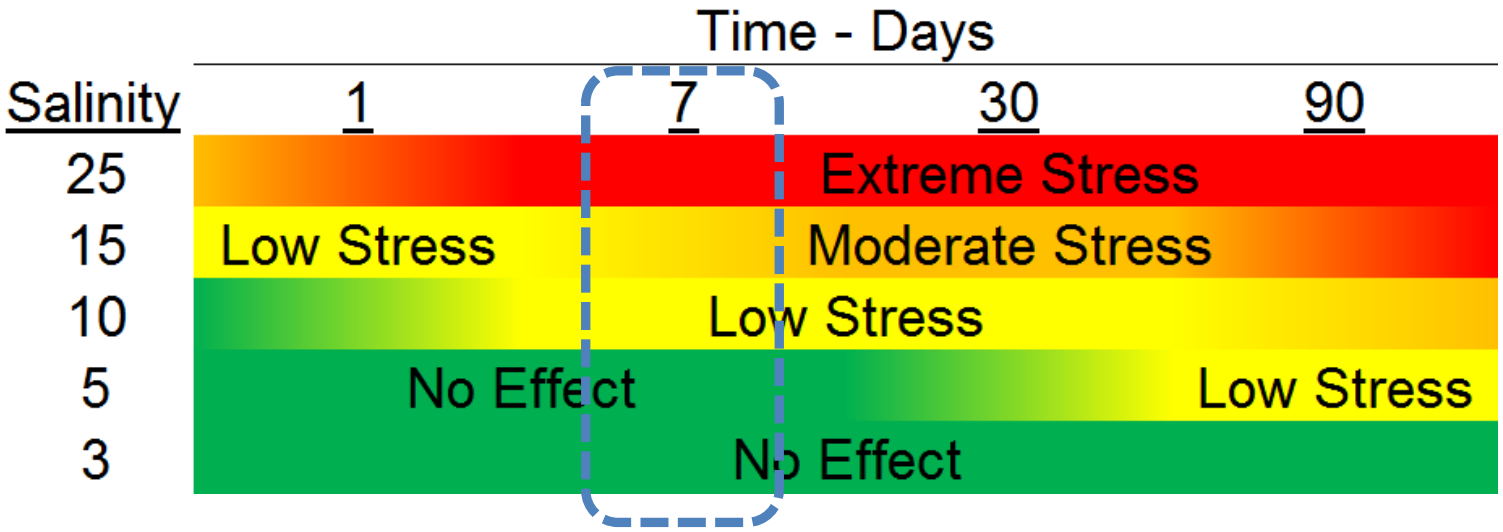
Environmental Forcing Factors

- Surface Water Withdrawals
- Sea level rise
- River channel dredging

Workflow for Salinity Effects



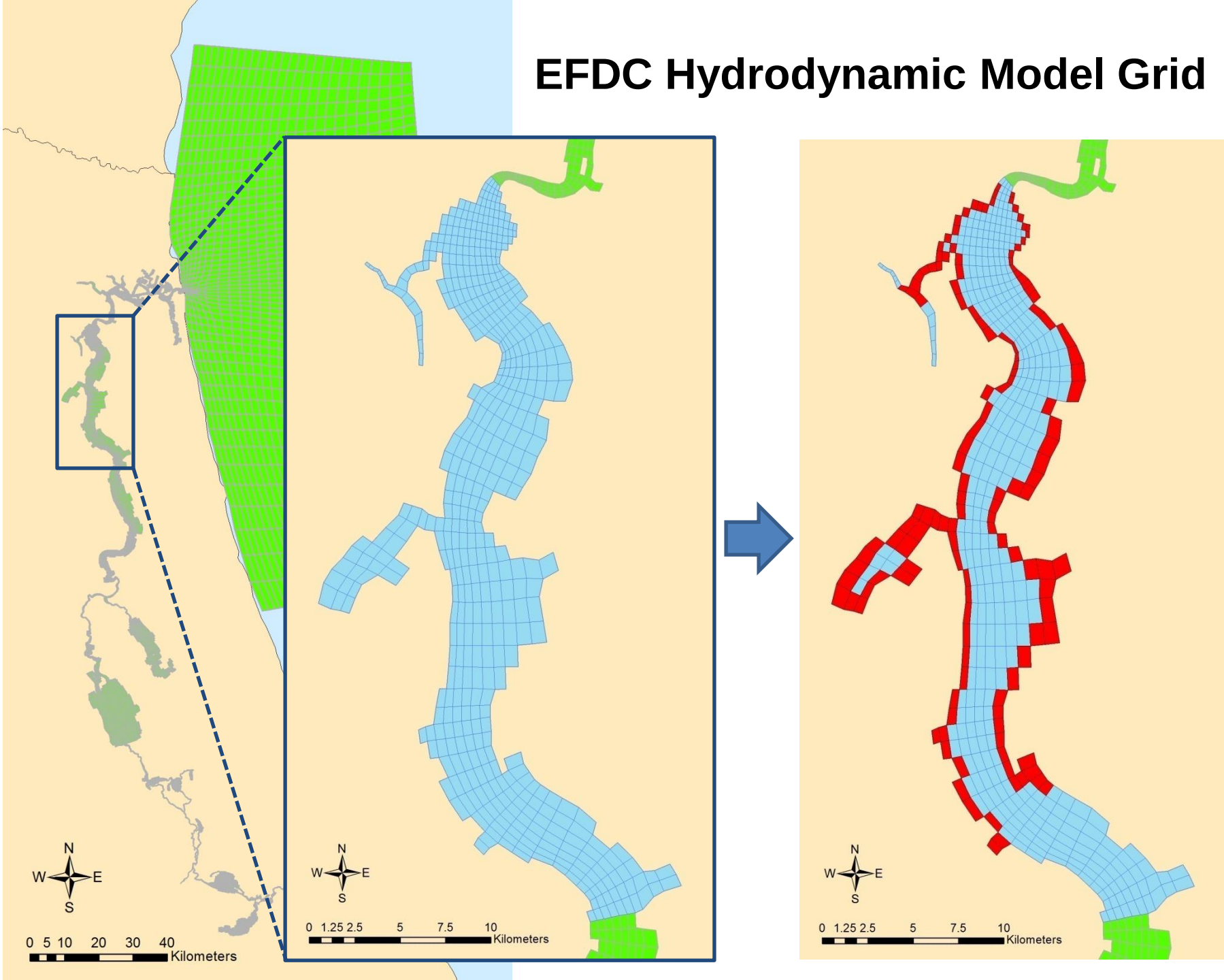
Salinity-Duration Exposure Model for *Vallisneria americana*



Salinity duration model derived from:

- Literature review
- Salinity exposure experiments
- 12 years of SAV and WQ monitoring
- Intensive weekly monitoring
- Stress Enzyme experiments

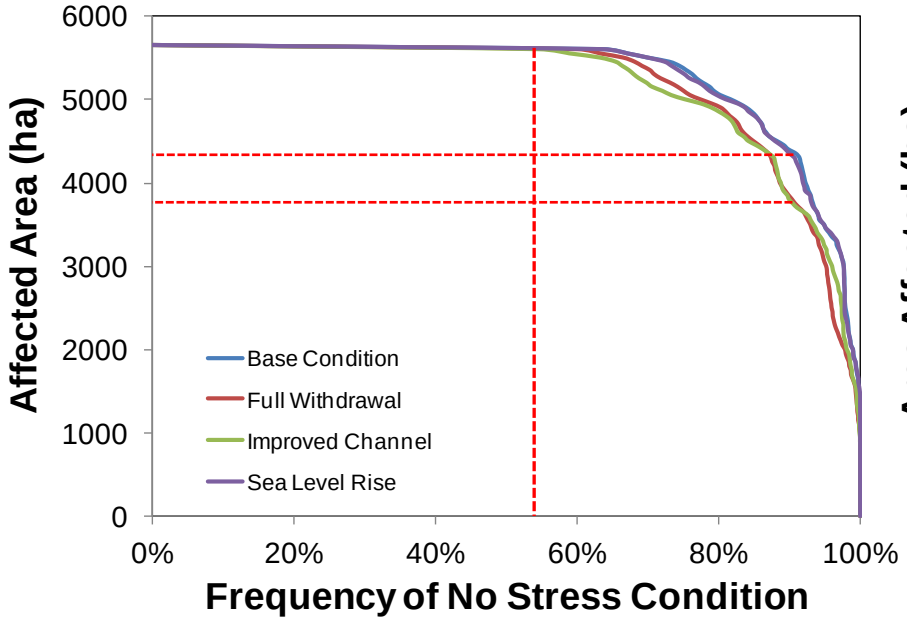
EFDC Hydrodynamic Model Grid

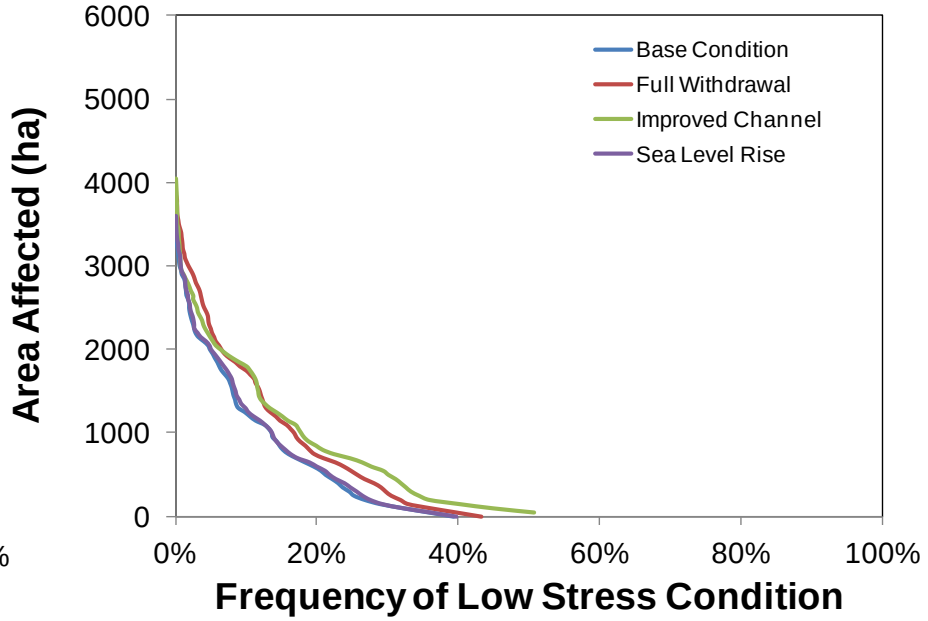


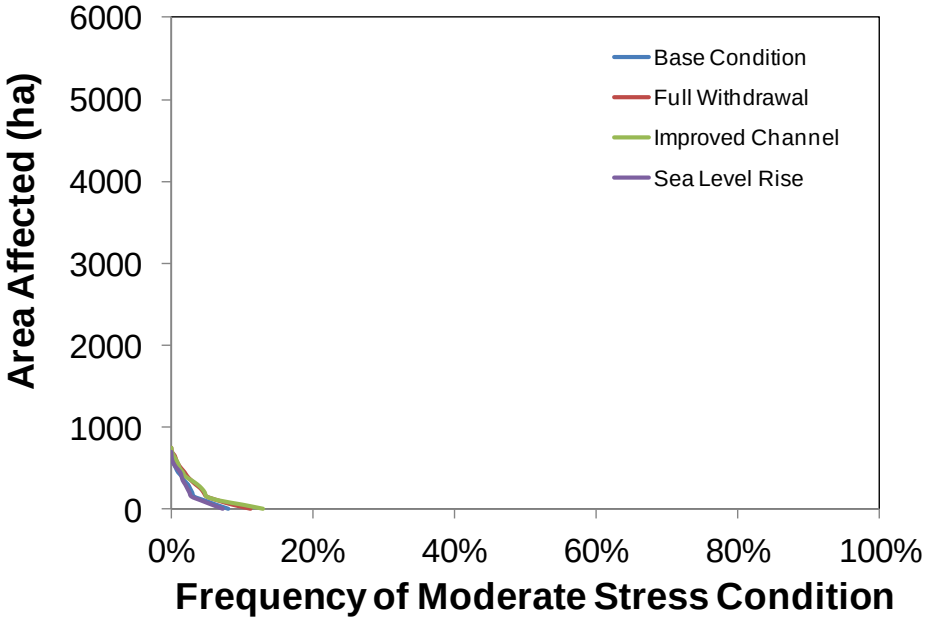
Model Scenarios

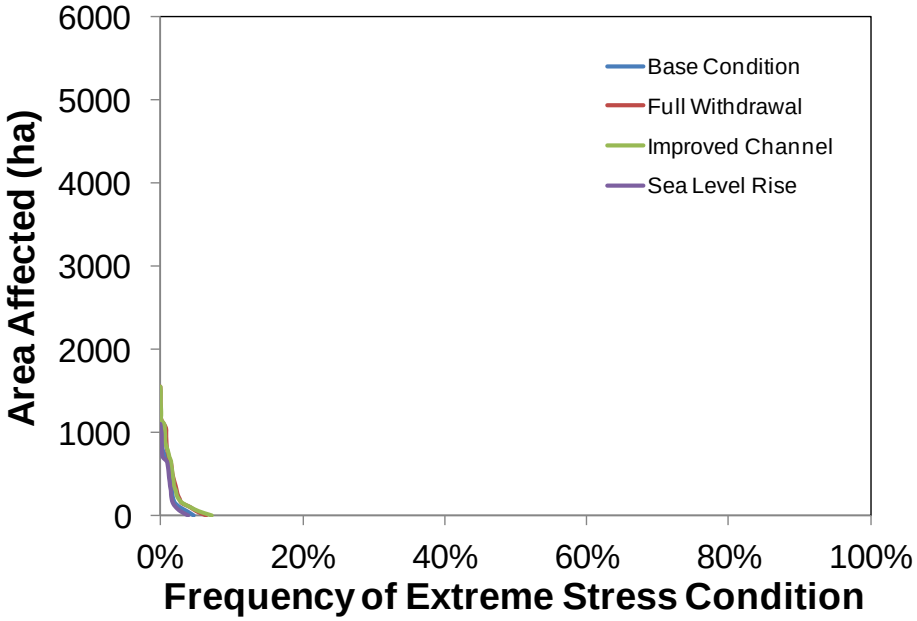
Scenario	Withdrawal	Landuse	Rediversion Projects	Sea Level
Base Condition	0	1995	No	Current
Full Withdrawal	11.5 $m^3 s^{-1}$	1995	No	Current
Sea Level Rise	0	2030	Yes	+ 28 cm
Channel improvement	0	2030	Yes	+ 14 cm

- *Not all model permutations were run*
- *Some effects can be inferred from comparing scenarios that were run*

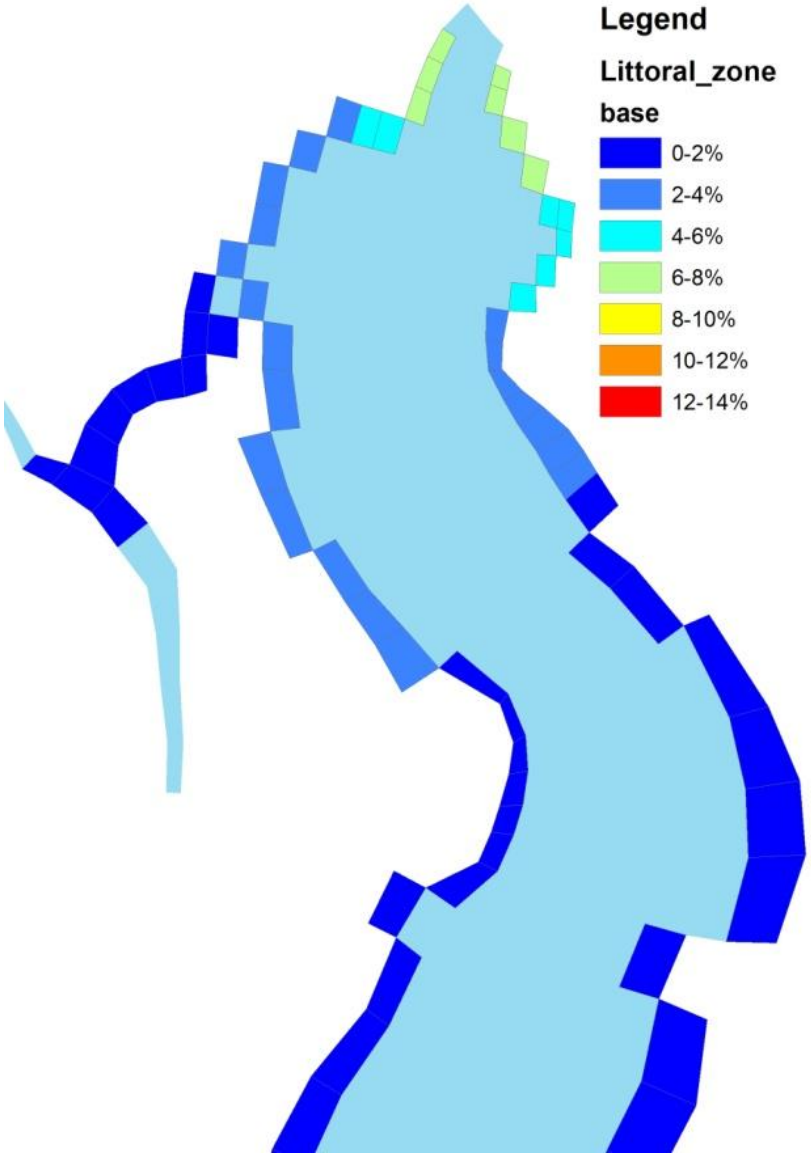

Affected Area (ha)
6000
5000
4000
3000
2000
1000
0
0%
20%
40%
60%
80%
100%
Base Condition
Full Withdrawal
Improved Channel
Sea Level Rise
Frequency of No Stress Condition


Area Affected (ha)
6000
5000
4000
3000
2000
1000
0
0%
20%
40%
60%
80%
100%
Base Condition
Full Withdrawal
Improved Channel
Sea Level Rise
Frequency of Low Stress Condition

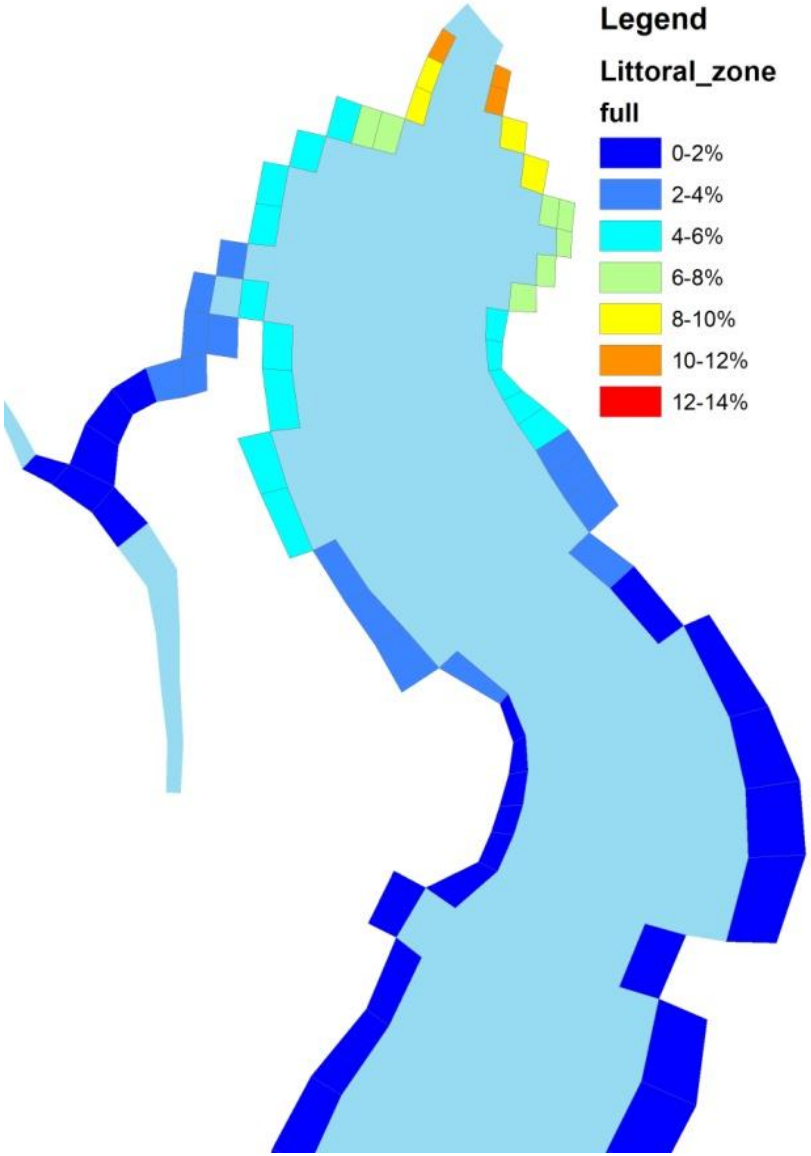

Area Affected (ha)
6000
5000
4000
3000
2000
1000
0
0%
20%
40%
60%
80%
100%
Base Condition
Full Withdrawal
Improved Channel
Sea Level Rise
Frequency of Moderate Stress Condition


Area Affected (ha)
6000
5000
4000
3000
2000
1000
0
0%
20%
40%
60%
80%
100%
Base Condition
Full Withdrawal
Improved Channel
Sea Level Rise
Frequency of Extreme Stress Condition

1995 Landuse

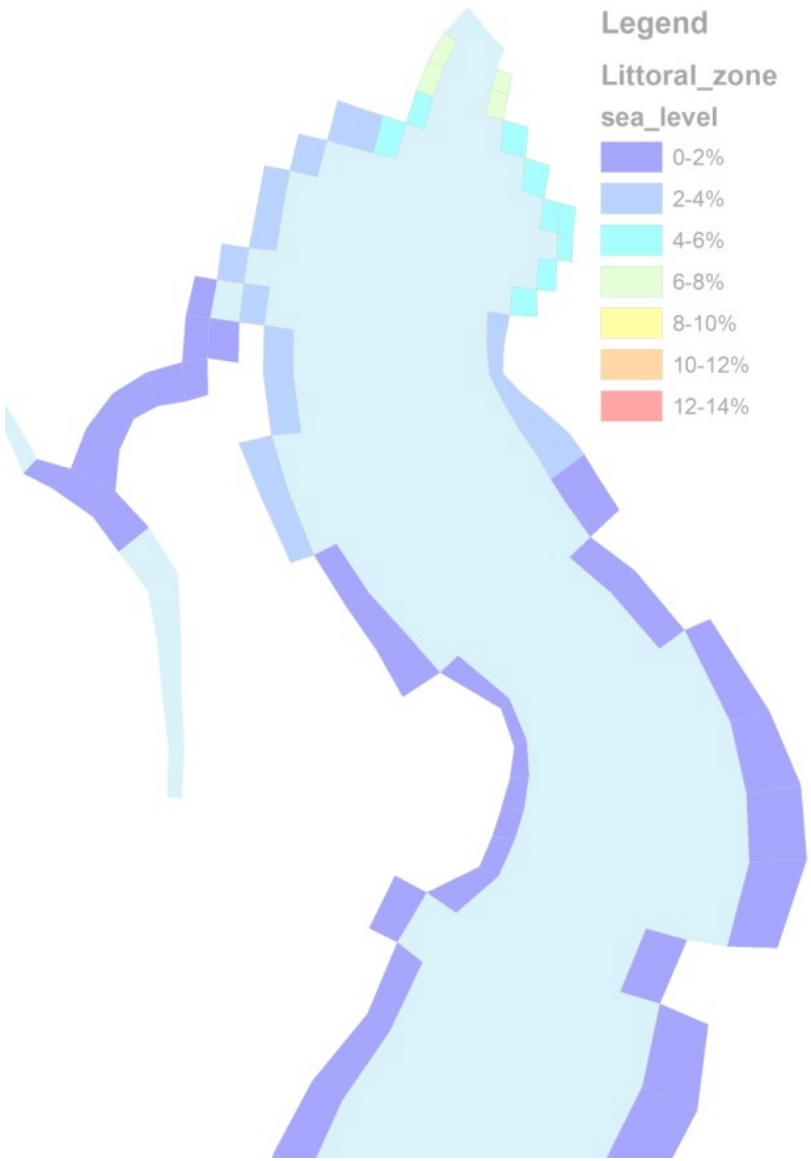


Base Condition

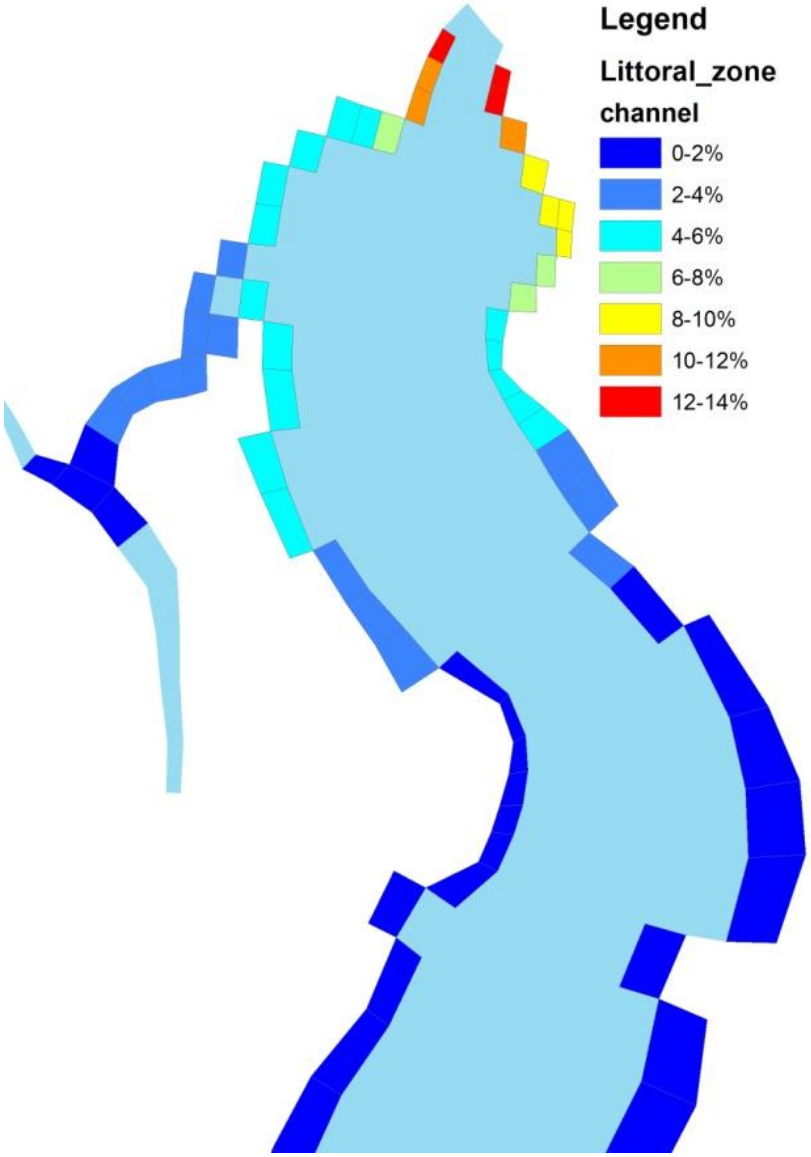


Full Withdrawal

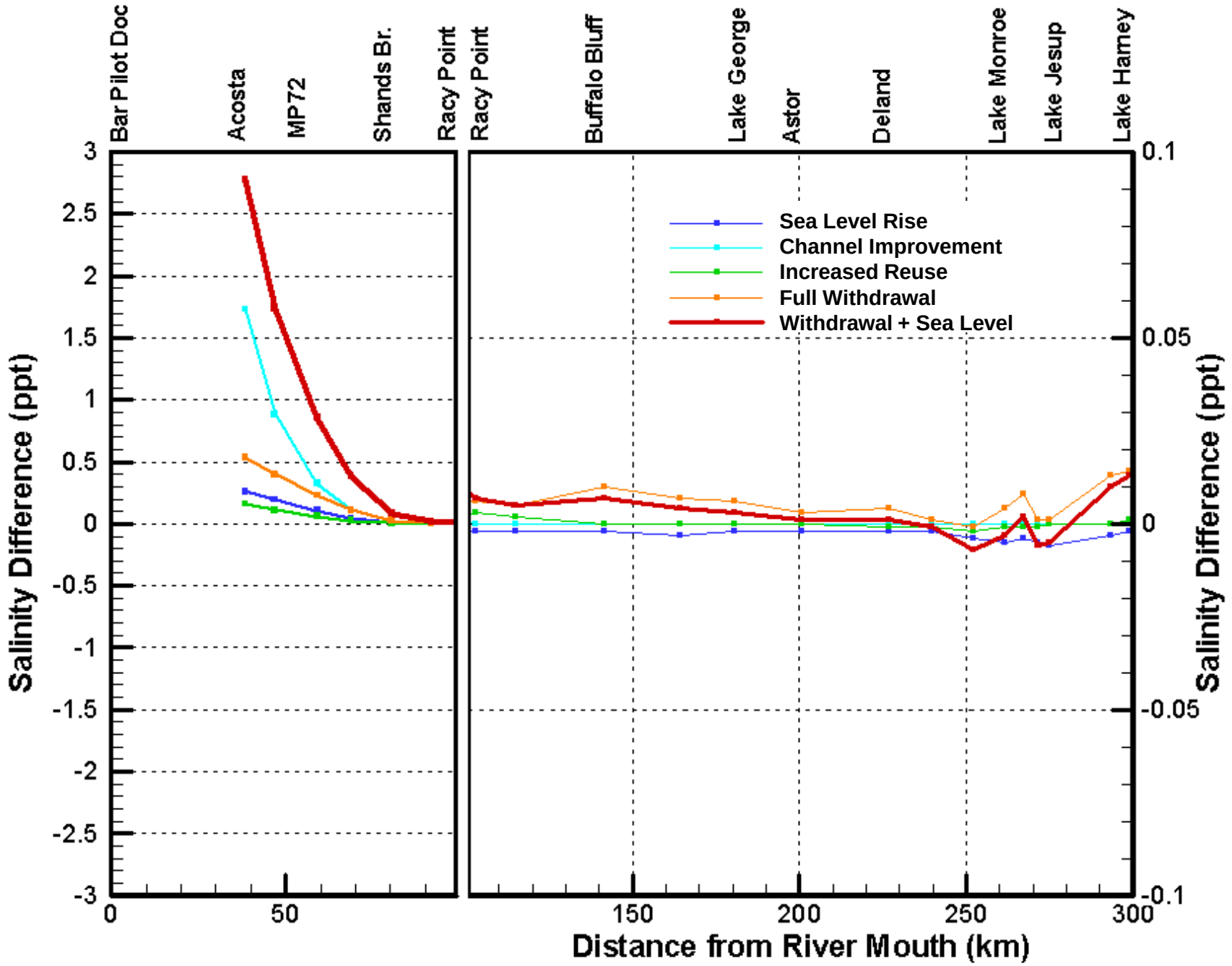
2030 Landuse + Rediversion Projects



Sea Level Rise



Channel Dredging


Bar Pilot Doc
Acosta
MP72
Shands Br.
Racy Point
Racy Point
Buffalo Bluff
Lake George
Astor
Deland
Lake Monroe
Lake Jesup
Lake Hamey
Sea Level Rise
Channel Improvement
Increased Reuse
Full Withdrawal
Withdrawal + Sea Level
Salinity Difference (ppt)
Salinity Difference (ppt)
Distance from River Mouth (km)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
0.1
0.05
0
-0.05
-0.1
0
50
150
200
250
300

Summary

- We developed a tool to estimate physiological stress of *V. americana* in the estuarine reach of the St. Johns River.
- The tool generates spatially explicit relative risk of increased stress conditions.
- The greatest risk of any single forcing was associated with channel improvement.
- Increased stress risk was confined to the most downstream areas.

Summary cont.

- Sea level rise, as modeled, was attenuated by channel morphology, future land use, and upstream rediversion projects.
- The addition of surface water withdrawals will exacerbate the effects of sea level rise.
- Future sea level rise will cause a “tipping point” where extant conditions can no longer attenuate increased salinity.

Questions?