Water level controls on wetland net primary productivity across coastal plain wetlandscape

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Introduction

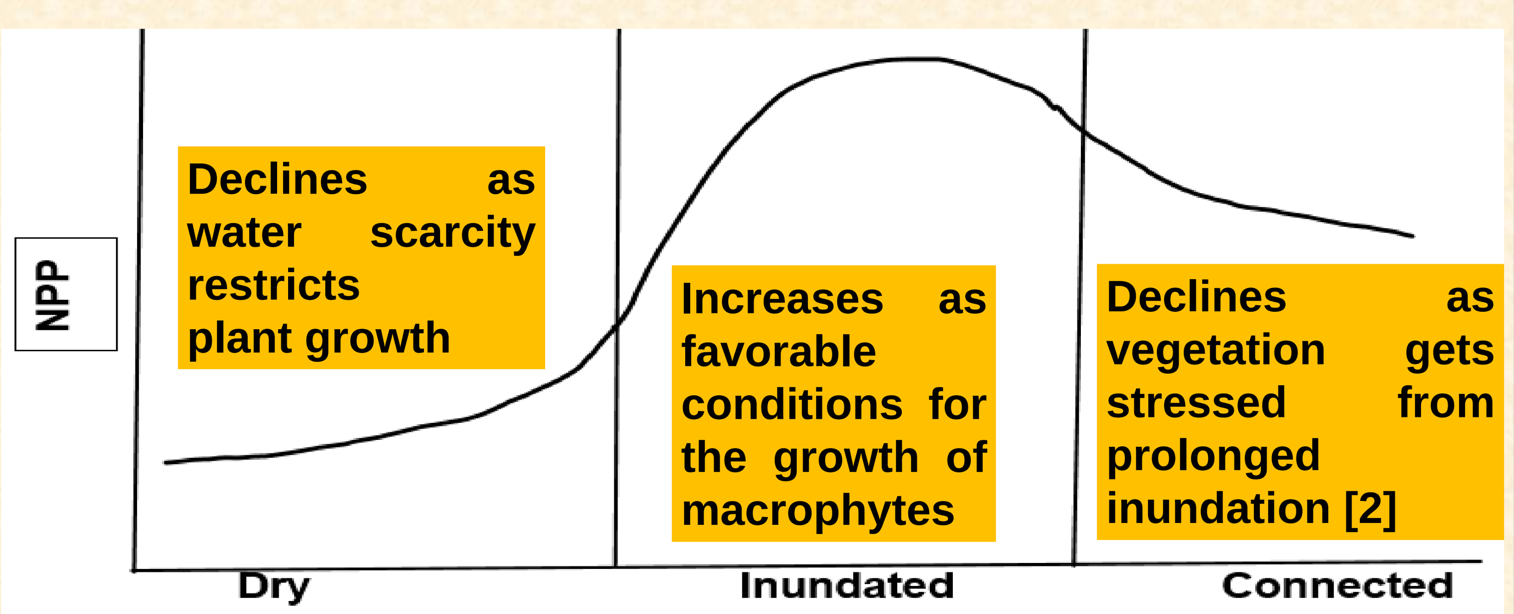
- Hydrologic conditions exert a dominant control on the productivity of wetlands [1, 2] but the shape of these relationships is poorly quantified, particularly concerning stress thresholds of prolonged inundation
- I seek to quantify the relationship between net primary productivity (NPP) and hydrological variation in water depth, as the terrestrial aquatic interface shifts across wetlandscapes

Hypothesis

1.How do hydrological factors like water depth, and hydroperiod (dry, inundated, and connected) influence net primary productivity?

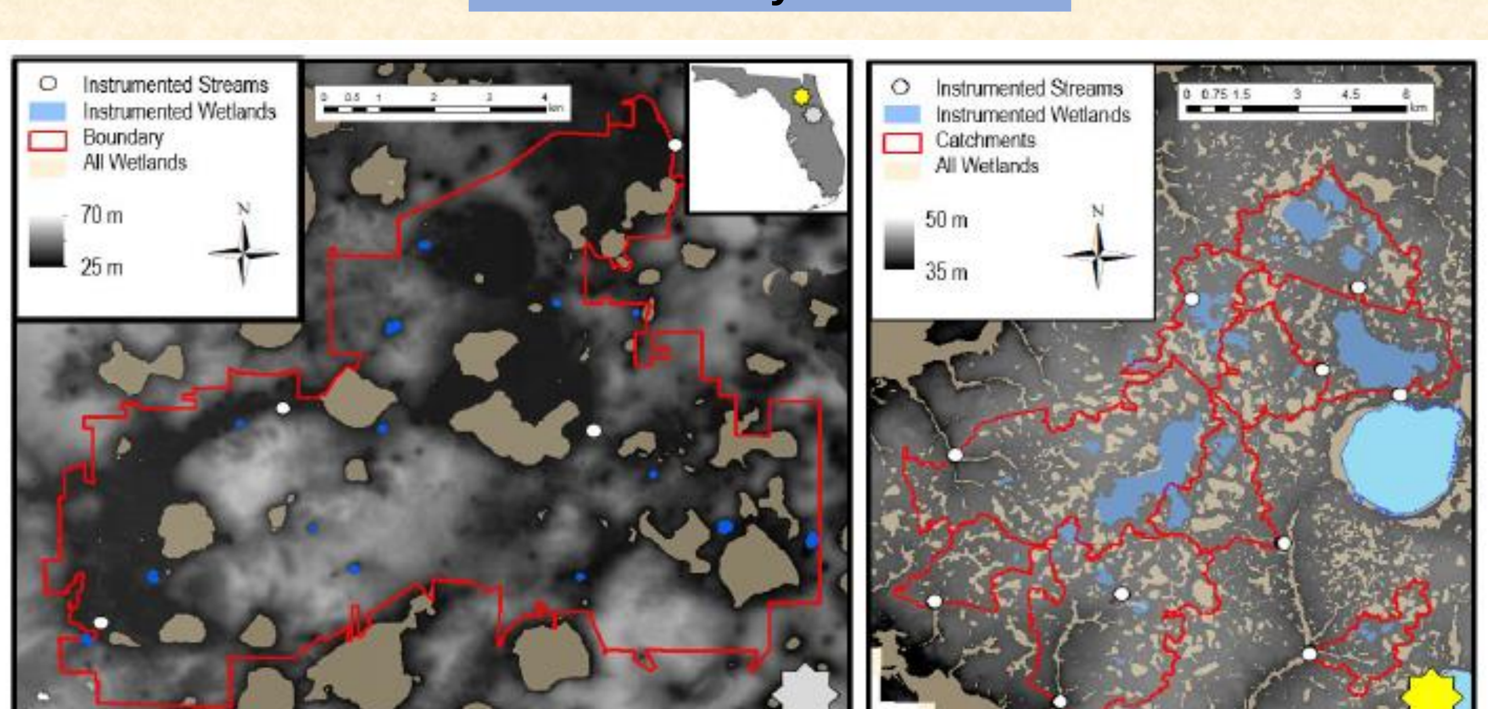
Wetland productivity peaks at intermediate inundation, and declines with high and low water levels





Proposed Methods

Study Area



Ordway-Swisher Biological Station

Bradford Experimental Forest

Hydrological data

Loggers to measure water level

- Time-varying extent of water depth and inundation,
- Shifting terrestrial aquatic interface geometry

Remote sensing data

- Time series of productivity will be collected using satellite images
- Normalized differential vegetation index (NDVI), water index (NDWI) and leaf area index (LAI) will be calculated:

$$\text{NDVI} = \frac{(\text{NIR} - \text{RED})}{(\text{NIR} + \text{RED})}$$

$$\text{LAI} = (0.3683 * \text{SR} - 1.1234)$$

$$\text{SR} = \frac{\text{NIR}}{\text{RED}}$$

$$\text{NDWI} = \frac{(\text{NIR} - \text{SWIR})}{(\text{NIR} + \text{SWIR})}$$

Field data validation

Monthly above-ground canopy biomass will be measured using litter traps and understory above-ground biomass using the quadrate method

Expected/Preliminary Results

- Quantify spatial and temporal patterns in NPP across different hydrological regimes
- Hydrological controls on wetland NPP across coastal plain wetlandscapes will be explored

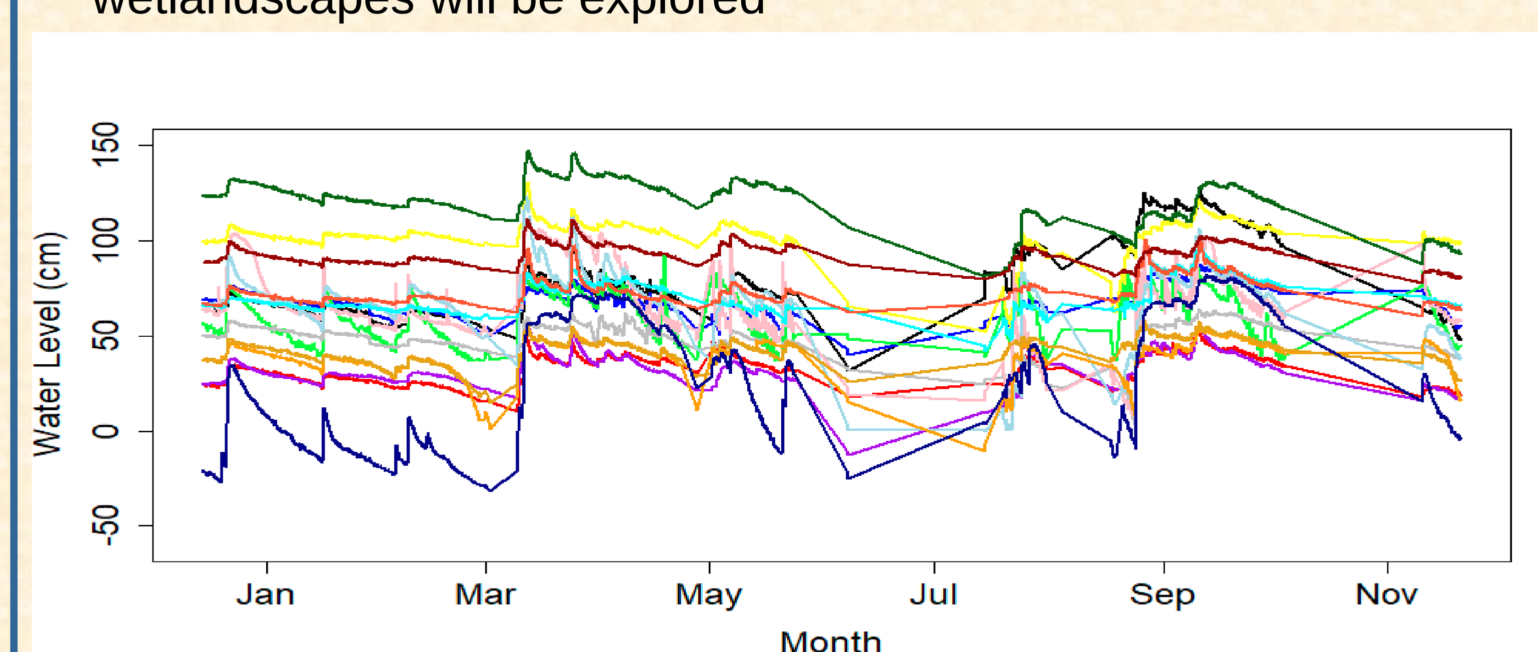


Fig 1. Water level fluctuations across wetlands

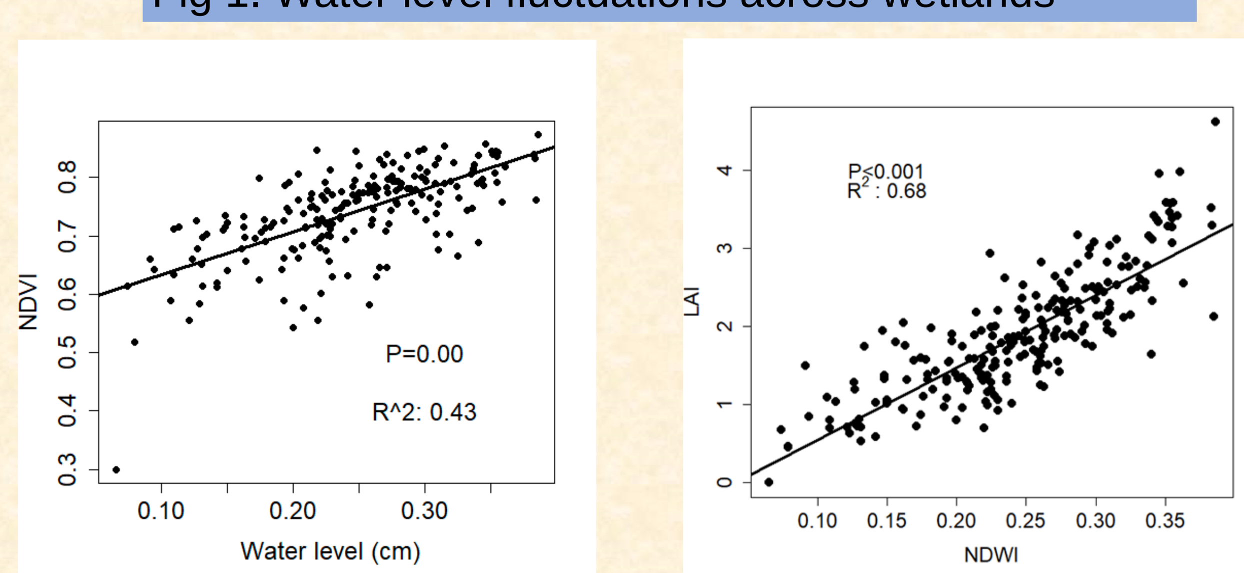


Fig 2. Linear regression of NDVI and LAI with NDWI

- LAI, NDVI and, NDWI are found strongly related (Fig 2 and 4)
- Spatial patterns (Fig. 4) show areas with high water levels also have high NDVI and LAI
- This suggests that water level controls productivity but to which extent and direction needs further analysis

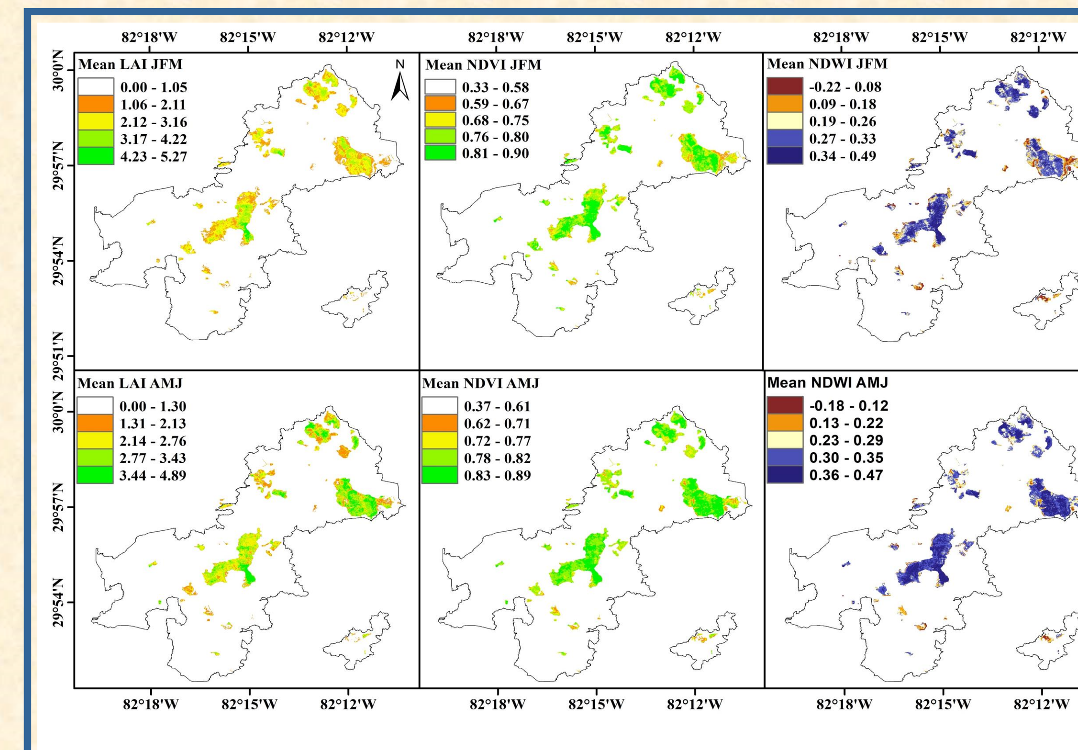


Table: Mean and Standard deviation

Month	LAI (Mean±Sd)	NDWI (Mean±Sd)
JFM	2.22±0.97	0.26±0.09
AMJ	2.57±0.84	0.31±0.07
JAS	2.28±0.69	0.28±0.05
OND	2.99±1.08	0.30±0.09

Month	NDVI (Mean±Sd)	NDWI (Mean±Sd)
JFM	0.78±0.084	0.26±0.09
AMJ	0.79±0.069	0.31±0.07
JAS	0.76±0.07	0.28±0.05
OND	0.80±0.07	0.30±0.09

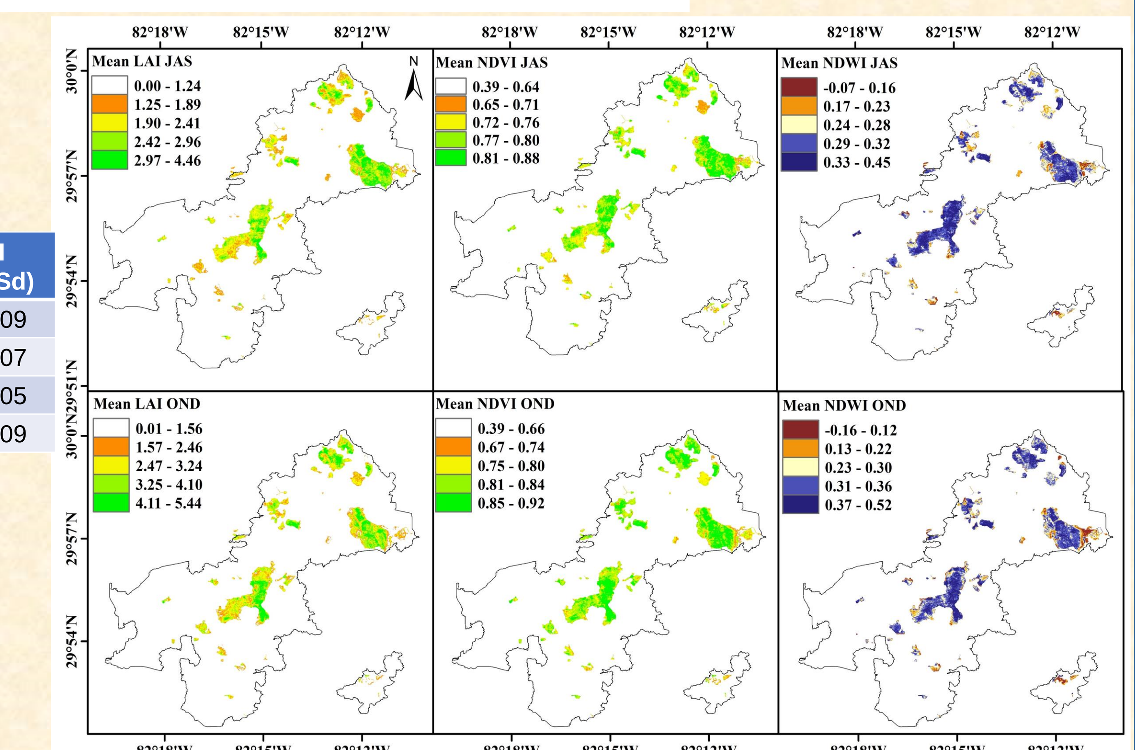


Fig 3. Spatial and temporal pattern of NDVI, LAI and NDWI

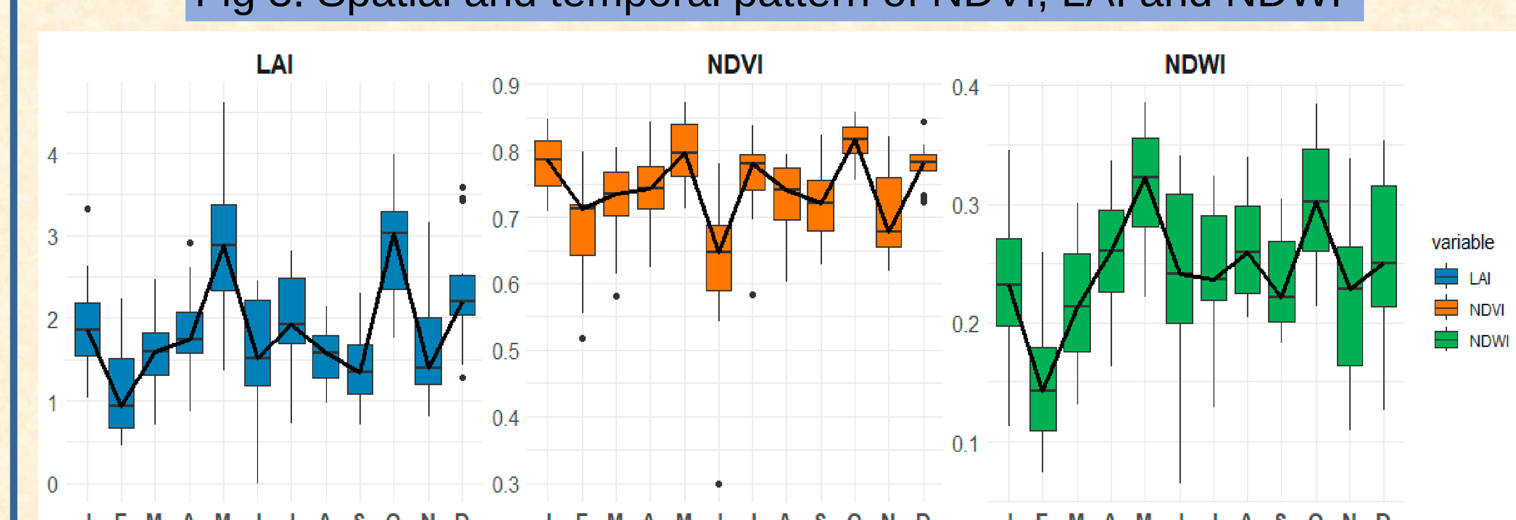


Fig 4. Monthly variation of NDVI, LAI and NDWI

Significance

This study will provide valuable insights into the complex interactions between water table dynamics, terrestrial-aquatic interfaces, and productivity of wetlands, contributing to a better understanding of vital ecological processes

Acknowledgements

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References

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2. Ye, X. C., Meng, Y. K., Xu, L. G., & Xu, C. Y. (2019). Net primary productivity dynamics and associated hydrological driving factors in the floodplain wetland of China's largest freshwater lake. Science of the Total Environment, 659, 302-313.

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