

Freshwater Diversions Provided Pulsed Hydrology to Coastal Swamps for Remediation

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PROJECT OVERVIEW

The project examined the indirect impacts of the hydrologic remediation of the Deep Horizon Oil Spill on rates of carbon cycling and ecosystem processes, which maintain elevation in baldcypress swamps of the Gulf Coast of the United States.

OBJECTIVES:

- I. Determine if the balance of swamp ecosystem processes related to peat accumulation (i.e., sedimentation, production and decomposition) was influenced by hydrological remediation for the Deepwater Horizon Oil Spill.
- II. Determine if soil respiration rates and greenhouse gas (CO₂, CH₄, N₂O) emissions from swamps were altered by remediation.
- III. Disseminate the findings of these studies in high impact peer review journals, websites, public presentations, and to report these findings to managers in research briefs and other venues.

HYPOTHESES:

We hypothesized that in comparison to control sites; remediated sites would have:

- 1) lower peat accumulation and above- and below-ground production
- 2) higher rates of soil respiration and decomposition

STUDY SITES

We collected data on above- and below-ground production, tree growth, decomposition, and regeneration. Pre-oil spill data collection began in coastal baldcypress swamps in Jean Lafitte NHP&P in 2005 within Middleton's North American Baldcypress Swamp Network (NABCSN; Fig. 1). For this study, three geographic regions were selected along the Gulf Coast including two control regions not likely to be impacted by the oil spill (Big Thicket National Preserve and St. Marks National Wildlife Refuge, TX and FL, respectively), and a hydrologically remediated site in Jean Lafitte NHP&P (red sites in Fig. 1). At each study location, we established 5 study sites that consist of 5 subplots each to provide a robust assessment of within site variability.

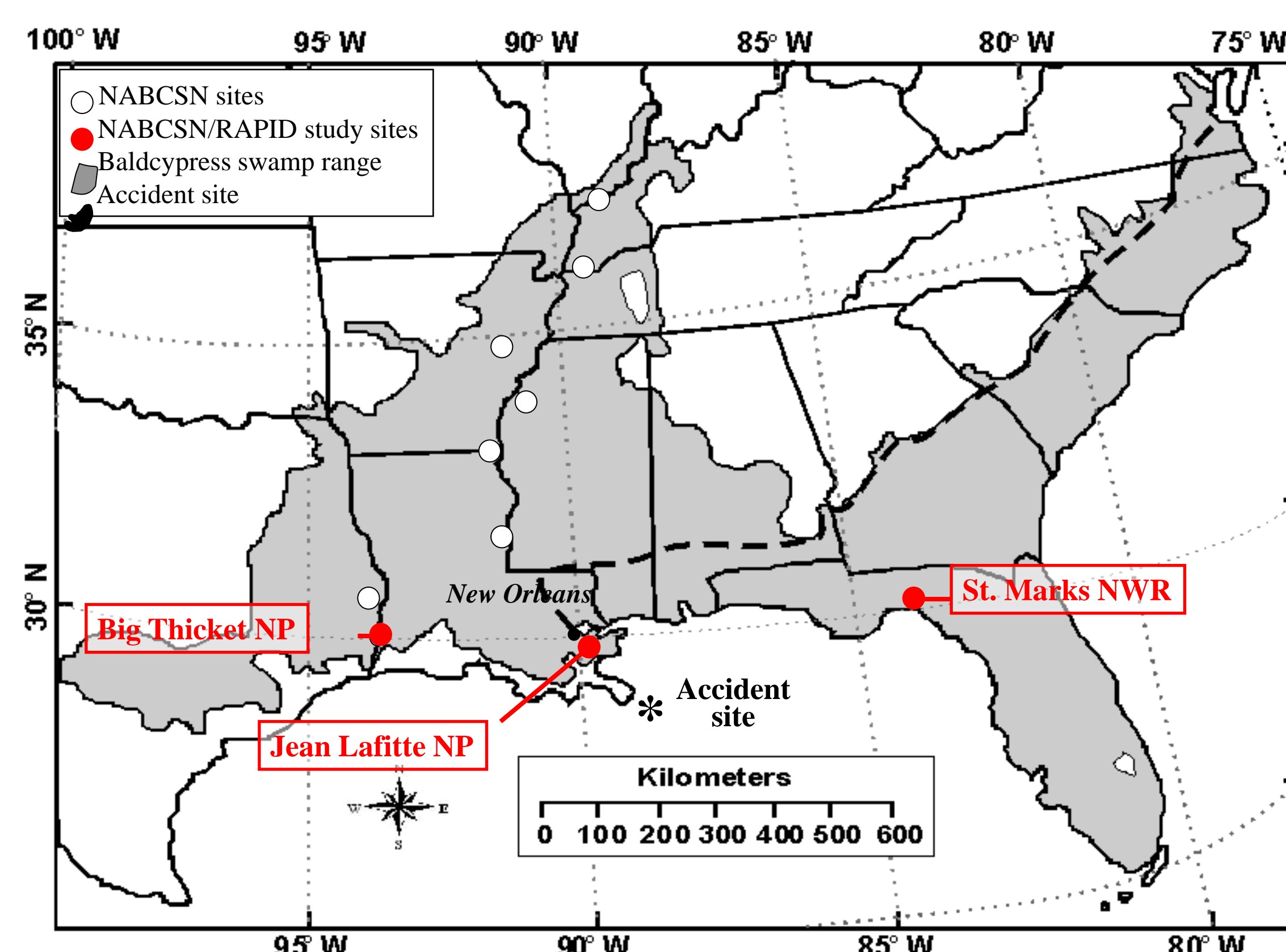


Fig.1. Study area map showing the geographic region of baldcypress swamps in the United States (gray shading). Also shown is the location of NABCSN (white circles) and study sites along the Gulf Coast for the hydrologic remediation study (red circles).

HYDROLOGIC REMEDIATION

A proactive action to prevent the oiling of coastal environments was to open the freshwater diversions of the Mississippi River to nearly full capacity. The water may have pushed oil away from coastal wetlands south of New Orleans, LA (NOLA 2010). The diversions rerouted ~35000 cfs (~1000 m³ s⁻¹) of river water into Louisiana's sensitive coastal wetlands. The Davis Pond diversion at 10,650 cfs or 302 m³ s⁻¹ increased freshwater flow through our long-term study sites in Jean Lafitte National Historic Park (Fig. 2).

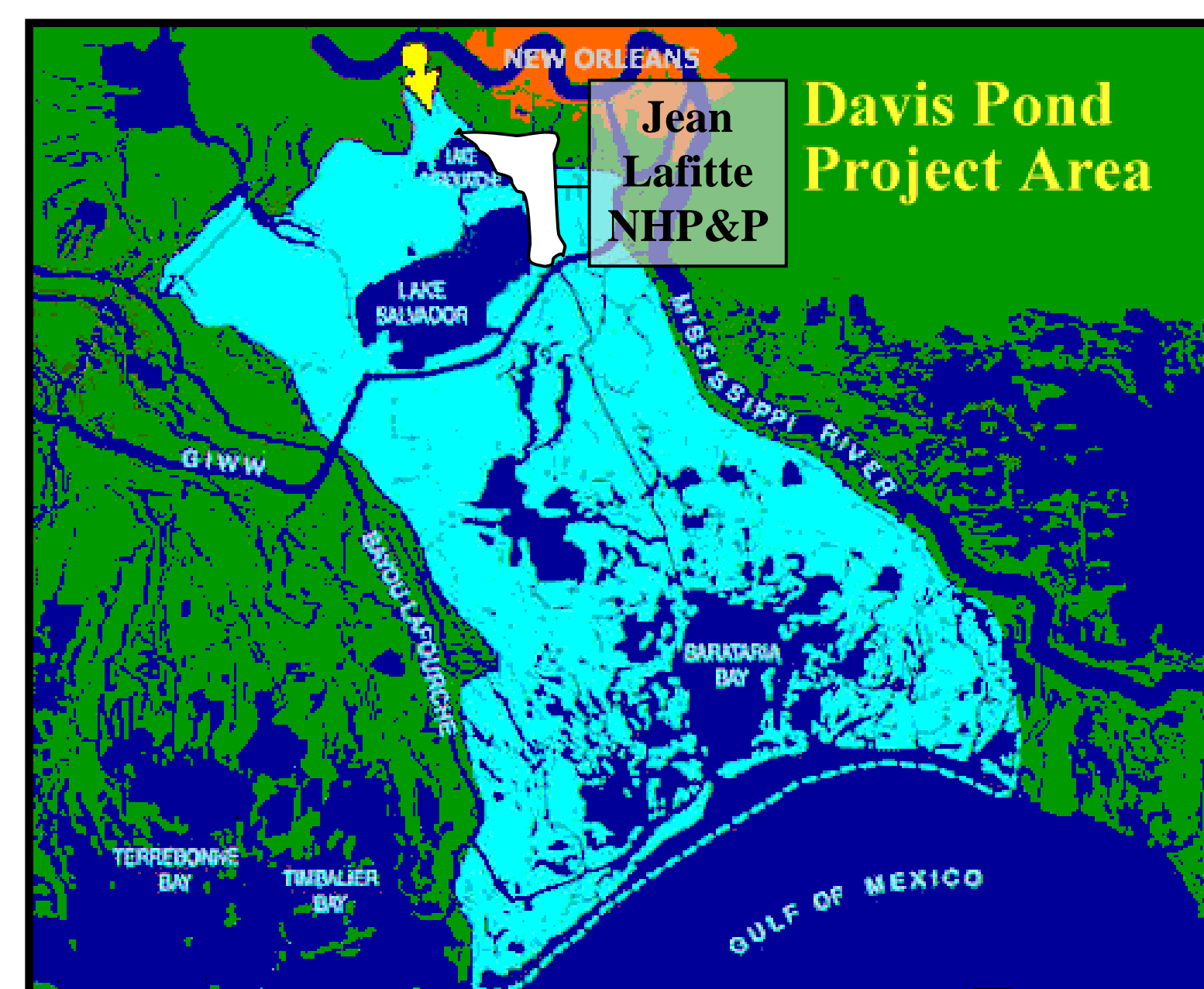


Fig. 2. Davis Pond Diversion of Mississippi River (light blue) and Jean Lafitte National Historic Park and Preserve

Hydrologic remediation was related to increased water levels and reduced salinity.

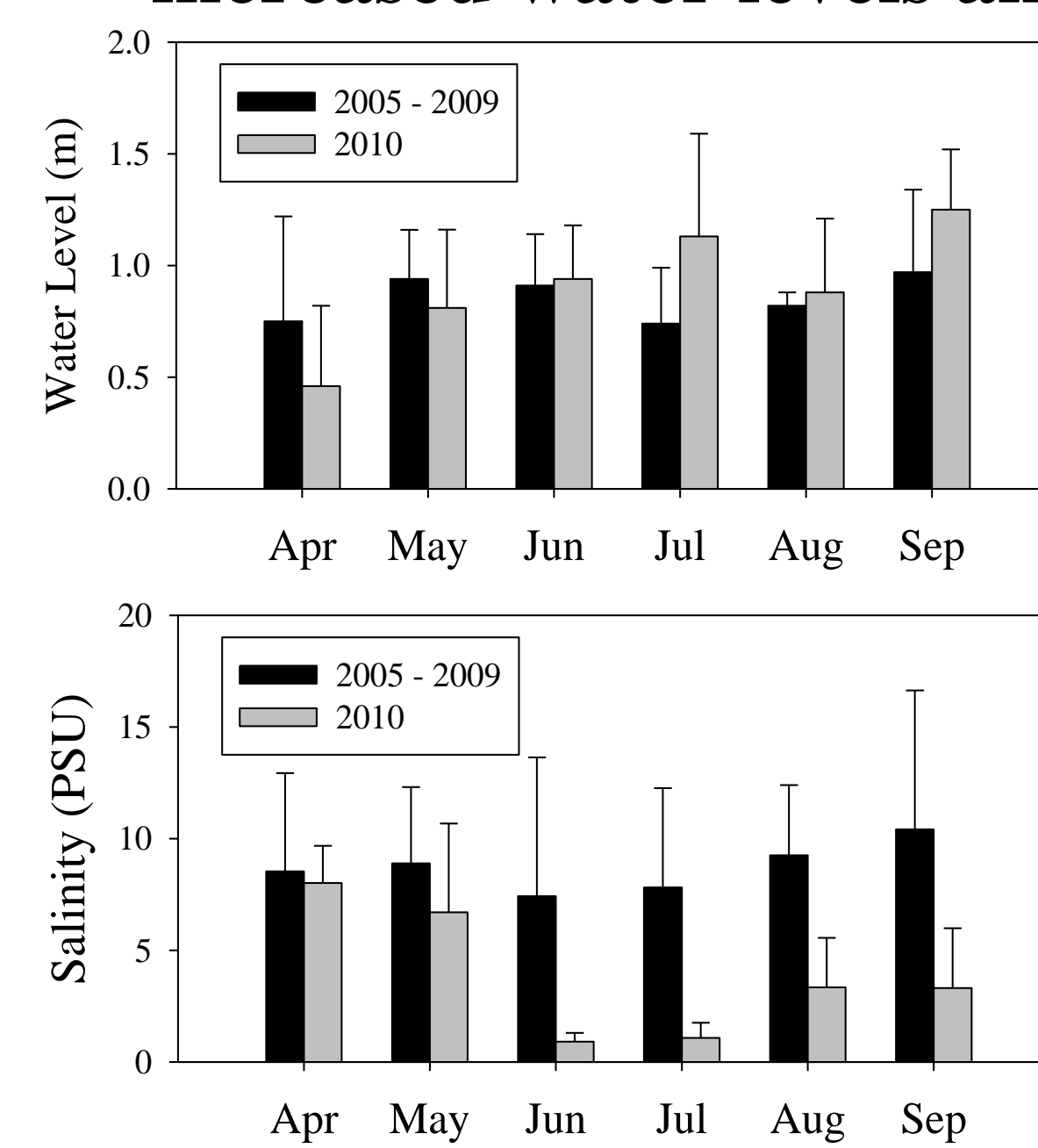
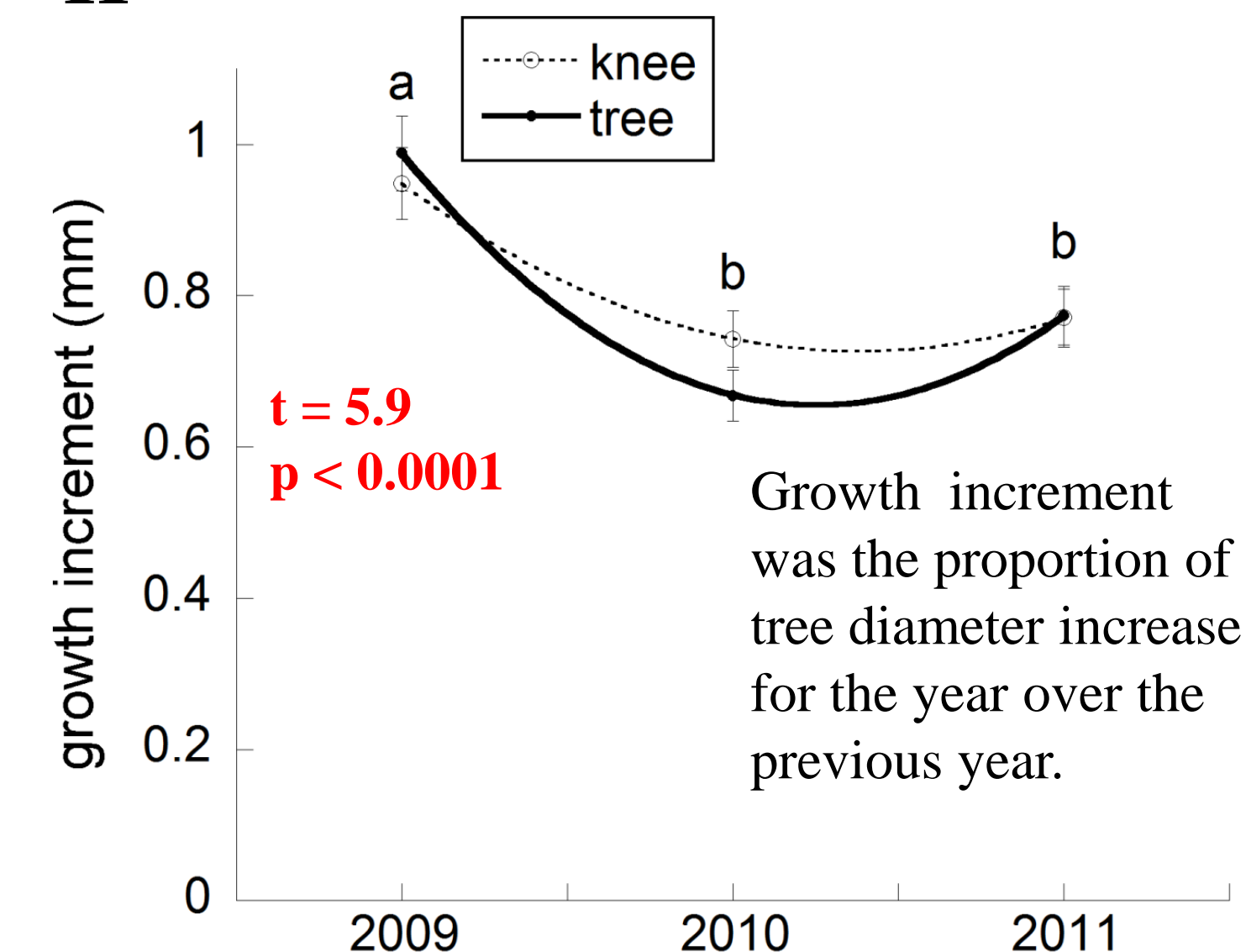


Fig. 3. Monthly mean water level (top) and salinity (bottom) for 2005-9 (black) and 2010 (grey), Barataria Waterway, Lafitte, LA. [Waterdata.usgs.gov/nwis/st/729285009000400](https://waterdata.usgs.gov/nwis/st/729285009000400)
Porewater salinity at our JLNHP sites fell from 0.5 to 0.3 psu from 2009 to 2010. The Davis Pond Diversion was opened in May 2010.

Tree and knee growth were lower for baldcypress in Jean Lafitte NHP&P following hydrologic remediation, 2010-11



PROCEDURES AND METHODS

PRIMARY PRODUCTIVITY

Tree & knee growth



Leaf litter



Canopy coverage



Root production



Cone production



DECOMPOSITION

- Leaf & wood decomposition (litterbag)
- Relative decomposition rates (cotton strip)

SOIL & POREWATER

- Seasonal soil core & porewater samples for organic matter and nutrient concentration

GREENHOUSE GAS FLUX & SOIL RESPIRATION

- Floating & static chambers (right) to determine gas flux rates of CO₂ (respiration), CH₄, and N₂O.

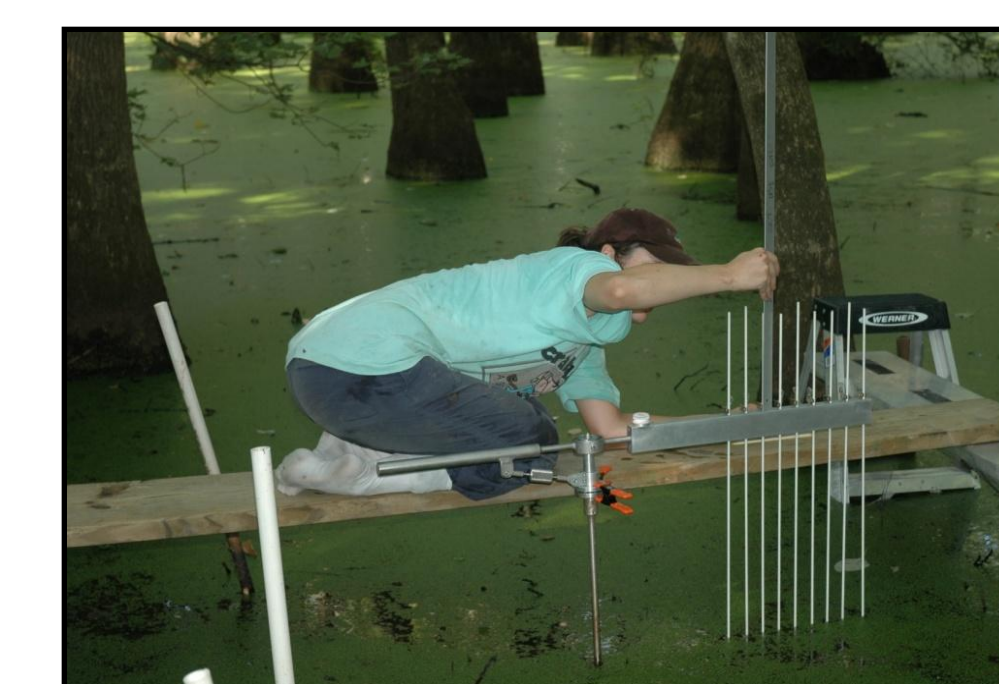
- Quarterly sampling.



SURFACE ELEVATION TABLE (SET)

- SET monuments established at six regional sites
- SET absolute elevation corrected with Continuously Operating Reference Stations (CORS LSU)

SET elevation



Absolute elevation

