CLEMSON UNIVERSITY

Quarterly Report

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Faculty of FORESTY

School of AGRICULTURAL, FOREST, AND ENVIRONMENTAL SCIENCES

College of AGRICULTURE, FORESTRY & LIFE SCIENCES

Baruch Institute of Coastal Ecology and Forest Sciences
Hwy. 17 N.
177 Hobcaw Rd.
Georgetown, SC 29440

(843) 546-1013
FAX (843) 546-6296

To:

William Bailey and Mary E. Richards
Planning Division
Savannah District
US Army Corps of Engineers
100 W. Oglethorpe Ave.
Savannah, GA 31401

Office of Naval Research
100 Alabama Street, SW
Suite 4R15
Atlanta, GA 30303-3104

Sherry Whitaker
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180

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By:

Jamie Duberstein
Baruch Institute of Coastal Ecology and Forest Science
Clemson University
PO Box 596
Georgetown, SC 29442
Cell: 706-410-6722

US Army Corp. of Engineers:

Please see below for an executive summary, then details of major accomplishments, actions, and progress associated with the vegetation and salinity monitoring within the Savannah National Wildlife Refuge. This work is done under Cooperative Agreement Number W912HZ-14-2-0002 under the terms of the Piedmont South Atlantic Coast (PSAC) Cooperative Ecosystems Studies Unit (CESU). The Cooperative Agreement Title is “Identifying and Evaluating Impacts to Wetlands from the Savannah River Estuary”.

Respectfully,

Jamie Duberstein
Clemson University

Executive Summary:

Water monitoring stations were built to house two sensors: a belowground salinity/water level sensor, and an aboveground salinity sensor. These stations were deployed, equipped with sensors, in early April. Sensors were programmed to take measurements hourly, and data collection began 04/04/2014. Water data still needs to be post-processed to determine water levels. Initial results indicate that the average spring (April/May) salinity ranged between 0.1 - 1.8 ppt at the Front 1 and Back 3.5 areas, respectively. Two marsh vegetation samples (April and June) have been collected and sorted, and the drying/weighing of the June sample is currently underway. The Final Report will include a comparison of this 2014 June sample to those June samples available (2004 or 2005?) in the historic databases maintained by Wiley Kitchens. Those files were transferred to Clemson in June.

March:

- Built monitoring stations for deploying the In-Situ Aquatroll water sensors. They consist of two wells, both of same diameter and length above- and below-ground. Figure 1 shows the monitoring station. Specifications are:
    - Marsh surface will be located at 0.25" below the surface of the monitoring station base; this coincides with thickness of the flat pvc.
    - The Belowground salinity/water depth sensors are Aquatroll 200 (In-Situ) and are suspended to a depth reaching the lower portion of the left well in Figure 1. The belowground section extends ~ 12 ½" (36 cm), and a portion has thin slits cut into it for water exchange ("wellpoint" or "screened" pvc). Water freely exchanges between the belowground portion of the well and the marsh root zone at depths ranging ~ **2 ½ - 12 ½" (6 – 36 cm) below the soil surface; this is the belowground salinity sampling zone.**
    - The aboveground sections extend ~ 4' (123 cm) above the surface. For the belowground salinity well (left well in Figure 1), material is regular schedule 40 pvc.
    - The aboveground salinity sensor is an Aquatroll 100 and is housed suspended in the well on the right side of Figure 1. The upper portion (~ 4') of the well is the wellpoint/screened variety, and water freely exchanges through the entire well, except the bottom 2 ½" (6 cm) occupied by the mounting coupler. The sensor hangs suspended to a depth of approximately 2.5" (6 cm) above the platform surface (i.e., above the mounting coupler), coinciding with 2 5/8" above the marsh surface.
    - The belowground portion of the right well shown in Figure 1 extends ~ 12 ½", is made of regular schedule 40 pvc that has holes drilled in it for drainage, is capped to facilitate maintenance, and is solely in place as support and stability.
    - Aboveground sections are long enough to remain mostly above high water, though sensors can operate accurately and safely even if they are submerged. Wells are sufficiently high enough to allow interfacing with the belowground salinity sensors during most tidal cycles. Note that opening the wells housing the belowground

March (Cont'd):

salinity sensors is not permitted if the estuary flood stage exceeds the height of the upper well because un-natural mixing of floodwater with interstitial (root zone) water will occur.

- We hope to outfit each monitoring station with staff gauges attached to the upper wells. Hence, upper wells are actually longer than necessary to stay out of high water. That upgrade is for another year.
- Tops of the wells are sealed with a locking cap, to which the suspension wires are attached. This helps ensure better precision on water level readings between periods of interfacing with the sensors (e.g., when uploading data).

Figure 1. Water monitoring station

March (Cont'd):

- Programmed the water sensors for deployment. Measurements will be made and recorded **hourly** starting 01 April 2014. Note that not all sensors will not be deployed at the field sites at this time, but should be within days of this activation time. Sensor clocks were synchronized at a time when daylight savings was in effect. Therefore, **sensor clocks will record data using EDT**. Water depth is measured using specific gravity of the water; sensors for all sites were set to fresh (specific gravity 0.999). We plan to adjust the specific gravity to coincide with site salinity. For reference, specific gravity of brackish water is 1.012 and specific gravity of sea water is 1.024; this is a minor adjustment.

  Data from belowground sensors (Aquatroll 200) includes:
  - Pressure (PSI)
  - Temperature (deg C)
  - Depth (cm)
  - Specific Conductivity (µs)
  - Salinity (PSU)
  - Total Dissolved Solids (ppt)

  Data from aboveground sensors (Aquatroll 100) includes:
  - Temperature (deg C)
  - Specific Conductivity (µs)
  - Salinity (PSU)
  - Total Dissolved Solids (ppt)

  Data from Barometer sensors includes:
  - Pressure (PSI)
  - Temperature (deg C)

- Continued working on the process to purchase a boat and hire a technician.

April:

- Deployed water monitoring stations and barometric pressure sensors. Quality data should be available after the first or second week in April, allowing time for the wells to settle in.
    - Removed all historic (Kitchens) monitoring wells.

- Collected the first marsh vegetation sample on April 4th and 5th.
    - Samples (n=108) were sorted (by species) in Georgetown, immediately put into drying ovens and dried to a constant weight, and weighed for dry biomass.

- Gave an invited talk at the American Planning Association national conference in Atlanta, Georgia. A suggested citation follows:
    - Duberstein JA, Hayes C (2014) Savannah Harbor Expansion Project impacts to salinity and vegetation. Invited speaker for the symposium Competitive Port Geography in Savannah. American Planning Association national conference. 27 April. Atlanta, GA. 15 mins.

- Selected an applicant for the temporary technician position associated with this grant. John (Josh) Salter from Valdosta, Georgia was slated to begin work on May 8th.

- An order was put forward for the 16' John boat associated with this grant.

- A purchase order was issued, and scheduling began, for the acquisition of the remote sensing GIS imagery. Collection of the imagery is set to begin June 2014, and requires <5% cloud cover. We will be notified when collection has been completed.

May:

- Downloaded water and barometric pressure sensors on May 14th and 16th.
    - Water depths have not been post-processed
    - The barometric pressure sensor at Back 4 was damaged, and data will have to be disregarded. Fortunately, a second barometric pressure sensor located at Swamp 1 (Figure 2) remained operative.
    - Salinity values for belowground sensors deployed within the marsh areas:

Area	Average salinity	Minimum salinity	Maximum salinity
Back 1	0.10	0.06	0.12
Back 2	0.11	0.06	0.22
Back 3	0.36	0.01	1.22
Back 3.5	1.78	0.33	2.68
Back 4	1.41	0.42	3.02
Middle 1	0.17	0.10	0.40
Middle 2	0.13	0.05	0.61
Middle 3	0.33	0.09	1.80
Middle 4	1.74	0.14	3.06
Middle 5	0.95	0.28	1.74
Front 1	0.08	0.04	0.26
Front 2	0.21	0.04	1.76

    - Data used to derive statistics include hourly readings from belowground sensors 04 April 2014 00:00 - 13 May 2014 23:30.

- Data from the April marsh vegetation sample has been compiled into MS Excel format. Importance values have been calculated for each species in each plot.
    - Some species were not able to be identified. Pictures were taken, and we will attempt to discern their identity based on observations on the upcoming June sample.

June:

- Marsh vegetation samples were collected from all 108 study plots on June 15th and 16th.
    - Samples were transported to Georgetown (SC) and placed in cold storage at the University of South Carolina's Baruch Institute for Marine and Coastal Sciences.
    - Samples were immediately sorted by species and stems counted, finishing by June 19th. The samples are currently being dried in a forced air oven.
    - Samples are weighed after they have remained in the forced air oven at 55° C (130° F) for at least 5 days. This assures that no moisture exists in the plant material.

- The water monitoring station at Back 4 was apparently damaged by one or more hogs. The station and its sensors have been repaired, but data leading up to the point of repair will have to be carefully scrutinized.
    - The barometric pressure sensor (damaged previously) was repaired

- We have identified potential areas for monitoring the forested wetlands (Figure 2). We would like to get approval from USACE for plot locations. All sites are within the refuge acquisition boundary, and have been approved by Jane Griess at the Savannah NWR (via Theresa Thom, Savannah NWR Aquatic Biologist) for monitoring.
    - The most upstream plot is "Swamp 1", and the dominant trees have been measured annually for approximately 10 years. The land is owned by the State of Georgia, but it is managed by the USFWS through an existing agreement.
        - UTM: 17S 485328 (east) N3566827 (north)
    - Swamp 2 is located on Savannah NWR land.
        - UTM: 17S 485653 (east) 3564066 (north)
    - Swamp 3 is located on land owned by the Georgia Ports Authority. We will seek approval to establish the monitoring area after first hearing back from USACE with regard to placement of the forested wetland monitoring areas.
        - UTM: 17S 484900 (east) 3561838 (north)

- We plan to download data from water sensors and establish forest plots during the last week in July, providing all approvals have been made.

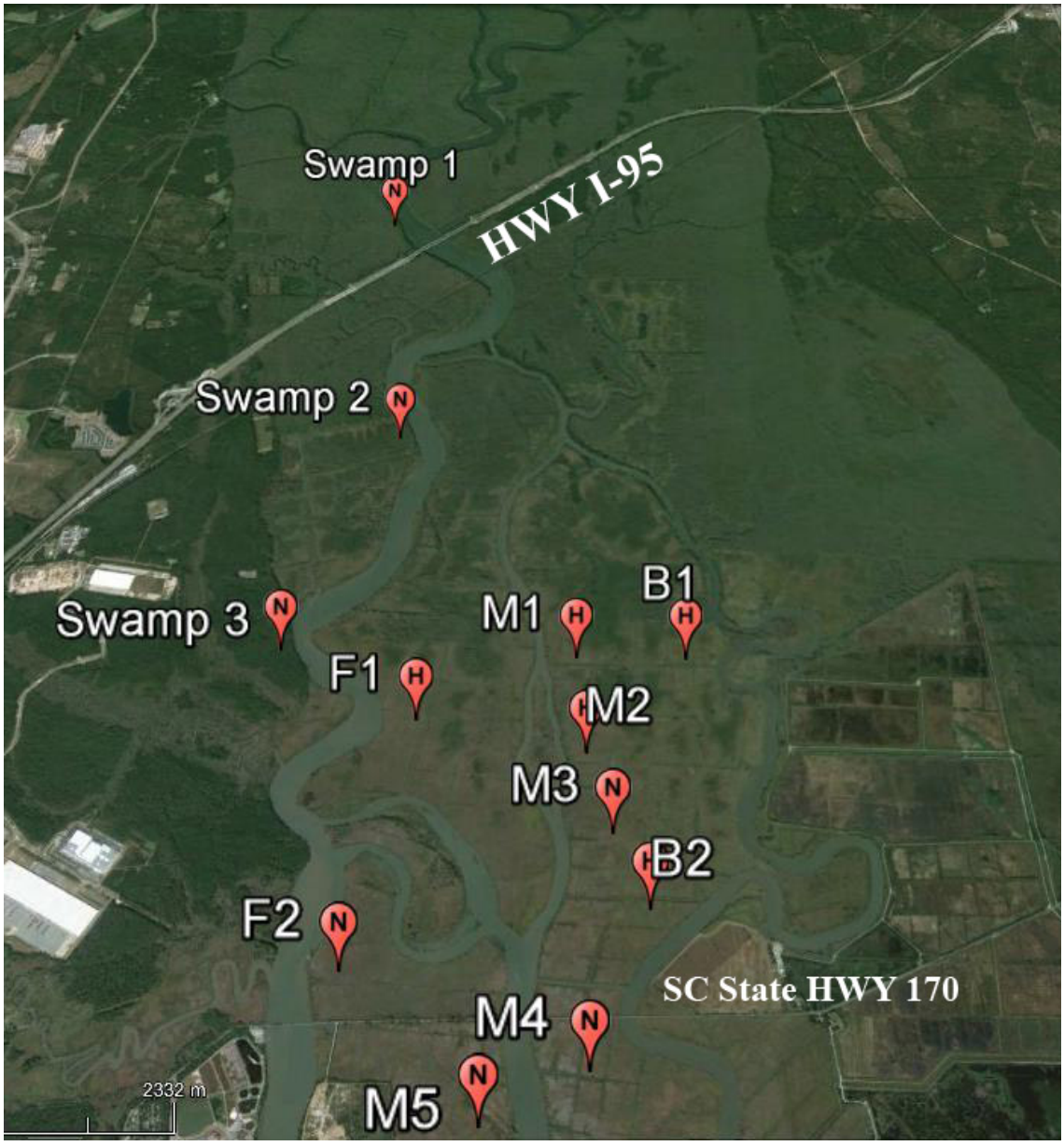

Figure 2. General locations for the three forested wetland monitoring areas (Swamp 1, 2, and 3) with respect to some marsh monitoring areas. Letters inside balloons indicate whether these are new (N) or historic (H) monitoring areas; there were no historic forested wetland monitoring areas.

- The boat, motor, and trailer were received from The Boat Shed (Georgetown, SC) on June 20th (Figure 3).
    - Boat: 2015 Sea Arc 1660MV
    - Motor: 2014 Yamaha F40LA
    - Trailer: 2014 Wesco 1620FSE

Figure 3. Jonboat (16') for collecting vegetation samples.

- We have received many of the historic databases from Wiley Kitchens (via Zach Welch, subcontractor). This helps us do a much better comparison of communities since our datasets can be compiled in a similar format (e.g., abbreviations for marsh grass species). The pictures and species names provided also help minimize discrepancies.