

Fiscal Year 2016: 3rd Quarter Status Report

01 April – 30 June, 2016

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10 November 2016

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This quarterly status report is provided to satisfy the reporting requirements outlined in Section 13 of our original Research Cooperative Agreement Schedule. Please see below for an executive summary, bulleted items highlighting major accomplishments, actions, and progress associated with the vegetation and salinity monitoring within the Savannah National Wildlife Refuge in the months of April, May, and June 2016. 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". This particular quarterly report is nearly identical to the 2nd Quarter report because of the recent switch from the previous 'calendar year' reporting scheme to the Federal Fiscal Year reporting scheme. However, data tables have been updated to reflect the switch to the Fiscal Year format. As such, data from October – December 2015 was included in salinity summary tables and the table of data losses.

Respectfully,

Jamie Duberstein
Clemson University

Executive Summary:

All regularly scheduled field work was carried out successfully during this quarter. This included salinity and water level downloads, measurements of tree growth, and a synoptic vegetation collection effort in June. Additionally, in April 2016 we upgraded 18 Aquatroll sensors (salinity recorders) that were provided gratis by the company; this was in response to the rate of sensor malfunction that we'd been experiencing in the recent past. Sensors that were already previously upgraded, deployed, and collecting in-situ data were calibrated to maintain accurate salinity measurements. Data tables are provided for the 3rd quarter of Fiscal Year 2016, including monthly site salinity statistics, a record of data losses, and three monthly "spot checks" of salinity conditions comparing values collected autonomously by Aquatrolls to values measured in-person using a handheld unit.

April 2016

Marsh Vegetation

- No new activity to report.

Water Data

- Data stored within Aquatroll sensors were downloaded on 19-20 April 2016. Due to the complexity of the field mission this month (*e.g.*, exchanging some sensors, calibrating and re-programming others), human error resulted in failing to download the complete records of all sensor data during the April download/exchange/calibration effort. No data were lost, and missing data will be downloaded during the May trip.
 - An updated summary of salinity statistics (*e.g.*, Table 1) was not provided to USACE in April.
- 18 Aquatroll sensors were exchanged for a newer version of the sensor, with an updated circuit board.
 - This exchange was provided gratis by In-Situ in response to the recently high rate of sensor failure.
 - The sensor exchange resulted in some data loss, though losses were minor (< 2 days).
- Salinity calibration and routine cleaning was performed on all deployed sensors that already had updated circuit boards because they had been previously exchanged (due to failure). Calibration and cleaning was done 19-21 April 2016.
- Analysis of 2015 water level values recorded at Swamp 3 revealed daily patterns that were tidal, but long-term trends (Figure 1) indicated some unknown error was occurring, perhaps as though the belowground well was filling with sediments.
 - The Swamp 3 monitoring station was pulled from the ground on 20 April with the intention to clear the belowground well of accumulated sediments and outfit the well with several layers of leg hosiery, which has proven to decreased intrusion of sediments at other (non-SHEP) well deployments.
 - The lower portion of the belowground well was removed from the platform and inspected. No sediments were accumulated inside the well. The well was re-assembled, and outfitted with leg hosiery just as a preventative. The monitoring station was then re-set in the ground.

- The belowground sensor was removed under the assumption that the sensor must be malfunctioning because the well was performing well, as there were no accumulated sediments. The sensor was sent to the In-Situ service department to determine the problem. Note this sensor has the new circuitry.
- A new (replacement) belowground sensor was programmed and deployed immediately at Swamp 3.
- Despite the problems with the water level readings at Swamp 3, there were no recent losses of salinity data that resulted from malfunctioning sensors. However, there were minor widespread data losses due to sensor upgrades in April. These salinity and water level data losses spanned less than two days. An updated table of 2016 salinity data losses were provided to USACE (*e.g.*, Table 2).
- A “spot check” of salinity conditions were measured using a handheld YSI meter during the download/exchange/calibration effort in April.
 - Reports typically provide summaries of hourly Aquatroll measurements of salinity as practical salinity units (psu), though measurements of total dissolved solids as parts per thousand (ppt) are also collected.
 - Here we report both values to facilitate comparisons with handheld YSI measurements.
 - Accuracy of the handheld YSI meter is 0.1 (ppt), while accuracy of the Aquatrolls is 0.001 (psu, ppt); Aquatroll values were rounded to the nearest 0.1 to facilitate comparisons.
 - A comparison (Aquatrolls versus handheld YSI) of salinity values for April 2016 was provided to USACE in April (Table 3).

Forest monitoring

- Monthly measurements of baldcypress tree growth were last taken on 20 April at Swamp 1, Swamp 2, and Swamp 3.
- Average basal area increase since last measurement:
 - Swamp 1: -0.2 cm² (15 Mar. – 20 April)
 - Swamp 2: -0.2 cm² (15 Mar. – 20 April)
 - Swamp 3: -0.1 cm² (15 Mar. – 20 April)

Herpetofauna (MS student) study

- No new activity to report.

Swamp 3 water levels

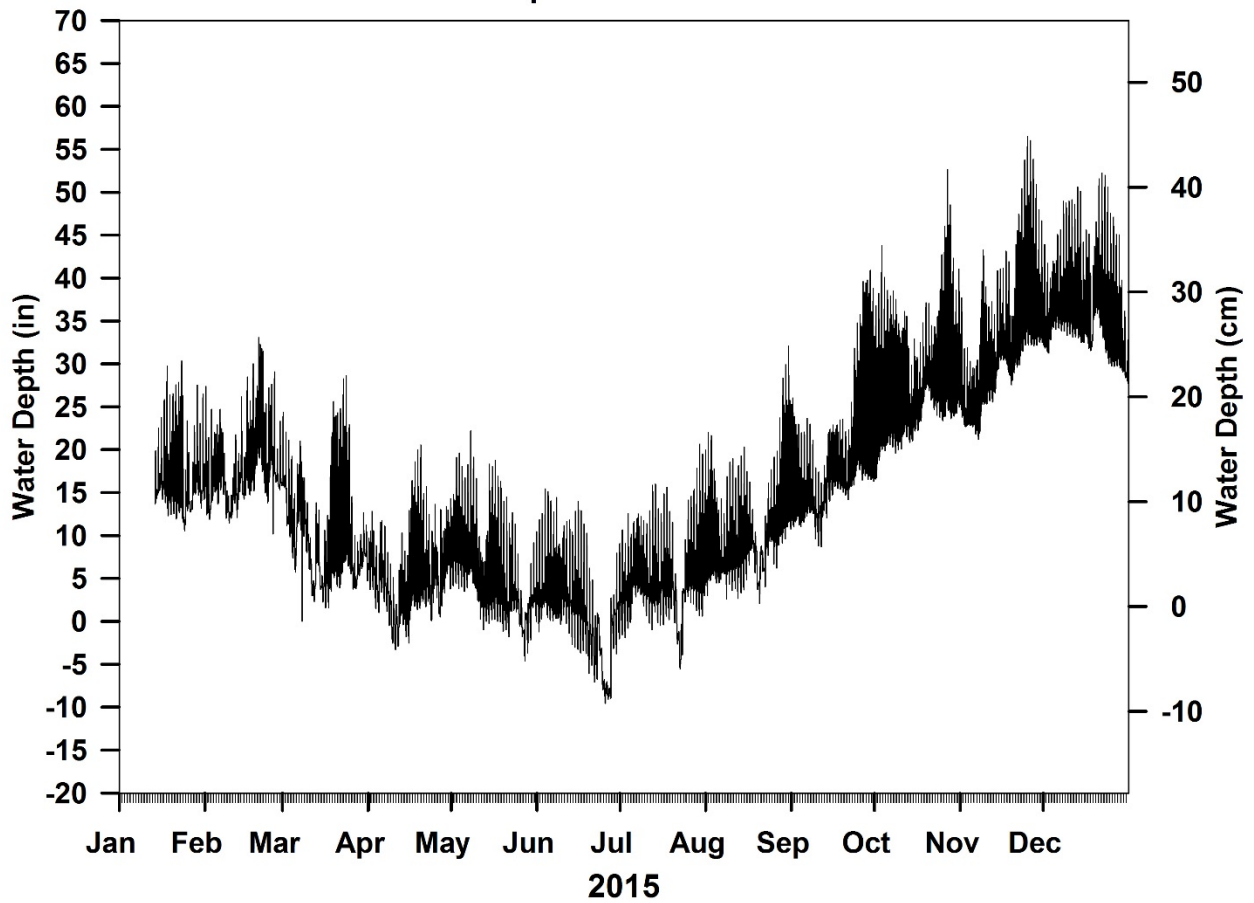


Figure 1. Calendar year 2015 hourly water level measurements at the Swamp 3 tidal forest monitoring area. These measurements were post-processed to compensate for atmospheric conditions, but were not adjusted for ground level. The well was inspected and no sediment accumulation was present, leading to the interpretation that the sensor was malfunctioning. The sensor was replaced in April 2016. In-Situ confirms that this was a pressure sensor failure. Salinity data (Table 1) do not appear to be affected.

May 2016

Marsh Vegetation

- The June synoptic sample event was set to begin 06 June.

Water Data

- Data from all water sensors were downloaded on 18 and 19 May 2016.
 - Recall that the complete records of sensor data were not downloaded in April. The missing data were downloaded in May, and an updated salinity table (*e.g.*, Table 1) was provided to USACE in May.
- There were no malfunctioning sensors identified in May 2016.
- A “spot check” of belowground salinity conditions were measured using a handheld YSI meter during the May sensor download. Salinity values were compared to those measured via Aquatrolls, provided in this FY16 3rd Quarter Report as Table 4.

Forest monitoring

- Monthly measurements of baldcypress tree growth were last taken on 19 May at Swamp 1, Swamp 2, and Swamp 3.
- Average basal area increase since last measurement:
 - Swamp 1: 1.6 cm² (20 April – 19 May)
 - Swamp 2: 2.3 cm² (20 April – 19 May)
 - Swamp 3: 1.9 cm² (20 April – 19 May)

Herpetofauna (MS student) study

- Field data collection ended 31 May 2016.

June 2016

Marsh Vegetation

- A synoptic marsh vegetation sample event was carried out on 06 June 2016, and included collecting all marsh vegetation within a 2.7 ft² (0.25 m²) area at each of 108 points throughout the freshwater-to-oligohaline tidal marsh area of the estuary.
- Samples from the 108 “plots” were sorted by species and number of stems/individuals counted.
- The vegetation from each species was then put in a separate paper bag, oven dried to remove all water, then weighed.
- Data entry, validation, and computations for Importance Values are underway.
 - $IV = [(relative\ frequency + relative\ biomass)/2 * 100]$

Water Data

- Data from all water sensors were downloaded on 23 and 24 June 2016.
 - An updated salinity table (Table 1) was included with the June monthly report to USACE.
- A table of 2016 salinity data losses are listed in Table 2.
 - There had been no major loss of salinity data since the sensor swap on 21 April 2016. However, there were losses of water level data from the sensor at Middle 5.
 - The sensor was taken from deployment and replaced with a known working sensor.
 - We are working toward integrating and post-processing water level data quicker so we can minimize losses incurred with equipment failures that are difficult to detect using only a month or two of data (e.g., Figure 1).
- A “spot check” of belowground salinity conditions were measured using a handheld YSI meter during the June sensor download. Belowground salinity values were compared to those measured via Aquatrols, provided in this FY16 3rd Quarter Report as Table 5.

Forest monitoring

- Monthly measurements of baldcypress tree growth were last taken on 23 June at Swamp 1 and Swamp 2; and 24 June at Swamp 3.
- Average basal area increase since last measurement:
 - Swamp 1: 4.3 cm² (19 May – 23 June)
 - Swamp 2: 4.0 cm² (19 May – 23 June)
 - Swamp 3: 2.4 cm² (19 May – 24 June)

Herpetofauna (MS student) study

- Field data collection ended 31 May 2016.
- Data are being entered and interpreted.

Table 1. Fiscal Year 2016 average, maximum, and minimum salinity (psu: practical salinity units) measured via sensors at above- and below-ground locations at (12) marsh monitoring areas and (3) tidal forest areas. Summaries are based on hourly measurements starting 01 October 2015 through 30 June 2016 for all monitoring areas unless noted by superscript; details of data losses are provided in Table 2. Measurements taken during dry well conditions were removed from calculations of summary statistics.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Back 1	October 2015	0.06 (0.01)	0.00	0.32	0.19 (0.00)	0.13	0.48
	November 2015	0.04 (0.00)	0.00	0.06	0.14 (0.00)	0.08	0.25
	December 2015	0.03 (0.00)	0.00	0.05	0.09 (0.00)	0.07	0.10
	January 2016	0.03 (0.00)	0.01	0.05	0.09 (0.00)	0.08	0.10
	February 2016	0.03 (0.00)	0.00	0.05	0.07 (0.00)	0.07	0.09
	March 2016	0.08 (0.00)	0.00	0.12	0.09 (0.00)	0.06	0.11
	April 2016	0.07 (0.00) ^b	0.00 ^b	0.12 ^b	0.10 (0.00) ^b	0.08 ^b	0.10 ^b
	May 2016	0.06 (0.01)	0.00	0.15	0.12 (0.00)	0.09	0.13
	June 2016	0.06 (0.01)	0.00	0.18	0.10 (0.00)	0.08	0.13
Back 2	October 2015	0.19 (0.00)	0.13	0.48	0.31 (0.00)	0.10	0.58
	November 2015	0.14 (0.00)	0.08	0.25	0.11 (0.00)	0.06	0.35
	December 2015	0.09 (0.00)	0.07	0.10	0.07 (0.00)	0.06	0.10
	January 2016	0.09 (0.00) ^a	0.08 ^a	0.10 ^a	0.06 (0.00) ^a	0.04 ^a	0.09 ^a
	February 2016	0.07 (0.00)	0.07	0.09	0.07 (0.00) ^a	0.04 ^a	0.09 ^a
	March 2016	0.09 (0.00)	0.06	0.11	0.08 (0.00)	0.07	0.10
	April 2016	0.10 (0.00)	0.08	0.10	0.10 (0.00)	0.07	0.13
	May 2016	0.12 (0.00)	0.09	0.13	0.14 (0.00)	0.08	0.19
	June 2016	0.10 (0.00)	0.08	0.13	0.15 (0.00)	0.09	0.26

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Back 3	October 2015	0.29 (0.02)	0.00	1.87	1.86 (0.01)	1.28	2.41
	November 2015	0.07 (0.01)	0.00	0.75	1.65 (0.01)	0.68	2.05
	December 2015	0.05 (0.00)	0.00	0.08	1.72 (0.01)	0.77	1.91
	January 2016	0.04 (0.00)	0.00	0.07	1.49 (0.01) ^a	1.12 ^a	1.88 ^a
	February 2016	0.03 (0.00)	0.00	0.06	1.15 (0.01) ^a	0.62 ^a	1.39 ^a
	March 2016	0.06 (0.01)	0.00	0.15	0.68 (0.01)	0.12	1.46
	April 2016	0.07 (0.01) ^b	0.00 ^b	0.48 ^b	0.42 (0.01)	0.01	1.03
	May 2016	0.33 (0.04)	0.00	1.28	0.36 (0.01)	0.01	1.20
	June 2016	0.25 (0.03)	0.00	1.61	0.43 (0.01)	0.00	1.12
Back 3.5	October 2015	0.64 (0.04)	0.00	3.39	2.37 (0.01) ^a	1.35 ^a	2.63 ^a
	November 2015	0.08 (0.01)	0.00	1.25	2.37 (0.00)	2.22	2.56
	December 2015	0.03 (0.00)	0.00	0.27	2.44 (0.00)	2.34	2.63
	January 2016	0.03 (0.00)	0.00	0.18	2.14 (0.01)	1.23	2.61
	February 2016	0.04 (0.00)	0.00	0.11	2.07 (0.00)	1.83	2.31
	March 2016	0.06 (0.01)	0.00	0.38	1.78 (0.02)	0.43	2.20
	April 2016	0.08 (0.01)	0.00	0.61	1.92 (0.00) ^b	1.78 ^b	2.1a ^b
	May 2016	0.28 (0.03)	0.00	2.08	1.81 (0.01)	1.45	2.14
	June 2016	0.27 (0.03)	0.00	2.05	1.73 (0.01)	0.88	2.06

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Back 4	October 2015	1.23 (0.07)	0.00	6.25	3.87 (0.05)	0.22	6.56
	November 2015	0.27 (0.02) ^a	0.00 ^a	3.68 ^a	2.77 (0.02) ^a	1.94 ^a	3.55 ^a
	December 2015	0.09 (0.01) ^a	0.00 ^a	0.66 ^a	1.92 (0.01) ^a	0.74 ^a	2.37 ^a
	January 2016	0.05 (0.00)	0.00	0.57	2.27 (0.01)	1.73	2.65
	February 2016	0.08 (0.01)	0.00	0.62	2.69 (0.00)	2.42	2.83
	March 2016	0.21 (0.02)	0.00	2.39	2.75 (0.01)	0.02	2.86
	April 2016	0.33 (0.03) ^b	0.00 ^b	3.59 ^b	2.48 (0.01) ^b	1.96 ^b	2.83 ^b
	May 2016	0.76 (0.07)	0.00	5.37	2.42 (0.00)	1.92	2.63
	June 2016	0.72 (0.06)	0.00	7.18	2.10 (0.01)	1.52	3.36
Front 1	October 2015	0.06 (0.01)	0.00	0.65	0.22 (0.00)	0.08	0.45
	November 2015	0.02 (0.00)	0.00	0.25	0.15 (0.00)	0.07	0.29
	December 2015	0.03 (0.00)	0.00	0.09	0.10 (0.00)	0.07	0.11
	January 2016	0.03 (0.00)	0.00	0.08	0.08 (0.00)	0.05	0.10
	February 2016	0.03 (0.00)	0.00	0.06	0.08 (0.00)	0.07	0.09
	March 2016	0.04 (0.00)	0.00	0.06	0.08 (0.00)	0.07	0.09
	April 2016	0.03 (0.00) ^b	0.00 ^b	0.13 ^b	0.06 (0.00) ^b	0.27 ^b	0.08 ^b
	May 2016	0.05 (0.01)	0.00	0.47	0.11 (0.00)	0.06	0.15
	June 2016	0.07 (0.01)	0.00	0.43	0.12 (0.00)	0.04	0.33

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Front 2	October 2015	0.38 (0.03)	0.00	4.14	1.11 (0.02)	0.31	2.18
	November 2015	0.05 (0.01)	0.00	1.09	0.40 (0.01)	0.16	0.94
	December 2015	0.04 (0.00)	0.00	0.05	0.21 (0.00)	0.06	0.39
	January 2016	0.03 (0.00)	0.01	0.05	0.14 (0.00)	0.05	0.33
	February 2016	0.03 (0.00)	0.00	0.05	0.13 (0.00)	0.05	0.32
	March 2016	0.06 (0.00)	0.00	0.31	0.20 (0.00)	0.08	0.47
	April 2016	0.08 (0.01)	0.00	3.75	0.25 (0.00)	0.17	0.44
	May 2016	0.14 (0.02)	0.00	3.43	0.42 (0.01)	0.15	0.68
	June 2016	0.29 (0.03)	0.00	4.45	0.46 (0.01)	0.13	1.52
Middle 1	October 2015	0.20 (0.02)	0.00	3.13	0.56 (0.01)	0.32	1.22
	November 2015	0.04 (0.00)	0.00	0.33	0.35 (0.00)	0.17	0.54
	December 2015	0.02 (0.00)	0.00	0.12	0.27 (0.00)	0.14	0.35
	January 2016	0.04 (0.00) ^a	0.00 ^a	0.05 ^a	0.20 (0.00)	0.11	0.33
	February 2016	0.04 (0.00)	0.00	0.09	0.23 (0.00)	0.16	0.33
	March 2016	0.05 (0.00)	0.00	0.11	0.20 (0.00)	0.14	0.27
	April 2016	0.07 (0.00)	0.00	0.25	0.21 (0.00) ^b	0.10 ^b	0.25 ^b
	May 2016	0.14 (0.02)	0.00	1.18	0.27 (0.00)	0.19	0.42
	June 2016	0.17 (0.05)	0.00	2.53	0.27 (0.00)	0.13	1.28

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Middle 2	October 2015	0.13 (0.03)	0.00	3.80	0.73 (0.02)	0.16	2.53
	November 2015	0.01 (0.00)	0.00	0.07	0.25 (0.01)	0.05	0.64
	December 2015	0.04 (0.00) ^a	0.00 ^a	0.08 ^a	0.07 (0.00)	0.05	0.10
	January 2016	0.03 (0.00) ^a	0.02 ^a	0.04 ^a	0.07 (0.00)	0.05	0.12
	February 2016	0.03 (0.00)	0.00	0.05	0.09 (0.00)	0.06	0.16
	March 2016	0.06 (0.00)	0.00	0.14	0.09 (0.00)	0.04	0.14
	April 2016	0.08 (0.01)	0.00	0.45	0.11 (0.00) ^b	0.07 ^b	0.21 ^b
	May 2016	0.12 (0.02)	0.00	1.17	0.21 (0.00)	0.08	0.32
	June 2016	0.17 (0.08)	0.00	3.36	0.29 (0.01)	0.06	2.17
Middle 3	October 2015	0.07 (0.02)	0.00	4.04	1.27 (0.04) ^a	0.31 ^a	4.04 ^a
	November 2015	0.01 (0.00)	0.00	0.34	N/A ^a	N/A ^a	N/A ^a
	December 2015	0.01 (0.00) ^a	0.00 ^a	0.07 ^a	0.40 (0.00)	0.28	0.57
	January 2016	0.04 (0.00) ^a	0.03 ^a	0.05 ^a	0.29 (0.01)	0.10	0.60
	February 2016	0.03 (0.00)	0.02	0.05	0.24 (0.00)	0.03	0.50
	March 2016	0.09 (0.02)	0.00	0.27	0.40 (0.01)	0.13	0.74
	April 2016	0.07 (0.02)	0.00	0.53	0.30 (0.01) ^b	0.09 ^b	0.58 ^b
	May 2016	0.26 (0.06)	0.00	2.04	0.66 (0.01)	0.00	1.40
	June 2016	0.16 (0.09)	0.00	5.90	0.57 (0.03)	0.06	5.83

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Middle 4	October 2015	0.73 (0.06)	0.00	6.43	3.91 (0.01) ^a	3.70 ^a	4.26 ^a
	November 2015	0.14 (0.02) ^a	0.00 ^a	2.07 ^a	N/A ^a	N/A ^a	N/A ^a
	December 2015	N/A ^a	N/A ^a	N/A ^a	1.17 (0.01)	0.56	1.68
	January 2016	0.02 (0.00) ^a	0.00 ^a	0.06 ^a	1.02 (0.01)	0.20	1.52
	February 2016	0.02 (0.00)	0.00	0.08	1.24 (0.01)	0.84	2.11
	March 2016	0.06 (0.01)	0.00	0.45	1.40 (0.01) ^b	0.48 ^b	2.48 ^b
	April 2016	0.06 (0.01)	0.00	1.20	1.16 (0.01)	0.34	3.16
	May 2016	0.21 (0.03)	0.00	2.74	1.43 (0.02)	0.41	3.02
	June 2016	0.28 (0.05)	0.00	7.28	1.86 (0.02)	0.64	3.58
Middle 5	October 2015	0.54 (0.03)	0.00	4.53	1.50 (0.02)	0.87	2.56
	November 2015	0.07 (0.01)	0.00	1.25	1.03 (0.01)	0.49	1.48
	December 2015	0.02 (0.00)	0.00	0.15	0.38 (0.00)	0.19	0.75
	January 2016	0.02 (0.00) ^a	0.00 ^a	0.10 ^a	0.29 (0.00) ^a	0.19 ^a	0.40 ^a
	February 2016	0.05 (0.00) ^b	0.00 ^b	0.13 ^b	0.43 (0.01) ^a	0.26 ^a	0.76 ^a
	March 2016	0.16 (0.01)	0.00	0.66	0.51 (0.01)	0.29	0.90
	April 2016	0.14 (0.01)	0.00	1.89	0.43 (0.00)	0.31	0.87
	May 2016	0.20 (0.02)	0.00	2.62	0.64 (0.01)	0.38	0.93
June 2016	0.33 (0.03)	0.00	5.09	0.70 (0.01) ^b	0.18 ^b	2.02 ^b	

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Swamp 1	October 2015	0.05 (0.00)	0.00	0.10	0.09 (0.00)	0.06	0.10
	November 2015	0.04 (0.00)	0.00	0.07	0.10 (0.00)	0.09	0.10
	December 2015	0.04 (0.00)	0.00	0.06	0.09 (0.00)	0.07	0.11
	January 2016	0.03 (0.00)	0.00	0.06	0.09 (0.00)	0.08	0.11
	February 2016	0.03 (0.00)	0.00	0.05	0.06 (0.00)	0.03	0.10
	March 2016	0.04 (0.00)	0.00	0.05	0.06 (0.00)	0.05	0.07
	April 2016	0.04 (0.00) ^b	0.00 ^b	0.05 ^b	0.06 (0.00) ^b	0.04 ^b	0.07 ^b
	May 2016	0.04 (0.00)	0.00	0.05	0.06 (0.00)	0.03	0.08
	June 2016	0.03 (0.00)	0.00	0.05	0.06 (0.00)	0.04	0.08
Swamp 2	October 2015	0.28 (0.02)	0.00	1.46	0.17 (0.00)	0.15	0.18
	November 2015	0.14 (0.01)	0.00	0.53	0.18 (0.00)	0.17	0.20
	December 2015	0.05 (0.00)	0.00	0.10	0.20 (0.00)	0.18	0.22
	January 2016	0.04 (0.00)	0.00	0.09	0.18 (0.00)	0.15	0.22
	February 2016	0.06 (0.00)	0.00	0.11	0.15 (0.00)	0.12	0.18
	March 2016	0.07 (0.00)	0.00	0.12	0.13 (0.00)	0.10	0.16
	April 2016	0.08 (0.00) ^b	0.01 ^b	0.11 ^b	0.10 (0.00) ^b	0.08 ^b	0.14 ^b
	May 2016	0.10 (0.01)	0.00	0.21	0.11 (0.00)	0.07	0.14
	June 2016	0.08 (0.01)	0.00	0.47	0.11 (0.00)	0.07	0.14

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 1 (cont'd). Fiscal Year 2016 average, maximum, and minimum salinity at above- and below-ground locations in marsh and tidal freshwater forest monitoring areas.

Area	Month	Aboveground Salinity (psu)			Belowground Salinity (psu)		
		Avg. (std. err.)	Min	Max	Avg. (std. err.)	Min	Max
Swamp 3	October 2015	0.10 (0.01)	0.00	1.98	0.44 (0.01)	0.24	0.87
	November 2015	0.02 (0.00)	0.00	0.10	0.23 (0.00)	0.16	0.35
	December 2015	0.02 (0.00)	0.00	0.09	0.15 (0.00)	0.13	0.21
	January 2016	0.02 (0.00)	0.00	0.08	0.10 (0.00)	0.09	0.14
	February 2016	0.04 (0.00)	0.00	0.09	0.09 (0.00)	0.08	0.12
	March 2016	0.03 (0.00)	0.00	0.08	0.09 (0.00)	0.07	0.12
	April 2016	0.03 (0.00) ^b	0.00 ^b	0.08 ^b	0.08 (0.00) ^b	0.06 ^b	0.12 ^b
	May 2016	0.05 (0.00)	0.00	0.44	0.12 (0.00)	0.04	0.17
	June 2016	0.10 (0.02)	0.00	2.26	0.13 (0.00)	0.07	0.25

^a Incomplete data record. See Table 2 for details.

^b Data loss less than 48 hours as a result of updating field sensor.

Table 2. Summary of FY16 salinity data losses between 01 Oct 2015 - 30 June 2016 from Aquatroll sensors deployed at SHEP monitoring areas. Data loss periods and number of days may include periods within FY15. Minor data losses were incurred when new sensors with updated circuit boards were deployed as replacements for older sensors that were apparently prone to failure. Minor data losses were also incurred when data were downloaded near pre-programmed sensor measurements. Water level data losses may be beyond dates listed.

Area	Position	Data loss period		# Days	Reason
		Beginning	End		
Back 3.5	Belowground	09/07/2015 02:05	10/11/2015 00:00	33.91	Circuit board failure
Middle 3	Belowground	10/15/2015 04:33	12/11/2015 12:00	57.31	Circuit board failure
Middle 4	Belowground	10/16/2015 04:16	12/11/2015 12:00	56.32	Circuit board failure
Back 4	Aboveground	11/30/2015 14:06	12/11/2015 12:00	10.91	Hog damage
Back 4	Belowground	11/30/2015 13:20	12/11/2015 12:00	10.94	Hog damage
Middle 4	Aboveground	11/30/2015 10:00	01/23/2016 00:00	53.58	Circuit board failure
Middle 2	Aboveground	12/19/2015 05:24	01/23/2016 00:00	34.77	Circuit board failure
Middle 3	Aboveground	12/19/2015 04:41	01/23/2016 00:00	34.80	Circuit board failure
Middle 1	Aboveground	01/05/2016 02:53	01/23/2016 00:00	17.88	Circuit board failure
Middle 5	Aboveground	01/05/2016 00:47	01/23/2016 00:00	17.97	Circuit board failure
Back 2	Aboveground	01/05/2016 00:20	01/23/2016 00:00	17.99	Circuit board failure
Back 3	Belowground	01/19/2016 06:36	02/13/2016 13:00	25.27	Circuit board failure
Back 2	Belowground	01/23/2016 18:06	02/13/2016 12:00	20.75	Circuit board failure
Middle 5	Belowground	01/19/2016 23:42	02/13/2016 18:00	24.76	Circuit board failure
Middle 5	Aboveground	02/13/2016 17:00	02/13/2016 18:00	0.04	Download event
Middle 4	Belowground	03/14/2016 12:00	03/14/2016 15:00	0.13	Download event
Back 1	Aboveground	04/19/2016 16:49	04/21/2016 00:00	1.30	Sensor Upgraded
Back 1	Belowground	04/19/2016 15:45	04/21/2016 00:00	1.34	Sensor Upgraded
Back 3	Aboveground	04/19/2016 12:38	04/21/2016 00:00	1.47	Sensor Upgraded
Back 3.5	Belowground	04/19/2016 13:00	04/21/2016 00:00	1.46	Sensor Upgraded
Back 4	Aboveground	04/19/2016 13:59	04/21/2016 00:00	1.42	Sensor Upgraded
Back 4	Belowground	04/19/2016 13:00	04/21/2016 00:00	1.46	Sensor Upgraded
Front 1	Aboveground	04/19/2016 10:12	04/21/2016 00:00	1.57	Sensor Upgraded
Front 1	Belowground	04/19/2016 09:55	04/21/2016 00:00	1.59	Sensor Upgraded
Middle 1	Belowground	04/19/2016 10:45	04/21/2016 00:00	1.55	Sensor Upgraded
Middle 2	Belowground	04/19/2016 10:17	04/21/2016 00:00	1.57	Sensor Upgraded
Middle 3	Belowground	04/20/2016 09:00	04/20/2016 10:00	0.04	Download event
Swamp 1	Aboveground	04/20/2016 16:00	04/21/2016 00:00	0.33	Sensor Upgraded
Swamp 1	Belowground	04/20/2016 15:00	04/21/2016 00:00	0.38	Sensor Upgraded
Swamp 2	Aboveground	04/20/2016 17:00	04/21/2016 00:00	0.29	Sensor Upgraded
Swamp 2	Belowground	04/20/2016 17:00	04/21/2016 00:00	0.29	Sensor Upgraded
Swamp 3	Aboveground	04/20/2016 19:00	04/21/2016 00:00	0.21	Sensor Upgraded
Swamp 3	Belowground	04/20/2016 17:00	04/20/2016 19:00	0.08	Pressure sensor failure ^a
Middle 5	Belowground	06/23/2016 13:00	06/23/2016 23:00	0.42	Pressure sensor failure ^a

^a Sensor collected salinity data accurately but long-term analysis of water depth identified problems with water depth data. Data losses reflect the deployment of the new sensor.

Table 3. Comparison of belowground salinity measurements taken April 2016 via autonomous sensors (In-Situ Aquatrolls) versus a "spot check" measured via handheld YSI salinity meter (units: parts per thousand = ppt). Reports typically provide summaries of hourly Aquatroll measurements of salinity as practical salinity units (psu) though measurements of total dissolved solids as parts per thousand (ppt) are also collected. Here we report both Aquatroll measurements to facilitate comparisons with handheld YSI measurements. Accuracy of the handheld YSI meter is 0.1 (ppt), while accuracy of the Aquatrolls is 0.001 (psu, ppt); Aquatroll values were rounded to the nearest 0.1 to facilitate comparisons.

Site	Aquatroll Total		YSI "spot check" (ppt)	YSI Measurement Time	Aquatroll Measurement Time
	Aquatroll Salinity (psu)	Dissolved Soilds (ppt)			
Back 1	0.1	0.1	0.1	04/19/2016 16:16	04/19/2016 15:45
Back 2	0.1	0.1	0.1	04/19/2016 10:15	04/19/2016 08:00
Back 3	0.2	0.2	5.7 ^a	04/19/2016 11:24	04/19/2016 10:00
Back 3.5	1.8	2.2	1.8	04/19/2016 12:11	04/19/2016 11:00
Back 4	2.1	2.5	2.4	04/19/2016 13:00	04/19/2016 11:00
Front 1	0.1	0.1	0.1	04/19/2016 09:12	04/19/2016 07:55
Front 2	0.2	0.3	0.3	04/21/2016 15:05	04/21/2016 14:26
Middle 1	0.2	0.3	0.2	04/20/2016 11:01	04/20/2016 10:45
Middle 2	0.1	0.1	0.1	04/20/2016 10:07	04/20/2016 09:17
Middle 3	0.1	0.2	0.1	04/20/2016 08:58	04/20/2016 08:00
Middle 4	0.9	1.1	1.3	04/20/2016 12:01	04/20/2016 12:00
Middle 5	0.4	0.6	0.4	04/20/2016 13:18	04/20/2016 13:00
Swamp 1	0.1	0.1	0.1	04/20/2016 14:53	04/20/2016 14:00
Swamp 2	0.1	0.1	0.1	04/20/2016 16:28	04/20/2016 15:00
Swamp 3	0.1	0.1	0.1	04/20/2016 17:50	04/20/2016 16:00

a: Spot check was not performed prior to hand pumping the well. Value reported was measured after pumping.

Table 4. Comparison of belowground salinity measurements taken May 2016 via autonomous sensors (In-Situ Aquatrolls) versus a "spot check" measured via handheld YSI salinity meter (units: parts per thousand = ppt). Reports typically provide summaries of hourly Aquatroll measurements of salinity as practical salinity units (psu) though measurements of total dissolved solids as parts per thousand (ppt) are also collected. Here we report both Aquatroll measurements to facilitate comparisons with handheld YSI measurements. Accuracy of the handheld YSI meter is 0.1 (ppt), while accuracy of the Aquatrolls is 0.001 (psu, ppt); Aquatroll values were rounded to the nearest 0.1 to facilitate comparisons.

Site	Aquatroll Total		YSI "spot check" (ppt)	YSI Measurement Time	Aquatroll Measurement Time
	Aquatroll Salinity (psu)	Dissolved Solids (ppt)			
Back 1	0.1	0.2	0.1	05/18/2016 15:54	05/18/2016 15:00
Back 2	0.2	0.2	0.2	05/18/2016 09:26	05/18/2016 09:00
Back 3	0.2	0.3	0.6	05/18/2016 15:10	05/18/2016 14:00
Back 3.5	1.8	2.2	1.7	05/18/2016 13:45	05/18/2016 13:00
Back 4	2.5	3.0	2.5	05/18/2016 14:22	05/18/2016 14:00
Front 1	0.1	0.2	0.1	05/18/2016 10:16	05/18/2016 10:00
Front 2	0.6	0.8	0.8	05/18/2016 16:40	05/18/2016 14:00
Middle 1	0.3	0.3	0.2	05/18/2016 17:14	05/18/2016 17:00
Middle 2	0.2	0.3	0.2	05/18/2016 11:40	05/18/2016 11:00
Middle 3	0.7	0.9	0.7	05/18/2016 10:55	05/18/2016 10:00
Middle 4	2.5	3.0	2.3	05/18/2016 12:30	05/18/2016 12:00
Middle 5	0.8	1.0	0.8	05/18/2016 13:10	05/18/2016 13:00
Swamp 1	0.1	0.1	0.1	05/19/2016 11:16	05/19/2016 10:00
Swamp 2	0.1	0.1	0.1	05/19/2016 10:26	05/19/2016 10:00
Swamp 3	0.1	0.2	0.1	05/19/2016 09:34	05/19/2016 09:00

Table 5. Comparison of belowground salinity measurements taken June 2016 via autonomous sensors (In-Situ Aquatrolls) versus a "spot check" measured via handheld YSI salinity meter (units: parts per thousand = ppt). Reports typically provide summaries of hourly Aquatroll measurements of salinity as practical salinity units (psu) though measurements of total dissolved solids as parts per thousand (ppt) are also collected. Here we report both Aquatroll measurements to facilitate comparisons with handheld YSI measurements. Accuracy of the handheld YSI meter is 0.1 (ppt), while accuracy of the Aquatrolls is 0.001 (psu, ppt); Aquatroll values were rounded to the nearest 0.1 to facilitate comparisons.

Site	Aquatroll Total		YSI "spot check" (ppt)	YSI Measurement Time	Aquatroll Measurement Time
	Aquatroll Salinity (psu)	Dissolved Solids (ppt)			
Back 1	0.1	0.2	0.1	06/23/2016 12:45	6/23/2016 12:00
Back 2	0.2	0.2	0.2	06/23/2016 13:20	6/23/2016 12:00
Back 3	0.4	0.5	1.0	06/23/2016 13:45	6/23/2016 13:00
Back 3.5	1.4	1.7	1.7	06/23/2016 14:10	6/23/2016 13:00
Back 4	2.2	2.7	2.2	06/23/2016 14:45	6/23/2016 13:00
Front 1	0.2	0.2	0.2	06/23/2016 11:10	6/23/2016 11:00
Front 2	0.5	0.7	0.8	06/23/2016 09:15	6/23/2016 13:00
Middle 1	0.4	0.5	N/A	crew forgot to measure	6/23/2016 9:00
Middle 2	0.4	0.6	0.5	06/23/2016 10:00	6/23/2016 9:00
Middle 3	0.7	0.9	0.8	06/23/2016 10:30	6/23/2016 10:00
Middle 4	1.5	1.9	1.9	06/23/2016 11:50	6/23/2016 11:00
Middle 5	0.9	1.2	1.1	06/23/2016 12:10	6/23/2016 12:00
Swamp 1	0.0	0.1	0.1	06/23/2016 15:50	6/23/2016 15:00
Swamp 2	0.1	0.1	0.1	06/23/2016 17:00	6/23/2016 15:00
Swamp 3	0.1	0.2	0.1	06/24/2016 11:05	6/23/2016 15:00