

# Documenting Surface Elevation Change in Berry's Creek Marshes 2009-2010

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The SET provides a constant plane in space from which the distance to the sediment surface can be measured by means of pins lowered to the marsh surface (USGS 2010). Benchmark rods were established, marker horizons of feldspar were emplaced and baseline readings were taken at two locations in the Berry's Creek watershed during the spring of 2009. Each site was revisited and readings were taken in the spring and fall of 2010. This report is a summary of those measurements.



At each site, three replicate benchmarks have been installed. At each benchmark, nine pins are lowered to the marsh surface. Readings are taken in each of four orientations resulting in a total of 108 measurements. At the time of each subsequent reading, results obtained from each pin are compared. The average of the resulting differences becomes one data point that represents the level of the marsh surface. To obtain a yearly rate, this value is divided by the number of days that have elapsed between establishment of the benchmark and the subsequent reading. Approximately one year elapsed between the readings summarized in this report. Table 1 provides the dates for each reading and the time elapsed in days and years.

**Table 1: Time Elapsed Between Readings**

Location	Initial Date	Subsequent Date	Days	Years
EDS-1,	4/30/2009	11/17/2010	566	1.55
EDS-2, EDS-3	4/30/2009	11/17/2010	566	1.55
WS-1, WS-2	4/30/2009	11/15/2010	563	1.54
WS-3	5/1/2009	11/15/2010	562	1.54

Tables 2 and 2a are summaries of the changes in elevation measured at each location. The complete data set is found in Appendices at the end of the report.

**Table 2: SETs Measurements 2009/2010**

Site	Marsh Type	Dominant Vegetation	Rate of Elevation Change (mm/yr)
Eight Day Swamp	High	Phragmites	25.6
Walden Swamp	High	Phragmites	34.2

**Table 2a: Average Elevation Change (mm)**

Eight Day Swamp		Walden Swamp	
All Platforms	39.14	All Platforms	52.01
Std Error	4.53	Std Error	26.70
EDS-1	39.47	WS-1	55.75
Std Error	14.80	Std Error	5.32
EDS-2	31.14	WS-2	96.28
Std Error	7.28	Std Error	11.92
EDS-3	46.81	WS-3	4.00
Std Error	7.84	Std Error	3.26
EDS-1 pos 2	54.89	WS-1 pos 2	61.89
EDS-1 pos 4	56.78	WS-1 pos 4	63.33
EDS-1 pos 6	-4.78	WS-1 pos 6	40.22
EDS-1 pos 8	51.00	WS-1 pos 8	57.56
EDS-2 pos 2	29.78	WS-2 pos 2	130.67
EDS-2 pos 4	29.56	WS-2 pos 4	86.78
EDS-2 pos 6	50.33	WS-2 pos 6	76.00
EDS-2 pos 8	14.89	WS-2 pos 8	91.67
EDS-3 pos 2	33.78	WS-3 pos 2	-4.33
EDS-3 pos 4	53.78	WS-3 pos 4	3.67
EDS-3 pos 6	65.67	WS-3 pos 6	11.56
EDS-3 pos 8	34.00	WS-3 pos 8	5.11

Feldspar horizons were emplaced inside three corners of each benchmark plot. One reading is taken at each horizon resulting in a total of nine values associated with each marsh; the average of all readings produces a summary value. Tables 2 and 2a are summaries of the accretion measured by use of feldspar horizons emplaced at each benchmark location. Not all horizons produced recognizable accretion; where negligible material accumulated above the horizon, “0.0 accretion” is designated. All recoverable values are included in the calculation for accretion rate.

**Table 3: Feldspar Horizon Measurements 2009/2010**

Site	Positive Accretion (Percent)	Accretion Rate (mm/yr)
Eight Day Swamp	89	12.2
Walden Swamp	89	7.2

**Table 3a: Average Accretion (mm)**

Eight Day Swamp		Walden Swamp	
All Platforms	11.1	All Platforms	18.9
Std Error	3.4	Std Error	3.9
EDS-1	16.7	WS-1	25.0
Std Error	3.3	Std Error	2.9
EDS-2	11.7	WS-2	20.0
Std Error	4.4	Std Error	0.00
EDS-3	5.0	WS-3	11.7
Std Error	2.9	Std Error	6.0
EDS-1		WS-1	
Plot A	20.0	Plot A	30
Plot B	10.0	Plot B	25
Plot C	20.0	Plot C	20
EDS-2		WS-2	
Plot A	10.0	Plot A	20
Plot B	20.0	Plot B	20
Plot C	5.0	Plot C	20
EDS-3		WS-3	
Plot A	10.0	Plot A	20
Plot B	0.0	Plot B	0.0
Plot C	5.0	Plot C	15

## Discussion

While it is tempting to draw conclusions from this data set, one must acknowledge that marsh sediment processes take place slowly over long periods of time; to quote Jim Lynch, USGS SET's methodology expert, "...It will take a long time to get enough data to see what's going on."(2010, personal communication)

Elevation change measured by the SET is influenced by both surface and subsurface processes occurring within the soil profile (USGS 2010). The marker horizons reveal surface processes only. One can surmise the relative contribution of these processes by looking at the difference between the rates obtained by each. The relatively high rate of positive change measured by the SET could have been caused by swelling of the marsh surface due to root growth and water storage in the subsurface. Cahoon et al., (1995) proposed changes in water storage and in the volume of the root zone related to seasonal patterns of plant production as an explanation for elevation change in a Louisiana marsh. The rate of elevation change measured in Eight Day Swamp, 30.5 mm/yr, agrees closely with deposition rates of 33, 38 and 45 mm/yr obtained by Weis et al. (2005) using radionuclide dating of cores. The marker horizons, which measure surface processes, yielded a somewhat lower accretion rate (7.1 mm/yr). Walden Swamp exhibited a similar rate of elevation change, 53.1 mm/yr, with a lower accretion rate of 2.7 mm/yr.

According to the 2010 measurements, the accretion rates are 12.2 mm/yr at Eight Day Swamp and 7.2 mm/yr at Walden Swamp respectively.

**Table 4: Marsh Processes (USGS 2010)**

<b>SURFACE PROCESSES:</b>
1) Sediment deposition
2) Sediment erosion
<b>SUBSURFACE PROCESSES:</b>
3) Root Growth
4) Decomposition
5) Pore water Flux
6) Compaction

## **References**

- Cahoon, D., Reed, D., Day, J Jr. 1995. Estimating shallow subsidence in micro tidal salt marshes of the southeastern United States: Kaye and Barghoorn revisited. *Marine Geology* 128, 1-9.
- Lynch, J. 2010. USGS Patuxent Wildlife Research Center, Personal Communication.
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Patuxent Wildlife Research Center.
- Weis, P., Barrett, K, Proctor, T., and Bopp, R. 2005. Studies of a contaminated brackish marsh in the Hackensack Meadowlands of northeastern New Jersey: An assessment of natural recovery. *Marine Pollution Bulletin* 50, 1405–1415.

**Appendix 1: Eight Day Swamp Surface Elevation Table Readings (mm)**

EDS-1					EDS-2					EDS-3				
Position	Pin	4/30/2009	11/17/2010	Difference	Position	Pin	4/30/2009	11/17/2010	Difference	Position	Pin	4/30/2009	11/17/2010	Difference
2	1	91	106	15	2	1	56	105	49	2	1	64	121	57
	2	45	136	91		2	68	92	24		2	64	130	66
	3	42	101	59		3	71	89	18		3	111	133	22
	4	40	101	61		4	67	94	27		4	102	135	33
	5	83	111	28		5	85	90	5		5	107	134	27
	6	65	133	68		6	65	100	35		6	113	141	28
	7	70	117	47		7	61	92	31		7	103	130	27
	8	65	140	75		8	70	97	27		8	101	123	22
	9	50	100	50		9	53	105	52		9	81	103	22
4	1	21	105	84	4	1	43	98	55	4	1	54	129	75
	2	21	109	88		2	65	85	20		2	90	139	49
	3	38	96	58		3	67	97	30		3	80	129	49
	4	50	93	43		4	65	105	40		4	56	127	71
	5	58	99	41		5	60	92	32		5	80	130	50
	6	48	78	30		6	75	85	10		6	75	119	44
	7	13	105	92		7	75	90	15		7	86	144	58
	8	60	96	36		8	68	100	32		8	76	119	43
	9	60	99	39		9	64	96	32		9	80	125	45
6	1	60	115	55	6	1	30	78	48	6	1	82	149	67
	2	118	108	-10		2	24	93	69		2	79	142	63
	3	134	95	-39		3	20	91	71		3	87	143	56
	4	105	98	-7		4	37	90	53		4	89	149	60
	5	123	93	-30		5	48	91	43		5	89	151	62
	6	123	95	-28		6	42	82	40		6	95	145	50
	7	52	87	35		7	49	90	41		7	97	154	57
	8	55	84	29		8	46	101	55		8	92	168	76
	9	112	64	-48		9	62	95	33		9	60	160	100
8	1	55	104	49	8	1	74	80	6	8	1	100	138	38
	2	60	107	47		2	62	86	24		2	98	126	28
	3	65	116	51		3	64	88	24		3	93	126	33
	4	64	113	49		4	51	82	31		4	78	113	35
	5	66	140	74		5	74	80	6		5	80	117	37
	6	62	116	54		6	76	71	-5		6	80	118	38
	7	60	112	52		7	63	82	19		7	97	124	27
	8	58	105	47		8	62	75	13		8	80	100	20
	9	63	99	36		9	50	66	16		9	77	127	50

**Appendix 2: Walden Swamp Surface Elevation Table Readings (mm)**

Position	Pin	WS-1			Position	Pin	WS-2			Position	Pin	WS-3		
		4/30/2009	11/15/2010	Difference			4/30/2009	11/15/2010	Difference			5/1/2009	11/15/2010	Difference
2	1	42	120	78	2	1	179	254	75	2	1	110	145	35
	2	53	120	67		2	156	272	116		2	96	138	42
	3	61	128	67		3	150	251	101		3	112	134	22
	4	121	122	1		4	69	271	202		4	109	146	37
	5	25	132	107		5	223	276	53		5	94	131	37
	6	45	115	70		6	155	265	110		6	112	118	6
	7	50	121	71		7	123	276	153		7	90	143	53
	8	40	113	73		8	83	276	193		8	112	118	6
	9	100	123	23		9	117	290	173		9	97	135	38
4	1	51	122	71	4	1	176	250	74	4	1	112	135	23
	2	71	125	54		2	156	263	107		2	118	137	19
	3	87	126	39		3	172	240	68		3	115	135	20
	4	52	126	74		4	82	245	163		4	127	143	16
	5	63	111	48		5	192	259	67		5	101	140	39
	6	67	125	58		6	127	216	89		6	88	135	47
	7	41	115	74		7	175	195	20		7	98	156	58
	8	33	98	65		8	144	247	103		8	75	141	66
	9	12	99	87		9	157	247	90		9	80	140	60
6	1	43	120	77	6	1	230	235	5	6	1	106	165	59
	2	80	114	34		2	200	253	53		2	106	135	29
	3	87	126	39		3	155	246	91		3	98	149	51
	4	78	120	42		4	195	245	50		4	96	141	45
	5	95	118	23		5	115	241	126		5	96	137	41
	6	92	127	35		6	140	244	104		6	85	123	38
	7	80	109	29		7	118	232	114		7	96	133	37
	8	90	109	19		8	170	244	74		8	65	131	66
	9	70	134	64		9	150	217	67		9	71	124	53
8	1	73	120	47	8	1	172	256	84	8	1	68	135	67
	2	73	120	47		2	230	253	23		2	69	130	61
	3	81	125	44		3	170	248	78		3	78	123	45
	4	70	133	63		4	94	230	136		4	116	129	13
	5	80	133	53		5	120	230	110		5	52	127	75
	6	45	122	77		6	110	235	125		6	93	126	33
	7	50	123	73		7	136	252	116		7	164	133	-31
	8	80	119	39		8	100	233	133		8	75	129	54
	9	55	130	75		9	195	215	20		9	95	139	44